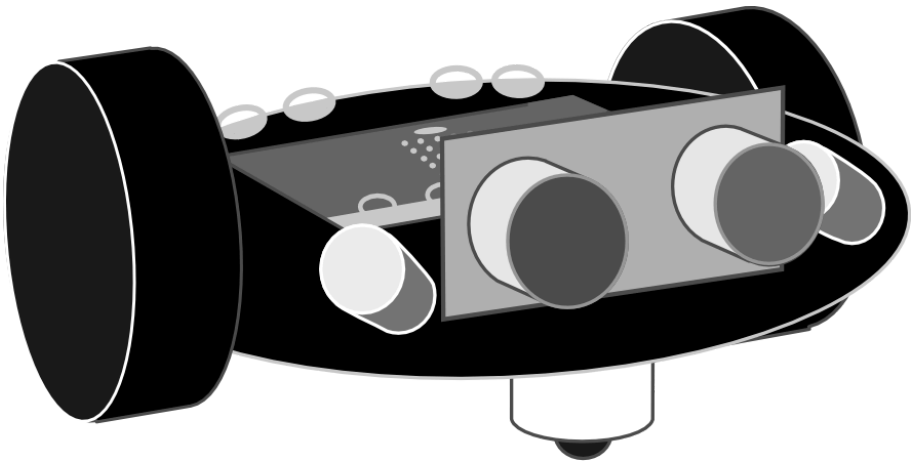
Educator Guide

AI: How to Train Your Robot

Developed by
the MIT Media Lab & i2 Learning



raise.mit.edu i2Learning.org

About i2 Learning

i2 partners with schools and school districts to turn their classrooms into STEM learning labs. Working with school leaders and outside STEM organizations, i2 Learning provides a complete package of project-based STEM curriculum, teacher professional development, materials, and online support for schools to run full week, month, or summer immersive STEM programs with teachers and students of all backgrounds and abilities. i2 programs have been successfully implemented at over 100 schools engaging and inspiring thousands of students across the world.

For more information about i2 Learning, visit www.i2learning.org.

About STEM

The term STEM is an acronym for science, technology, engineering, and mathematics. In the real world, content knowledge and skills from these four disciplines are often used together to solve a given problem. A microbiologist studying a new microorganism (science) might need to create (engineer) a new microscope (a technology) to magnify the organism to a certain degree (math) in order to see it. Every i2 Learning course integrates the STEM disciplines in a similar way. Students are presented with authentic challenges that require them to pull from knowledge across STEM subjects as they learn, solve problems, and discover new things.

The **Artificial Intelligence** course focuses on the following STEM concepts:

Science: The AI course helps students see how artificial intelligence plays an important role within a number of scientific areas even outside of computer science, such as medicine and space exploration. It also touches on the ethical implications of scientific progress through its discussions of ethical dilemmas and stakeholder analysis.

Technology: Students will use the tools in this course to become more familiar with some of the artificially intelligent technologies that pervade our world. They will learn how these technologies work, and also design their own artificially intelligent systems as part of their final projects.

Engineering: As students create their own artificially intelligent robots to accomplish specific goals, they will rely on the iterative engineering and design process to plan, build, tweak and finalize their work, ultimately arriving at their final product.

Mathematics: The computational thinking central to being a strong mathematician is at the heart of the programming work students will complete in this course.

Note about Products

Unless otherwise explicitly stated, MIT has no connection with any of the products mentioned in this document and their inclusion does not constitute an endorsement by MIT.

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Course Components

The AI: How to Train Your Robot includes the six main components listed below.

Educator Guide

You are reading the Educator Guide right now! The Educator Guide includes the following:

- Background information
- Course overview
- Learning goals
- Assessment information
- Course vocabulary
- Daily overview and learning objectives
- Daily lessons guides, which include the following:
  - Materials and preparation
  - Activity photo and video links (for teacher reference)
  - Vocabulary
  - Activity lesson plan
- Additional Activities » If you have additional time, or your students are very engaged in the course, consider adding some of the Additional Activities, which are found at the end of the Educator Guide.

Be sure to read through each part of the educator guide carefully as it includes all the basic information and support you will need to teach the course successfully. In each day-by-day section of this guide, you will find activities to fill about 5 hours of classroom time.

Using the Digital Educator Guide

For teachers using the digital copy of the Educator Guide, make sure you are aware of the following:

- The Table of Contents functions as a shortcut to all items listed in the Table of Contents.

- Make sure that you have enabled **View > Show Document Outline**, which functions as a shortcut to accessing any corresponding lessons or pages.
- You can edit and personalize your own version of the Educator Guide as you please by going to **File > Make a copy** in the original document to make your own version.

Student Pages

Each group of students should be provided with Student Workbook Pages.

1) Workbook Pages » These pages provide space for students to document their thinking as they participate in the course activities and create their final projects. These pages are available as digital documents that students can edit within their google drive, or as a PDF that can be printed for students to complete by hand. Teachers can edit or tailor the workbook pages as they please by making their own copy of the document online **(you can do this by going to File > Make a copy in the original document)**.

Depending on what you think will work best for the students in your class, you may choose to use the pages in a variety of ways:

- load pages on tablets or other electronic devices for student use
- project images of Student Pages on the board
- print the entire set of pages or print select pages to distribute to students.

Using the Digital Student Pages

For teachers using the digital copies of the Student Pages, make sure you are aware of the following:

- The **Table of Contents** functions as a shortcut to all items listed in the Table of Contents.
- You can edit and personalize the Student Pages as you please by going to **File > Make a copy**.

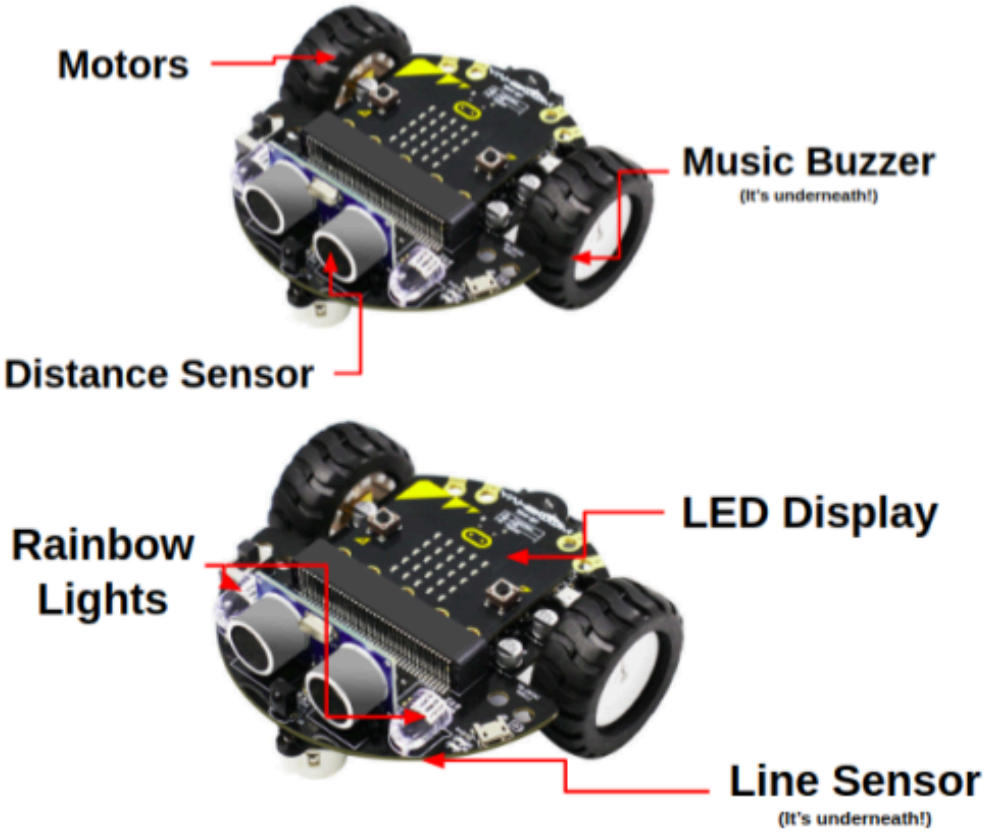
Micro:bit Robot

This course uses a programmable robot that wirelessly connects to a custom version of Scratch blocks built by the Personal Robots Group at the MIT Media Lab. The robot uses a microcontroller (or a mini computer) called a micro:bit. Micro:bits are inexpensive, educational tools that have been integrated into a number of Computational Thinking curricula. The robot used in this course comes from a company called Elecfreaks. The robot is commercially available and more units can be purchased online. This course is also compatible with a robot from Yahboom that can also be purchased online. The difference between the two robots is that the Elecfreaks robot comes pre-assembled, but requires batteries. The Yahboom robot has a rechargeable battery, but needs to be assembled before the course and only works with micro:bit v1.5.

You may be familiar with micro:bit and have possibly used it with Makecode or MicroPython in other coding courses. It is important to understand that this course uses a **significantly different** from what is normally used for micro:bits. Some important differences include:

1) You need to download our custom hex file to your micro:bit and program it using PRG AI Blocks. Please see the Tech Setup section for more details.
2) Rather than downloading .hex file programs onto the micro:bit, your micro:bit runs code by maintaining a constant connection to your computer to run instructions. Without a computer, your micro:bit robot will not do anything.
3) The micro:bit communicates with computers using Bluetooth Low Energy (BLE). Your computer must have BLE if you want to use a robot in this course.

Here are some features your students can program with the robot:



Extra Fun!

If you decide to purchase the micro:bits and robots for your class, do not feel restricted to only use them with the programming environment we used in this course. Both tools are quite powerful and exciting and we encourage you to explore them in your classes.

- More information and programming activities for the micro:bit can be found on the product's website.
- More information and programming activities for the robot can be found in Yahboom's documentation.

Programming Activity Guide

This course is meant to provide a suitable programming challenge for all students regardless of their background in computer science. All students can use the Programming Activity Guide to become familiar with:

- Saving and loading programs. Since this is not "normal" Scratch, projects are not automatically saved. **Students should get in the habit of saving their work every day.**
- Special features of our AI Blocks programming website, like recording the stage to share work.

Students without prior programming experience can follow the guide for:

- Step-by-step instructions on how to complete a basic version of each programming activity.
- Short tutorials on fun features in AI Blocks like sounds and costumes

Students with prior programming experience can look at the 'Go Further' challenges to get ideas on how to take their work to the next level.

Classroom Requirements

Classroom requirements for the **AI: How to Train Your Robot** course include the following:

- It is ideal to have desks or tables that students can move around to facilitate group work.
- You will need one area of the room or table that can be designated as the "materials table".
- You will need access to internet and Bluetooth-enabled computers for the entire course. Ideally, the computers will also have a webcam that students can access, but that is not a hard requirement.

Education Standards

The educational standards to which the Artificial Intelligence course aligns are listed below.

Common Core: Literacy	
Standard	**Lesson**
RI.6 - Assess how point of view or purpose shapes the content and style of a text	Day 1 ● Ethical Dilemmas Day 3 ● Welcome ● Ethical Matrices
RI.7 - integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words	Day 2 ● Algorithmic Bias Discussion
RI.9 - Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors' take	Day 2 ● Algorithmic Bias Discussion
W.1 - Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence	Day 1 ● What is AI? ● AI or Not? ● Ethical Dilemmas ● Reflection
W.5 - Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach	Day 4 ● Peer Review
W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism	Day 3 ● Reflect Day 4 ● Welcome

SL.1 - prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively	Day 2 ● Algorithmic Bias Discussion
SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.	Day 2 ● Algorithmic Bias Discussion
SL.4- present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development and style are appropriate to task purpose and audience.	Day 5 ● Final Project Showcase Preparation ● Final Project Showcase

Next Generation Science Standards

Next Generation Science Standards (NGSS) is a registered trademark of Achieve. Neither Achieve nor the lead states and partners that developed the NGSS was involved in the production of, and does not endorse, this product.

Standard	Lesson
3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem	Day 4 ● Final Project Planning ● Final Project Work Time Day 5 ● Final Project Finishing Up

Massachusetts Digital Literacy and Computer Science Standards

Standard	Lesson
3-5.CAS.c.6 - Identify ways in which people with disabilities access and use technology	Day 3 ● Final Project Research ● Reflect Day 4 ● Welcome
3-5.CS.a.1 - Identify a broad range of computing devices (e.g. ., computers, smart phones, tablets, robots, e-textiles) and appropriate uses for them.	Day 4 ● Welcome ● Final Project Planning ● Final Project Work Time Day 5

	• Final Project Finishing Up
3-5.CS.a.4 - Identify and solve simple hardware and software problems that may occur during everyday use (e.g. power, connections, application window, or toolbar)	Day 1 • Intro to AI Blocks Day 2 • Intro to Image Recognition • Animal Recognition Day 3 • Intro to Text Classification • Command Recognition
3-5.CS.a.5 - Describe the differences between hardware and software	Day 1 • Intro to AI Blocks
3-5.CS.b.1 - Compare and contrast human and computer performance on similar tasks (e.g., sorting alphabetically, finding a path across a cluttered room) to understand which is best suited to the task	Day 3 • Intro to Text Classification • Reflect Day 4 • Welcome
3-5.CT.b.1 - Define an algorithm as a sequence of instructions that can be processed by a computer.	Day 2 • Welcome • Pizza Recipe Algorithm • Pizza Delivery App
3-5.CT.b.4 - Individually and collaboratively create an algorithm to solve a problem	Day 2 • Pizza Recipe Algorithm • Pizza Delivery App
3-5.CT.c.1 - Describe examples of databases from everyday life (e.g., library catalogs, school records, telephone directories, contact lists).	Day 2 • Intro to Image Classification
3-5.CT.d.1 - Individually and collaboratively create, test, and modify a program in a graphical environment (e.g., block-based visual programming language).	Day 1 • Intro to AI Blocks Day 2 • Animal Recognition Day 3 • Command Recognition
3-5.CT.d.2 - Use arithmetic operators, conditionals, and repetition in programs	Day 1 • Intro to AI Blocks Day 2 • Animal Recognition Day 3

	• Command Recognition
3-5.CAS.c.5 - Identify resources in the community that can give people access to technology	Day 3 • Final Project Research • Reflect Day 4 • Welcome
3-5.DTC.a.3 - Use digital tools (local and online) to manipulate and publish multimedia artifacts	Day 4 • Final Project Planning • Final Project Work Time Day 5 • Final Project Finishing Up
3-5.DTC.b.1 - Communicate key ideas and details individually or collaboratively in a way that informs, persuades, and/or entertains using digital tools and media-rich resources	Day 5 • Final Project Showcase Preparation • Final Project Showcase
3-5.DTC.b.2 - Collaborate through online digital tools under teacher supervision	Day 4 • Peer Review
6-8.CAS.c.1 - Describe current events and emerging technologies in computing and the effects they may have on education ,the workplace, individuals, communities, and global society	Day 1 • Reflection Day 2 • Algorithmic Bias Discussion Day 3 • Intro to Text Classification
6-8.CAS.c.4 - Evaluate how media and technology can be used to distort, exaggerate, and misrepresent information.	Day 2 • Algorithmic Bias Discussion • Reflection Day 3 • Intro to Text Classification
6-8.CAS.c.5 - Evaluate the bias of digital information sources, including websites	Day 2 • Algorithmic Bias Discussion Day 3 • Intro to Text Classification
6-8.CS.a.5 - Individually and collaboratively design and demonstrate the use of a device (e.g. a robot, e-textile) to accomplish a task)	Day 1 • Intro to AI Blocks

6-8.CS.b.1 - Explain why some problems can be solved more easily by computers or humans based on a general understanding of types of tasks at which each excels.	Day 3 ● Reflect Day 4 ● Welcome
6-8.CS.b.2 - Describe how humans and machines interact to solve problems that cannot be solved by either alone (e.g., “big data” experiments that involve drawing conclusions by analyzing vast amounts of data).	Day 3 ● Reflect Day 4 ● Welcome
6-8.CT.b.1 - Design solutions that use repetition and conditionals	Day 1 ● Intro to AI Blocks Day 2 ● Animal Recognition Day 3 ● Command Recognition
6-8.CT.b.2 - Use logical reasoning to predict outputs given varying inputs.	Day 2 ● Animal Recognition Day 3 ● Command Recognition
6-8.CT.b.3 - Individually and collaboratively, decompose a problem and create a sub-solution for each of its parts (e.g., video game, robot obstacle course, making dinner).	Day 3 ● Reflect Day 4 ● Welcome ● Final Project Planning
6-8.CT.c.5 - Select and use data-collection technology (e.g., probes, handheld devices, geographic mapping systems) to individually and collaboratively gather, view, organize, analyze, and report results for content-related problems.	Day 2 ● Intro to Image Classification
6-8.CT.d.1 - Individually and collaboratively compare algorithms to solve a problem, based on a given criteria (e.g., time, resource, accessibility).	Day 2 ● Pizza Recipe Algorithm ● Pizza Delivery App Day 3 ● Text Classification

6-8.CT.d.3 - Create a program, individually and collaboratively, that implements an algorithm to achieve a given goal.	Day 2 ● Pizza Recipe Algorithm ● Pizza Delivery App
6-8.CT.d.5 - Trace programs step-by-step in order to predict their behavior	Day 1 ● Intro to AI Blocks
6-8.DTC.a.1 - Identify and explain the strengths, weaknesses, and capabilities of a variety of digital tools	Day 1 ● Reflection Day 2 ● Algorithmic Bias Discussion

Vocabulary

Artificial Intelligence - a program made by people that makes computers do things that seem intelligent (or smart) in the same way that humans are intelligent
Robots - machines that sense their environment, do calculations of some kind, and then perform an action
Technology - skills and tools that people use to achieve goals, often to make life easier
Ethics - moral guidelines for how people in society should behave if they want to be fair
Algorithm - a set of steps or rules to follow in order to solve a problem or accomplish a specific goal
Input - something that goes into an algorithm, often some kind of data
Output - what comes out of an algorithm, the end result
Binary - describing something that has only 2 options
Feature - a specific attribute or quality of an object that can be recognized
Dataset - a collection of inputs, outputs, or both; data that can be used by algorithms
Training Set - a collection of inputs and outputs given to machine learning algorithms to have them learn from patterns in data
Testing Set - a collection of inputs given to machine learning algorithms to measure their accuracy
Image classification - using machine learning to recognize pictures
Algorithmic Bias - errors in algorithms, often caused by skewed data sets, that create unfair outcomes, such as privileging one arbitrary group of users over others, or discriminating against particular groups.
Discrimination - treating one group of people differently than another group in an unfair way

Coded gaze - another term for “algorithmic bias”; the ways algorithms treat people unfairly.
Artificial Unintelligence -the study of loopholes (failures, or “glitches”) within artificial intelligence systems
Adversarial Patches or Stickers - images or other data created specifically to fool artificial intelligence systems.
Stakeholder - a person with an interest or concern in something
Area of Interest - A topic or area that a stakeholder cares about, for example “health” or “cost”
Ethical Matrix - A tool used to think about stakeholders and the reasons they are interested in a technology
Conflict of Interest - when one or more stakeholders has two different areas of interest that conflict with each other
Speech recognition - the process of taking a voice recording, analyzing its audio spectrum, and translating it into text
Intent recognition - the process of taking text and translating it into a simple word or phrase that captures the meaning or purpose underneath

Course Overview

Day 1	Day 2	Day 3
Welcome (15 mins) Students are welcomed to the course and the stage is set for the type of activities they will engage in during the week	**Welcome (10 mins)** Students review what they learned yesterday and go over the activities for today.	**Welcome (15 mins)** Students review what they learned yesterday and go over ethical matrices and the activities for the day.
What is AI? (30 mins) Students discuss definitions of technology and artificial intelligence.	**Pizza Recipe Algorithm (10 mins)** Students create an algorithm to make a pizza.	**Ethical Matrices (30 mins)** Students will learn about stakeholders and use ethical matrices to guide their moral reasoning about an AI technology.
Ethical Dilemmas (60 mins) Students will be introduced to moral reasoning with an ethical decision making example.	**Pizza Delivery App (30 mins)** Students create an algorithm that determines the best type of pizza to create based on data input from several questions.	**Intro to Text Classification (60 Minutes)** Students explore how computers use word embeddings to make sense of language.
Intro to AI Blocks (90 mins) Students will follow tutorials to refresh their knowledge of programming and get to know their robots.	**Intro to Image Classification (60 Minutes)** Students train an image classifier on several data sets of images.	**Command Recognition (90 mins)** Students will use natural language processing to teach their robots to respond to voice commands.
Reflect (30 mins) Students reflect on what they have learned about AI and its role in society today.	**Algorithmic Bias Discussion (30 Minutes)** After watching and reading several sources students discuss the impact of biased algorithms on different groups of people.	**Final Project Research (30 mins)** Students will conduct research and begin idea generation for their own robot projects.
	Animal Recognition (60 mins) Students will use image recognition to have their robots recognize pictures of different animals.	**Reflect (30 mins)** Students set the criteria for the final project and reflect on their brainstorming to begin coming up with concrete ideas about what they will build with their robots.

	Reflect (10 mins) Students reflect on what they have learned today about algorithmic bias in AI systems today.	

Day 4	Day 5	Notes
Welcome (15 mins) Students will create a list of tools to include in the “final project toolbox”.	**Welcome (15 mins)** Students check in with each other about the work they need to do to finish their projects.	
Final Project: Planning (30 mins) Students choose a direction for their final project and begin planning what the major components of the project will be.	**Final Project: Finishing Up (120 mins)** Students put the final touches on their projects for the showcase.	
Final Project: Work Time (105 mins) Students start to build a first version of their final projects based on their plans.	**Final Project: Showcase Preparation (30 mins)** Students prepare to present the work they accomplished this week at the showcase.	
Final Project: Peer Review (30 mins) Students look at each others’ projects to offer feedback	**Final Project: Showcase (60 mins)** Students present their robots to visitors.	
Reflect (15 mins) Students prepare a “final to-do list” for the next day’s work.	**Reflect (15 mins)** Students reflect on the ethical and technical considerations that went into designing their robots, as well as their learning throughout the week.	

Learning Goals

Over the course of the week, students will meet the following four goals:

- Use a functional definition of Artificial Intelligence (AI) to accurately be able to distinguish between technologies that use AI and technologies that do not use AI
- Reason about ethical dilemmas, especially the ethical implications of AI
- Explain how AI algorithms function using data sets
- Apply AI to solve a problem that is relevant to their lives

They will achieve these overarching goals by meeting the following daily objectives:

Day 1

- Define artificial intelligence, technology, and robots, and identify examples of each
- Differentiate between examples and non-examples of artificial intelligence
- Employ strategies to reason through ethical dilemmas
- Use block coding (AI Blocks 3.0) to meet certain goals with their programs and robots
- Share personal beliefs about AI and technology

Day 2

- Define the term “algorithm” and come up with real-world examples of algorithms
- Create algorithms to produce a pizza and determine the best type of pizza to deliver to a customer
- Use data sets of pictures to train image classifiers with a machine learning algorithm
- Discuss the implications of algorithmic bias and what can be done to mitigate it
- Create a program that uses an image classifier to recognize and react to certain animals
- Reflect on the pros and cons of artificial intelligence, including examples of “artificial unintelligence”

Day 3

- Complete an ethical matrix by identifying stakeholders, areas of interest, and conflicts of interest
- Use an ethical matrix to unpack the ethical implications of an AI technology
- Explore a dataset of words to learn about how computers represent language.
- Discuss what bias exists in big datasets and how to mitigate those problems.
- Create a program that uses voice commands to initiate a response from a robot
- Research and brainstorm potential ideas for final projects
- Determine the criteria and constraints for the final project

Day 4

- Create a list of tools and skills that can be used on the final projects
- Use graphic organizers to plan for final projects
- Analyze tasks from the final project to break them into smaller components
- Build time-management and planning skills by working on an open ended project
- Provide and receive feedback to and from peers in the classroom to improve final projects
- Use constructive feedback to make improvements to their product

Day 5

- Complete all components of the final projects
- Create presentations to accompany final projects
- Present final projects to an authentic audience at the showcase
- Reflect on final projects and the week of learning about AI

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Preparation and Materials

Before Day 1

1. Prepare laptops by going through the tech set up to install Google Chrome and prepare your robot.
2. Make sure that your classroom and students' computers have Bluetooth that is compatible with the robots that are used in the course. Install software on the robots and make sure robots are labeled by name before students begin working with them.
3. The last day of the course offers an opportunity for students to share their work with others in the school community. Consider who from your school community (parents, staff, other students, community leaders, etc.) you would like to invite. If possible, publicize the showcase with signs around the school or by sending out an invitation.
4. Finally, you as an instructor may be new to teaching a technology subject. Check out CS Teaching tips, especially the worksheets on Lecturing and Encouraging Help Seeking to help you and your students.

Day 1

1. Art supplies (if choosing discussion option #3 in the "Welcome" activity)
2. Materials to journal (if choosing discussion option #2 in the "Welcome" activity)
3. Projector to display images and videos from a computer
4. Materials for poster creation (for discussion option #2 in "What is AI?")
5. Chart paper and markers
6. Robots
7. Computers with internet connection

Day 2

1. Projector connected to computer with internet and course slideshow
2. Student workbooks pages
3. Areas in the classroom with different background colors
4. Computers with internet access
5. Cat/Dog dataset images (training set and testing set)
6. Reading materials for algorithmic bias discussion
7. Pros/Cons of AI chart

8. *Optional: paper pizza building materials: construction paper, scissors, tape*
9. *Optional: actual pizza building materials*

Day 3

1. Student Workbook Pages
2. Completed Pizza Delivery App Algorithm
3. Chart Paper or Whiteboard
4. Projector connected to computer with internet connection
5. Student computers with internet access
6. Robots
7. Robot programs from Day 1 “Intro to AI Blocks”
8. Access to video links for final project research

Day 4

1. Student workbook pages or copies of final project planning documents
2. Chart Paper, Board or Projected version of “Final Project Toolbox”
3. Robots
4. Student computers with internet access
5. Supplies to decorate the robots and build “worlds” for the final projects

Day 5

1. Student workbook pages or copies of final project planning documents
2. Chart Paper, Board or Projected version of “Final Project Toolbox”
3. Robots
4. Student computers with internet access
5. Supplies to decorate the robots and built “worlds” for the final projects
6. Posters for final project showcase presentations
7. Projector with slides

Assessments

For more information on assessing your students, see the **Assessment Rubric**, found after this section.

Critical Thinking

When students are working on STEM activities, it is **much more important to assess their critical thinking skills and the ways in which they approach the problem-solving process** rather than assess what they created or their specific coding skills.

🗨 *Discuss* Questions

Embedded throughout the course are opportunities to assess how students are thinking. The bulleted 🗨 **Discuss** questions provide **chances to assess both small-group and whole-class thinking** of either small groups of students or the whole class.

⇔ *Share* Activities

Embedded throughout the course are opportunities to learn about presenting your work, and giving feedback to others. These activities provide **chances to communicate learnings and build constructive feedback skills** in either pairs of students or as a whole class.

Observing and Listening

As students work through the activities, **listen carefully to their conversations and justifications for their design decisions**. The collaboration and use of science and engineering practices that you see will help you understand how students are approaching problems.

