

TECHNOLOGY

MACHINE LEARNING



COURSE

**MACHINE LEARNING SHORT COURSE
- HOME STUDY VERSION**

Objectives

CORE

- Understand what machine learning is
- Understand potential issues with the application of machine learning

CHALLENGE

- Be able to identify ways in which a machine learning model could solve a real world problem

Course activities

Activities

1. What is machine learning?
2. How do machines learn?
3. Facial recognition
4. Self-driving cars
5. Natural language processing
6. Instagram's anti-bullying AI
7. Uses of machine learning
8. Spot possible problems
9. Explore your idea
10. Develop your idea
11. Design your model
12. Explain your idea

Introduction

Machine learning is playing an increasingly important role in lots of different aspects of all our lives.

It's important that you understand what machine learning is and how it is being used - not just those of you who will go on to invent it or build with it (although that is important), but also those of you who will use it and be affected by it.

And that's everyone!



1 – What is machine learning

Activity

Go to Activity A in your Student Workbook and answer the questions in the top section:

- Have you heard of the term machine learning? YES / NO
- If yes what do you think it means?

When you have answered the questions watch the video on the following slide and then answer the remaining questions.



ACTIVITY A

WHAT IS MACHINE LEARNING?

COURSE

MACHINE LEARNING SHORT COURSE

Questions to answer before you watch the video

Have you heard of the term machine learning? YES / NO
If yes what do you think it means?

After you have watched the video on the next slide answer these questions

What is machine learning?

Why is the use of machine learning increasing rapidly?

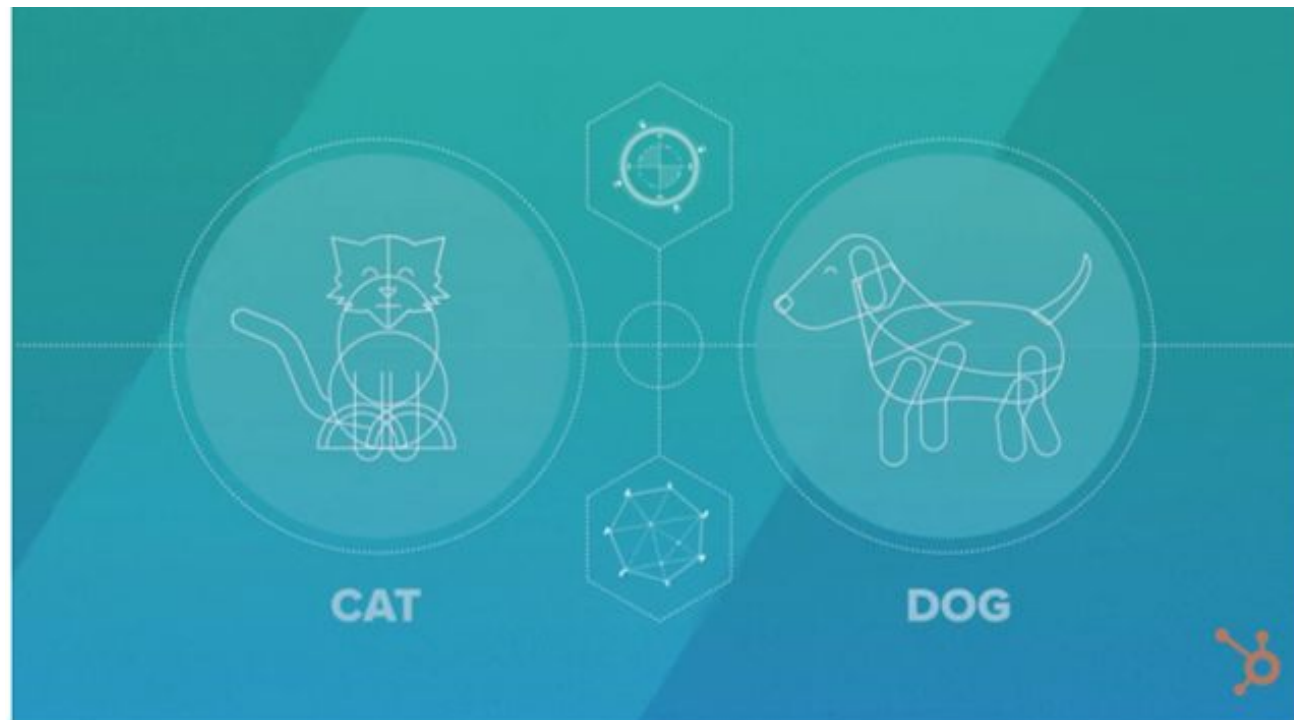
Can you think of any any issues or problems caused by the increase in the use of machine learning?