As students become more comfortable working with each other and implementing the engineering design process, **we recommend contrasting what you see at the beginning of the week with what you see later in the course.**

Showcase

Designed to highlight projects created by groups throughout the week, the end-of-week Showcase is a great opportunity to assess students by encouraging them to share what they learned throughout the week.

Assessment Rubric

Students gain positive attitudes and skills		
Goal	**Evidence: I see students...**	**Notes**
Students are engaged	• Participate in activities • Share ideas during discussion • Vocalize enjoyment	
Students apply their knowledge	• Share prior knowledge • Make connections from one activity to another • Relate previously collected data to new contexts	
Students collaborate	• Hear and respect the ideas of others • Encourage group members and classmates • Give thoughtful feedback to others	
Students use programming and engineering practices		
Day 1 Goal	**Evidence: I see students...**	**Notes**
1. Identify AI	• Ask about criteria of AI and constraints (i.e. is a toaster AI? Why not?) • Notice what is AI in their everyday lives	
2. Programming their robot and using computational thinking	• Use a variety of blocks • Apply math, logic, and abstract thinking to help solve problems or explain observations	
3. Engage in argument from evidence	• Support ethical and moral argument with accurate claims, reasons, and evidence • Discuss the challenges of evaluating ethical decisions	
Day 2 Goal	**Evidence: I see students...**	**Notes**
1. Creating and understanding algorithms	• Explain the components of an algorithm and how they function • Include necessary components in algorithms	
2. Understand the	• Recognize some of the tradeoffs they made when creating their algorithms	

subjectivity of AI	• Make observations about biased and unbiased datasets • Talk about ways to address algorithmic bias in their projects and AI used in society	
3. Create a program that uses an image classifier	• Build a dataset that is unbiased • Use the image classifier in the context of a program	
Day 3 Goal	**Evidence: I see students...**	**Notes**
1. Complete an Ethical Matrix	• Identify stakeholders, areas of interest, and conflicts of interest • Discuss ethical implications of different technologies	
2. Use voice commands	• Curate a dataset to train a language processing algorithm • Create a program that incorporates voice commands	
3. Analyze and reflect on AI	• Determine pros and cons of AI technology • Begin forming ideas for final projects	
Day 4 & 5 Goal	**Evidence: I see students...**	**Notes**
1. Research and Plan	• Generate novel ideas or extensions of existing ideas for final projects • Create a plan for executing final project ideas	
2. Construct final projects	• Make and test hypotheses • Design and improve technologies • Talk about solutions in groups or class discussions	
3. Give and respond to feedback	• Give effective constructive feedback to others • Appropriately receive constructive feedback • Incorporate feedback into final projects	
4. Present and communicate information	• Share information during activities • Prepare to present projects in showcase • Communicate about final projects clearly during showcase	

Tech Setup

Installing Chrome

Using the robot requires that you use the Google Chrome browser. Chromebooks already have the browser installed. Other computers may need to install the browser. See instructions for downloading it here:
https://support.google.com/chrome/answer/95346?co=GENIE.Platform%3DDesktop&hl=en

Robot Setup

Full instructions for setting up your robot for this course can be found on this website. Here, we will give a brief summary of what is required. We recommend that you go through these instructions before STEM Week, ideally with a team of volunteers to help.

1. Use the instruction manual that comes with the robots to assemble them. This includes attaching the motors, the wheels, and installing the batteries.
2. The robots require 3 AAA batteries. We recommend buying them from Amazon where the price for batteries is$0.24- $0.30 per battery.
   Note: The batteries last a very long time (>7 months) with appropriate use. Be sure to get students in the habit of turning off their robots when they are done using them.
3. Download the micro:bit software that allows it to communicate with our AI Blocks and the robot. The link for the software can be found on this page in the setup instructions.
4. Open our AI Blocks programming website and use the PRG Microbit Robot Blocks extension to connect your robot to your computer.

After you download the appropriate hex file on the micro:bit once, you will be able to connect it using Bluetooth on any computer. You only need to repeat that step if you download a different hex file at some point.

Giving Students Access to Online Materials

Different teachers will find different strategies helpful for making sure students have access to the appropriate links and online resources in this course. One way to make sure students are able to access the links necessary for each activity is for teachers to distribute the links to them via email or post them on a google classroom page (or another class website). The links can be taken from either of the links pages above, or from the educator guide (links are included in the instructions for each of the activities as they appear in the educator guide).

- Links By Day Document:
  https://docs.google.com/document/d/1_Lk63q6N5p8r_LYmhoYbdJhEeioEE_ONB4DLZQetxig/edit?usp=sharing

If you have any questions about how to distribute these links and online resources to your students please feel free to contact the i2 Learning team who can help you devise a strategy that will work for your classroom and technology needs and allow all of your students to have efficient access to the required materials during this course.

Technology Support

We have created several tools that will assist you in preparing and using the technology required in this course.

The following presentations give step-by-step instructions for a variety of technical set-ups required in the course:

It includes materials on how to:

- How to Set Up A New Project on Teachable Machine: Video
- How to Open a program saved on your computer in AI Blocks: Presentation
- How to Save a program in AI Blocks onto your computer: Presentation
- How to Record the AI Blocks Stage to Share Projects: Presentation
- How to Connect the Robots to the Computers with Bluetooth: Website | Video

Day 1

Students will:

- Define artificial intelligence, technology, and robots, and identify examples of each
- Differentiate between examples and non-examples of artificial intelligence
- Employ strategies to reason through ethical dilemmas
- Use block coding to meet certain goals with their programs and robots
- Share personal beliefs about AI and technology

Activities

Welcome>> 15 mins

Students are welcomed to the course and the stage is set for the type of activities they will engage in during the week

What is AI?>> 30 mins

Students discuss definitions of technology and artificial intelligence, and think about examples of artificial intelligence used in their lives.

Ethical Dilemmas>> 60 mins

Students are introduced to moral reasoning and use specific strategies to think about model dilemmas

Intro to AI Blocks and Robots>> 90 mins

Students follow tutorials to refresh their knowledge of programming and get to know their robots by practicing coding skills to program the robot.

Reflect>> 30 mins

Students reflect on what they have learned about AI and its role in society by participating in a “take a stand” activity

Welcome

Day 1

Welcome

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ None	▪ Art supplies (for discussion #3)	● Paper or Notebook for journal entry (for discussion #2)

Resources

Slides for this activity

Vocabulary

Artificial Intelligence - a program made by people that makes computers do things that seem intelligent (or smart) in the same way that humans are intelligent

Robots - machines that sense their environment, do calculations of some kind, and then perform an action

Technology - skills and tools that people use to achieve goals, often to make life easier

Ethics - moral guidelines for how people in society should behave if they want to be fair

Lesson

15 mins

Objectives

1. Students will be introduced to the learning topics for the week through an interactive activity or discussion.

Introduction

In this course students will build robots that are artificially intelligent. These robots can interact with people and their environment, which means that they can have both good and bad consequences for society. This course will help students think about those consequences and how to think about the ethical implications involved in them.

We will rely a lot on online tools like AI Blocks which means that students can take what they learn in class and use them for their own projects at home.

Directions

1. Welcome students to Day 1 of How to Train Your Robot. Introduce students to what they will do in the class:
    - Learn about AI in the real world
    - Program robots and train machine learning algorithms
    - Reason about ethical dilemmas that come up with technology
    - Work together to design robots that solve real-world problem
2. If you would like to pre-introduce students to the new vocabulary for the day: **artificial intelligence**, **robots, technology, ethics**. We will learn about the definitions of these words throughout the day.
    - **Artificial Intelligence** - a program made by people that makes computers do things that seem intelligent (or smart) in the same way that humans are intelligent
    - **Robots** - machines that sense their environment, do calculations of some kind, and then perform an action
    - **Technology** - skills and tools that people use to achieve goals, often to make life easier
    - **Ethics** - moral guidelines for how people in society should behave if they want to be fair

 Discuss

 Note:

You can choose which discussion activity is most suitable for your class. The goal for discussion activities is that students have an opportunity to make their learning personally meaningful.

Discussion Option #1: Would You Rather?

This activity would be good for students with a broad range of knowledge about technology who are willing to actively participate in a game.

Engineers are people who build technology. In order to do their job, they have to make a lot of tough design decisions and solve ethical problems. In order to get your student engineers into the mindset of engineering decision making, we're going to play "Would you rather?" Example: Ask students "Would you rather to never eat your three favorite foods the rest of your life or only be allowed to eat your three favorite foods for the rest of your life?" Students must say which one they would rather do. They should share with each other, and a few should share with the entire class.

1. Would you rather have a robotic pet that looks and sounds exactly like a real pet, or one that is obviously a robot?
2. Would you rather have an AI helper that can do anything but shares information about you with the company that built it, or an AI helper that can only do what you teach it but keeps your information secret? (Privacy is often a concern with technology!)
3. Would you rather have an AI math tutor that can solve almost any math problem, but cannot tell you how it got to the answer or an AI that can only solve some math problems, but can show you all of its steps? (Transparency is another huge problem with algorithms. They cannot always explain their answers.)
4. Ask students to make up their own questions! What are some other tradeoffs that come with technology around security, how technologies are advertised, features, and other topics?

Discussion Option #2: Journal Activity

This activity would be good for students who are familiar with technology and are open to reflecting on their own experiences through writing.

Discussion Option #3: Artistic Activity

This activity would be good for students with a broad range of knowledge about technology who are interested in an independent, creative activity.

Technology is often built to make something simpler or solve a problem. In this course, we will think about how we can design robots that solve problems. Draw a robot that does something that you think is important. Write a story about what superpowers the robot has and the people who it helps.

What is AI?

Day 1

What is AI?

For the whole group	For each group of 2	For each student
▪ Chart paper ▪ Colored markers ▪ Projector to show examples for AI	▪ Materials for poster creation (for discussion option #2)	

Resources

Slides for this activity

Google Doodle of Johann Sebatian Bach:
https://www.google.com/doodles/celebrating-johann-sebastian-bach
Example of robot dog: https://www.youtube.com/watch?v=sJciRIZQTg4
Example of self-driving car: https://www.youtube.com/watch?v=uHbMt6WDhQ8
Example of AI learning to play games: https://www.youtube.com/watch?v=kopoLzvh5jY
Explanation of Go playing AI: https://www.youtube.com/watch?v=PUaCQUal7rM

Video about the opportunities and risks of AI: https://www.youtube.com/watch?v=9qGao-3Hrc8

Vocabulary

Artificial Intelligence - a program made by people that makes computers do things that seem intelligent (or smart) in the same way that humans are intelligent.

With AI, computers and machines can *understand* their environment, *learn* more about it, *make decisions* and plans, and then *interact* with humans and the environment.

Robots - machines that sense their environment, do calculations of some kind, and then perform an action.

A machine is any moving mechanical device that does work.

Without AI, robots can sense but not understand, they can do calculations but they cannot learn and make decisions, and they can do actions but they cannot interact.

Technology - skills and tools that people use to achieve goals, often to make life easier

Lesson

30 mins

Objectives

1. Students will be able to identify examples of technology
2. Students will be able to define and identify examples of technology, artificial intelligence and robots and differentiate between them.

Standards

1. W.1 - Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence

What is Technology?

1. Work with students to come up with a definition of technology. Begin with the broad question: **How would you explain what technology is to a 5-year-old?**
   An example definition is, “Technology includes the skills and tools that people use to achieve goals, and to make their life or work easier,”
2. Examples can be a powerful way to solidify their understanding of what something is. Prepare to write a list of examples of technology on the board. Ask students: **What are examples of technology that you have seen or used - even just throughout today?**
   Answers can range from very exciting things - virtual reality headsets, genetically engineered food, spaceships that land straight up and down - to very mundane things - ponytail holders, pencils, rubberbands.
3. We often focus on the benefits of technology, but it’s important that students know that technology can be harmful as well as helpful, often it is both at the same time!



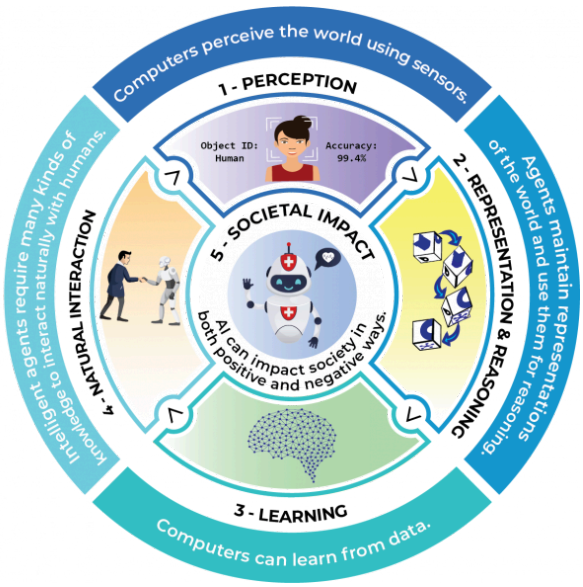
4. Using the list of technologies on the board, ask students: **What are some ways that the technology we use everyday can be helpful and harmful?**

What is AI?

1. Explain to students that the technology that we will focus on in this class is artificial intelligence. Start by creating a working definition of AI with the students.
2. Work with students to come up with a definition of AI. **How might you describe what AI is to a 5-year-old?** If students cannot readily come up with a response, offer to help them break down the two words 'artificial' and 'intelligence' first.
3. The term **artificial** is an adjective used to describe that which is not natural and is usually made by people. Have class share out examples of things that are "artificial".
   If no one brings it up, make sure that technology, machines, and robots come up.
4. **Intelligence** is something related to using your mind to do things like understand what is going on, apply knowledge, solve problems, and be creative (there are no simple definitions of intelligence!) Have class share out actions they would describe as intelligent.

It might be useful to think of things that they can do which babies, animals, and even computers cannot do. Some important ideas are being good at puzzles, being creative, knowing the right thing to do, being able to talk.

5. Connecting the two ideas, we can create a definition of AI that revolves around things that seem intelligent, by human definitions of intelligence, being simulated on machines and robots. Our official definition of **"artificial intelligence (AI)"** is a program made by people that makes computers do things that seem intelligent (or smart) in the same way that humans are intelligent.
6. Explain to students that AI can do four main things, they can *understand* their environment, *learn* new knowledge and skills, *plan* and make decisions, and *interact* with humans and the environment. These are four of the Five Big Ideas of AI. The fifth idea is societal impact. The positive and negative effects that AI has on our world is central to our understanding of the technology.



7. Review at least one example of each of the four things things AI can do:
    - Understand/Perceive: Chatbots (Siri, Alexa) can detect when someone said their name and can understand speech. Toy robots often have cameras and other sensors that can see objects.
    - Learn: Netflix and YouTube learn what kinds of videos you like to recommend more; personalizing and improving over time. The Bach Google doodle learned how to play music that sounds like Bach by hearing previous examples. Reinforcement learning algorithms play games thousands of times to learn how to beat them.
    - Decide/Plan: DeepBlue AI and AlphaGo beat the world's best chess and Go players and they had to plan ahead many steps. Google Maps can plan the best way to get between two places.
    - Interact: Chatbots (Siri, Alexa) can have a back and forth conversation with people, responding to what they say and executing commands. Self-driving cars control all parts of a car to constantly respond to the environment.

🗨 Discuss

✎ Note:
You can choose which discussion activity is most suitable for your class. The goal for discussion activities is that students have an opportunity to make their learning personally meaningful.

Discussion Option #1: AI and Society
This activity works well for students who are learning about AI for the first time and would like to see lots of examples of AI in the real world.



The Association for the Advancement of Artificial Intelligence or AAAI (triple-A I) is an international organization that oversees research in AI. They see AI benefiting the world in 6 particular ways: in healthcare, education, business, science, social justice, and security.

Here is a video (https://www.youtube.com/watch?v=9qGao-3Hrc8) where a scientist talks about some of the possible opportunities of Artificial Intelligence. Discuss the video as a class with the following questions.

1. **Which of the 6 Opportunities of AI did the scientist discuss in the video?**
    - Healthcare: Robots that can help children walk, AI that can help people see better
    - Accelerating science: robots in space like Spirit and Ocean One (https://www.youtube.com/watch?v=p1HmgP9l4VY).
    - Reinventing business: having robots perform repetitive tasks in factories
    - National defense and security: AI that can help in hazardous situations like Robotic Swarm and bomb defusing robots.
2. **Take one of the examples of AI and think about how it may work.**

We do not expect students to know exactly how they work, but here are some explanations that can be useful:

- Robots that help children walk - use sensors to understand where the ground is and to get input from the user. Activates motors that assists the person in walking.
- AI to help people see - uses cameras to see objects and read text and then uses speech to relay that information to the user.
- Spirit: robot in space - has lots of cameras and sensors on board that allow the robot to navigate the rough terrain of Mars to collect data. Robots cannot be 100% remote controlled because it takes an average of 13 minutes for radio signals to go between Mars and the Earth!
- Ocean One (https://www.youtube.com/watch?v=p1HmgP9l4VY): underwater robot - has lots of cameras and sensors on board to help the people driving it navigate underwater. This means stabilizing itself, avoiding obstacles, and identifying objects.
- Factory robots - coordinate with one another and with any humans to figure out the fastest way to complete tasks, use AI to detect bad parts
- Robotic swarm - search and rescue robots have to coordinate with one another to figure out the fastest way to search the area
- Bomb defusing robots - help human remote controllers by doing some functions, especially ones that are time sensitive, very quickly. Work to minimize the risk of setting off a bomb.



We know that technology can be very helpful and can introduce new problems at the same time. These are the 6 dangers of AI. The next video will talk about some of the dangers of AI that we need to consider.

1. **Which of the 6 dangers of AI did the scientist discuss in the video? What are examples of problems that we still need to overcome?**

- Unforeseen consequences: flaws in design led to the death of a pedestrian with a self-driving car
- Overreliance on technology: AI can help us make decisions but this can lead to manipulation
- Algorithmic bias: it may be harder for us to find new and unusual things if algorithms are trained on past data (we will explore this more later), facial recognition does not always equally recognize people from different backgrounds
- Privacy: individuals are increasingly being monitored and tracked

2. **What are some strategies we might employ to balance the good and bad effects of AI?**
   Here are some things students may bring up depending on their background knowledge.
   - Unforeseen consequences: be careful when we are designing technology and think about what kinds of situations our technology might be in.
   - Overreliance on technology: do not build technology that makes hidden decisions or that tries to manipulate people.
   - Algorithmic bias: understand the limitations of data - if we only train on past data or if we forget to include some groups, then we could introduce bias.
   - Privacy: be careful about what kind of information we collect and make sure people know and can control the data we have.

Discussion Option #2: Poster Making Activity
This activity works well for students who are learning about AI for the first time and would like to create informational posters that can be displayed in the classroom.

Have students draw or create collages to make posters about the four different functions that AI can perform and real world examples of those functions. The Five Big Ideas of AI poster can provide some inspiration.

Discussion Option #3: The Pros and Cons of AI
This activity is good for students who are already decently familiar with AI and are ready to have a class discussion about ways that AI can be harmful as well as hurtful.

On the board or chart paper, create a large table with three columns: ‘Examples of AI’ ‘How can this AI help us?’ ‘How might this AI hurt us?’ Explain to students that AI is a technology with good and bad effects. Throughout the week, we will see and build a lot of helpful technology, but it’s important for us to know that AI has some cons as well. Some of these issues we can fix, while others we cannot. It’s important for us to be aware of pros and cons when we make and use any technology.

Example:

Examples of AI	How can this AI help us?	How might this AI hurt us?
Smart speaker (e.g. Alexa)	Can do things handsfree Easier access to music Easier access to information on the Internet Entertaining	Listening to conversations Misunderstanding us and answering questions wrong Buying something we do not want Can be hacked
Self-Driving Cars	Allows more people to drive ...	Not perfect, can get cause accidents ...

AI or Not?

Day 1

AI or Not?

Materials and Preparation

For the whole group	For each group of 2	For each student
• Chart paper or virtual chart to project • Videos and examples of each item on the "AI or Not?" cards • Blank chart paper for "Pros/Cons of AI" chart (with markers to write on it)		• "AI or Not?" workbook pages

Resources

Slides for this activity
Student workbook page
Printable "AI or Not?" Cards
Video example: Teachers reasoning through toaster, automatic door, and robot dog

Lesson
30 mins

Objectives

1. Students will be able to identify examples and non-examples of artificial intelligence
2. Students will be able to construct viable arguments supported by reasons and evidence

Standards

1. W.1 - Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence

Introduction

There can be some confusion about which items are considered “artificially intelligent” and which are not. This activity pushes students to clarify these distinctions, and construct sound arguments for why certain examples constitute “artificial intelligence” and why others do not.

There are several ways you might structure this activity. One is a full class debate over each example, where the class is involved in open discussions to decide if examples are AI or not. Another is to assign smaller groups to each example, and then having them share their opinions with the whole group. In either set up, students will have to use strong reasoning skills to argue for their opinions.

It is critical that at the end of this activity, students have accurate answers for which examples are AI and which are not, and that they are able to articulate reasons to support each answer. Whereas sometimes classroom debates can end in “ties,” this discussion must end up with the correct identification of examples as AI or not.

Directions

1) Explain to students that now that they have a working definition of artificial intelligence, they will apply that definition to several examples to see if the examples are of AI, or not.

2) To model the type of thinking you expect from students in this activity, you may choose to do talk through one example yourself before opening up to full class discussion or sending off students to work in a small group. When going through this example, make sure you introduce students to the key questions that help distinguish AI from Not AI:
    a) Does the example perceive/understand its environment?
    There is a difference between perceiving/understanding the environment and just sensing it. A camera senses light and colors, but does not know what objects they represent.
    b) Does the example continue to learn?
    There is a difference between learning and using a knowledge bank. Computer programs that play solved games, simple games without an element of chance, like Tic Tac Toe or Checkers can win every time. However, they are not learning how to beat their opponent, they are following exact mathematical instructions for the game. Games like chess require a computer to react to their opponent’s strategy.
    c) Does the example make plans or decisions on its own?
    There is a difference between making a plan and following a plan. GPS apps make a plan. In contrast, the first versions of robot vacuum cleaners used simple bump-and-turn algorithms, but did not make a real plan to clean the floors of different rooms.
    d) Does the example interact with its environment?
    There is a difference between interacting with an environment and following a script. Automated phone tellers, like those in voicemail, can talk with you but they follow a pretty rigid script. Modern voice assistants can carry on more freeform conversations.

e) Who is doing the thinking - "where is the intelligence" - with the humans who programmed it or with the device/program?
This is a catch all for any example. If a system does one of the four intelligent things above, think about how it works. Is it making intelligent actions on its own or did all of the intelligence come from the humans who programmed it.

It's also important to model for students how to construct a logical argument, giving reasons and evidence to support whether an example is AI or not. For example, you might think out loud: "*I believe that the video games foes (e.g. pacman ghosts) are NOT AI because they just follow their programming without getting better over time. The ghosts behave the same way no matter what level you are on.*" This argument has a claim, reason, and evidence (see color coding). After this model, move onto the next stages of this activity.

3) As mentioned above, this activity can be run as a full group activity, or in smaller groups. If running this activity in a full class discussion, put up an image for each example, and open a discussion about whether it is AI or not. For small group work, giving each group one example to work through. In both arrangements, have students develop an argument for whether the example given is AI or not. After some time, small groups should come together to present their thinking to the class.

4) By the end of the activity, all students should have a clear answer for each example, and also understand the reasoning behind each example. Here are the correct answers for each example:

Not AI	**AI**
Toaster	Autonomous robot dog
Automatic door	Chatbots
Car (old school)	Self-driving car
Remote control robot	Snapchat face filter

To summarize the reasoning, you could create a chart like the one below for this activity to help students think through the examples:

MODEL CHART	Reasons it might be AI	Reasons it might not be AI
Toaster	It makes food, like humans	Does not understand when toast is done Needs a human to turn it on and off
Chatbots	Understands audio and turns it into text on its own Understands text and turns it into actions on its own Some can learn to recognize voices	Most of the responses it gives are scripted It cannot handle every question people come up with
Automatic Doors	It opens doors, replaces people door openers	Senses things close to it, does not understand what those objects are. Humans programmed what sensor value triggers it to open
Car (Old School)		Cannot do anything without input from a human
Remote control Robot		Cannot do anything without input from a human
Autonomous Robot Dog	Some can learn to recognize voices and faces Responds to its environment without a human telling it what to do	
Snapchat filters	Perceives and detects faces and people's eyes, mouth open/closed, etc. on its own	It's not clear that it does anything useful, although it is entertaining
Self-driving car	Understands and perceives what areas are good to drive on, which are not on its own Plans route using its map Interacts and deals with different road conditions on its own	

✎ Note:

In order for students to be able to fully grasp the subsequent work in this course about artificial intelligence, it is imperative that they leave this session with a strong understanding of what artificial intelligence is, and how it differs from traditional computer programming, or other "automated" technology such as automatic doors etc.

One of the most effective ways to think about this distinction is to ask the question "where does the intelligence, or thinking, take place?" For artificially intelligent programs, the program itself is making the decisions (for example, youtube's algorithm is what comes up with recommendations, and a self-driving car decides whether to stop or not). In non-examples of artificial intelligence, it is the human programmers that tell the computer how to respond to certain commands (a human must program an automatic door to open when a certain signal is triggered; a remote control robot must be controlled by a human, etc).

8. Let's revisit the Pros/Cons of AI chart - is there anything that we might want to add or remove from our list? This chart will be revisited throughout the week.

⋮ Discuss

Why might we want to develop artificial intelligence? How might AI be helpful to us?

AI can be helpful to solve problems and make things more convenient. For example, AI in self driving cars might be more convenient, and chatbots like Alexa help keep people organized with reminders and calendars.

But both of these examples could cause damage as well. Self-driving cars can be dangerous, and Alexa and listen in when it's not supposed to and collect too much data.

Ethical Dilemmas

Day 1

Ethical Dilemmas

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ Projector to show brainpop video		• Student workbook pages • Copies of the ethical dilemma(s) you choose to discuss as a class (or can be projected for all to see)

Resources

Slides for this activity

Brainpop video about Ethical Dilemmas (5 minutes): https://www.youtube.com/watch?v=GQDYLvV0_zk

Vocabulary

Ethics - moral guidelines for how people in society should behave if they want to be fair.
Morality is the difference between good and bad, wrong and right, following the rules and breaking the rules

Lesson

30 mins

Objectives

1. Students will be able to define a moral/ethical dilemma and employ strategies to reason through them

Standards

1. W.1 - Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence
2. RI.6 - Assess how point of view or purpose shapes the content and style of a text

Introduction

As we mentioned in the Welcome, every technology has good and bad consequences. We not only want to teach students about technology, we also want them to be able to think carefully about those consequences of the technology. In this lesson we will introduce ethical dilemmas and equip students with some tools to think about them carefully.

Directions

1. Have students watch the following video about ethical dilemmas together https://www.youtube.com/watch?v=GQDYLvV0_zk



Discuss

What are ethics? Ethics are a set of moral guidelines that individuals in society follow to be fair to one another. Who decides these guidelines?