Understanding what ML is and how it functions should help you recognise where you are interacting with computers in your everyday life and what this means for you (as a human?).

NAME

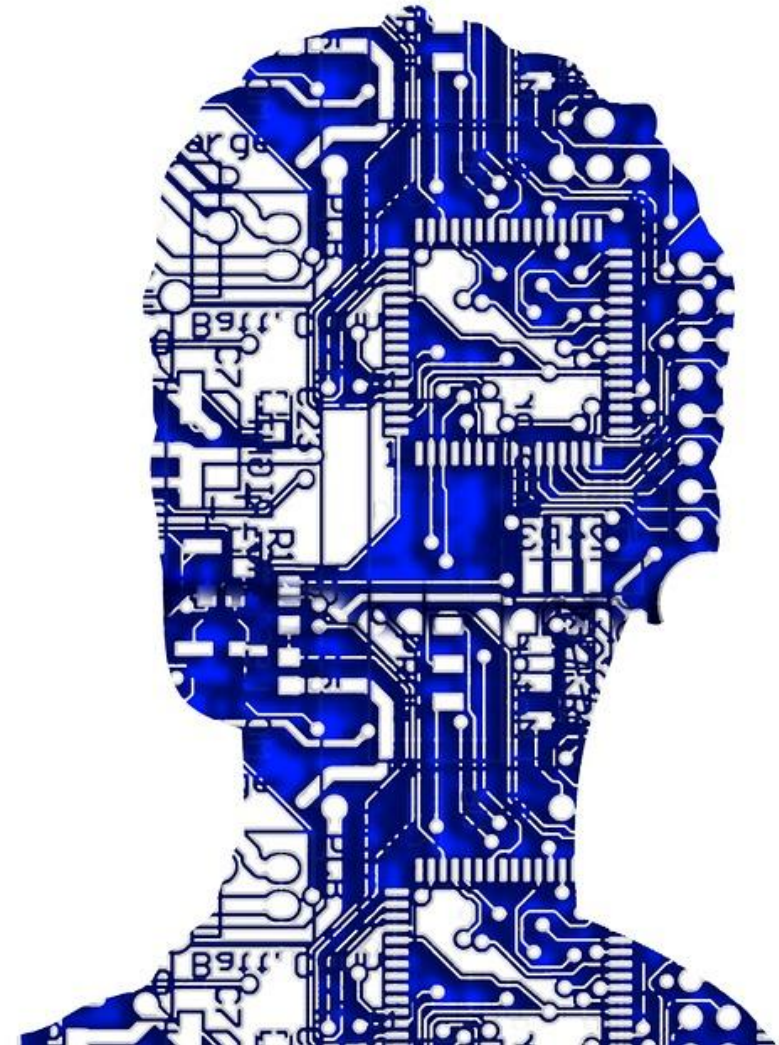
1 – What is machine learning?

Watch this video: [What is Artificial Intelligence \(or Machine Learning\)?](#) (6 mins, 14s). Have you changed your definition of what machine learning is? When you have watched the video go back to Activity A and answer the remaining questions.



1 – What is machine learning?

Machine learning is a system where - rather than a computer programmer deciding the best way to sort, organise, classify or use information – a computer program develops its own set of instructions based on information that users feed it.



2 – How do machines learn?

You want a computer to perform a complex task...