What was the first ethical dilemma that Tim described? The girl in the video was paid to mow her neighbor's lawn. It took the girl about half an hour less to mow the lawn than usual. The amount that the neighbor paid was most likely related to how long it thought it would take. This means that the girl was given too much money to mow her neighbors lawn. What strategies did Tim employ to discuss the ethical dilemma? Tim suggested that the girl put herself in her neighbor's shoes and considered the consequences of each action. What advice would you give the girl and why?

What was the second ethical dilemma that Tim described? A boy's friend cheated off of his test. The friend asked the boy not to tell the teacher about it. What strategies did Tim employ to discuss the ethical dilemma? Tim made a pro/con list for the different consequences of each of the actions. What advice would you give the boy and why?

Would you expect everyone to have the same advice for these situations? What does that mean?

2. Different people may have different opinions about the right thing to do. Different people may also have the same opinion about what to do, but have different reasons for wanting to do it. **The important thing** is to learn how to understand different opinions and to make the best decision possible.
3. Have students look at the ethical dilemmas on their AI ethical dilemma reading page. Students should work with another person to look at the different sides of the ethical dilemma. Students should use the pro-con list and/or perspective taking from different sides to help with their reasoning. Give students time to work on them.
4. Ask students to use their persuasive reasoning skills to share their decision and their reasoning with a partner or with the class. "I think that the old man should be given the water. Because it is important to respect your elders and honor people who are older than you. Respecting elders is

an important value for functioning societies." This argument has a claim, reason, and evidence (see color coding).

Ethical Dilemmas

A. **Brainpop Example.** Yesterday I caught my best friend cheating off my test. He's never done it before and he begged me to keep it secret. If his parents find out, he'll be grounded for weeks. What should I do?

B. **Best of the Worst.** Two young men, brothers, had got into serious trouble. They were secretly leaving town in a hurry and needed money. Karl, the older one, broke into a store and stole a thousand dollars. Bob, the younger one, went to a retired old man who was known to help people in town. He told the man that he was very sick and that he needed a thousand dollars to pay for an operation. Bob asked the old man to lend him the money and promised that he would pay him back when he recovered. Really Bob was not sick at all, and he had no intention of paying the man back. Although the old man did not know Bob very well, he lent him the money. So Bob and Karl skipped town, each with a thousand dollars. Which is worse, stealing like Karl or cheating like Bob?

C. **A Rock and a Dry Place.** Two people were walking in the desert on their way back to the nearest oasis. They had with them just their clothes and water carriers, no food, no animals, nor any equipment. Upon stopping for some water they realized that they only had enough water for one of them to reach the oasis. One of the wanderers was old and wise, a well respected elder who had lived a great life of honor. The second traveler was younger, but strong in body and spirit. The wanderers had to decide what to do with their remaining water - what should they do?

D. **Climate Catastrophe.** In the city of Winterfell ran a river. The river once was the pride of the area, but for many years now it had become a wasteland where everything from trash, industrial waste, and unwanted junk was dumped. The city raised a significant amount of money to clean up the river, and found only one company that would be able to return the river to nearly its original quality. The city wants to hire this company, until someone brings to their attention that a different branch of the company is deeply involved in drilling for oil, and has been responsible for the damage of many ecosystems in the areas where it drills, including at least one major oil spill. Paying for this company to clean the Winterfell river would almost certainly support them to damage other environments elsewhere. What should the people of Winterfell do?

E. **Big Brother.** A school wants to install new artificial intelligence "chatbots" with cameras in each space in their building, including classrooms, hallways, and stairwells. These devices have the capability to listen to and recognize human speech, connect with the other devices in the building, and take pictures and video. The devices are marketed as a way to help teachers and students and keep everyone safe. However, some people think that installing the chatbots will invade everyone's privacy and will be a distraction. What are the pros and cons of the school installing these devices? Should the school install them?

✎ Note:

Review these 5 dilemmas and think which one(s) might be the most fruitful for class discussion. Some teachers

have found discussing the dilemma from the brainpop video is also helpful. Dilemma E, which is about artificial intelligence, is also helpful to bring to discussion, as it sets students up to think about the pros and cons of using artificial intelligence, and some of the deeper ethical considerations of AI. This thinking will come up again in several subsequent parts of the course.
You can also decide if you want to have the entire class discuss the same dilemma, or split students up into groups so each group discusses a different situation.

Intro to AI Blocks

Day 1

Intro to AI Blocks

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ Projector	● Laptops with Wifi connection ● Robots ● Access to internet links below	● Programming Guides

Resources
Slides for this activity
Teaching tips for Introducing Computing and Teaching Scratch

Link for AI Blocks
- Template program file for controlling robot

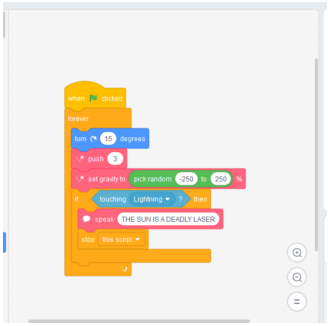
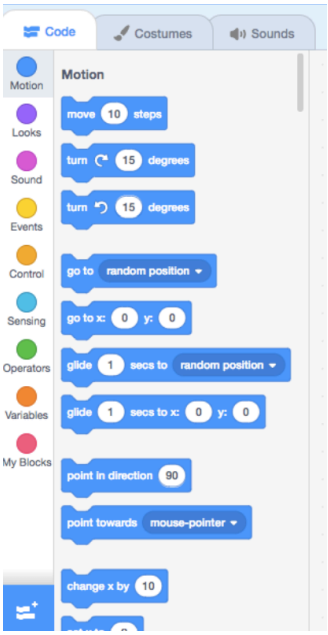
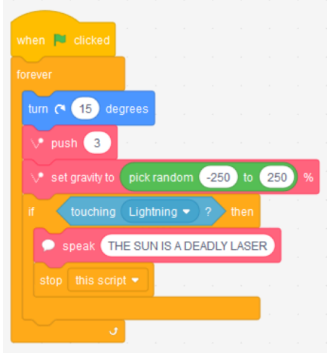
Getting Started instructions to connect robot to computer
Programming Guide: Introduction to AI Blocks | Introduction to AI Blocks with robots
Save and Load program files
Programming Tutorial Video: Introduction to AI Blocks with robot

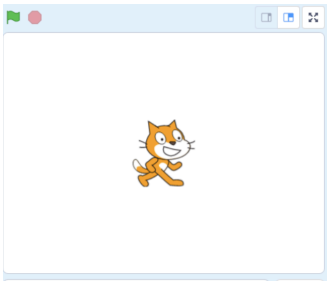
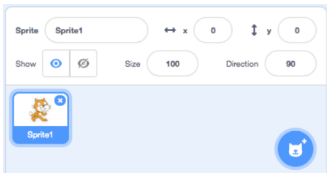
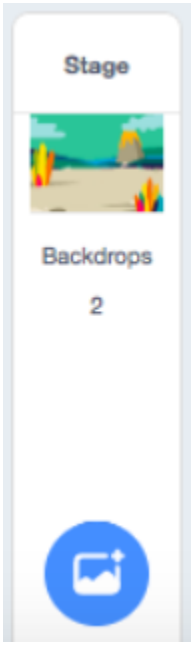
Vocabulary

Coding - assembling a set of instructions that tells a computer how to do something you want it to

Important AI Blocks Components

We will be using a block-based programming language to program the robots. Here are the important parts of the language.

	**Workspace**- the part of the program editor interface in which to place code blocks you want to use to code your animation
	**Block Palette** - the part of the program editor all the way to the left where you can see the different types of code blocks that can be used in the Workspace
	**Script** - a set of blocks that are linked together in order to have a set of actions happen in sequence

	**Stage** - the area of the program editor interface where the animations happen
	**Sprite** - a character that can be coded in a scene in AI Blocks
	**Backdrop** - a picture or drawing that can be placed in the background of a scene in AI Blocks

Note: Scratch is both a programming language and an online, community-based platform. The AI Blocks that we are using to program the robots is separate from the online programming community. But you can explore that community at https://scratch.mit.edu to learn more about programming.

Lesson

1 hr 30 mins

Objectives

1) Students will be able to use block coding (AI Blocks) to meet certain goals with their robots

Standards

1. 3-5.CS.a.4 - Identify and solve simple hardware and software problems that may occur during everyday use (e.g. power, connections, application window, or toolbar)
2. 3-5.CS.a.5 - Describe the differences between hardware and software
3. 3-5.CT.d.1 - Individually and collaboratively create, test, and modify a program in a graphical environment (e.g., block-based visual programming language).
4. 3-5.CT.d.2 - Use arithmetic operators, conditionals, and repetition in programs
5. 6-8.CS.a.5 - Individually and collaboratively design and demonstrate the use of a device (e.g. a robot, e-textile) to accomplish a task)
6. 6-8.CT.b.1 - Design solutions that use repetition and conditionals
7. 6-8.CT.d.5 - Trace programs step-by-step in order to predict their behavior

Introduction

AI Blocks is an online tool that we can use to program games, animations, and videos. The programming tools are blocks that snap together. The different colors of the blocks distinguish the kind of block it is and what it can do. We will be using AI Blocks to program our robots. Today we will go through tutorials to get more familiar with AI Blocks and with robots.

Directions

1. Have students take out their robots. and go through the instructions explaining how to connect the robot to the computer.
2. Have students begin exploring the different features of the robot - measure distance, detect a line beneath it, play music, drive, display icons on its LED matrix, and flash LED headlights.
3. Have students open AI Blocks using the link provided at the beginning of this lesson guide.
4. Use the activity slides to show students how to program the starter activities for the robot. Every activity has primer code, for beginners, and a stretch goal, for students who are moving more quickly.
   There is a version of the activity about a pet robot, for students who are interested in robots as characters or companions, and an icecream truck, for students who prefer the idea of robots as cars.
5. Within the activity, students do the following:
   a. Have the robot drive in a square. **Stretch goal:** create a more complex motion path for the robot to drive along.
   b. Learn about forever loops to have the robot do light and sound animations. **Stretch goal:** have the robot play sound and light animations while also moving in a motion path.
   c. Learn about conditionals to have the robot use sensors to react to input from the environment. **Stretch goal:** have the robot use sensors to drive autonomously.
   d. Learn about loops to create a complex dance sequence. **Stretch goal:** have the robot accomplish a task and then celebrate with a dance.
   e. Learn about robot behavior to design a scripted interaction.

6. At some point while students are working, show students how to load and save their work. Have them load a saved project, make changes to it, and then save the project in their Google Drive. Use the “How to Save a Program File and then Upload it to Google Drive” presentation to show students step-by-step how to save their work.

Discuss

Would you consider the things you built artificial intelligence? What would have to be different for it to be AI?

The programs that students wrote so far would not be considered artificial intelligence. This is because students wrote exact instructions for the robot to follow.

In the third activity, some students may argue that the robot perceives its environment because it uses the distance sensor, but really the robot only senses its environment. Students had to program it with exact instructions for it to know something was in front of it. At best, the third program is a simulation of AI.

Reflect

Day 1

Reflect

Materials and Preparation

For the whole group	For each group of 2	For each student
• Reflection “Take a Stand” Powerpoint • “pros/cons of AI” chart		

Resources

Slides for this activity

Lesson

30 mins

Objectives

1) Students will be able to reflect on their learning about AI by sharing their beliefs about AI and technology

Standards

1. W.1 - Write arguments to support claims in analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence
2. 6-8.CAS.c.1 - Describe current events and emerging technologies in computing and the effects they may have on education ,the workplace, individuals, communities, and global society
3. 6-8.DTC.a.1 - Identify and explain the strengths, weaknesses, and capabilities of a variety of digital tools

Introduction

To end the first day, students will reflect on the role of AI and technology in their lives. This reflection connects some of what students have learned about AI and Ethical Reasoning earlier in the day. It sets the stage for bigger conversations throughout the week about the ethical implications of using artificial intelligence in our world.

Directions

1. In this activity students will react to a series of statements about AI and technology. One way to achieve this is to have a full group discussion about each statement. Alternatively students can individually reflect on each statement, and then discuss.
2. For full group discussions, present the slides for this activity, and have students move about the room according to their stances. When students have moved to their chosen spots, facilitate a conversation about their beliefs on each stance.
3. For an individual reflection, read statements out loud to students, and have them write a brief reflection on each. Then facilitate a conversation about the statements based on what students wrote.



Discuss

As students discuss their stances on each statement, push their thinking with the following questions:

- Why do you think that?
- What examples can you think of that support your thinking?
- Does anyone disagree with [Student]? Why?
- Is that true in all cases? Can anyone think of a counter-example?

Statements:

1. What is the role of technology in your life (cannot live without it -> it scares me)?
2. AI might make our lives easier by doing more tasks for us
    a. I am very excited by this possibility -> I am very concerned about this possibility
    b. I think this is very likely to come true -> I think this is very unlikely to come true
3. AI might create some dangers for those who use it?
    a. I am not very concerned by this possibility -> I am very concerned about this possibility
    b. I think this is very likely to come true -> I think this is very unlikely to come true
4. AI might mean we become over reliant on machines and replace the need for humans in jobs and relationships
    a. I am very excited by this possibility -> I am very concerned about this possibility
    b. I think this is very likely to impact me in my lifetime -> I think this is very unlikely to impact me in my lifetime
5. AI might become the perfect friend, there to listen whenever we need and ready to meet our every desire
    a. I am very excited by this possibility -> I am very concerned about this possibility
    b. I think this is very likely to impact me in my lifetime -> I think this is very unlikely to impact me in my lifetime
6. AI might cater to all our desires so well that we prefer AI interaction to human interaction
    a. I am very excited by this possibility -> I am very concerned about this possibility
    b. I think this is very likely to come true -> I think this is very unlikely to come true

7. I am able to influence how AI develops in the future (strongly agree -> strongly disagree)

Extension Activity #1

Thank you to Mrs. Angie Charky from California for contributing the following extension activity.

The debate about whether robotics and AI are good or bad for humanity is ongoing. Students can explore new perspectives by reading the following Scholastic News article about different stances on this debate. See the "Should We Worry About Robots Taking Over" article, also available in Spanish.

Students can also complete an opinion piece using the associated guide questions (not available in Spanish).

Day 2

Students will:

- Define the term “algorithm” and come up with real-world examples of algorithms
- Create algorithms to produce a pizza and determine the best type of pizza to deliver to a customer
- Use data sets of pictures to train image classifiers with a machine learning algorithm
- Discuss the implications of algorithmic bias and what can be done to mitigate it
- Create a program that uses an image classifier to recognize and react to certain animals
- Reflect on the pros and cons of artificial intelligence, including examples of “artificial unintelligence”

Activities

Welcome>>	15 mins
	Students review what they learned yesterday and go over the activities for today.
Pizza Recipe Algorithm>>	10 mins
	Students create an algorithm to make a pizza..
Pizza Delivery App>>	30 mins
	Students create an algorithm that determines the best type of pizza to create based on data input from several questions
Intro to Image Classification>>	60mins
	Students train an image classifier on several data sets of images
Algorithmic Bias Discussion>>	30 mins
	After watching and reading several sources, students discuss the impact of biased algorithms on different groups of people.
Animal Recognition>>	60 mins
	Students use image recognition to have their robots recognize pictures of different animals.
Reflect>>	10 mins

Students reflect on what they have learned today about algorithmic bias in AI systems today.

Welcome

Day 2

Welcome

Materials and Preparation

For the whole group	For each group of 2	For each student
• Projector, whiteboard, or chart paper to display the word “Algorithm”		

Resources
Slides for this activity

Vocabulary
Algorithm - a set of steps or rules to follow in order to solve a problem or accomplish a specific goal

Lesson
15 mins

Objectives

1) Students will define the term “algorithm” and produce several examples of algorithms that are familiar to them.

Standards

1. 3-5.CT.b.1 - Define an algorithm as a sequence of instructions that can be processed by a computer.

Introduction
Machine learning is a hot topic in AI. Recently, faster and more powerful computers as well as easier access to large datasets have made it easier to develop machine learning systems. Today, students will go through several machine learning algorithms, but first we ask the question: what is an algorithm?

Students may be familiar with the term algorithm, particularly in math where they may use the “standard US algorithm” to solve multiplication problems. In a plain sense, an algorithm is a set of steps or instructions used to solve a problem (like a multiplication problem, for example) or achieve a specific goal. A recipe is another common example of an algorithm - when you follow the steps, you achieve the goal of creating a delicious meal!

Algorithms are used in many facets of computer programming, especially in artificial intelligence programs, to accomplish particular tasks. Throughout the Day 2 activities, students will explore what an algorithm is, how it gets used in artificial intelligence programs (with a particular focus on how to curate data sets that get used with AI algorithms), and also grapple with what issues arise when algorithms are created with bias.

For today’s welcome, it is important that students begin to get a sense of what an algorithm is. If your students have a stronger sense of what an algorithm is, you might ask them to list some of the algorithms they know about, and explain what makes them algorithms. For students with a less clear understanding of algorithms, start with the simpler pizza-recipe algorithm activity.

Directions

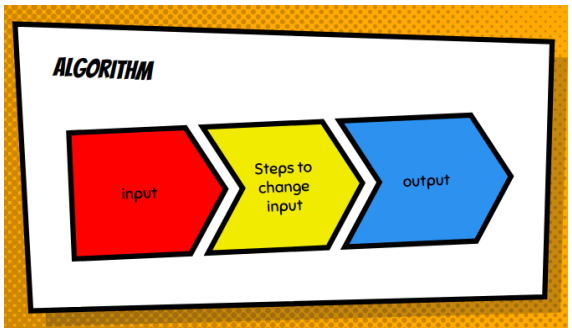
1. Welcome students to the second day of learning about AI and ethics. Ask them if they came across any examples of AI at home or elsewhere after the first day of the course. Ask them if they have any further thoughts about the AI Pro/Con Chart

2. Explain that today students will learn about different AI algorithms. First we will define what we mean by algorithm and give some examples. Then we will see some examples of AI that use algorithms to identify images. Finally we will discuss some pitfalls that occur when AI algorithms are not used properly.

3. With the word “algorithm” written or projected large enough for all students to see it, ask students to share what comes to mind when they hear this word. Many students might talk about math, where they use the “US Standard Algorithm” for multiplication. Some might talk about computer programming.

4. Provide students with the following definition of algorithm:

Algorithm - a set of steps or rules to follow in order to solve a problem or accomplish a specific goal
In general, algorithms have three main parts: the input, the steps to change the input, and then the output.



5. Share with students some examples of algorithms, such as math algorithms, recipes, or maybe processes used in the classroom for specific purposes (e.g. the “start the day” algorithm might include putting belongings away, getting breakfast, and then start “do now” activities before a morning meeting).

6. If you feel your students could use a hands-on experience to understand the concept of an algorithm, engage them in the following activity - pizza recipe algorithm. If you feel as though your students firmly understand algorithms (most likely through prior computer programming experience), you might quickly review the pizza recipe making activity, and move into the Pizza Algorithm Activity.

Day 2

Algorithms as Opinions

Pizza Recipe Algorithm

Materials and Preparation

For the whole group	For each group of 2	For each student
• Projector for slides *Optional for building the Pizza:* ▪ Pizza Bread ▪ Pizza Sauce (or sauces) ▪ Toppings (Cheese, Pepperoni, Pineapples)		• Student workbook pages

Resources

Slides for this activity

Vocabulary

Algorithm - a set of steps or rules to follow in order to solve a problem or accomplish a specific goal

Lesson

30 minutes

Objectives

1) Students will write a recipe for making a pizza to better understand the components of an algorithm
2) Students will reflect on how to optimize their algorithm for a specific goal

Standards

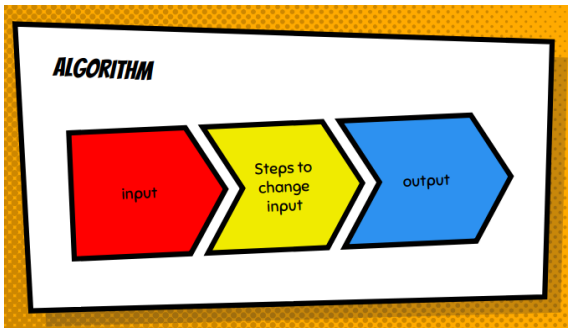
1. 3-5.CT.b.1 - Define an algorithm as a sequence of instructions that can be processed by a computer.
2. 3-5.CT.b.4 - Individually and collaboratively create an algorithm to solve a problem
3. 6-8.CT.d.1 - Individually and collaboratively compare algorithms to solve a problem, based on a given criteria (e.g., time, resource, accessibility).
4. 6-8.CT.d.3 - Create a program, individually and collaboratively, that implements an algorithm to achieve a given goal.

Introduction

An algorithm is a set of instructions that computers follow to do work. Computers use algorithms programmed by computer scientists to complete tasks and achieve goals. However, unlike people, computers are very literal. The algorithms that computer scientists write have to be very specific because the computer will follow exactly what they say. To demonstrate, the instructor will pretend to be a computer and the students will write an algorithm to make a peanut butter and jelly sandwich.

Directions

1. An algorithm is definition. It has three main parts: the input, the steps to change the input, and then the output.



2. An algorithm is a lot like a recipe. The ingredients are the input, the steps that you take to cook the cake are the steps to change the input, and the output is a yummy treat! For example, here is an "algorithm" for making a cake. **What are my inputs?** (Cake, flour, sugar, salt, eggs, etc.) **What are the steps to cook the cake?** (First, mix together the dry ingredients, then mix the wet ingredients, mix the wet ingredients into the dry ingredients, pour the batter into the pan, set the oven to 350 degrees - actually we should have done that sooner, put the cake in the oven, wait 20-30 minutes). **What's the output?** Cake!



3. Now we are all going to write algorithms for making the **best** pizza. You have 5-10 minutes to create this algorithm. Remember that you are writing for a computer that knows nothing about the world, so be sure to write out the instructions very carefully.

Discussion Option: Write the algorithm with the class, make the pizza
Pull out ingredients for pizza making (e.g. Lunchable pizza box).

Organize students into small groups. Ask students to work together with their group to tell you the next step in the pizza algorithm. For example, ask the first group: what's the first step to making a pizza? Ask the other groups in the class for any objections or other ideas. Have students record that step on the board, then perform the instruction *exactly* as described. Move on to the next group and ask them if they want to revise the current instruction or go to the next step.

Work through writing the entire algorithm with the class. Ask them:

- What went well about their working together to write the algorithm?
- What did not go as planned? What was surprising?
- Is this the only algorithm that works for making pizzas? Could other pizza recipe algorithms have different outputs?
- Why might someone choose one pizza recipe algorithm over another?

Alternate Discussion Option: Have students write algorithms individually, discuss in pairs
Okay, now I want you to write your own algorithms. I want you to take the next 5-10 minutes to write an "algorithm" (or recipe) for the BEST pizza. Be sure to specify what your inputs are.

[let time elapse for students to work]

Okay, now I want you to turn to your partner and share your algorithms. I want you to talk about what your algorithms have in common and how they are different.

[give students a few minutes to chat]

Come back together as a class: Who can share with the class what their algorithms had in common? What was different?

1. I asked you to write an algorithm to make the "best" pizza. If we had to give your algorithm a title, what word would you replace with "best?" [most students will say the yummiest/tastiest].
2. Point out that every algorithm, even the pizza algorithms optimize for something. Did anyone put that you should clean up and put away ingredients at the end? That would be optimizing for tidiness. Did anyone use a cauliflower crust or lots of vegetable toppings? That would be optimizing for healthiness. The kind of pizza recipe you write depends on your opinion of what the best pizza is.





What's the best pizza? The most stuffed one, the healthiest one, or the one that's easiest to make?

3. When we think of computer algorithms, usually we think that they do not have opinions. But the truth is that computer algorithms optimize for different goals too. The things that it optimizes for are like opinions, that come from the person who wrote the algorithm. We will learn more about this later.

Pizza Delivery App

Day 2

Pizza Algorithm

Materials and Preparation

For the whole group	For each group of 2	For each student
• Projector for slides	• *Optional: paper pizza building materials: construction paper, scissors, tape*	• Corresponding student workbook pages (graphic organizers)

Resources

Slides for this activity

Graphic Organizers:

- Printable: https://docs.google.com/document/d/1Mn4Qgp9z-B8Ch2_bMj31FGRjRP5fpNHnlj5kGKmSblw/edit?usp=sharing
- Interactive: https://docs.google.com/spreadsheets/d/1YbQitcCIZBuoJgAF2W58efA4gBAyMznH-pZQicIQPJY/edit?usp=sharing

Vocabulary

Input - something that goes into an algorithm, which is often some kind of data
Output - what comes out of an algorithm, the end result
Binary - describing something that has only 2 options
Feature - a specific attribute or quality of an object that can be recognized

Lesson

30 minutes

Objectives

1) Students will create an algorithm that predicts people's favorite pizza toppings based on a several multiple choice questions

Standards

1. 3-5.CT.b.4 - individually and collaboratively create an algorithm to solve a problem
2. 6-8.CT.d.1 - Individually and collaboratively compare algorithms to solve a problem, based on a given criteria (e.g., time, resource, accessibility).
3. 6-8.CT.d.3 - Create a program, individually and collaboratively, that implements an algorithm to achieve a given goal.

Introduction

Many algorithms include three critical components: an input, instructions to manipulate the input, and an output. In the pizza recipe algorithm students completed earlier, the inputs are ingredients, the instructions are the steps included in the "recipe", and the output is the final pizza.

In this activity, students will create an algorithm to predict a customer's favorite pizza toppings based on a small amount of input data. The input is a simple questionnaire where people indicate their preferences (favorite flavor, favorite color, favorite texture etc.), the students must write the instructions to go from the input to finally prescribing the type of pizza that matches the customer's preferences.

The key to this activity is not just the creation of the algorithm, but also the creation of the questions that customers are asked. This gets students starting to think about what types of information are necessary inputs for an algorithm. This concept will come up later in today's activities when students are thinking about which specific physical features of cats and dogs are important to emphasize when collecting data for a cat/dog classifier.

Directions

1. Conduct a quick class poll about 1) how students feel about pizza, and 2) what are their favorite toppings. This could be done with raised hands, a class discussion, or even an online survey platform such as kahoot.

2. Ask students, "what kinds of factors determine what kind of pizza people like to eat?" As students share their thinking, try to capture their thinking in the form of a question. For example, if a student said "some people like meat on their pizza," you might rephrase that as a question in the following way: "do you like meat on your pizza?"

3. Explain to students that the goal of this activity is to create an algorithm that will ask people a few questions about their pizza preferences, and then prepare for them the perfect pizza. If you

want, add some flare to the challenge by telling students that Domino's (or another favorite local pizza joint) is designing a new app to help people order their pizza.

4. Explain that the algorithm will ask customers up to 4 questions, and based on the answer to the questions, it will recommend a kind of pizza. Relate these components to the 3 components of an algorithm:
    a. Input = answers to questions
    b. Steps to change input = how the answers relate to pizza-type
    c. Output = completed pizza

5. Model for the students how to compose their algorithm. First come up with 4 binary questions that can be used to gather input from the customer. These questions are "features" your algorithm will use to decide what pizza combination to recommend. You can source some of these questions (and answers) from students.

6. Have students brainstorm up to 4 questions they want to ask for their algorithms. Explain to students that it is important the questions are multiple choice with defined answers (not open ended), and best if they are binary (with only 2 options to choose from). This will limit the number of possibilities they need to account for. At the end of this step, students should have up to 4 questions, each with designated possible answers.