With **computer programming**:

- You break down the complex activity into a set of simple instructions.
- You use these instructions to tell the machine how to perform the task.

With **machine learning**:

- You collect a set of examples of the task being done.
- The computer learns how to do the task from the examples you give it.

The next activity shows how this works in practice. In this case, the machine is being taught to recognise images.

2 – How do machines learn?

Activity - Quick, Draw

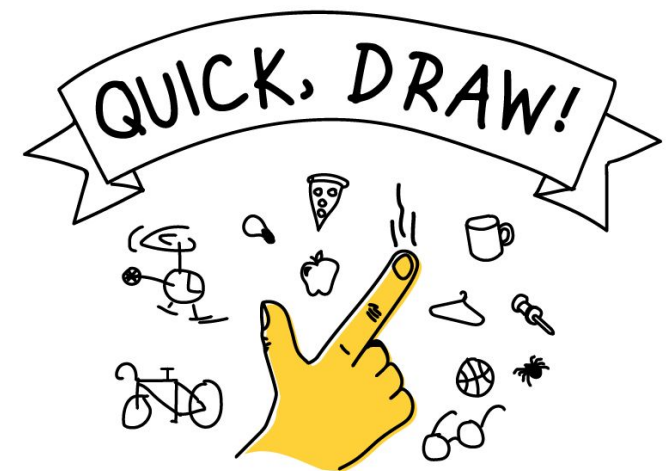
This is a game built with machine learning. You draw, and a neural network tries to guess what you're drawing. When you have finished, look at how your drawings were recognised and also the 'data set' of images that have been drawn by others.

Play the game here:

<https://quickdraw.withgoogle.com/>

Find out how it works here:

<https://www.youtube.com/watch?v=X8v1GWzZYJ4>

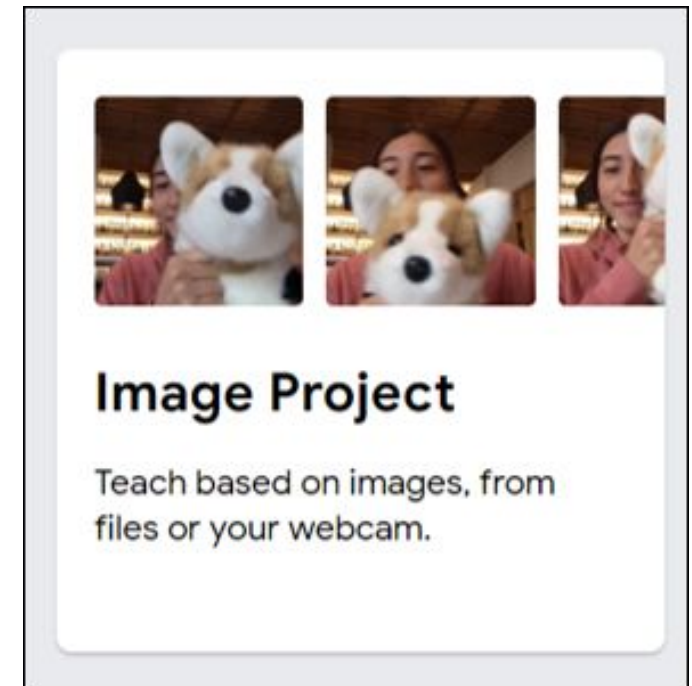


2 - How do machines learn?

Activity - Teachable Machine

Teachable Machine allows you to capture images with your webcam, or upload images from your computer, to train a computer model:

<https://teachablemachine.withgoogle.com/train/image>



Watch the tutorial video, then follow its instructions to train your own model. *Note: If the webcam is disabled on the computer you're using, you'll need to upload images as samples instead.*

2 – How do machines learn?