7. Model how to use a combination of the answers to decide what kind of pizza to deliver.

8. Have students create a list of all the possible answer combinations. Given 4 binary questions, there should be 2^4, or 16 possible answer combinations. It is not necessary to delve into the math of this, but you can double check that students have identified all possible combinations by multiplying together the number of options per each question. For example, a group with two 3-choice questions, and two 2-choice questions will have 36 combinations (3 x 3 x 2 x 2).

9. Have students map out the type of pizza that their algorithm will make for each of the combinations. Different answer combinations are able to map onto the same type of pizza. However, each combination can only have one possible pizza associated with it. Students can use the "Pizza Delivery App Algorithm Graphic Organizer" in the workbook pages to help them organize this work.

🗨 Discuss

What was simple about designing this algorithm? What was challenging?

What were the most important things to consider when designing the algorithm?

Would all customers be happy using this algorithm? What might you change to make customers even more satisfied?

Is your algorithm Artificial Intelligence, or not? Why? *

Encourage students to identify the claim, reasons, and evidence in their responses.

Our answer: this pizza recipe algorithm is NOT AI because, although it makes decisions based on input data, it still follows exact instructions from us, the programmers. The questions and the relationship between the questions and the combinations to assign were all designed by us. Thus, the intelligence lies with the programmer, not the algorithm by itself.

Extension Activity #1

When the "Pizza Algorithm Maps" are completed, students can test their algorithms by asking each other the questions or building their app in AI Blocks.

If students want to build their app in AI Blocks, have them use this spreadsheet template which will output their questions and answers into a version they can use in a template AI Blocks program. To distribute the worksheet to students, make a copy of the spreadsheet by opening the spreadsheet and going to 'File > Make a Copy'.

Extension Activity #2

For an artistic flare, students can "create" the different pizzas prescribed by their apps using construction paper - that way they can present a physical "pizza" to their customer after they answer the questions!

Day 2

Algorithmic Bias

Intro to Image Recognition

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ Projector for videos ▪ Objects that students can take pictures of for their image recognizer		● Student workbook pages ● Laptops with internet ● Cat and Dog data set images (training data set and testing data set)

Resources

Slides for this activity
Teachable Machine: https://teachablemachine.withgoogle.com/
Cats and Dogs Image Data:
Train: https://drive.google.com/drive/folders/1L__myEBU5RwnMImLRbBqD7Y4SVEVx6P5
Test: https://drive.google.com/drive/folders/1LU0vVMoKVd0N7U2HFQ4j_vqqfLE4R2wL
Extra Data: https://drive.google.com/drive/folders/1DxNdtYfQrdSIE2Q_SfU_XsvOgxUK5XUw

Tutorial Video on Image Recognition (teachers):
https://www.youtube.com/watch?v=TtHhSdZgXXI&list=PLC6D6JHLRjFM31_sZj74kpbFnfcOKjbMs&index=3

Vocabulary

Dataset - a collection of inputs, outputs, or both; data that can be used by algorithms
Training Set - a collection of inputs and outputs given to machine learning algorithms to have them learn from patterns in data
Testing Set - a collection of inputs given to machine learning algorithms to measure their accuracy
Image classification - using machine learning to recognize pictures

Lesson

60 mins

Objectives

1. Students will be able to train a machine learning system to recognize certain images and minimize potential biases.

Standards

1. 3-5.CT.c.1 - Describe examples of databases from everyday life (e.g., library catalogs, school records, telephone directories, contact lists).
2. 6-8.CT.c.5 - Select and use data-collection technology (e.g., probes, handheld devices, geographic mapping systems) to individually and collaboratively gather, view, organize, analyze, and report results for content-related problems.

Introduction

Image classification is a method in machine learning where a machine learns to label images with the objects they represent. Connecting image recognition to the three parts of an algorithm: the input is the image that you want to recognize, the steps to change the input involve using a neural network to determine key features or characteristics of each class to determine if the input has those features, and the output is the class with the most similar features.

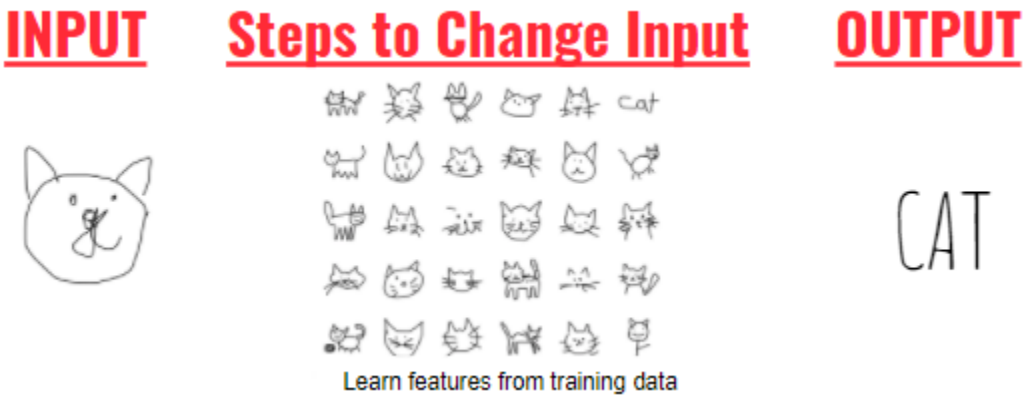
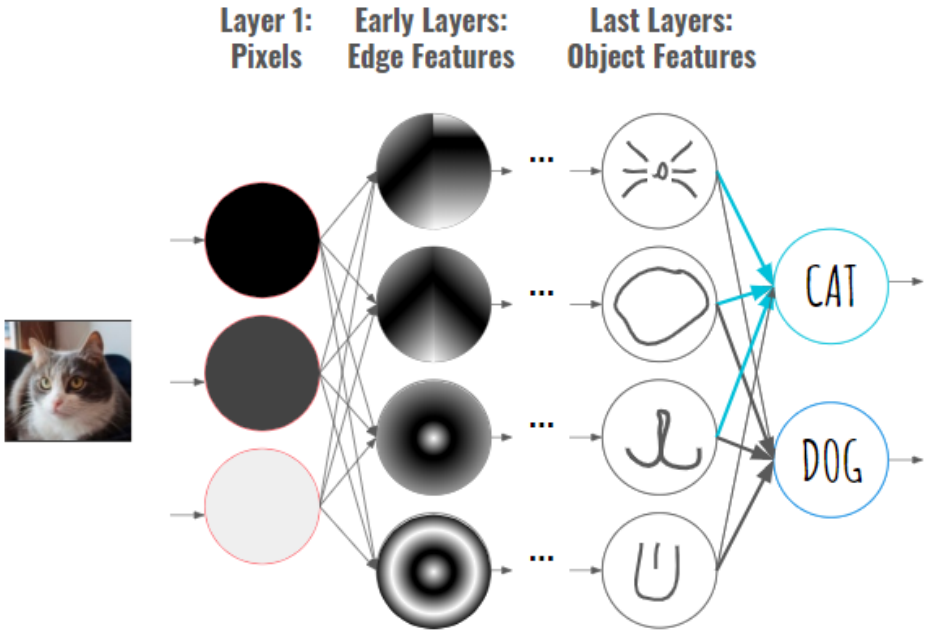


Image recognition can be broken down into the three parts of an algorithm. The input is the image that you want to recognize, in this case the drawing of a cat. The steps to change the input involve using a neural network to determine key features or characteristics of each class from training data to determine if the input has those features. In this case, the training data are multiple other drawings of cars. The output is the class with the most similar features, in this case, the label 'Cat.'

It is important for students to understand that computers do not see the world the same way that humans and other animals do. We may see shapes and colors, computers see grids of numbers, or pixels. Neural networks process images through multiple layers of nodes. Nodes function similarly to the neurons in our brains. Each node does a little bit of work, and then passes the result to other nodes in the neural network. This allows a neural network to combine simple data, like an individual pixel, into

more complex features like lines and shapes, and then even more complex features like the idea of whiskers or a head shape (in the case where we're recognizing images of animals).



A neural network broken down so that you can see its nodes and layers. On the input end (left) the neural network receives pixels. Connected nodes in layers combine pixels to realize features like whiskers and mouth shapes as you move to the right. After seeing multiple images of cats, the neural network will learn to associate features with classes. For example, whiskers give strong evidence that an image is of a cat.

Neural networks need to get trained on a lot of data to work. This training data is curated by humans who give the neural network and image and the correct label for that image. This allows the neural network to begin to associate features with certain classes. For example, after seeing thousands of images of cats, a neural network will learn to take whiskers as strong evidence that it is seeing a cat.

The machine learning program that students will use is called "Teachable Machine", and is designed by computer scientists at Google. The Teachable Machine system uses a neural network to classify images. It learns how to classify objects by associating features in the training data with any similar features it finds in an image you input. The Teachable Machine neural network has already been pre-trained with thousands of images. This allows us to give relatively few training images, a few dozen, to train our own models. However, even with pre-training, the more data that you input into the Teachable Machine program, the more accurate the program is at identifying the information it is meant to identify.

For example, one program students work on in this activity is meant to identify whether an image is a cat or a dog. A program which relies on a dataset of 5 images of cats and 5 images of dogs will produce different results than one with 10 pictures of cats and 5 pictures of dogs, or 100 pictures of cats and 50

pictures of dogs. In this activity, students will work on fine tuning a dataset of images that accurately identifies whether an image shows a cat or a dog.

Directions

1. Have students navigate to the Teachable Machine www.teachablemachine.withgoogle.com website and go through the quick tutorials. It is helpful if the whole class watches this together, so you can pause for any questions the students might have. Start by training something simple, like training rock paper scissors hand shapes. (Gather examples, Train your models, Export your models).
2. To demonstrate the idea that we need to accurately train our models with a variety of different images, have students train one class in front of a wall with one background and another class in front of a different background. For example, have students train the rock class in front of the whiteboard/blackboard and the paper class in front of a window or door (or some other surface that looks very different).
3. When students test their machine, they'll find that the machine cares more about the background behind them rather than the shapes their hands are making. The background in the image is a feature that the machine is using unintentionally!
4. To help the machine learn that the background should not be an important feature, make sure to train classes with multiple different backgrounds and other conditions like how close the object is to the camera, the amount of light, and the people pictured in the image.



Discuss

What surprised you about teaching the machine to recognize rocks, paper and scissor hand signals ? Students should say things like again they had to be very careful because the computer would take the image too literally and not know exactly what to pay attention to. Also, they had to give the computer a lot of examples for it to work. The machine requires at least 30 examples!

5. Now we're going to work on a classifier that recognizes cat and dog images. Point students to the biased cat-dog model or have them train their neural networks themselves (see Step 6).



Note:

Do not tell the students, but the data that was used to train the model is biased such that there are many more cats than dogs and a wider variety of cats than dogs.

6. If you want students to train the model themselves, point them to the biased cat-dog training data folder. Have them train one class for cats and another for dogs using images.
7. After students finish training their system, point then to the cat-dog test data folder. Students should find that their system is perfect for cats, but classifies some dogs as cats.See if students can look at the biased cat-dog training data to see why (i.e. there are many more cats than dogs, there are much better examples of different kinds of cats than dogs, some of the dogs look like cats!)
8. Now ask students to use the biased and unbiased examples to make their own unbiased dataset to train their cat-dog classifier.

Extension Activity

If students are enjoying dataset curation and want to take it a step further, split the class into two groups. Have one group curate a training set (max 30 pictures) and the other group work on a test set (max 10 pictures). Set some limits on what can be in the dataset (What counts as a cat or dog? Are other objects allowed? Do they have to be real pictures or do drawings count?) Challenge the two groups to continue developing their training and test sets until they come up with a really strong model.

Day 2

Algorithmic Bias Discussion

Algorithmic Bias Discussion

Materials and Preparation

For the whole group	For each group of 2	For each student
• Projector for slides		• Reading materials on Algorithmic Bias

Resources

Slides for this activity

Algorithmic Bias Reading Materials:

- Gender Shades Explanation (5 mins) https://www.youtube.com/watch?v=TWWsW1w-BVo
- Gender Shades Spoken Word Piece (3 mins) https://www.youtube.com/watch?v=QxuyfWoVV98
- Machine Learning and Human Bias (3 mins) https://www.youtube.com/watch?v=59bMh59JQDo
- How to Deal With a (Seemingly) Racist Computer (Article) https://drive.google.com/open?id=1aBwVbSYxFY0XVtSI-Z8XEcDWqrvTf8Nn84oKo7rZ1l0
- Google's New Dermatology App (Article) https://www.vice.com/en/article/m7evmy/googles-new-dermatology-app-wasnt-designed-for-people-with-darker-skin
- Voice Recognition: Different Accents https://www.youtube.com/watch?v=gNx0huL9qsQ
- Voice Recognition: (American) Children at Different Ages: https://www.youtube.com/watch?v=GZnUibN6m4A

Vocabulary

Algorithmic Bias - errors in algorithms, often caused by skewed data sets, that create unfair outcomes, such as privileging one arbitrary group of users over others, or discriminating against particular groups.

Discrimination - treating one group of people differently than another group in an unfair way

Coded gaze - another term for "algorithmic bias"; the ways algorithms treat people unfairly.

Lesson

30 minutes

Objectives

1) Students will read or watch different sources to gain a greater understanding of “algorithmic bias”.
2) Students will participate in an open discussion about algorithmic bias, its implications in our world, and what can be done to mitigate it.

Standards

1. 6-8.CAS.c.1 - Describe current events and emerging technologies in computing and the effects they may have on education ,the workplace, individuals, communities, and global society
2. 6-8.CAS.c.4 - Evaluate how media and technology can be used to distort, exaggerate, and misrepresent information.
3. 6-8.CAS.c.5 - Evaluate the bias of digital information sources, including websites
4. 6-8.DTC.a.1 - Identify and explain the strengths, weaknesses and capabilities of a variety of digital tools
5. RI.7 - integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words
6. RI.9 - Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors’ take
7. SL.1 - prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others’ ideas and expressing their own clearly and persuasively
8. SL.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

Introduction

The following section of the activity is a class discussion about the impact of algorithm bias in our society. The resources for this discussion include several articles and videos that can give students background information on how algorithm bias can have negative and often prejudicial outcomes. In planning the discussion, think about which resources are most appropriate for your students and how these resources will support their discussion and understanding of algorithm bias. Each source comes with accompanying guiding questions that can support specific discussion on each text.

Directions

1) Share selected materials about algorithm bias and other pre-discussion resources with students. Choose which resources will be best for your class from the link above.

2) Decide how to structure the conversation. It is possible to have students watch and read all of the material, and then discuss. It is also possible to pause after each source and answer a few questions before moving on to the next source, and then opening up to a bigger discussion at the end.

Discuss

What is algorithmic bias? What causes algorithmic bias? Algorithmic bias is when a computer-based algorithm produces unfair outcomes for certain groups of people by privileging some and/or discriminating against others. Often algorithmic bias can be caused by skewed data sets. It can happen intentionally and by accident.

What are some examples of algorithmic bias identified in these materials? Because algorithms are built by humans, they perpetuate some of the biases that humans already have. Some examples of this are in medical school admissions (MUSE article), facial recognition (Joy Boulamwini's TED talk and research video), and in social media (interview with Cathy O'Neil from MUSE).

What are some of the implications of these biases in our world? When algorithms perpetuate biases that already exist, they make problems like racism, sexism, classism continue. This is even more dangerous since it is challenging to see exactly how algorithms work, so we might not be exactly sure how they are working in negative ways.

(If you use a resource from Joy Buolamwini) What issue in facial recognition technology does Joy identify? That facial recognition systems are very good at recognizing males with white skin, but not as good at recognizing females with dark skin.

Why is this a problem? Think of some ways that facial recognition is used (Snapchat/camera filters, Google searches, self-driving cars). It's not fair that technology that is advertised as being built for everyone does not work as well for some people. For example, people with darker skin cannot use fun camera filters or if automatic cars have a hard time seeing people with darker skin.

There are some positive effects: if cameras have a harder time seeing people with darker skin then there's less of a chance of their privacy being breached by surveillance. However, this also has some risks—what if an innocent person is accused of a crime because of a bad recognition system?

What are some ways to help avoid algorithmic bias? Looking more carefully at the algorithm itself and not accepting its results blindly. Making sure that the data set is more equitable. Testing out algorithms to make sure they do not contain bias.

Based off what you know about training algorithms, how could this problem be fixed? Have students think about how they improved the cat-dog classifier. They included many more examples and made sure they were balanced in all of the important classes. In the case of cats and dogs this means including lots of different breeds of each.

What are some rules we might want to put in place about using this kind of technology fairly and safely? Should we put rules in place about how much and what kind of testing to before selling a technology? Should outside organizations (like another version of the FDA) help provide oversight to make sure that everyone is doing a good job testing. Companies could apply for certification to prove their product is fair.

Animal Recognition

Day 2

Animal Recognition

Materials and Preparation

For the whole group	For each group of 2	For each student
• Projector for slides	• Internet capable computers • Animal Recognition Activity Slides	• Computers with internet • Images of cats and dogs

Resources

Slides for this activity
Link for AI Blocks
- Template file for animal recognition project

Cat Dog image dataset
Programming Guide: Animal Recognition | Save and Load program files
Programming Tutorial Video: Exporting Teachable Machine model to AI Blocks

Lesson

1 hr 30 mins

Objectives

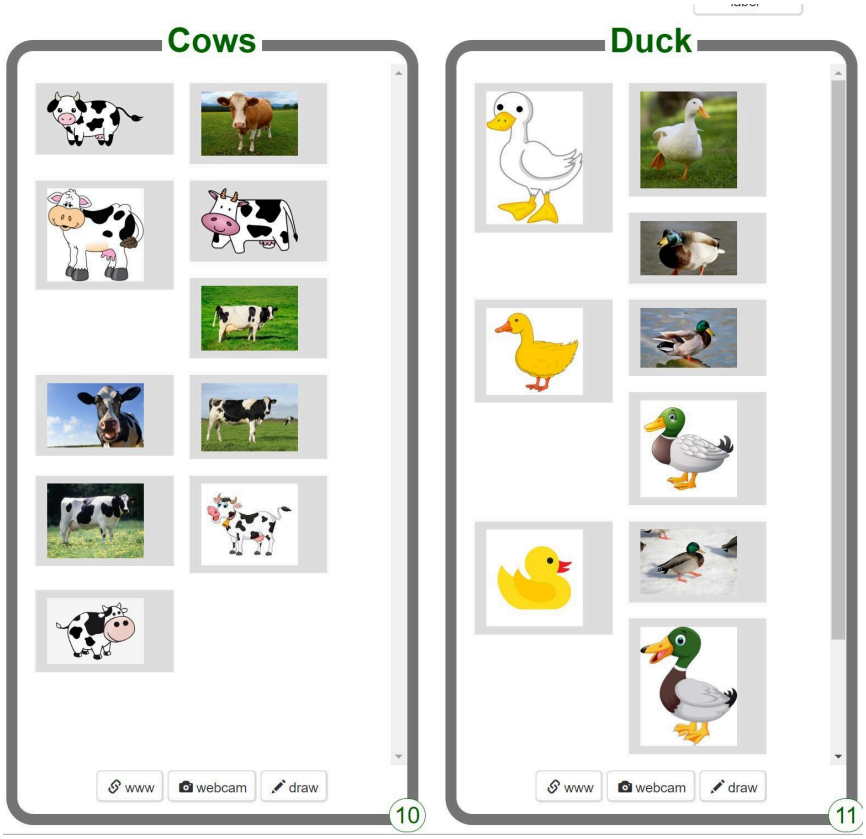
1) Students will be able to train a machine learning model for image recognition in order to create a program that recognizes and reacts to specific animals.

Standards

1. 3-5.CT.d.1 - Individually and collaboratively create, test, and modify a program in a graphical environment (e.g., block-based visual programming language).
2. 6-8.CT.b.1 - Design solutions that use repetition and conditionals.
3. 6-8.CT.b.2 - Use logical reasoning to predict outputs given varying inputs.

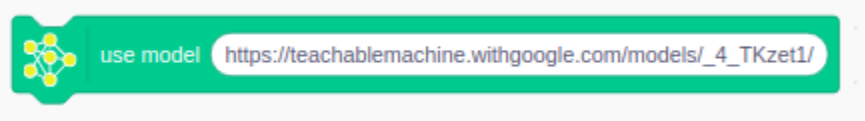
Introduction

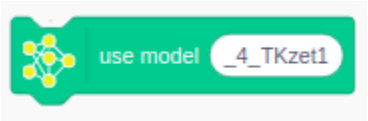
Robotic pets have come into widespread use as a fun alternative for people who cannot take care of live animals. In this project, students will use Teachable Machine image classification models, their robots, and AI Blocks to create a robot character that behaves like any animal it sees.



Directions

1. Have students open the AI Blocks website with the Teachable Machine extension. The link to this page is listed above in the “resources” section. If you would like, students can load the pre-made version of the Program for this activity using ‘Load > File from computer’, and selecting the “animal recognition program. Otherwise, they can rewrite the simple program themselves by following the activity slides.
2. Make sure students understand the ’use model’ block. To use this block, students place the URL of the teachable machine model you would like to use inside the block. If you use the pre-made program, the default model embedded in the block is of a biased cat-dog Students should adjust the example program to work with an unbiased cat-dog classifier, like the one they made in the previous activity.





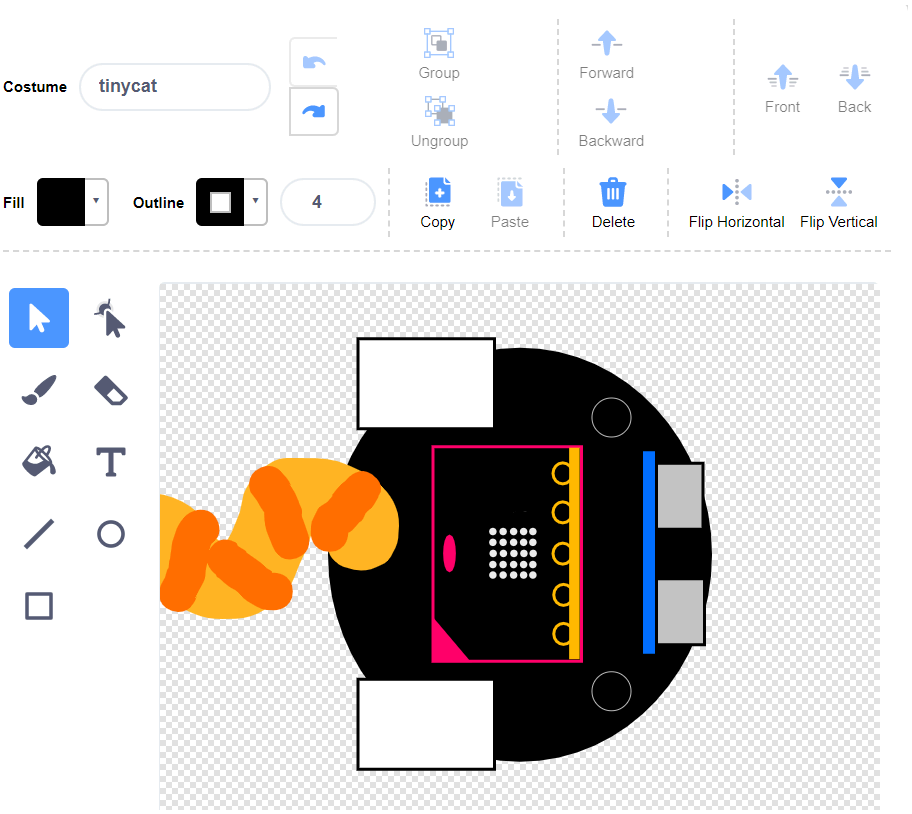
If students want to load a different model, then they can place the URL of that model in that space. You can only use one image model in a project.

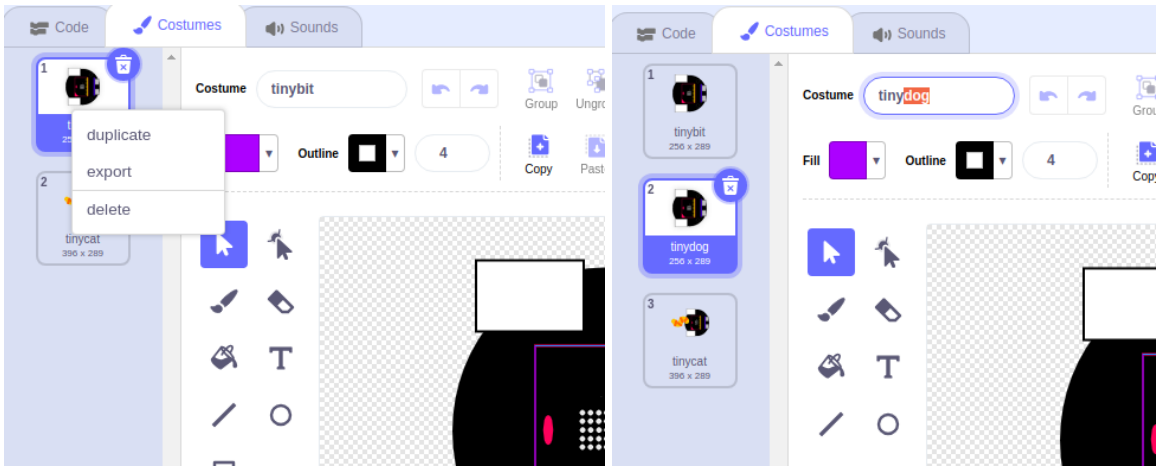
3. Make sure students understand the 'when model detects' block. After the 'use model' block runs, the names of the classes for the model will load. The 'when model matches' block constantly predicts. As soon as the camera sees an animal it will trigger the code underneath.



4. Have students program a response once the "cat" or "dog" category is identified. They could have the program say "cat" or "dog" (using the sound recording feature) based on the response, or choose another way for the program to indicate that a dog or cat was identified.

   One possible reaction to identifying a cat or dog is to change the "costume" of the sprite to resemble a dog or cat. On the 'Costumes' tab they can duplicate the plain robot costume and draw on it to make a costume that looks like a cat or dog. In the image below, we used the paintbrush tool to make a 'tinycat' costume. They can also duplicate the original costume again and make a 'tinydog' costume.





5. Once their program is ready, have students use the printed out images of the [cat-dog image dataset] to see how their simulated robot reacts to seeing cats and dogs.

After students have the basic program working, they can think about different directions to extend their work.

Extension Option #1: Robot Programming

If students would like to connect the robot hardware to their Program, they can load the micro:bit robot extension.

Extension Option #2: Dive into Image Classification

Students can add another animal for the program to recognize. In addition to coming up with training data and using Teachable Machine to train that new model, they should come up with a test set. They can then use code similar to the example to program a response to the new input.

Extension Option #3 Dive into Programming

When the animals are recognized, they can do different things - play music, move around, have their name appear on the screen, wag their tail, play with yarn, etc. Encourage students to get creative with what their robot does to represent a particular animal.

Extension Option #4: Learn About New Animals

Students can make a project to inform the public about different animals. After seeing an image, the project would display fun facts about the animal. This kind of project could be useful at a zoo or wildlife preserve.