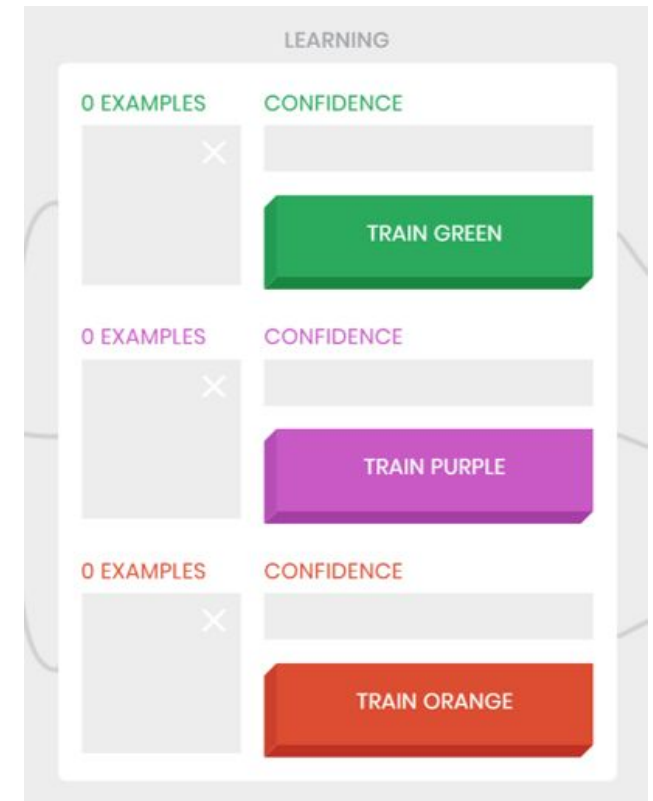
Activity - Teachable Machine

In this, the previous version of Teachable Machine, you can train a model to recognise different gestures using your camera live in your browser.

Watch this video to see how the activity works:
<https://www.youtube.com/watch?v=3BhkeY974Rg>

Play the game here (if your camera is not disabled):

<https://teachablemachine.withgoogle.com/v1/>



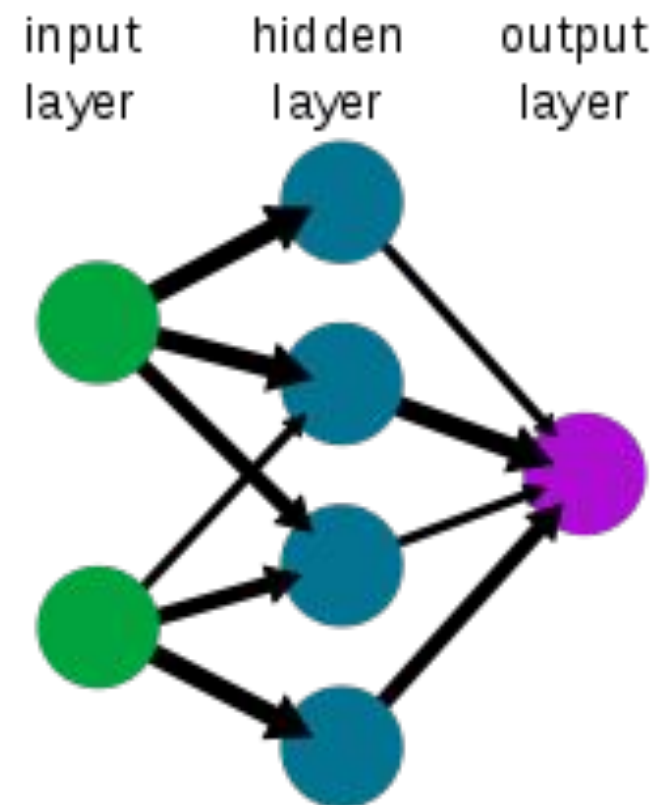
2 – How do machines learn?

The Quick,Draw activity you tried earlier uses neural networks to analyse your drawing and compare it with thousands of other drawings in its library.

Neural networks are modelled loosely on the human brain and enable computers to learn from being fed data.

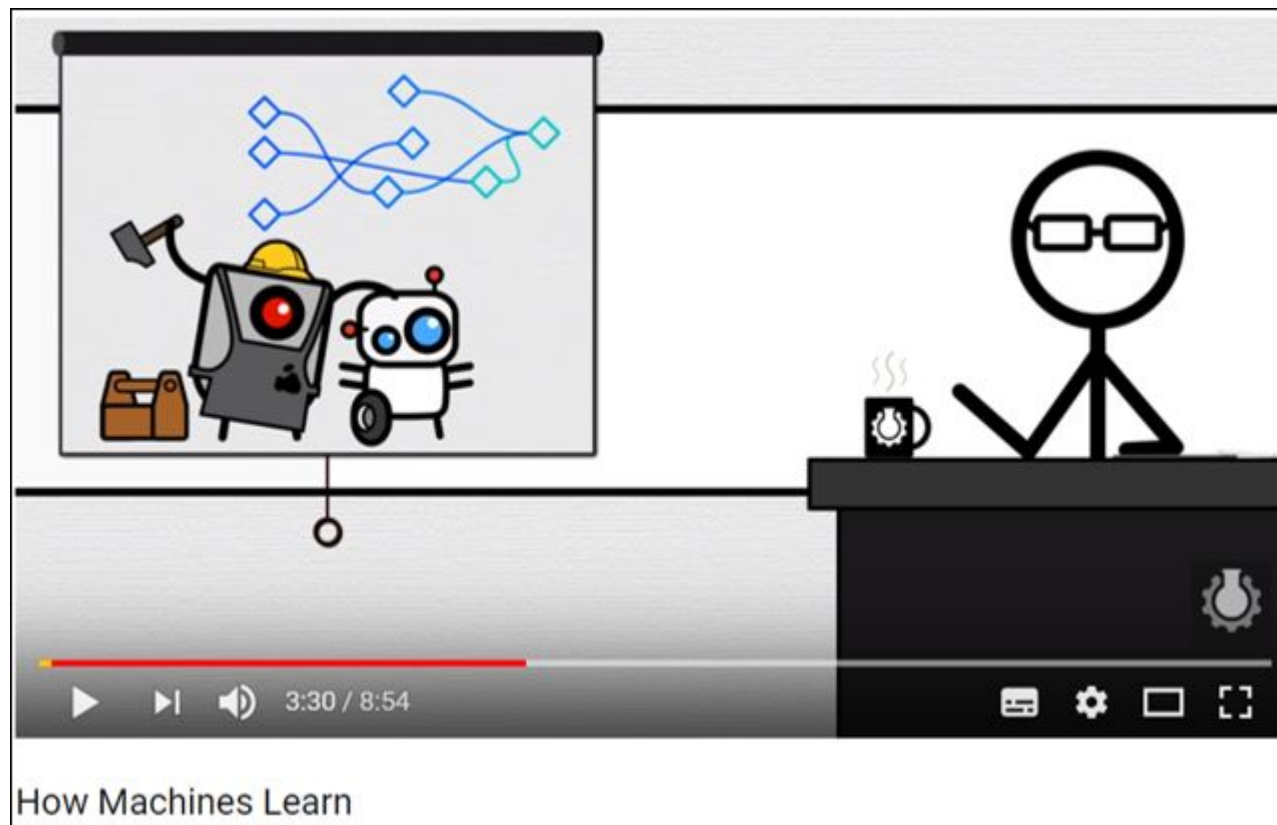
The typical neural network consists of thousands of interconnected artificial **neurons**, which are stacked in rows that are known as **layers**, forming millions of connections.

A simple neural network



2 – How do machines learn?

This video, [How Machines Learn](#) (8 mins, 54s), explains how **neural networks** are used to train machine learning models.