🗨 Discuss

As students are finishing their projects, have them discuss the following questions to reflect on the connection between what their programming and its impact.

> What kinds of things did you take into consideration to make the machine learning model effectively recognize the animals? Students might talk about making sure there is a variety of images in the data set and that all classes have similar numbers of examples.
>
> Who is this project appropriate for and who might be left out? Is there any potential for bias? Students may mention that this is a fun project for younger children to practice learning about animals and their sounds. It may leave out people who are not familiar with traditional farm animals. Bias might occur if we only choose certain types of pictures (for example, only cats and dogs with fur).
>
> How would you advertise your project? What information would you give a user in terms of how it should be used? Students should tell the user about the training data that was used. It would work well for pictures of cats and dogs that look similar to the training set (pictures that are in focus, pictures with one animal at a time, etc.). When advertising it, maybe they should share examples from the training set and talk about accuracy on the test set.

Reflection

Day 2

Reflection

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ Examples to project for class ▪ Pros/cons of AI chart		

Resources

Slides for this activity

Artificial unintelligence example #1: https://www.youtube.com/watch?v=i1sp4X57TL4

Artificial unintelligence example #2: https://www.youtube.com/watch?v=piYnd_wYlT8

Vocabulary

Artificial Unintelligence -the study of loopholes (failures, or "glitches") within artificial intelligence systems

Adversarial Patches or Stickers - images or other data created specifically to fool artificial intelligence systems.

Lesson

30 mins

Objectives

1. Students will discuss the pros and cons of artificial intelligence, including "artificial unintelligence"

Standards

1. 6-8.CAS.c.4 - Evaluate how media and technology can be used to distort, exaggerate, and misrepresent information.

Introduction

In the reflection below, students are prompted to think about the pros and cons of artificial intelligence. As we have seen in today's activities, there are many potential downsides to using Artificial Intelligence. Algorithmic bias and the harm and injustice it causes is front and center among these negative consequences of AI. Students will likely bring this up at the start of the discussion.

Another potential negative aspect of AI is what some people within the field call "Artificial Unintelligence," which is a term that describes examples in which machines are deliberately fooled. Because AI programs are, well, computer programs, they are susceptible to be hacked. The consequences of this possibility could lead to a number of dangerous outcomes. One specific type of this hacking is called an adversarial patch, where hackers create a "patch," or something that can be applied over data (for example, changing an image) that causes the AI algorithm to act "adversarially," or against, its intended outcome.

Directions

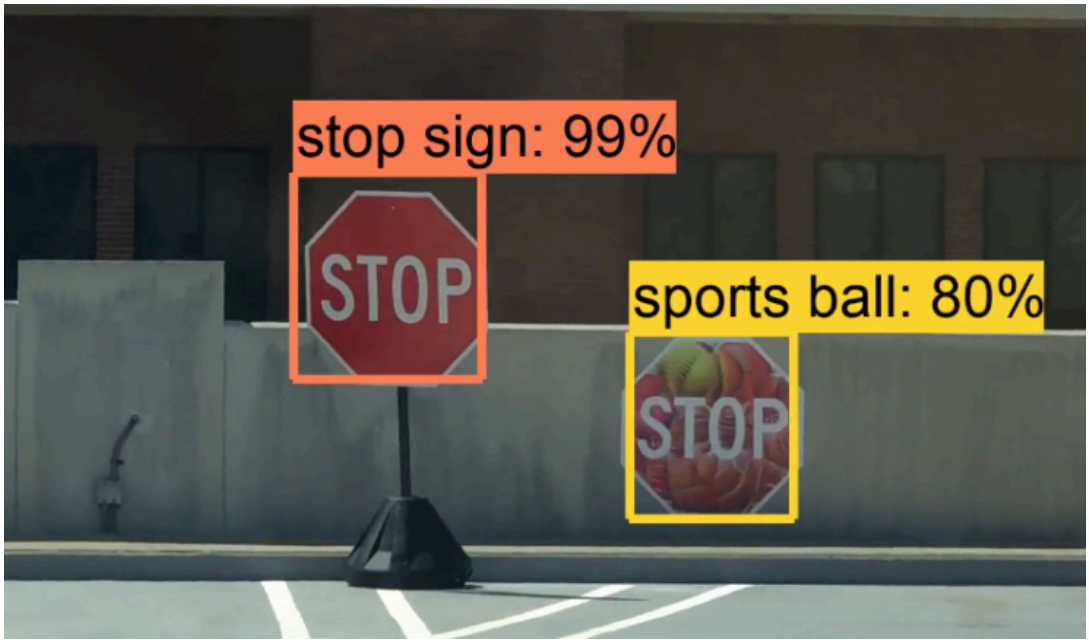
1. Tell students that for today's reflection, they will be focused on adding to the "Pros and Cons of AI" Chart. Based on what they learned today regarding algorithms and algorithmic bias, ask them if they would like to add anything to the chart.

   🗨 Discuss

   What are some of the pros and cons of artificial intelligence? Students might add some of the negative outcomes associated with algorithmic bias that they discussed. They also might add some positives of image classifiers that they worked with in the programming activity (for example, image classifiers can make certain jobs more efficient, or identify problems when they arise)

2. Tell students that there is a field of research (called 'artificial unintelligence') dedicated to exploring how to hack AI. Show students the first video about adversarial stickers. Then show the second video about adversarial textures. Also show the following images:





Discuss

Do you think these examples are positive or negative aspects of AI? Negative: they can stop AI from performing its intended function, and even cause problems; Positive: they can help AI get better at its job by giving it more robust (and diverse) data to learn from, and helping programmers overcome these potential pitfalls. *Add new insights to the Pro/Con chart.*

(If time) How do you think the adversarial stickers were made? Adversarial stickers were made with AI! Researchers used an algorithm where they adjusted the way the toaster looked slowly over time to increase the system's confidence that it was seeing a toaster.

Note:

Teacher Resources for Adversarial Attacks

We are still looking for kid-friendly explanations of adversarial attacks on neural networks. If you would like to read more, then please try this blog or this short video. You may be able to translate the information to students.

Be prepared to take a stance of not knowing all of the answers and encourage the class to do more research if they are particularly interested in or excited about this topic.

What should developers of AI do to avoid the pitfalls of adversarial patches?

3. Remind students that in the coming days, they will begin working on their own AI projects designed to address a particular problem. While it is not necessary to come in with ideas in mind, it will be helpful to plant this seed in students minds so that they are not totally unprepared

Day 3

Students will:

- Complete an ethical matrix by identifying stakeholders, areas of interest, and conflicts of interest
- Use an ethical matrix to unpack the ethical implications of an AI technology
- Create a program that uses voice commands to initiate a response from a robot
- Research and brainstorm potential ideas for final projects
- Determine the criteria and constraints for the final project

Activities

Welcome>>	15 mins
	Students review what they learned yesterday and go over the activities for today.
Ethical Matrices>>	30 mins
	Students learn about stakeholders and use ethical matrices to guide their moral reasoning about AI technology. **Students explore how computers use word embeddings to make sense of language.**
Intro to Text Classification>>	60 mins
	Students explore how computers use word embeddings to make sense of language.
Command Recognition>>	90 mins
	Students use natural language processing to teach their robots to respond to voice commands.
Final Project Research>>	30 mins
	Students conduct research and begin idea generation for their own robot projects.
Reflect>>	30 mins
	Students reflect on their brainstorming to begin coming up with concrete ideas about what they will build with their robots.

Welcome

Day 3

Welcome

Materials and Preparation

For the whole group	For each group of 2	For each student
.		• Student workbook pages • Completed Pizza Delivery App algorithm

Resources

Slides for this activity

Vocabulary

Stakeholder	a person with an interest or concern in something
Area of Interest	A topic or area that a stakeholder cares about, for example “health” or “cost”
Ethical matrix	A tool used to think about stakeholders and the reasons they are interested in a technology

Lesson

15 mins

Objectives

1. Students will identify stakeholders and areas of interest/concern for their Pizza algorithms

2. Students will identify conflicts of interest among the stakeholders of their Pizza algorithms

Standards

1. RI.6 - Assess how point of view or purpose shapes the content and style of a text

Introduction

Ethical matrices are tools for ethical analysis where students identify the stakeholders in an issue and their varying areas of interest. To introduce this tool, students will return to their pizza algorithms from the previous day's opening activity.

In our ethical matrix, the stakeholders go down the first column and the different areas of interest they may have go across the first row. Then, the cells in the middle are filled in with the major concerns each stakeholder has with respect to each topic. Here is an example of an ethical matrix for the pizza delivery app that students created.

Pizza Delivery App		Areas of Interest			
		Tastiness	Ease of Using the app	Speed	Cost
Stakeholders	App User (Pizza Eater)	✔ The eater definitely cares how tasty the pizza is. The tastier the better.	✔ The eater might(or might not) care how healthy the pizza is.	✔ Hungry Pizza eaters might also want their pie quickly!	✔ The person using the app and paying for it definitely cares how much it costs.
	App User's Family				? They probably only care if they have to help pay for it.
	Maker of the Pizza	✔ The pizza maker wants the pizza to be tasty so people will enjoy it	? If using the app is really frustrating for customers, they would care because they would get angry calls.	? The pizza maker wants to make the pizza fast in order to deliver it quickly and move on to making another pizza	✔ This is how they make money. They definitely care about this!

Directions

1. Welcome students to the third day of learning about AI and algorithms. Explain to students that over the past two days they have learned about how AI collects data and learns from that data, especially in recognizing images. Today, they will learn about how to use a new kind of AI to interact with humans and the environment - voice commands. By the end of the day, they will begin to think about what they want to build for their final projects that incorporate all of the learning that they have done through the week.

2. Ask students to recall their Pizza Delivery App algorithms from the second day.

🗨 Discuss

What were some of the goals that our algorithms had in the Pizza Delivery App activity? Many students were operating with the goal of making the pizza that was the best fit for the customer.

If students do not bring up other possible goals, prompt them by asking ***What are some other possible goals for our algorithm?*** Other possible options: cost (cheapest pizza), healthiest pizza (using the healthiest ingredients), fastest pizza (fastest to prepare)

When there are multiple options for these goals, how do we decide which goal is most important? Students may suggest that if they are eating the pizza they would prioritize their own preferences, regardless of healthiness or cleanliness. However, if they were in a rush they might want the quickest pizza, or if they did not have that much money on them, the cheapest pizza might be the goal.

3. Explain to students that ethical matrices are a tool that ethical analysts, such as themselves, can use to think about these competing goals. Specifically, the ethical matrix helps us think about who is affected by a specific technology and what is in the best interest for different groups of people. It also points out when these goals are in conflicts with each other. Similar to the different perspectives and pros and cons examples that we did the first day, this is another method of ethical reasoning we can use to decide what goals to prioritize.
4. Have students look at their first 'Ethical Matrix' handout in the student workbook pages. First, we are going to fill out the stakeholders. They go down the first column. Explain to students that stakeholders are all of the people who care about something because they are impacted by it in some way.

🗨 Discuss

Who are some people or groups who might care about your Pizza algorithm? Direct stakeholders: The app user, the app user's family, their doctor/dentist, their teacher, their classmate, their babysitter, their sports coach.

5. Now, we are going to fill out the things that each of these stakeholders are concerned about. Three major areas of concern might be tastiness, healthiness, and cleanliness across the top. This should leave 1-2 spaces to add more concerns.
6. Now, go through the first stakeholder with the students and put an 'X' in a space where that stakeholder has a concern. For example, the person eating the pizza definitely cares about tastiness and about cleanliness. They might also care about healthiness too.

🛈 Note

The goal of this activity is not to make sure that X's are in certain spaces, but to make sure

that students are thinking about the perspective of the stakeholders and able to justify the X's they place. This is a great place to have students practice the argumentation skill of supporting their claims with specific reasons. They might use the sentence frame "This stakeholder cares about _____ because _____"

7. Have students go through the other stakeholders and to fill out the matrix.

Example Pizza Delivery App Ethical Matrix

	Tastiness	Healthiness	Speed	Cleanliness
Pizza Eater	X The eater definitely cares how tasty the pizza is. The tastier the better.	? The eater might(or might not) care how healthy the pizza is.	X Hungry Pizza eaters might also want their pie quickly!	? The eater might (or might not) care how clean the pizza is to eat.
Parent of Pizza Eater		X The parent cares a lot that the pizza is healthy.		X If a parent has to clean up the mess, they would really prefer the cleaner pizza.
Maker of the Pizza	X The pizza maker wants the pizza to be tasty so people will enjoy it		? The pizza maker wants to make the pizza fast in order to deliver it quickly and move on to making another pizza	
School Bus Driver				X If someone brings the pizza on the bus, the bus driver cares a lot that it's not messy.

🗨 Discuss

Where did you put X's on your matrix and why? As students start sharing where they put their X's, press them to think about their reasons for putting the X's there. Push students to clearly explain their reasoning!

8. Explain to students that we can now use the ethical matrix to think about where there might be conflicts of interest. This is where the areas of interest, or sometimes the stakeholders, clash with each other. For example, the healthiness and tastiness areas might conflict. Or the parent's view on healthiness might contradict what the eater thinks about healthiness.

🗨 Discuss

Now that we see what each stakeholder cares most about, what conflicts of interest do you notice? There is a conflict of interest for healthiness and tastiness. The tastiest pizza might not be the healthiest. Another conflict is between the parents and the eater. The parents care way more about healthiness than the person eating the pizza.

How might we resolve these conflicts of interest to make the best pizza for everyone? We might go interview different stakeholders about what is most important to them and try to prioritize the most important elements, and then try to compromise on things that are less important. We might hold a discussion where all the stakeholders can look at different options and vote on their favorites.

Note:

Optional Extended Activity

After the ethical matrix is complete, assign different groups to different stakeholders and ask them to design the perfect Pizza algorithm for them. For example, the "eater" group might always maximize tastiness, and the "dentist" group will always find ways to maximize healthiness. Then bring the groups together to try and come to consensus around an algorithm that works for all of them.

Ethical Matrices - Redesign Alexa

Day 3

Ethical Matrices

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ Chart Paper or Model Ethical Matrix ▪ Computer with projector		● Student workbook pages with ethical matrix

Resources

Slides for this activity

Smart Speaker Video #1: https://www.youtube.com/watch?v=o4A3MiLsNJc

Vocabulary

Stakeholder	a person with an interest or concern in something
Conflict of Interest	When one or more stakeholders has two different areas of interest that conflict with each other

Lesson

30 mins

Objectives

1. Students will complete ethical matrices by identifying different stakeholders in an AI technology and their respective areas of interest
2. Students will be able to identify conflicts of interest between stakeholders

Standards

1. RI.6 - Assess how point of view or purpose shapes the content and style of a text

Introduction

“Smart speakers” or “A.I. assistants” such as Amazon’s Alexa, Google Assistant, or Apple’s Siri seem to

be increasingly present in our lives. They help us stay organized, be more efficient, and remember all those small details that we cannot keep in our brain. There are also some potential downsides to having these speakers so involved in our lives. For different groups of people, these upsides and downsides can be dramatically different. For example, companies benefit from the amount of data they can collect from smart speakers, but owners of these devices and their privacy are negatively affected by this.

In this activity, students will identify who the stakeholders are in AI assistants, and think about which areas of most interest to them concerning the devices. This type of "stakeholder analysis" and "ethical matrix" work models what students will be completing for their own final projects. To scaffold this work, students will answer three core questions - "who are the stakeholders?", which can be recast as "who are the different groups of people that might care about this product?". After identifying stakeholders, students think about the specific areas of interest for the product, answering the questions "what particular features of the product are most important?" and "why do these stakeholders care about this product?". After identifying these areas of interest, students will determine which particular areas of interest are salient for each stakeholder, and think about why that might be. Lastly, students will look for conflicts of interest by asking "are there any areas of interest that conflict with each other?".

The important aspect of this activity is the thinking about ethical stakeholders and their potential conflicts of interest, so if smart speakers are not the best topic to use as a model, please feel free to use a different one. There are materials in the "additional activities" portion of the educator guide to conduct this activity about self-driving cars. Other relevant and rich models for this activity might be facial recognition software used in policing, or AI software used to detect plagiarism.

Directions

1. Remind students that part of our work this week is not just learning about how Artificial Intelligence programs work, but also about discussing the ethical implications of Artificial Intelligence in our lives. Tell them that in this activity, we're going to complete what is called an ethical matrix to think about the ethical implications of a particular use of Artificial Intelligence in Smart Speakers like Amazon's Alexa, Siri, and Google Assistant. Show students the ethical matrix by projecting it (or presenting on chart paper), and directing them to the blank ethical matrix page in their student workbook.

2. Have students review how smart speakers work. It might be helpful to show them one of the brief videos included in the resource section above.

   Brief recap: smart speakers' microphones are always on and they take the physical sound waves of our speech, turn those sounds into electronic signals. Once the electric signals are turned into words, a system called "natural language processing" turns the words into meaning, and then an artificial intelligence algorithm decides what to do based on the language that is understood.

3. Explain to students that the first step in completing an ethical matrix is identifying the stakeholders. They will do this by answering the question, “who are the groups of people that care about Smart Speakers?”. Have students add in these stakeholders - this can be done as a whole class, or by small groups first, and then having groups share out. Then have students fill in the stakeholders down the first column of the ethical matrix.



Discuss

Who are the groups of people that care about Smart Speakers? Companies making them, customers who buy them (owners), children in the house with them, apps that operate through Smart Speakers (spotify, weather, etc.), the government (who makes rules about different products

4. After the stakeholders have been identified, students should begin thinking about what specific elements that the stakeholders care about. We will call these “areas of interest.” Generally, areas of interest tend to be broad issues, such as “safety”, “cost”, “efficiency”, etc. Two big areas of interest that are especially relevant to artificial intelligence programs are “privacy” (when it comes to data collection and usage), and “ease of use”. Have students fill in the areas of interest across the top row of the ethical matrix.



Discuss

What are the areas of interest for smart speakers? Cost, reviews/reputation, safety, privacy, ease of use and effectiveness (how well does it work).

5. After identifying the areas of interest, students look to their ethical matrix, and place a mark (X or ✔ work well) where a stakeholder might be invested in an area of interest. For example, the owners of smart speakers are definitely invested in privacy, since they want their information to stay private when using the speakers.

6. Once the marks have been made indicating which stakeholders care about certain areas of interest, it is time to delve into more specifics. Ask students to think about what each stakeholder believes about each area of interest, and what is their motivation for caring in each particular area.



Discuss

Why do each of these stakeholders care about this product? What are the particular features of the product that are most important to them?

Stakeholder	*Area(s) of Interest*
Companies making them	Making money (produced cheaply, sold at a higher price, encouraging more people to buy them), having a positive reputation and positive reviews (work well, helpful)
Owners	Convenience, works well, maintains privacy, cheap price
Children	Safe, easy to use, works well
Apps (spotify, weather, youtube)	Want their apps included with speaker, want data to refine their algorithms (spotify, youtube)
Government	Safety and privacy maintained for customers

7. After identifying the stakeholders and their areas of interest, students can look at their ethical matrices and see different conflicts of interest (highlighted above in paired coloring).

🗨 Discuss

Are there any conflicts of interest, where one stakeholder has conflicting or overlapping concerns? See above for conflicts of interest in paired coloring.

8. After identifying conflicts of interest, push students to think about which priorities should win out. Or, alternatively, are there any compromises that might resolve these conflicts?

🗨 Discuss

Which interests should take precedence in cases of conflicts of interest? Why?
Students could answer in a number of ways here; as long as their answers are supported by clear evidence logical reasons, that is fine.

What happens when we prioritize the interests of some stakeholders, but ignore the interests of others? Just like with the algorithmic bias example we looked at yesterday, it is important to take in everyone's perspective when building new technologies. When we leave people out then we create technologies that are not fair, and have negative consequences, whether intended or not. It's important to come up with solutions that work well for everyone.

At what point might we say that technology is not appropriate and should not be built? What is the government's role to regulate technology? Unfortunately, a solution that works for everyone is not always possible. Therefore, we have to have some hard rules, in the USA often made by the government.. If something puts people in danger, causes irreversible harm to the environment, completely erodes personal privacy, or causes a societal injustice we have to choose to not use the technology.

Intro to Text Classification

Day 3

Text Classification

Materials and Preparation

For the whole group	For each group of 2	For each student
.		• Student workbook pages • Laptops with internet

Resources

Slides for this activity

Explore Word Analogies Demo: https://mitmedialab.github.io/arduino-scratch2/word2viz-master/

Vocabulary

Speech recognition - the process of taking a voice recording, analyzing its audio spectrum, and translating it into text

Text classification - the process of taking text and labeling it with the category or idea that best captures its meaning or purpose

Word Embeddings - a way for computers to represent language and their relationship with words using numbers

Lesson

60 mins

Objectives

2. Students will explore word embeddings to gain a better understanding of how computers represent language and issues that may arise with this representation

Standards

3. 3-5.CT.c.1 - Describe examples of databases from everyday life (e.g., library catalogs, school records, telephone directories, contact lists).

Introduction

Text classification is a machine learning method that is used in many systems we see today. For example, voice assistants like Alexa, Google Home, and Siri use speech recognition and text classification to understand what tasks we want it to complete. Many email services use spam filters that use text classification to determine if the sender or content of an email may be spam. Social media websites like Twitter and Facebook also use text classification to help them recognize if content is inappropriate for their websites. Text classification allows AI systems to be more flexible. Users do not have to say exact keywords, they can say something similar and the system will understand.

Relating text classification to the three parts of an algorithm, the input is text from a user, the steps to change the input involve comparing that text to other examples of text whose labels are known, and the output is the name of the most appropriate label.



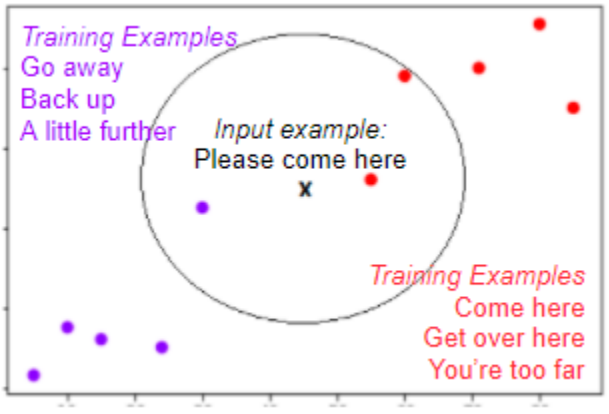
Text classification broken into the parts of the algorithm. The input is the text that we want to classify, in this case "please come here." The steps to change the input involve comparing the input text to known examples for different labels or classes. We have two labels, forward and backward with examples such as "come here" and "back up" for each respective label or class. The output is the label or class that is most similar to the input text, in this case "please come here" is most like the "Forward" label.

The first step in classifying text involves transforming that text into a word embedding. Word embeddings capture relationships in language using numbers. For example, the word “king” is strongly related to ideas of royalty and masculinity, but weakly related to femininity. The image below shows word embeddings for words like “king” “queen” “woman” and “princess” and their relationships to ideas like royalty, masculinity, femininity, and age (young vs. old).

	King	Queen	Woman	Princess
Royalty	0.99	0.99	0.02	0.98
Masculinity	0.99	0.05	0.01	0.02
Femininity	0.05	0.93	0.99	0.94
Age	0.7	0.6	0.5	0.1
...	...	...	...	...

Four partial word embeddings for “king,” “queen,” “woman,” and “princess.” The words are compared (on a scale of 0 to 1) to the ideas of royalty, masculinity, femininity, and age. For the word “king” we see that it’s relationship with royalty and masculinity are high (close to 1), with femininity is low (close to 0) and with age is medium high. The word woman is closely related to femininity, but not very close to royalty or masculinity. Princess is very related to royalty and femininity, but very far from masculinity and age (because princesses are young).

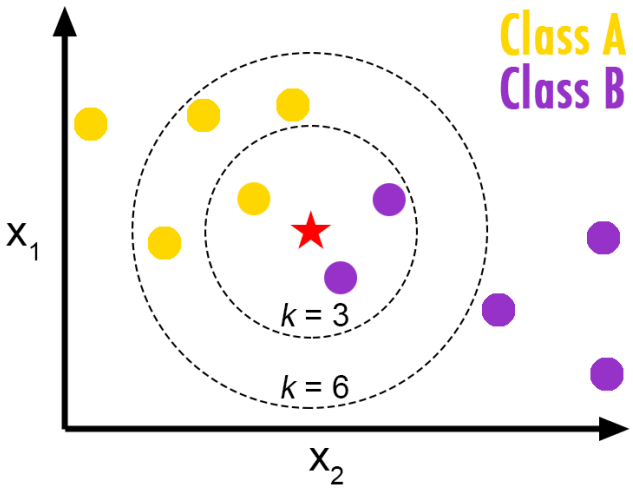
After text is converted into word embeddings, they can then be compared to other words using their distance apart. The image below shows how we might graph text that we have transformed into word embeddings. We do not know exactly what the axes represent, but we can see that examples in different classes tend to cluster together.



A graph showing where different training examples are located relative to one another. There is one label or class, purple dots, with examples “go away” “back up” and “a little further.” There is another label, red, with examples “come here” “get over here” and “you’re too far.” In the middle, we have an unlabelled input example that says “please come here.”

If we want to label a new example that we have not seen before, we can do that by comparing that label to its k nearest neighbors. K is a number we choose, for example 3, which represents the number of neighbors we will consider when deciding how to classify a new input. In the example above, the 3 nearest neighbors to our unlabelled input example are one purple dot and two red dots. Therefore, we predict that our new example should be labeled as red.

One problem with k nearest neighbor algorithms for text classification is that the algorithm is very sensitive to its input data and the k we choose. Although the algorithm is very powerful, we should be aware of this issue.



The image shows data plotted on a two-dimensional graph. Some of the data is colored yellow and labelled ‘Class A’ while the rest of the data is purple and labelled ‘Class B’. In the middle, there is an unlabelled example represented by a red star. Around the red star, there is a circle labelled k=3 that indicates that the 3 nearest neighbors to the red star are one yellow dot and two purple ones. Then there is a larger circle around the red star labelled k=6 that indicates that the 6 nearest neighbors to the star are four yellow dots and two purple ones. **How does changing k change the way we would label our unlabelled example?**

Another problem with text classification is that word embeddings are known to have a lot of biases. In the next activity, students will explore word embeddings and their biases.

Directions

1. Have students look at the student workbook pages about exploring word embeddings.

2. The first page asks students to think about what the axes of word embeddings mean. Have students look at the animal points labeled on the graph and figure out which axes labels best describe how the animals have been arranged. They should see that as they move along the x-axis, from mouse to whale, the animals get larger. As they move along the y-axis, from salmon to dog, the animals move from being sea creatures to land dwellers.
3. Next, have students try plotting points on a graph themselves, as if they are word embeddings. They should associate daughter most closely with “girl” and “young,” then move closer to old as they plot mother and grandmother. Similarly, they should plot son close to “boy” and “young” and then move across the x-axis to place father and grandfather.
4. Now, have students navigate to the Explore word analogies website (https://mitmedialab.github.io/arduino-scratch2/word2viz-master/).
5. Starting from an empty graph, have students set the axes of the graph to be the same as the one they just did by hand. The x-axis should read young, old and the y-axis should read boy, girl. Make sure that students hit the ‘Change axes labels’ button to update their graph!
6. One by one, have students add the words daughter, mother, grandmother, son, father, and grandfather to the graph. They should see that, except for mother and daughter getting switched, the graph is pretty accurate.