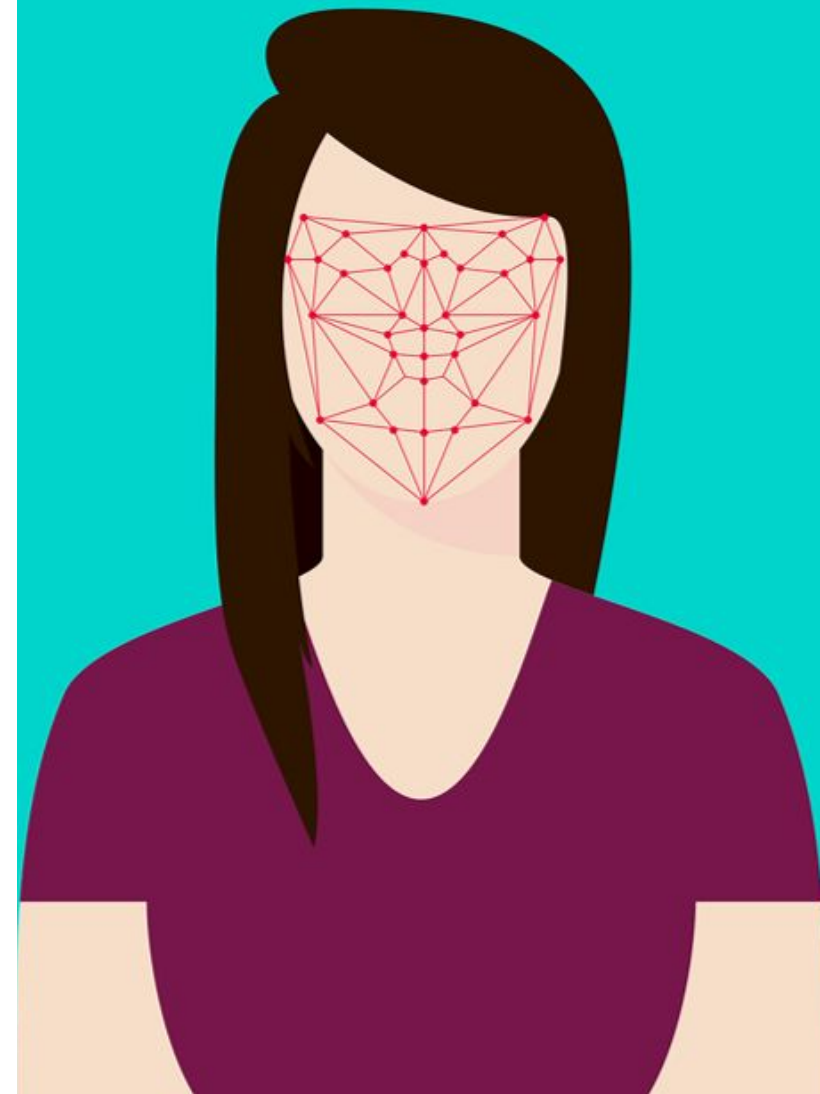


3 – Facial recognition

Facial recognition is increasingly being used for a wide range of applications:

- Identity check e.g. unlocking your phone, checking in at the airport
- Security e.g. scanning crowds entering a pop concert to spot potential terrorists
- Police support e.g. scanning people in the street for wanted criminals

What do you think are the advantages and disadvantages of using facial recognition technology? Record your answer in the first section of Activity B in the workbook.



3 – Facial recognition

FaceApp

FaceApp uses machine learning algorithms to alter people's faces with various filters.

Users take or upload a photo from their phone and the app's algorithms do the rest. You can make yourself look younger or older, swap your gender, or transform your expression.

However, concerns have been raised with regards to privacy and security issues. Who owns the photos that you have uploaded and how they will be used by the person owning / holding them.



3 – Facial recognition

This [video](#) (3 minutes, 19s) discusses concerns raised over police trials of facial recognition technology. Do you think the police are right to use this technology to track down criminals? Are people right to be concerned? Mark your answer in the second section of Activity B in the workbook.



3 – Facial recognition

This [video](#) (1 minute, 14s) explains how facial recognition is being used in China to monitor students in class. Do you think this would be beneficial in your school? Record your answer in the third section of Activity B in the workbook.



3 - Facial recognition

Facial recognition software is becoming more sophisticated all the time, watch this [video](#) (58s) to see how it has already been adapted for use during the Coronavirus pandemic.