🗨 Discuss

What would make a word embedding associate “mother” more with “young girl” than “daughter?” How do you think word embeddings learn? Students might bring up that mothers are closely associated with babies, who are really young. Word embeddings learn about language by reading large amounts of text, think every newspaper ever written. You can imagine that a lot of these newspapers bring up “mother” and “baby” together quite a lot. This could be why mother is so close to young, however word embeddings are black boxes, so we do not know for sure why they do this.

7. Next, have students change the y-axis to “male - female” instead. How does this change the graph? Students should see that this is very inaccurate. The representations of language that computers have are not perfect. Although they are very powerful and can be right some of the time we should not blindly trust them.
8. Have students clear their graph (either by double-clicking the words on the graph or opening another empty graph).
9. Now have them plot the following professions on the graph with the axes young-old and male-female: nurse, doctor, scientist, dancer, teacher, actor, artist. What associations does the word embedding have between gender and age?

🗨 Discuss

What did you discover when you looked at professions and gender in word embeddings? The word embeddings clearly associate some professions as being more feminine than masculine, or more for older or younger people. In society, we would call

these stereotypes and we generally recognize them to be harmful. We would not tell anyone that they could not have a job because of their age or gender. Therefore, it is important that we know that word embeddings may carry on some of these stereotypes.

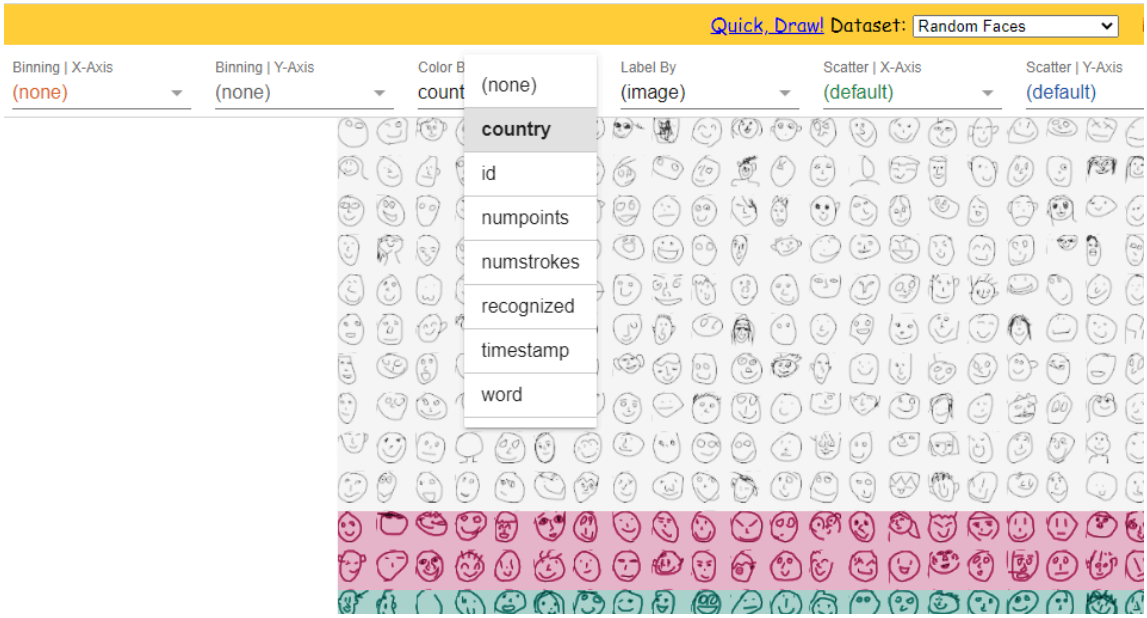
What products do you know of that may use word embeddings? Lots of products use word embeddings. Voice assistants, language translations, and search algorithms are some important examples. People are worried that bias hidden in software that we get information from, like informational searches or voice assistants, might teach people harmful stereotypes that we as a society do not agree with. For example, on some search algorithms if you look for professions like “doctor” or “nurse” then you will only get information and images that are skewed toward a particular gender and that could be discouraging.

Sometimes we cannot fix biases in training data. How else might we go about handling bias in AI algorithms? Search algorithms and even the text classifier we use in this class have to be built on top of word embeddings even though they are biased. This is because the amount of data that it takes to make the word embedding is very expensive and difficult to collect. However, we can make it better by allowing people to give feedback that we use to either handcode or retrain our algorithms. For example, people gave feedback to Google that when translating some words it would unfairly bias toward a certain gender depending on the word that was translated. In response, Google released a new version of its translation algorithm that addressed gender bias.

Extension Option:

The DAILy curriculum from the MIT Personal Robots Group includes an activity where students can explore different kinds of algorithmic bias in common applications that use AI. Students can follow the directions in the following worksheets then you can go over the worksheets with the students.

- Google Image worksheet: What does a physicist look like?
- Google Image worksheet: What does outdoor recreation look like?
- Google Translation worksheet: Who is a nurse, who is a doctor?
- Google Quickdraw dataset: What does a face look like? Students should try organizing the dataset by the country who drew it and whether the AI recognized it or not. They will see that people have different ideas about whether a face includes hair on the head, facial hair, ears, glasses, or other features.


Quick, Draw! Dataset: Random Faces
Binning | X-Axis
(none)
Binning | Y-Axis
(none)
Color B
count
(none)
country
id
numpoints
numstrokes
recognized
timestamp
word
Label By
(image)
Scatter | X-Axis
(default)
Scatter | Y-Axis
(default)

Command Recognition

Day 3

Command Recognition

Materials and Preparation

For the whole group	For each group of 2	For each student
▪	• Laptops with Wifi • Robots • Programs from Day 1	•

Resources

Slides for this activity

Link for AI Blocks

- Template file for command recognition project with AI
- Template file for command recognition project without AI

Programming Guide: Command Recognition | Save and Load program files

Programming Tutorial Video: Creating a text classification model in AI Blocks

Vocabulary

Lesson

1 hr 30 mins

Objectives

1. Students will use AI Blocks and robots to make a robot that responds to voice and text commands

Standards

1. 3-5.CS.a.4 - Identify and solve simple hardware and software problems that may occur during everyday use (e.g., power, connections, application window or toolbar).
2. 6-8.CT.d.1 - Individually and collaboratively compare algorithms to solve a problem, based on a given criteria (e.g., time, resource, accessibility).

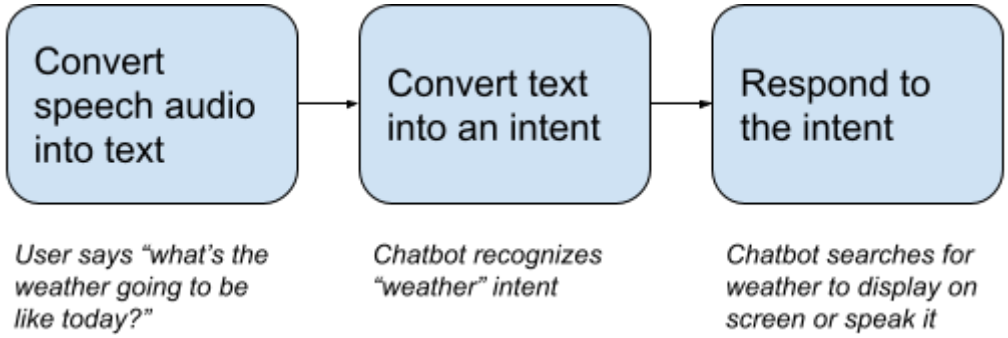
3. 6-8.CT.d.3 - Create a program, individually and collaboratively, that implements an algorithm to achieve a given goal.
4. 6-8.CT.d.5 - Trace programs step-by-step in order to predict their behavior.

Introduction

Chatbots like Siri, Alexa and Google Home are very popular today. They represent a part of AI known as **natural language processing (NLP)**. The overall goal of NLP is to create systems that can understand conversational human language.

Siri, Alexa, and Google Home in particular want to perform tasks that users give them. First, chatbots need to understand what humans say to them - that is to convert speech into text. Next, chatbots need to figure out what the text means and find the most important part of it. This summary of what the user wants the chatbot to understand is called an **intent**. An intent is usually a simple word or phrase such as "showWeather" or "search for puppies." Finally, the chatbot response to the intent.

Chatbot Algorithms

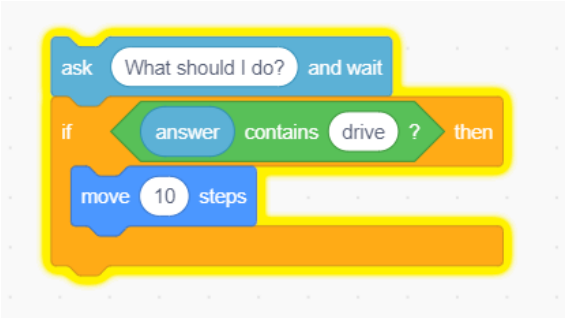


Directions

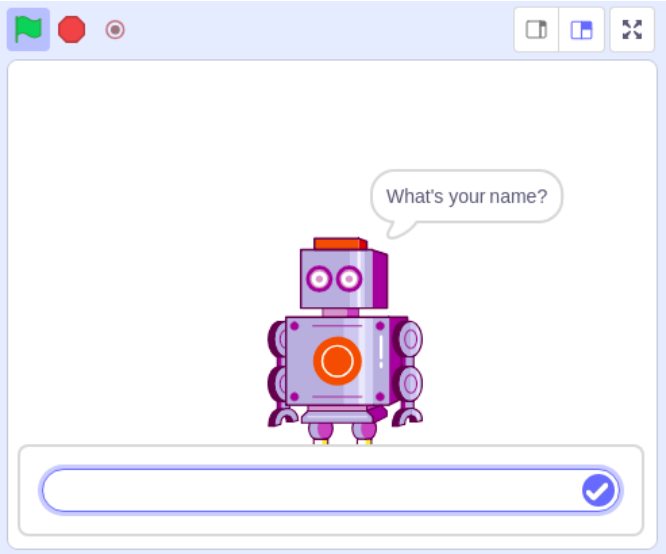
1. Have students open the AI Blocks website with the text classification extension.

(Optional) Non-AI Version of Program

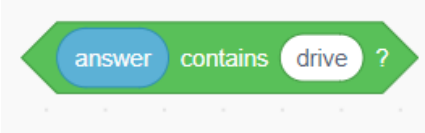
2. Students need to write a program where a user can give the robot one of three different commands: drive in a square, do a light and sound dance animation, and speak.
3. If you would like, students can load the already made program using AI Blocks using 'Load > File from computer'. Otherwise, they can rewrite the simple program themselves by following the activity slides.
4. Make sure that students understand the 'ask' and 'answer' blocks. There are two different kinds, the one for typing input and the one for speech input.



5. When the typing input block runs it will display a prompt on the stage for the user to submit their answer.



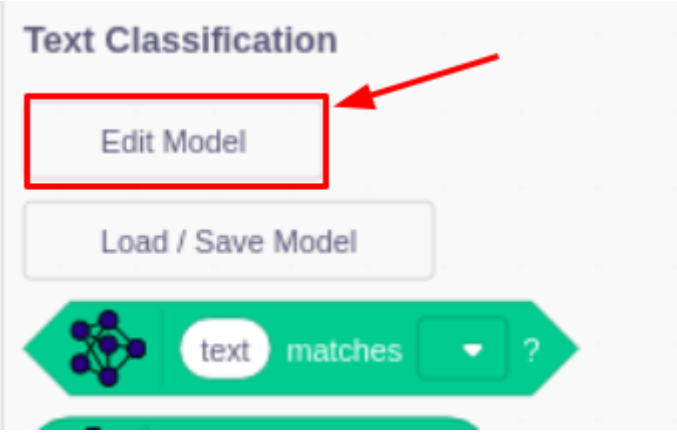
6. When the speech input block runs the microphone on the computer listens to the users' speech. Note: using speech input can be difficult in very noisy classrooms.
7. Make sure that students understand the 'contains' block. This simply looks at text to see if the keyword is present. It works only if a user knows exactly the right word to use.



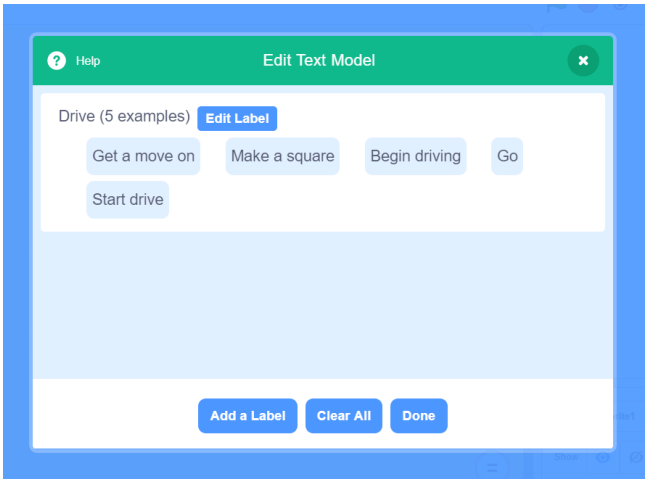
8. Students can use similar code from"Intro to AI Blocks" activity on Day 1 to make the robot 'Drive' 'Dance' and 'Speak'.

AI Version of Program

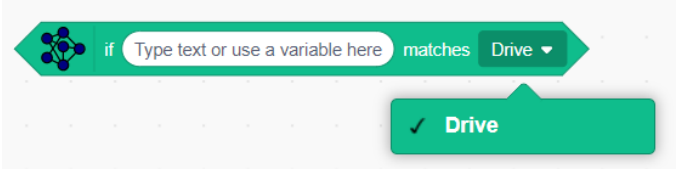
9. Now, students will create and train a machine learning model that recognizes the intent of user input. This means that the robot can be more flexible with user input. First, press the 'Edit Model'.



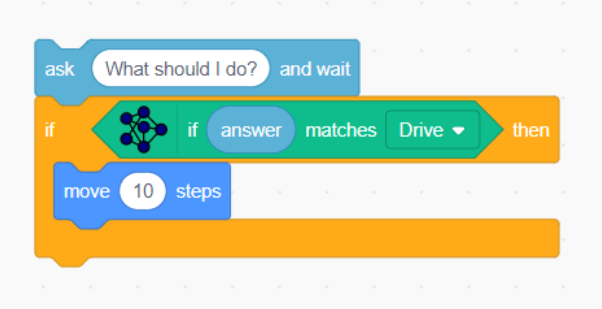
10. In order to add a new label, click on the ‘Add Label’ button. Name the first label ‘Drive’. Add examples of different ways people might ask the robot to drive. You will need 5 to 7 examples for the model to work well.



11. Now, add labels and examples for the two other commands: ‘Dance’ and ‘Speak’. The dance command will cause the robot to begin the light and sound animation while the ‘Speak’ command will make the robot say words.
12. Make sure students understand the ‘text matches’ block. After editing the model, the names of the classes for the model will load automatically. The ‘text matches’ block should be placed in a hexagonal conditional space, like an ‘if’ block.



13. Once their program is ready, have students test their text classification model to see if their robot behaves correctly.



Once students have the basic program working, they can think about different directions to extend their work.

Extension Option #1: Robot Programming

If students would like to connect the robot hardware to their Program, they can load the micro:bit robot extension. The programming instruction document has instructions for an example program where you can tell the robot to drive.

Extension Option #2: Dive into Text Classification

Students can add more commands for their robot to recognize. In addition to coming up with training data for the extended model, they should come up with a test set.
They can then use code similar to the example to program a response to the new input.

Extension Option #3 Dive into Programming

Encourage students to explore nested 'if' blocks to make the conversation more complex. For example, students can program the robot to drive in different shapes, play different animations, or respond to specific questions.

🗨 Discuss

Was the robot able to understand you well? For most students, the robot will be able to understand them well and do the right things. However, some chatbots work really well for some groups but not others. For example, speech recognition works better for adults than young children and it prefers people with an American accent. Also, using the right words to trigger an intent may be easier to guess for people who are more accustomed to interacting with chatbots.

What are some positive ways this technology can be used? What are some limitations of the technology? This technology could be used to remote control a robot in a handsfree way. Talking is also a faster, more natural way to control technology thn using a keyboard or mouse. However, this technology has a bit of a learning curve and only works when the microphone can hear the user clearly. The presence of a microphone may also make some users uncomfortable.

What are some features you might add to this program? Are there any negative sides to those features? You could have the robot always listen for a “wake word” however this would mean the microphone is on and possibly listening very often.
You could have the robot display lights or a sign when it is listening, there are probably no downsides to this.
You could make the robot voice and responses more humanlike, but this may confuse people or make them more vulnerable to being manipulated.

Day 3

Final Project Research

Final Project Research

Materials and Preparation

For the whole group	For each group of 2	For each student
▪		• Student workbook pages • Access to video links with example robots

Resources

Slides for this activity
Collection of exemplar projects
Videos of projects from Summer 2020
Slides of projects from Ms. Watts, Spring 2021: 1st Period, 4th Period

Lesson

30 mins

Objectives

1. Students will be able to brainstorm ideas and complete research about their final projects and the ethical dilemmas associated with them.

Standards*

1. W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism
2. 3-5.CAS.c.6 - Identify ways in which people with disabilities access and use technology
3. 3-5.CAS.c.5 - Identify resources in the community that can give people access to technology
4. 3-5.CS.b.1 - Compare and contrast human and computer performance on similar tasks (e.g., sorting alphabetically, finding a path across a cluttered room) to understand which is best suited to the task

5. 6-8.CT.b.3 - Individually and collaboratively, decompose a problem and create a sub-solution for each of its parts (e.g., video game, robot obstacle course, making dinner).
6. 6-8.CS.b.2 - Describe how humans and machines interact to solve problems that cannot be solved by either alone (e.g., “big data” experiments that involve drawing conclusions by analyzing vast amounts of data).
7. 6-8.CS.b.1 - Explain why some problems can be solved more easily by computers or humans based on a general understanding of types of tasks at which each excels.

* Throughout planning for the final project, students will address many of these standards

Introduction

In order to have students begin to think about their showcase projects, they will look at previous AI projects done with this curriculum. There are three projects to explore:

1. A robot that recognizes handwritten numbers
2. A robot that keeps people company
3. A robot that fetches items in the grocery store

Directions

1. Direct students to form pairs or small groups to explore the collection of final projects.
2. Tell students they are free to watch as many videos as they would like, but they must describe at least one project using the Final AI Project Planner worksheet. Students will need to answer the following questions on the worksheet:
    - What was the main goal of the project?
    - Where could it be used?
    - Who would use it? Who would it help?
    - How does it work?
    - Why is this project important?
3. Allow students to spend 15-20 minutes watching videos and filling out the handout.
4. Finally, go through each category and ask students to share what they learned.

✎ Note:

To make sure that students are engaged in this process of final project research and thinking deeply about ethical dilemmas attached to each robot shown, it may be helpful to watch one video with the class together or to demonstrate your own final project example. As you demonstrate to students, model how they could think through the video. This modeling might also support their thinking about some of the ethical dilemmas discussed.

✎ As students begin thinking about their final project, it will be important to remind them that their robots will not be nearly as “polished” as those they view in the videos.

Reflect

Day 3

Reflect

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ Board or chart paper to write down final project criteria		● Brainstorm Pages in Student workbook pages Printable

Resources

Slides for this activity
Brainstorm graphic organizers: Printable

Lesson

15 minutes

Objectives

1. Students will set the criteria for their final projects by deciding what elements must be included in the final project to show all that they have learned
2. Students will use their final project research and to create initial plans for their own final projects

Standards*

1. W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism
2. 3-5.CAS.c.6 - Identify ways in which people with disabilities access and use technology
3. 3-5.CAS.c.5 - Identify resources in the community that can give people access to technology
4. 3-5.CS.b.1 - Compare and contrast human and computer performance on similar tasks (e.g., sorting alphabetically, finding a path across a cluttered room) to understand which is best suited to the task

5. 6-8.CT.b.3 - Individually and collaboratively, decompose a problem and create a sub-solution for each of its parts (e.g., video game, robot obstacle course, making dinner).
6. 6-8.CS.b.2 - Describe how humans and machines interact to solve problems that cannot be solved by either alone (e.g., “big data” experiments that involve drawing conclusions by analyzing vast amounts of data).
7. 6-8.CS.b.1 - Explain why some problems can be solved more easily by computers or humans based on a general understanding of types of tasks at which each excels.

* Throughout planning for the final project, students will address many of these standards

Introduction

This reflection time outlines two big conversations to have with students. The first is setting the guidelines and criteria for student work. The next is an initial conversation about planning final projects. If there is only time for one conversation, it is best to set the criteria, and push the planning conversation until the next day, when much of the day will be built around planning and constructing the final products.

Before leading the conversation about final product criteria, it is important to have a strong idea already in mind for what the criteria should be. We have provided one sample list of criteria for guidance. To develop the final list, however, it will be much more effective for students themselves to generate the criteria than for the teacher to simply provide them to students. As the discussion goes on, if you find students are missing an element you feel to be critical to the project, it is important that you bring it up. However, if students create the criteria themselves for the final product, they will be more clear on what is required and also feel more motivated to meet these expectations.

Directions

Generating Criteria

1. Explain to students that for the rest of the week, they will be using the learning they have acquired throughout the week about Artificial Intelligence in order to design a final product that helps solve a problem or accomplish a specific task.
2. Tell them that before they begin brainstorming ideas for their project and constructing it, it is important that they come to an agreement as a class about what specific elements should be included in their final project. Have students suggest different components that should be included, and write them down on the board.
3. Review student submissions, and add anything that you feel might be missing.

Possible Final Project Criteria:

- Addresses a problem or need in people’s lives
- Uses one form of AI that was addressed during the week (image recognition, voice commands, etc.)

- Uses a data set to train an AI algorithm
- Explains how steps were taken to minimize bias within the data set
- Contains an “ethical matrix” evaluation of the ethical implications of this product
- Explains why the product is an example of Artificial Intelligence

*Brainstorming Ideas **

**If there is not time for this at the end of the day 3, it can shift to the day 4 welcome activity.*

1. Have students turn to the first brainstorming page in the student workbook. Explain to students that to plan their projects they will answer 5 different questions: who, what, where, why, and how.
2. Work through each question, explaining what specifically is being addressed by each question.
    a. Who: who will use this product, and who will it help?
    b. What: what does the project look like, and what does it do?
    c. Where: where is the product used?
    d. Why: why is this product important? Why is it being built?
    e. How: how does the product work? How will you use the technology we have learned about in this course (programming, robots, Teachable Machine, etc.)
3. Explain the 3 different levels of graphic organizers to help with this work
    a. Plain questions - only asks “who”, “what”, “where”, “how” and” why”
    b. Elaborated questions - asks each question in fuller detail
    c. Multiple choice - circle pre-chosen answers for each question
4. Have students work independently through their brainstorm sheets, circulating the room to help ideas flow.
5. Have students share their ideas with the class. Depending on how students are progressing with ideas, it may be helpful to bring the group together earlier (if more “priming of the pump” needs to be done) or later (if the work is flowing).
6. Discuss groupings with students for the final project. You might allow students to choose their own groups, or see whose initial brainstorms have similar ideas.

✎ Note

A variety of factors go into deciding which students should form groups together. A few things to consider when assigning groups:

- assigning groups socially can have clear pros and cons; as long as the decision is made purposefully there is no “right or wrong” here
- It will be helpful to ensure that at least one member of the group feels competent with programming and the AI components of the course.
- When it comes to size, we envision students groupings ranging from 2-4 students, Any larger than 4 students might not leave enough work for each students, and even with 2 students there is plenty to get done!

7. Leave time to answer any questions students might have about completing the final project.

Day 4

Students will:

- Create a list of tools and skills that can be used on the final projects
- Use graphic organizers to plan for final projects
- Analyze tasks from the final project to break them into smaller components
- Build time-management and planning skills by working on an open ended project
- Provide and receive feedback to and from peers in the classroom to improve final projects
- Use constructive feedback to make improvements to their product

Activities

Welcome>>	15 mins
	Students create a list of tools to include in the “final project toolbox”.
Final Project: Planning>>	30 mins
	Students choose a direction for their final project and begin planning what the major components of the project will be.
Final Project: Work Time>>	90 mins

	Students start to build a first version of their final projects based on their plans.
Final Project: Peer Review>>	30 mins
	Students look at each other's projects to provide feedback.
Reflect>>	15 mins
	Students prepare a "final to-do list" for the next day's work.

Welcome

Day 4

Welcome

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ Chart paper to create the "Final Project Toolbox"		● Student workbook pages filled in from previous day

Resources

Slides for this activity

Lesson

30 minutes

Objectives

1. Students will be able to brainstorm a list of materials and skills to be part of the "final project toolbox"

Standards*

1. W.8 - Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism
2. 3-5.CAS.c.6 - Identify ways in which people with disabilities access and use technology
3. 3-5.CAS.c.5 - Identify resources in the community that can give people access to technology
4. 3-5.CS.b.1 - Compare and contrast human and computer performance on similar tasks (e.g., sorting alphabetically, finding a path across a cluttered room) to understand which is best suited to the task
5. 3-5.CS.a.1 - Identify a broad range of computing devices (e.g. ., computers, smart phones, tablets, robots, e-textiles) and appropriate uses for them.
6. 6-8.CT.b.3 - Individually and collaboratively, decompose a problem and create a sub-solution for each of its parts (e.g., video game, robot obstacle course, making dinner).
7. 6-8.CS.b.2 - Describe how humans and machines interact to solve problems that cannot be solved by either alone (e.g., "big data" experiments that involve drawing conclusions by analyzing vast amounts of data).
8. 6-8.CS.b.1 - Explain why some problems can be solved more easily by computers or humans based on a general understanding of types of tasks at which each excels.

* Throughout the final project, students will address many of these standards

Introduction

Throughout the next two days of the course students will draw on all they have learned about artificial intelligence in order to complete their final project. To help them recall all that they have learned, and to provide a resource that they can refer to throughout the projects, the class will create a "Final Project Toolbox" - a list of tools, ideas, and concepts that have come up in the course that students can use in their final projects.

Directions

1. Bring students together and congratulate them on having learned so much already this week about Artificial Intelligence.
2. Tell students that in order to complete their final projects, they are going to use all that they have learned. And since they have learned so much throughout the week, it will be important to create a list of things they have learned so that they can look back to it as they create their final products. Tell students we will call this our "Final Project Toolkit", since it will create a list of "tools" that they can use in their final products
3. Have students turn to a partner and share some things they think should be included on the tool kit. Then bring the students together and have them share out.
4. Record students responses on the board or on an anchor chart (or digitally if a document can be projected) to capture their thinking
5. Find a way to share the "toolkit" with the whole class by posting the anchor chart, or reproducing smaller copies to distribute

Some things to include in the "Final Project Toolkit"

Programming skills: - Loops - Sounds -	Robot elements - Motion - Lights -	AI algorithms - Image classifier - Text classifier - Voice commands	Ethics - Ethical matrix - Pro/Con analysis

-

Final Project: Planning

Day 4

Final Project: Planning

Materials and Preparation

For the whole group	For each group of 2	For each student
▪		● Student workbook pages with planning from previous days and activities

Resources

Slides for this activity
Graphic organizers:
https://docs.google.com/presentation/d/1QDOqZy7Ix7II4rWHodQaIz_xErzIDlS28IZpkmr7Dmk/edit?usp=sharing

Lesson

30 mins

Objectives

1. Students will be able to construct plans for their final projects by using graphic organizers
2. Students will construct plans for 3 components of their project - the "task" their project will accomplish, the technology that will be used to accomplish the task, and the ethical concerns of the technology.
3. Students will perform a "task analysis" on their project by breaking each large task in their project into smaller components

Standards*

1. 3-5-ETS1-2 (NGSS): Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem
2. 3-5.DTC.a.3 - use digital tools (local and online) to manipulate and publish multimedia artifacts
3. 3-5.CS.a.1 - Identify a broad range of computing devices (e.g. ., computers, smart phones, tablets, robots, e-textiles) and appropriate uses for them.

* Throughout the work on the final product, students will address many of these standards

Introduction

In the reflection activity on Day 3 or in the welcome activity on Day 4, students solidified their final project plans by answering 5 key questions - who, what, where, how, and why - that relate to their final projects. In this session, students will turn the ideas that were developed in those sessions into practical next steps for completing the project. It is ok if not all details of their projects are determined at this point, however, students should have a strong idea of the core ideas of their project.

The planning in this session takes two parts. First, students elaborate on the details of their project in 3 categories: 1) the task their project will accomplish; 2) the technological means students will use to accomplish this task; and 3) the ethical implications of their project. The second component of planning involves a task analysis, where students divide up their work into smaller components

Directions

Planning

1. Share the Project Planning handout with students. Explain to students that they will use this document to start organizing their thoughts about the project they want to build.
2. Explain to students the 3 major components of the project that they are going to be planning for:
    a. Task - what will the project accomplish when it works correctly? Who needs to be involved (users etc.), and what materials need to be used (robots, Program, other materials)
    b. Technology - what technology needs to be used? How does the project use artificial intelligence, and what data set will be used to train the AI algorithm? What will the Program look like to run the technology?
    c. Ethics - what are the ethical implications of this product? Who are the stakeholders, and what are the areas of interest - are there any conflicts of interest?
3. Have groups spend time completing the graphic organizer pages that address these 3 areas. *Make sure groups are completing the level of graphic organizer that is most helpful to them.*

Task Analysis

4. Within each of the three categories outlined above, have students take time to outline the major 4-6 components they need to accomplish in order to complete that aspect of the project. In one version of the graphic organizer, several goals are already suggested. Check to make sure that

every project covers all of these topics. You might also suggest that students refer back to the criteria for the final projects that was set by class so they can make sure their goals align with the criteria.

5. Have groups break down their major goals into smaller steps. Students might think of these smaller steps as instructions (first do this, then do this...). A question to help guide students through this is "what steps need to be taken for this part of the project to get done?"

> ✎ Note
>
> One way for students to think about dividing up their code into smaller pieces is by writing a "pseudocode" outline of their program. This pseudocode would include all the steps necessary for the program to complete its intended task, but does not yet include the specific blocks used to carry out that goal. Once the pseudocode outline is created, then students can go ahead and add the proper blocks to achieve each part of the outline.

6. Once the plans are created, have students assign tasks to individuals or pairs within their large group. Push students to take on different types of tasks. For example, if one person really likes programming then they should do some of the programming tasks, but be sure to share too. Have students think about how they will balance limited resources like only one person working on the computer at a time or one person working with the physical robot at a time. Which tasks need multiple people on them?
7. Have groups keep their plan, or turn it in to the teacher. They should rely on the plan in the subsequent work periods, and update the plan as they go along.

Final Project: Work Time

Day 4

Final Project: Work Time

Materials and Preparation

For the whole group	For each group of 2	For each student
▪	• Laptops with internet • Robots • Craft supplies for decorating robot and other materials	• Student workbook pages with planning from previous days and activities

Resources

Slides for this activity

AI Blocks website

Lesson

1 hour 45 mins

Objectives

1. Students will be able to use various tools from previous activities in the course to produce a final project.

Standards*

4. 3-5-ETS1-2 (NGSS): Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem
5. 3-5.DTC.a.3 - use digital tools (local and online) to manipulate and publish multimedia artifacts
6. 3-5.CS.a.1 - Identify a broad range of computing devices (e.g. ., computers, smart phones, tablets, robots, e-textiles) and appropriate uses for them.

* Throughout the work on the final product, students will address many of these standards

Introduction

Now it's time for students to spend time executing on their plan. Provide students with a plethora of resources such as craft materials to begin designing, building, and programming their robot.

Directions

1. Have students start working on their final projects, following their project plan.
2. After 45 minutes - 1 hour of work, have students stop and do peer review.
3. Be sure to have students save their work on their laptops or Google Drive whenever they get to a significant milestone.

Final Project: Peer Review

Day 4

Final Project: Peer Review

Materials and Preparation

For the whole group	For each group of 2	For each student
▪	● Robot projects to show peers	● Student workbook pages with peer review handout

Resources

Slides for this activity

Lesson

30 mins

Objectives

1. Students will be able to provide constructive feedback to peers to help improve their projects.
2. Students will accept constructive feedback in order to improve their final projects.

Standards

1. 3-5.DTC.b.2 - Collaborate through online digital tools under teacher supervision
2. W.5 - Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach

Introduction

Feedback is an essential part of completing a large project. Without it, we fall victim to blindspots - issues in our project that we cannot see but others can. While especially helpful, feedback can also be troublesome because when we have worked very hard on a project, it can be hard to accept that things are not perfect with it. In this session, certain protocols and worksheets are used to help the feedback process go as effectively as possible. Feel free to use these tools, or other tools that you use in your classroom for feedback, to help this feedback session contribute to your students' work.

Directions

1. Have groups pause their work in whatever state it is currently in.
2. To prepare for receiving feedback from other groups in the class, ask groups to complete the "peer feedback" graphic organizer in the student workbook pages. Walk through each question

on the organizer and explain what is expected to answer each. Note that there are multiple versions of the organizer (one more open ended and one with multiple choice answers), so you can ensure students are using the version that is best for them. This organizer is intended to help make the feedback from other groups most effective.

3. After the feedback form is complete, have students prepare to show their project to groups. This means setting up the materials for the project and making sure all parts are ready. While they prepare, you can make sure that each group is paired with another group to share their work with.
4. Once all groups are ready with their materials, they should meet with another group and take turns going through the other group's pre feedback graphic organizer to see what kind of feedback that group wants.
5. Groups spend time using and testing projects of their partner group.
6. Each group will then fill out the feedback form that will be returned to the other group. Model how to fill out this form so students are clear on how the form works. Even for groups presenting the feedback orally, they should still fill out this form.
7. It will be helpful to assign one group to be "Group A" and another to be "Group B". First "Group A" will perform steps 8 and 9, and then "Group B" will follow by repeating steps 8-9 as well.
8. Have one group present the feedback. Depending on how groups preferred to receive feedback, some groups might present feedback orally, or others might give the feedback form to the groups to read.
9. Groups receiving the feedback have a chance to ask questions about the feedback they received.
10. After both groups have shared feedback, groups should fill out the "feedback reflection form"
11. Reflect on giving/receiving feedback.

⋮ Discuss

What was good about *giving* feedback?

What was good about *receiving* feedback?

What was hard about *giving* feedback?

What was hard about *receiving* feedback?

What feedback do you have on the feedback process? What worked well and what would you change?

Reflect

Day 4

Reflect

Materials and Preparation

For the whole group	For each group of 2	For each student
▪	● Peer review worksheets from previous activities	● Student workbook pages with filled out planning pages

Resources

Slides for this activity

Lesson

15 mins

Objectives

1. Students will create a final “to-do” list so that their project is complete the following day.
2. Students will reflect on the showcase to take place the following day, and adjust their to do list based on what needs to be completed before the showcase.

Directions

1. Pause students in their work.
2. Have groups complete the “final to-do list” organizer. Model how to use this organizer so that students understand how to use it for their planning.
3. If students seem pressed for time, you can give them the remaining time in the day to work on their projects. If they seem to be in a good place for their final project, you can continue with the following reflection.
4. Take some time to introduce the showcase that will take place the next day.

⋮ Discuss

What are the important things to share with visitors about that we have learned this week?

What information do we want to make sure visitors understand after coming to our showcase?

What are some ways to share information with visitors?

How can we use the showcase as a chance to get feedback on our projects?

How can we make sure our guests get to see as many projects as possible in the class?

Day 5

Students will:

- Complete all components of the final projects
- Create presentations to accompany final projects
- Present final projects to an authentic audience at the showcase
- Reflect on final projects and the week of learning about AI

Activities

Welcome>> 15 mins

Students check in with each other about the work they need to do to finish their projects.

Final Project: Finishing Up>> 120 mins

Students put the final touches on their projects for the showcase.

Final Project: Showcase Preparation>> 30 mins

Students prepare to present the work they accomplished this week at the showcase.

Final Project: Showcase>> 60 mins

Students present their robots to visitors.

Reflect>> 15 mins

Students reflect on the ethical and technical considerations that went into designing their robots, as well as their learning throughout the week.

Welcome

Day 5

Welcome

Materials and Preparation

For the whole group	For each group of 2	For each student
▪	● Materials for project	● Student workbook pages

Resources

Slides for this activity

Lesson

15 mins

Objectives

1. Students will reflect on the showcase to take place today.
2. Students make concrete plans for executing their to-do lists

Introduction

If not completed during the Day 4 reflection, spend some time discussing what students can expect for the showcase today.

Additionally, this welcome activity is a change for students to assess exactly what needs to happen to be prepared for the showcase. As students look over the to-do lists they created, they may need to ask for help on certain components of the project or reduce the scope of their work a bit. Have students spend some time thinking about their major goals and any help they might need to achieve them. Groups that are done with much of their project can be assigned to help other groups that need support in completing everything!

Directions

1. Review the expectations for the showcase taking place later in the day. This might include discussing the visitors who might be taking part of the showcase, or the schedule changes the showcase might cause.
2. As a class, have each group give a status update:
    a. How are they feeling about their progress on their project?
    b. Do they feel their to-do is doable?
    c. Is there anything they would like help on?

3. Remind students to ask for help if they feel like they are currently stuck on something or need more hands to get everything done!

Final Project: Finishing Up

Day 5

Final Project Finishing Up

Materials and Preparation

For the whole group	For each group of 2	For each student
▪	● Materials for project (Robots, laptops, craft materials)	● Student workbook pages

Resources

Slides for this activity
AI Blocks website

Lesson
2 hours

Objectives

1. Students will finalize their projects and begin preparing to present their work during the showcase.

Standards*

7. 3-5-ETS1-2 (NGSS): Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem
8. 3-5.DTC.a.3 - use digital tools (local and online) to manipulate and publish multimedia artifacts
9. 3-5.CS.a.1 - Identify a broad range of computing devices (e.g. ., computers, smart phones, tablets, robots, e-textiles) and appropriate uses for them.

* Throughout the work on the final product, students will address many of these standards

Directions

1. Allow groups this time to focus on finishing up their projects. Remind them of the goals for the project: to program, use AI, and to analyze the impact that their project will have on the world in terms of the stakeholders.

Final Project: Showcase Preparation

Day 5

Final Project Showcase Prep

Materials and Preparation

For the whole group	For each group	For each student
▪	● Chart paper or Posters ● Laptops	

Resources

Slides for this activity

Lesson

30 minutes

Objectives

1. Students will prepare a presentation and set up their exhibition space in order to be ready for the showcase.

Standards

1. SL.4- present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development and style are appropriate to task purpose and audience.
2. 3-5.DTC.b.1 - communicate key ideas and details individually or collaboratively in a way that informs, persuades, and/or entertains using digital tools and media-rich resources

Introduction

Students should now prepare their project for exhibition. Depending on the personality of your classroom, you can ask groups to give presentations, you can arrange a “science fair” style exhibition, or a combination of the two!

Final project showcases should include anything students need to present including a poster and set-up props. Students will use this time to prepare and rehearse their showcase.

Directions

1. Instruct students that they will now be showcasing their projects. This will occur in whichever format (formal presentations vs. science fair exhibitions, see ‘Introduction’) that you think suits them best.
2. Tell students they should focus on creating a poster - like an advertisement or brochure - about their project and rehearsing what everyone will say. Ask students what might be included on a poster for their project. Some important details to include are:
    a. Introduce the project - say everyone’s names and the title of the project.
    b. One sentence overview of the project that describes what it does.
    c. What was the inspiration for the robot project?
    d. What was the most challenging part of the project? What was most rewarding?
    e. How will the robot positively impact society? What are some possible negative impacts it may have and how might we respond to them?
3. Towards the end, have students do final tests on their project. It may be a good idea to video record the projects working before the showcase begins.

Final Project: Showcase

Day 5

Final Project Showcase

Materials and Preparation

For the whole group	For each group of 2	For each student
▪	● Final Projects Laptops and robots ● Presentation Posters and materials	

Resources

Slides for this activity

Lesson

1 hour

Objectives

1. Students will collaborate as a group to present their final projects to peers and guests.

Standards

1. SL.4- present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development and style are appropriate to task purpose and audience.
2. 3-5.DTC.b.1 - communicate key ideas and details individually or collaboratively in a way that informs, persuades, and/or entertains using digital tools and media-rich resources

Directions

1. Have students set up stations to display their final projects. Students may want to show things they have worked on throughout the week in addition to their final projects.
2. Welcome visitors to the Showcase! Orient visitors by explaining how the Showcase is structured.

3. Encourage visitors to ask questions about the projects students made, what they learned throughout the week, and anything that surprised them about what they learned.
4. Make sure that students are taking turns visiting others' projects too!
5. Thank everyone for coming.

Final Project: Reflect

Day 5

Reflect

Materials and Preparation

For the whole group	For each group of 2	For each student
.		

Resources

Slides for this activity

Lesson

15 mins

Objectives

1. Students will reflect on
    a. The past week of learning about AI
    b. How that has influenced their views on AI
    c. Their final projects and the design process that produced them,
    d. Next steps for future projects.

Introduction

Now that the showcase is over, give students time to reflect on the past week of the course.

Directions

Reflection questions:

1. What were some of the major things you learned this week?
2. What is one thing they would like to learn about or build if they had more time?
3. Has this week changed your thinking about Artificial Intelligence? If yes, how so? If no, why not?
4. What was hardest about the final project? What was easiest? What changes might you make if you were to continue working on the project?
5. How did it feel to work with a group to create the project?
6. What other ways might you think to use AI in future projects?

Note: Depending on your classroom routines, as well as the timing left after a busy day of the showcase, you

may also want to ask students to put their reflection into writing before sharing. Additionally, you might choose to skip certain questions above or add in your own!

Additional Activities

AI Scavenger Hunt

Additional

AI Scavenger Hunt

Materials and Preparation

For the whole group	For each group of 2	For each student
• Chart Paper • Markers • projector		Laptops with internet

Lesson
30 mins

Objectives

1. Students will be able to identify examples of AI in the world
2. Students will be able to identify the differences between machines, robots, and artificially intelligent robots

Introduction

AI is a very popular topic today. We have things like conversational agents on our phone, object detection algorithms on cameras, and self-driving cars being tested on the street. People often think of AI as a very futuristic thing. However, AI has been around for a long time - since the 1950s. Today, we find AI used in many more systems than initially come to mind. It is important to think about all the places that AI is used in our society and to reflect on how widely it is used in our society.

Direction

1. Have students think about different examples of AI by walking around the classroom or thinking about what technology they use throughout their day.
2. Record student responses on the board or chart paper.

⋮ Discuss

Do any of the examples of AI surprise you?

3. Have students explore other items that may not necessarily be inside of the classroom. Encourage them to consider things outside or on the internet. Do students think of examples like YouTube recommendations? SnapChat filters? Google searches? Ads?

⋮ Discuss

Do any of the new examples of AI surprise you?

Do you think it's important for AI to be obvious/for people to know what is AI and what is not?

1. Give students pen and paper. Have them create two lists: all the ways that computers are better than humans and all the ways that humans are better than computers.
2. After 5 minutes, Discuss.
3. For the items in the "humans are better" category, do Internet searches to see if programs or robots exist that can do that function

🗨 Discuss

Did any of the AI examples surprise you? Why?
Do you think it's important for AI to be obvious/for people to know what is AI and what is not?

Decision Trees

Additional

Decision Trees

Materials and Preparation

For the whole group	For each group of 2	For each student
• projector		AI Examples Worksheet AI Decision Tree Worksheet Computers (optional)

Vocabulary

Algorithm	A process, whether a set of instructions or calculation, that computers follow to solve a problem
Decision Tree	A graph that uses its branches to reason about a subject

Lesson

30 mins

Objectives

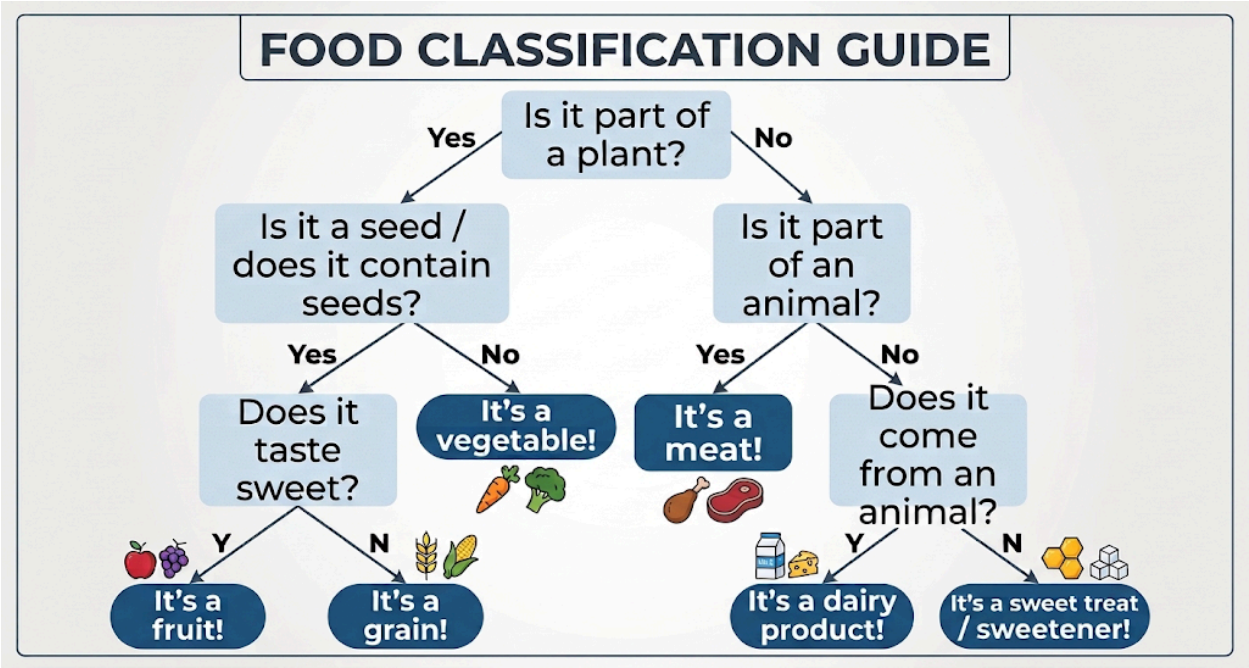
1. Students will be able to create a decision tree that distinguishes between technologies that use AI and technologies that do not use AI.

Introduction

Sometimes it is difficult to tell the difference between programming and AI. When you program something you write code, or instructions, to tell it exactly what to do. With AI, you do not give the computer instructions, you teach the computer what to do in those kinds of situations and allow it to come up with instructions on its own.

It becomes confusing when you come across very complex programs that seem to do something very intelligent. However, if the actions of the computer can be traced back to instructions a programmer writes then it is still not considered AI.

The first AI algorithm students will learn about is decision trees. Decision trees are useful tools for classifying objects or picking a next action. They can be used both by humans and computers. We will use a decision tree to decide what is AI and what is not. This will help us make simple rules about what AI must have and what it might have, but does not necessarily need. Here's an example of a decision tree for classifying fruits and vegetables. Students have this diagram in their student pages.



So let's think about an orange. The top of the decision tree asks if the food is part of a plant. Oranges are parts of plants, so we move down the 'Yes' branch on the left to the next rectangle. This rectangle asks if the food is a seed or contains seeds. Oranges do have seeds, so we move down the 'Yes' branch on the left again. Do oranges taste sweet? They do! So our decision tree tells us that oranges are fruits.

We can use our decision tree not only to classify all different kinds of foods, we can also learn information about the different kinds of foods. For example, we learn from the tree that fruits are parts of plants that contain seeds or are seeds and taste sweet. Vegetables, on the other hand, are parts of plants that are not seeds.

You may notice that this decision tree is not perfect. For example, eggplants and squash do not fit nicely into the tree. When this happens we can adjust our decision tree. In the activity with the students we will build a decision tree that may not be perfect. Finding **counterexamples** that do not fit in the tree will help students solidify their understanding of AI.

Directions

1. Tell students that we are going to learn about an AI algorithm that is used to make decisions. We will use it to decide if something is AI or if it is just a program.

🗨 Discuss

Who has heard the word algorithm before? Does anyone know what it means? Algorithms are processes that computers follow to solve a problem. In the case of programming, an algorithm is the set of instructions, called code, for the computer to follow exactly.

How is AI different from programming or robots? AI has different algorithms from normal programs or robots with AI. Instead of getting step-by-step instructions from code, AI solves problems by itself by recognizing patterns, using logic, or doing calculations.

What are some examples of programs robots that do not have AI? What are some examples of AI that is not a robot? There are a lot of robots that are used in factories to make cars. These robots do the same thing over and over again, so it is easy to write code for them. These robots do not use AI.

Chatbots like Google Home, Siri, and Alexa are all AI because they can have conversations with people. However, even though some of them work on a phone or smart speaker, the program does not have its own body. So these are examples of AI that are not robots.

2. Point out to students that the line between programming and AI can be a little difficult to comprehend since lots of examples of AI include programming. A good example is Google Voice Search. The speech recognition can understand, for the most part, whatever anyone says to it even if they say something strange or use an accent.

   After Google understands what you say, it is *programmed* to start a Google search for the thing you asked about. Different chatbots, like Siri, either open an app, do a search, or tell you one of it's programmed responses (like if you ask for a joke). Even though these chatbots have programming in them, we still consider them an AI.

Note: If you have a laptop and projector available, take a second to let students play around with Google and convince themselves that speech recognition was not done by simple coding.

3. Tell students that next we will create a decision tree to determine if some uses AI or not. First, we need to explain what a decision tree is. In the student handouts, there is an example decision tree for classifying foods. Walk students through the decision tree so that they can see how it works.
4. Now it's time to make our own decision tree to sort out what is AI and what is not. Here are some examples of both that we can use to help us decide:

   Not AI

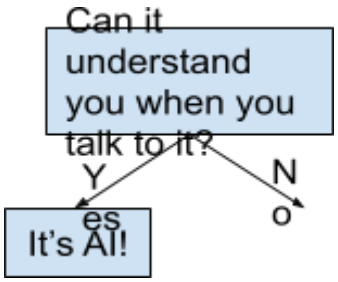
   Toaster
   Automatic-opening doors (like at grocery stores)

Car
Programmable or remote control robot (Dash and dot/Atom robot from Real Steel)

AI Examples

Snapchat Face filters
Chatbots (Siri, Alexa, Google Home)
Robot dog (AIBO)
Self-driving cars

5. Start a decision tree on the board by drawing a “decision leaf”, a rectangle with two branches coming out of it. In the first leaf, write ‘Can it understand you when you talk to it?’ For chatbots and robot dogs, the answer is ‘Yes’ so everything on the left branch is AI!



6. Have the class try and come up with decision leaves that divide up the rest of the examples into ‘AI’ and ‘Not AI’. Here are some ideas:
    a. Does it collect information to understand the world? (Cars and toasters do not)
    b. Can it do things without being told to by human? (Programmable robots, toasters, and cars cannot)
    c. After it’s turned on, does a person have to always be in control of it for it to work? (Cars and programmable robots cannot)
    d. Can it adapt to its environment and do different things if its surroundings change? (Automatic doors and programmable robots cannot)
7. Use some of the prompts above as the decision leaves in the tree. As you build the tree, show which of our examples end up on each side of the examples. Stop when you get to a point where all of the AI examples are separated from the Not AI examples.
8. Now let’s compare our tree to some other AI examples (talking doll, Google search engines) and Not AI examples (washing machines, remote control cars).

Discuss

How do the definitions of AI that we started with compare to the decision tree that we created?

Is there anything that we would add to the definition of AI now that we know more?

How might decision trees be helpful when designing intelligence?

Careers in AI

Additional

Careers in AI

Materials and Preparation

For the whole group	For each group of 2	For each student
		Laptops with Wifi

Introduction
Machine learning and AI are used in multiple different fields. This activity is meant to help students get an idea of *who* works in AI and *what* they do. You can take our recommendations, but feel free to explore

Video Series #1: Careers in AI Video Series from the Personal Robots Group
This video series was created by a high school intern in the Personal Robots Group. Through a series of conversations with people who use AI in their jobs every day, students will see that AI practitioners come from a variety of backgrounds and use a multitude of skills in their work.
Careers in AI for Middle School Students >>
https://www.youtube.com/playlist?list=PLE5Y5NduCHO4HxOQCs5CZUuBCd_4vJ9lR

Video Series #2: Women in AI
Career Girls is a free website that highlights women and their careers. They created a video series featuring women in AI careers to encourage girls to pursue those careers.
Why Consider AI Careers | Empowerment Lesson Career Girls >> https://youtu.be/kt9792UR7sg
Women in AI Playlist >>
https://www.youtube.com/watch?v=2zw8AOGT7Sw&list=PLApdl7sXvtv6Sj6XTmScHmrnSPPf3_P0y

Video Series #3: AI in Other Industries
The Age of AI is a YouTube Original series that features researchers who use AI in art, music, medicine, space exploration, prosthetics,
The Age of AI Trailer >> https://youtu.be/5IvQ3fYKnfM
Age of AI Playlist >>
https://www.youtube.com/watch?v=UwsrzCVZAb8&list=PLjq6DwYksrzz_fsWIpPcf6V7p2RNAneKc

Video Series #4: AI Crash Course with Jabril
In 20 episodes, Jabril will teach you about Artificial Intelligence and Machine Learning! This course is based on a university-level curriculum. In one set of videos, Jabril covers different applications of AI including games and robotics.

What is Artificial Intelligence >> https://youtu.be/a0_lo_GDcFw
Applications of AI Playlist >>
https://www.youtube.com/watch?v=_U21fT8VLp0&list=PL8dPuuaLjXtO65LeD2p4_Sb5XQ51par_b

Video Series #5: AI in Other Subjects
Math - Mathematics of Data Science - Data Science is Everywhere
Science - Ayanna Howard, Roboticist | MAKERS
Social Studies - Microsoft AI + Iconem: Preserving History ft. Common
English Language Arts - Can a computer write poetry? | Oscar Schwartz
Healthcare - Huggable Robot Befriends Girl in Hospital
Physical Education - The NBA Data Scientist
Fashion - AI reaches the fashion store
Psychology - Why we have an emotional connection to robots | Kate Darling
Biology - What intelligent machines can learn from a school of fish | Radhika Nagpal

Google Quickdraw

Additional

Google Quickdraw

Materials and Preparation

For the whole group	For each group of 2	For each student
		Laptops with Wifi

Introduction

Machine learning is a hot topic in AI. Recently, faster and more powerful computers as well as easier access to large datasets have made it easier to develop machine learning systems. Today, students will go through several machine learning algorithms, beginning with neural networks.