ACTIVITY SHEET B
FACIAL RECOGNITION

COURSE
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COURSE

What are the advantages and disadvantages of using facial recognition technology?

Are the police right to be trialling facial recognition technology to track down criminals? Are people right to be concerned?

Should schools in this country use facial recognition technology in the classroom? Explain your answer.

What are the issues surrounding facial recognition technology?

NAME

4 – Self-driving cars

Machine learning can be used to develop decision-making algorithms for self-driving cars. Watch this video [The ethical dilemma of self-driving cars](#) (4 mins 15s). What are the potential issues with this?



4 – Self-driving cars

Log on to moralmachine.mit.edu/, watch the intro video and then click on 'Start Judging' to select your response to each of the self-driving scenarios.

When you have completed this answer the questions on Activity C of the workbook.

What should the self-driving car do?

7 / 13

In this case, the self-driving car with sudden brake failure will continue ahead and drive through a pedestrian crossing ahead. This will result in ...

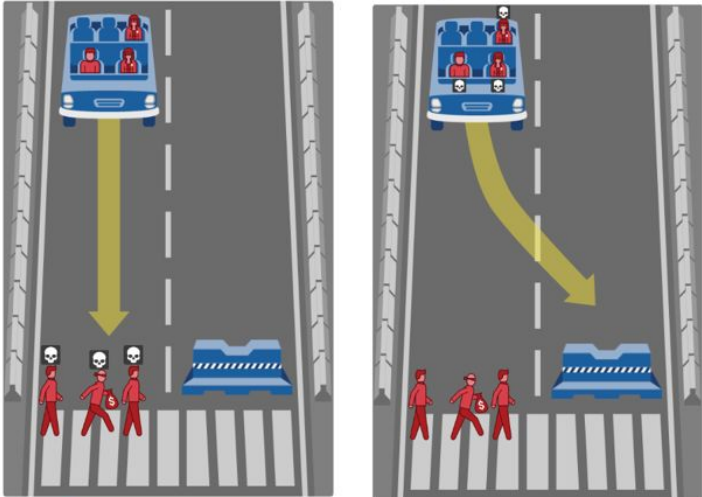
Dead:

- 2 men
- 1 criminal

In this case, the self-driving car with sudden brake failure will swerve and crash into a concrete barrier. This will result in ...

Dead:

- 2 female doctors
- 1 man



ACTIVITY SHEET C
SELF-DRIVING CARS

COURSE
MACHINE LEARNING SHORT
COURSE

What do you think are the most important factors for the self-driving cars decision making algorithms? E.g. the age or gender of the person

What would happen if these decisions were not pre-programmed?

Is it morally or ethically right to pre-program these decisions? Explain your answer.

What are the issues surrounding self-driving cars?

NAME

5 – Natural Language Processing

Watch this video [‘This Is The Algorithm That Lets Siri Understand Your Questions’](#) (2 mins, 27s)



5 – Natural language processing

For natural language processing to work well/be really effective, computer responses need to feel as human-like as possible.

Alan Turing, the founder of modern computing, proposed the **Turing test** in 1950 to determine whether or not a computer can think intelligently like a human. A computer would be considered intelligent if its conversation couldn't easily be distinguished from a human's.

The **Loebner Prize** is an annual competition in artificial intelligence that awards prizes to the computer programs considered by the judges to be the most human-like.



5 – Natural language processing

Activity - Test out a Chatbot

You are going to test out a chatbot to see how human-like it is in its conversation.

First, go to Activity D in your Student Workbook and write down three questions you think might trip up a chatbot. Try to think of questions that will help you decide whether it is a chatbot or a real person.

Once you have your questions, go to <http://www.cleverbot.com/> and try out the chatbot. In your Workbook:

- Note down anything silly or unusual that it says
- Would this chatbot pass the Turing test?

ACTIVITY D

NATURAL LANGUAGE PROCESSING

COURSE

MACHINE LEARNING SHORT COURSE

Write down your three questions for the chatbot

Did the chatbot say anything unusual or silly?