Directions

1. Welcome students to the second day of learning about AI and ethics. Ask them if they came across any examples of AI at home or elsewhere after the first day of the course.
2. Explain that today students will learn about different AI algorithms, their uses, and their pitfalls. First, we will play with an AI that recognizes drawings.
3. Have students spend some time playing the QuickDraw game at https://quickdraw.withgoogle.com/

Note: If time is a concern, this activity can be done with one laptop and you can choose students to come up and play different rounds. Let students know that they can continue to play later or they can access the website from any other device outside of the classroom.

Note: Teachers, you have a choice as to which discussion you conduct here. The goal for discussion activities is that students have an opportunity to make their learning personally meaningful.

🗨 Discuss

Discussion Approach #1: Video on Neural Networks

This activity works well for students with a broad range of knowledge about AI/computers who would benefit from a video about the topic and a class discussion to emphasize some ideas.

Watch this video (https://youtu.be/X8v1GWzZYJ4) on how Google Quickdraw works then answer the discussion questions.

1. What are some of the other technologies the video talked about that use neural networks? Do you know what the input data and output data for those technologies would be?
2. Besides "what" you drew, the neural network also knows what about your drawings? How do you think this helps the neural network figure out your drawings more easily?
3. The neural network tries to recognize patterns to figure out your drawings. Let's look at the patterns we see in the Quickdraw data.
    a. **Open the bowtie dataset (https://quickdraw.withgoogle.com/data/bowtie). What are some of the patterns you see here?** Two triangles on either side and a circle in the middle. However, you can see that sometimes people drew just two triangles, without the circle or one triangle and the circle and that's it. If you look closer you can see that some people drew a necktie or even just scribbles.
    b. **What kinds of doodles have similar patterns to bowties that might confuse the neural network?** If someone just drew one triangle and a circle, it looks a lot like a fish. If someone drew two rectangles with a square in the middle, it looks like a belt.
4. The neural network learns patterns from lots of examples of drawings that people submit. Let's think about what it means to teach the neural network about new objects.
    a. **Let's say that you wanted to train a neural network to recognize a new kind of doodle. How many examples of the data do you think you would need?** We can look at the other datasets. Most categories have more than 100,000 examples.
    b. **If you just copied a few examples over and over again, do you think the neural network would do a good job?** The algorithm would only learn one very narrow pattern. Depending on what we want the neural network to recognize, drawings of people for example, it would only do a good job if we have a dataset with examples that are not copied and pasted.

Discussion Approach #2: Inquiry-Based Investigation of Neural Networks

This activity works well for students with some prior knowledge of AI/computers who would enjoy independently exploring Quickdraw to understand it better.

Research Questions

1. What is the best way to get the computer to recognize your doodles? Why does it get things wrong?
    a. **Look at one of the examples you got correct. What was your strategy for drawing?** Time crunch aside, students most likely used a strategy where they tried to include the most important parts of what they were drawing. Like if they were told to draw an elephant they focused on the trunk and the ears.
    b. **Look at one of the examples you got incorrect. Were you surprised that the computer did not recognize something? When the computer got things wrong, how did you feel?** Neural nets are one of the most opaque algorithms. When it gets things wrong, it's not entirely clear why or how to fix it. In this game, getting things wrong is a bit

annoying. However, there are application spaces where neural nets get things wrong with very important consequences.

2. How do you think the computer learned to recognize so many different drawings?
    a. Look at the page that talks about the Quickdraw data (https://quickdraw.withgoogle.com/data).
    The computer learned to recognize drawings by looking at lots and lots of drawings. Does anyone want to guess how many? The computer learned from looking at 50 million drawings of 345 different items done by more than 15 million people.
    How many people live in your city or town? How many cities or towns the same size as yours would have to participate to get all of this data? That would be every person in New York City, Los Angeles, and Chicago submitting 3 drawings for the computer to learn from. That's a lot of drawings!

Discussion Approach #3: Applying Neural Networks to Other Problems

This activity works well for students who are curious about examples of AI we interact with everyday and would like to do a small research project about the topic.

Neural networks are very popular and have been around a long time. What they all have in common is that they have a lot of input data, like a picture, that is matched with a lot of output data. Here are some examples of neural networks that have made a big impact on the world. Choose one to investigate and share with your class. You can look for image classification algorithms that are not on this list.

1. Written number recognition (MNIST) http://yann.lecun.com/exdb/mnist - 2 layers
2. Credit card fraud detection https://blog.usejournal.com/credit-card-fraud-detection-by-neural-network-in-keras-4bd81cc9e7fe - 2 layers
3. Facebook Auto-tagging https://computer.howstuffworks.com/internet/tips/facebook-photo-tags.htm - 9 layers

When sharing with your class you can create a presentation slide or a poster. Try to answer the following questions:

- Who created the algorithm and what was it used for?
- What are the inputs and outputs?
- How big is the dataset needed to train the algorithm?

Could a similar algorithm be used to solve a problem you care about? How might you change the inputs and outputs to suit your problem?

Self-Driving Robot

Additional

Self-Driving Robot

Materials and Preparation

For the whole group	For each group of 2	For each student
• Chart Paper • Construction Paper (different colors) • Thick Markers (ideally black or blue)	Robots USB Webcam	Laptops with Wifi

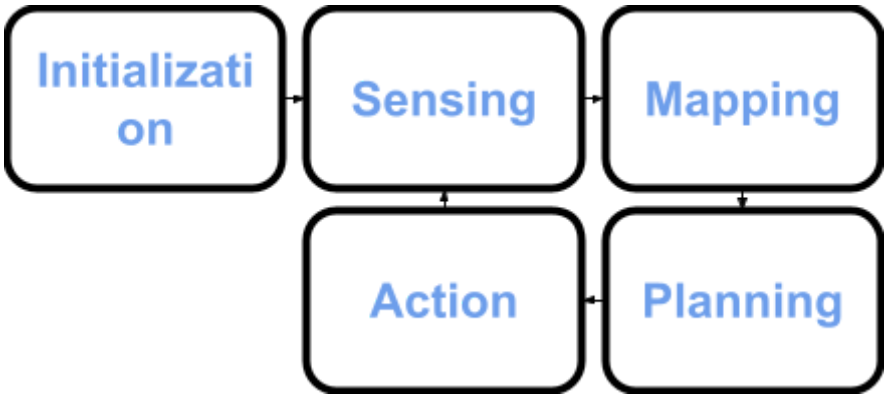
Vocabulary
Simultaneous Localization and Mapping (SLAM) -
Controls -

Lesson
1 hr 30 mins

Objectives
1. Students will be able to use AI Blocks and robots to make a self-driving car
2. Students will use localization and mapping to understand how machines position themselves in the world
3. Students will use data from machine vision (or other sensing) in decision making algorithms

Introduction
Explain this simplified version of how self-driving cars work.

Software Block Diagram of Self-Driving Cars



Initialization - Calibrating the robot and creating the datasets that are necessary to get the robot ready to drive
Sensing - Have the robot take a reading from the infrared sensors, ultrasonic distance sensor, and take a picture with the camera
Mapping - Have the robot use the sensor readings to recognize what is around it
Planning - Have the robot decide which motors to turn or keep still
Action - Have the robot do the action
Repeat from Sensing

Directions

How might you get a self-driving car to work? Students will teach their robot how to follow a path. This is done using the infrared sensors on the bottom of the robot. Give students robots and laptops and have them prepare to program their robots.

Introduce the overall code for self-driving cars.

Pseudocode - 2 Infrared Sensors

If the left sensor detects black line, turn left
If the right sensor detects black line, turn right
Repeat

Next, students need to teach their robot to recognize obstacles that are in its way. Use the ultrasonic distance sensor to detect when there is an object in front of the robot. Use a Teachable Machine model to take pictures of the obstacles that the vehicle can encounter.

Pseudocode

If an obstacle is detected by the ultrasonic distance sensor, stop and predict what it is
If the camera sees an obstacle, have the robot turn
Repeat this code until an obstacle is no longer detected

Have students create a map to demonstrate that their robot can navigate itself in the map. They should draw a path for the robot to follow with pop-up obstacles.
Have students “travel” to a new environment to try their robots on the maps that different groups created.

Discussion:
What happened when the robot was placed in a new environment? Did it do well or poorly?
How might we work together as a team to build a self-driving car that works in many environments? We want students to see that collaboration is a good path for solving some of the problems with translating to new environments and dealing with unfairnesses.
What issues might arise from trying to collaborate this way?
What are some of the benefits of self-driving cars?

Extra Activities

Ethics of Self-Driving Cars

Ethics of Self-Driving Cars

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ Chart Paper ▪ Computer with project		● Student workbook pages

Resources

Self-driving car information: https://www.youtube.com/watch?v=flU82NKrK7s (Updated 2019 Video shared by Mrs. O'Mara from Ohio) https://www.youtube.com/watch?v=FCdYq3AhCFc (2016) and https://newsela.com/read/waymo-self-driving-safety/id/37168/

Ethics of self-driving car information: https://ed.ted.com/lessons/the-ethical-dilemma-of-self-driving-cars-patrick-lin (Shared by Mrs. O'Mara from Ohio)

Vocabulary

Autonomous	Able to work without input from a human or others

Lesson
30 mins

Objectives

3. Students will be able to identify different stakeholders in self-driving cars to complete an ethical matrix
4. Students will be able to identify conflicts of interest between stakeholders in self-driving cars

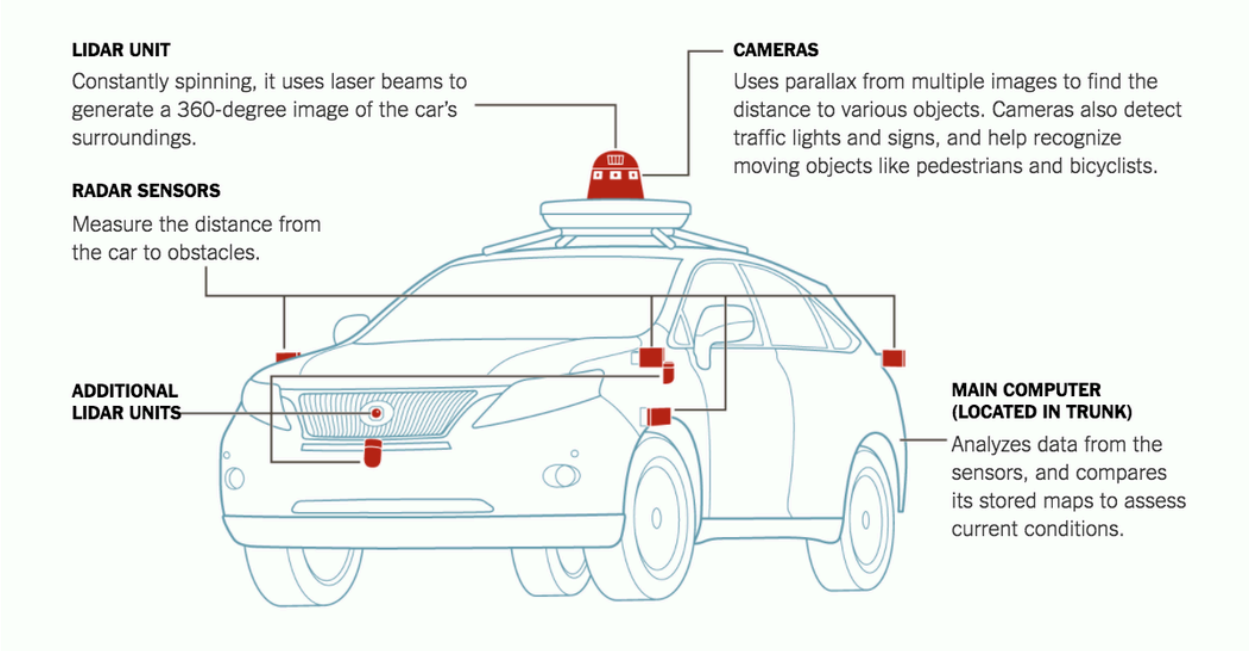
Introduction

Self-driving cars are an exciting technology and one of the most popular and futuristic applications of AI that is within reach today. So far, we do not have “fully autonomous” self-driving cars. However, we are on our way.

Levels of Self-Driving Cars

- Level 0: No automation. Everything that the car does must be handled by the human.
- Level 1: Car assists driver. The car can do things like control the steering or the vehicle speed of the car. However, the driver has full responsibility for being in control of the car and taking over if something goes wrong. Example: cruise control.
- Level 2: Low automation. The car can do things like steer and control speed by itself. The driver still has to pay close attention and has to do more complex things like paying attention to traffic signals or making turns. Example: autopilot in some higher end cars. This mostly only works on the highway.
- Level 3: Driver assists car. The car can do most maneuvers by itself. If it encounters a scenario that it is uncertain it can handle, the driver must be paying attention so they can take over. Example: Tesla cars.
- Level 4: High automation. The car can operate without human control, however it must be in very controlled surroundings like a test road. Example: Google’s Firefly pod-car that was partially used to help create maps for Google Maps. It did not have pedals or a steering wheel, but its top speed was 25 mph.
- Level 5: Fully autonomous. The car can drive itself without humans. It can drive in any surroundings as well as a human. Example: None yet! But many companies are working on it.

Basic Algorithm



Most self-driving cars have sensors like:

- Radar - to detect objects next to them
- Lidar - to create a 360 image of things around the car
- Cameras - to detect objects on the road and to recognize pedestrians and other vehicles
- Internal sensors - to understand the performance of the car (Is it driving as expected? Are the roads more slippery or is the wind very strong?)

Self-driving cars will use all of these systems to make a **map** of its environment.
Then, without human input, the computer on the car will plan a path to navigate its map.
Finally, the computer will send commands to the wheels and brakes to operate the car.

✎ Note:
The NewsELA article and youtube video linked above are just two possible ways you could support students' background knowledge of self-driving cars before they engage in this activity. It is important that students have some knowledge about self-driving cars before constructing an ethical matrix about them.

Directions

1. Using information from the introduction, explain the different levels of self-driving cars, the sensors they have, and their basic algorithm. Do students understand why self-driving cars are AI and not programming?

🗨 Discuss

What are all of the different road conditions that a self-driving car might have to handle on a normal drive? Nearby obstacles, the speed of the car, the weather, the type of road, and information about a car such as its weight and age. There are millions of factors to take into account.

How do we know that self-driving car algorithms are AI and not programming? Given all of the different combinations of factors that a self-driving car might have to deal with, it is not feasible to write a program that can handle each and every single possibility. The car must have the ability to adapt to situations it has not encountered before.

Think about the decision tree that we made about self-driving cars earlier this week. One of the aspects of that tree was that the computer could "adapt to different situations" and that "it did not need a human in control at all times." Normal programs cannot do this

2. Now have students think about the robots they have been programming.

🗨 Discuss

How do the sensors on the robot compare to the ones on a standard self-driving car?
Our robot has an optional camera - self-driving cars have cameras

Our robot has an ultrasonic distance sensor - self-driving cars have LIDARS which are more accurate distance sensors. Also, our robot only has one distance sensor and self-driving cars have them all over.

Our robot has infrared sensors to do line detection - self-driving cars often use extra sensors to figure out where the lines in the road are. However, the ideas are similar.

3. Show students a video of how self-driving cars work on YouTube: https://www.youtube.com/watch?v=flU82NKrK7s (2019) or https://www.youtube.com/watch?v=FCdYq3AhCFc (2016). If students are already familiar with self-driving cars, then you can have them look at this video about the Ethics of Self-Driving Cars video https://ed.ted.com/lessons/the-ethical-dilemma-of-self-driving-cars-patrick-lin.
4. Now that students understand a lot about self-driving cars, it is time to discuss ethical issues surrounding the technology. Introduce that we will be doing an ethical matrix for this technology so that we can think about how this technology should be designed.

🗨 Discuss

What are some good uses of self-driving cars? Self-driving cars can be much safer than humans driving. Humans get tired, are susceptible to emotions, and get distracted which can cause accidents. Self-driving cars are always paying attention.

People who have lost their ability to drive (for whatever reason) will have another option for getting around which greatly increases their independence.

Can you think of any negative effects this technology might have? If anyone can drive a car, this could lead to some dangerous or scary situations. Computer controlled cars might be hacked, introducing a new security risk. If an accident happens involving a self-driving car, it will be harder to assign blame - is it the people in the car, the people in the other car, the programmers who made the car, or someone else who is to blame? People who drive for a living will have their jobs threatened.

5. **Now that students have thought about some of the good and bad consequences, have them start filling out the ethical matrix with stakeholders and their interests.**

🗨 Discuss

Who are the stakeholders for self-driving cars? Car companies, passengers, pedestrians, governments, taxi cab drivers, etc.

What kinds of things do the stakeholders care about? Pedestrian safety, passenger safety, the law, making money, jobs.

6. **Now, ask students to fill in their ethical matrices with X's in the blocks that represent things that individual stakeholders care about.**

🗨 Discuss

What kinds of things do the stakeholders care about? Where are the conflicts of interest? There's a scary conflict of interest between passenger safety and pedestrian safety. Sometimes cars may be in an impossible situation where it's difficult to protect both. There is also the conflict between car companies who want to make a lot of money and professional drivers who do now want to lose their job. There's also a conflict between the car companies who make self-driving cars and those who do not. As soon as one company successfully make self-driving cars then all of the other car companies will have to rush to keep up so that they can stay in business. This rush could also jeopardize safety.

What happens when we prioritize the interests of some stakeholders, but ignore the interests of others? Just like with the algorithmic bias example we looked at yesterday, it is important to take in everyone's perspective when building new technologies. When we leave people out then we create technologies that are not fair. It's important to come up with solutions that work well for everyone.

At what point might we say that technology is not appropriate and should not be built? Unfortunately, a solution that works for everyone is not always possible. Therefore, we have to have some hard rules. If something puts people in danger, causes irreversible

harm to the environment, or causes a societal injustice we have to choose to not use the technology.

Model UN Debate - Self-Driving Cars

Additional

Model UN

Materials and Preparation

For the whole group	For each group of 2	For each student
		Paper and markers for Placards

Objectives

1. Students will engage in debate and make decisions about technology policy.

Lesson

60 minutes

Introduction

Have students prepare for Model UN by making placards. The placards should have the name of the student and a color or sticker for the stakeholder they represent. Have students make their own placards to use for volunteering to speak and taking votes.

Directions

Position Forming

1. Explain that we are a special UN committee convening to decide on the future of self-driving cars.

   We have to decide whether or not we will allow self-driving cars, what laws we will pass about the price of cars, who will develop them, and where they will be allowed to operate.
2. Assign students with different roles based on the stakeholders and the interests of the stakeholders that we discussed
   a. Car company - profit, long-term success (fewer people will want cars), safety, liability
   b. Passengers/People who can afford car - safety, cost, performance of cars, control
   c. Pedestrians - safety
   d. People who cannot afford car - resource usage
   e. Government - planning for traffic change, liability for accidents, planning for economic change, society safety (hackers, surveillance)
   f. Professional drivers (taxis, limos, bus, truck) - loss of customer base

    g. Driving companies - profit
    h. Insurance companies - liability of insuring machine,
3. Within their groups, have students think about the laws and policies that suit them best and how the self-driving car should be designed and used.
4. Within groups, choose a delegate to represent the position of the stakeholder. To the class, have delegates give a two-minute speech outlining their position.

Classroom Discussion

1. Open the classroom to discussion for 15 minutes. The goal is to decide what laws to pass regulating self-driving cars.

    Begin with “Greetings, distinguished delegates. I am your Chair, and I now call this committee to order. Today, we are discussing the topic of self-driving car regulation. Each speaker will have one minute to speak. All those wishing to speak, please raise your placards at this time.”
2. If someone would like to speak, they must raise their placard. Delegates have one-minute to speak.

    If one minute expires and the delegate is still speaking, then kindly cut him or her off by saying, “Excuse me, distinguished delegate. Thank you for your speech, but your time has expired. You may now sit down.”
3. Repeat the process by asking “All those wishing to speak, please raise your placards at this time.” Delegates must raise their placards to speak. After several speeches ask if there are any motions on the floor. Motions include:
    a. Break for informal discussion
    b. Asking Chair for information
    c. Calling a vote on a particular law
4. Within groups, have students write a summary about the laws that were passed. What things work well for their stakeholders and what are some concerns?
5. To the class, have each delegate give a two-minute summary.

Discussion

What were some of the challenges and opportunities in coming to an agreement?

Ethical Matrices - Facial Recognition Surveillance

Day 3

Ethical Matrices

Materials and Preparation

For the whole group	For each group of 2	For each student
▪ Chart Paper or Model Ethical Matrix ▪ Computer with projector		● Student workbook pages with ethical matrix

Resources

Vocabulary

Stakeholder	a person with an interest or concern in something
Conflict of Interest	When a stakeholder has two different areas of interest that conflict with each other

Lesson

30 mins

Objectives

1. Students will complete ethical matrices by identifying different stakeholders in an AI technology and their respective areas of interest
2. Students will be able to identify conflicts of interest between stakeholders

Standards

RI.6 - Assess how point of view or purpose shapes the content and style of a text

Introduction

As students learned during the “Algorithmic Bias” readings and discussion, Artificial intelligence programs that deal with facial recognition have many troublesome aspects to them. One particularly controversial way facial recognition software is used is in surveillance, where governments and police departments use facial recognition on security camera footage to identify suspects in crimes. Some claim that this technology is meant to keep people safe, and by their logic, if more potentially “bad” people can be identified, then fewer bad things will happen. For others, the way facial recognition is used means that many innocent people could suffer consequences based on errors in the facial recognition software, and in general, the use of facial recognition software represents a huge invasion of privacy.

In this activity, students will identify who the stakeholders are in the use of facial recognition technology for security and surveillance purposes, and think about which areas are of most interest and concern to these stakeholders concerning this technology. This type of “stakeholder analysis” and “ethical matrix” work models what students will be completing for their own final projects. To scaffold this work, students will answer three core questions. First, they ask “who are the stakeholders?”, which can be recast as “who are the different groups of people that might care about this product?”. After identifying stakeholders, students think about the specific areas of interest for each stakeholder, answering the questions “why do these stakeholders care about this product?” and “what particular features of the product are most important to them?”. Lastly, students will look for conflicts of interest by answering “are there any areas of interest that conflict with each other?”.

The important aspect of this activity is the thinking about ethical stakeholders and their potential conflicts of interest, so if facial recognition in surveillance is not the best topic to use as a model, please feel free to use a different one. There are materials in the “additional activities” portion of the educator guide to conduct this activity about self-driving cars. Other relevant and rich models for this activity might be smart speakers (written into the unit), or AI software used to detect plagiarism.

Directions

1. Remind students that part of our work this week is not just learning about how Artificial Intelligence programs work, but also about discussing the ethical implications of Artificial Intelligence in our lives. Tell them that in this activity, we’re going to complete what is called an ethical matrix to think about the ethical implications of a particular use of Artificially Intelligent facial recognition technology in surveillance and police work. Show students the ethical matrix by projecting it (or presenting on chart paper), and directing them to the blank ethical matrix page in their student workbook.

2. Have students review how facial recognition programs work. They will rely on their understanding of image recognition developed in day two with the “teachable machine” and cat/dog classifier activities.

Brief recap: image recognition, including facial recognition, relies on a large database of images (in this case, faces) to train an AI algorithm to recognize certain faces. In some of the surveillance algorithms used by governments and police forces, once a face is recognized, the program searches for other faces in a database that are similar to the target face. The database in the US is built in some cases off of people’s drivers license photos. When a match is made, the police use the information to help aid their investigations.

3. Explain to students that the first step in completing an ethical matrix is identifying the stakeholders. They will do this by answering the question, “who are the groups of people that care about facial recognition in surveillance?”. Have students add in these stakeholders - this can be done as a whole class, or by small groups first, and then having groups share out.



Discuss

Who are the groups of people that care about facial recognition technology? Regular citizens, governments, police departments, technology companies, groups of people affected by algorithmic bias in facial recognition programs (women, people of color), people accused of crimes

4. After the stakeholders have been identified, students should begin thinking about what specific elements that the stakeholders care about. We will call these “areas of interest.” Generally, areas of interested tend to be broad issues, such as “safety”, “cost”, “efficiency”, etc. Two big areas of interest that are especially relevant to artificial intelligence programs are “privacy” (when it comes to data collection and usage), and “ease of use”. Have students fill in the areas of interest across the top row of the ethical matrix.



Discuss

What are the areas of interest for facial recognition in security surveillance? Privacy, public safety, civil rights, cost

5. After identifying the areas of interest, students look to their ethical matrix, and place a mark (X or ✔ work well) where a stakeholder might be invested in an area of interest. For example, the government is definitely invested in public safety, since it is their job to keep citizens safe.

6. Once the marks have been made indicating which stakeholders care about certain areas of interest, it is time to delve into more specifics. Ask students to think about what each stakeholder believes about each area of interest, and what is their motivation for caring in each particular area.

🗨 Discuss

Why do each of these stakeholders care about this product? What are the particular features of the product that are most important to them?

Stakeholder	*Area(s) of Interest*
Regular citizens	Safety, privacy
Governments	Safety, privacy for citizens, efficiency in stopping crime, budget concerns
Police Departments	Efficiency in stopping crime, public safety, budget concerns
Technology Companies	Want their products to be used in order to make money
Groups of people affected by algorithmic bias in facial recognition programs (women, people of color)	Privacy, civil rights, safety
People accused of crimes	Civil rights

4. After identifying the stakeholders and their areas of interest, students can look at their ethical matrices and see different conflicts of interest (highlighted above in paired coloring).

🗨 Discuss

Are there any conflicts of interest, where one stakeholder has conflicting or overlapping concerns? See above for conflicts of interest in paired coloring.

5. After identifying conflicts of interest, push students to think about which priorities should win out. Or, alternatively, are there any compromises that might resolve these conflicts?

Discuss

Which interests should take precedence in cases of conflicts of interest? Why? Students could answer in a number of ways here; as long as their answers are supported by clear evidence logical reasons, that is fine.

What happens when we prioritize the interests of some stakeholders, but ignore the interests of others? Just like with the algorithmic bias example we looked at yesterday, it is important to take in everyone's perspective when building new technologies. When we leave people out then we create technologies that are not fair, and have negative consequences, whether intended or not. It's important to come up with solutions that work well for everyone.

At what point might we say that technology is not appropriate and should not be built? What is the government's role to regulate technology? Unfortunately, a solution that works for everyone is not always possible. Therefore, we have to have some hard rules, in the USA often made by the government.. If something puts people in danger, causes irreversible harm to the environment, completely erodes personal privacy, or causes a societal injustice we have to choose to not use the technology.

TEMPLATE and OTHER HELPFUL COMPONENTS:

Note template