Would this chatbot pass the Turing test? Explain your answer.

What could be done to make the chatbot seem more human?

NAME

6 – Instagram's anti-bullying AI

Instagram's anti-bullying AI asks users: 'Are you sure you want to post this?'

Instagram said early tests found it encourages users to 'share something less hurtful once they have had a chance to reflect'



▲ The initiative comes after Instagram has come under fire for not doing enough to tackle online bullying.

6 – Instagram's anti-bullying AI



Instagram is inviting users to think again before posting unkind comments with a new tool designed to curb bullying on the social media platform.

The company is rolling out a new feature that uses machine learning to identify negative comments before they are published and asks “Are you sure you want to post this?” before it is shared on another person’s post. It does not stop people from making negative comments, but it gives them the opportunity to cancel the message before it is posted.

This feature uses **natural language processing** to interpret and classify the posts.

6 – Instagram's anti-bullying AI

You are going to build a prototype of this anti-bullying AI model using the **Machine Learning for Kids** online tool. This tool creates machine learning blocks and adds them to Scratch so you can include them in your code and build an AI model.

To get started go to:

<https://machinelearningforkids.co.uk/>

Click on *Get started* and select the *Try it now* option.

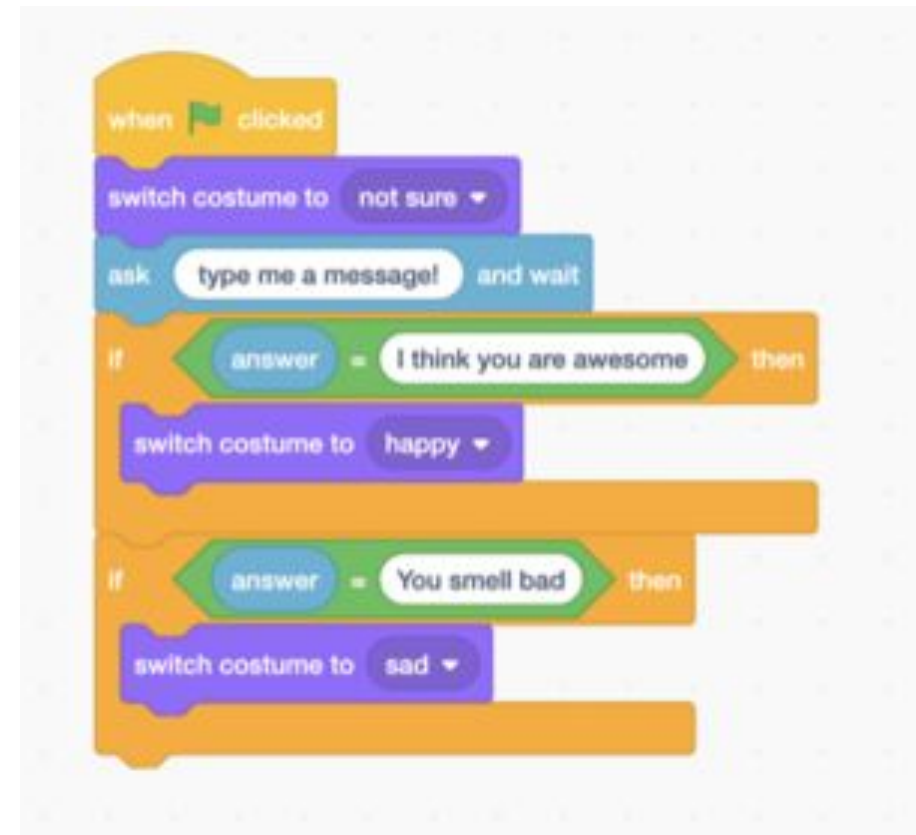


6 – Instagram's anti-bullying AI

If we were building this model using traditional programming in Scratch, we could use a series of **IF statements** to check the tone of each message before sending it.

We could then display a happy face if the message was kind and a sad face if the message was mean.

What would be the problem with this approach?



6 – Instagram's anti-bullying AI

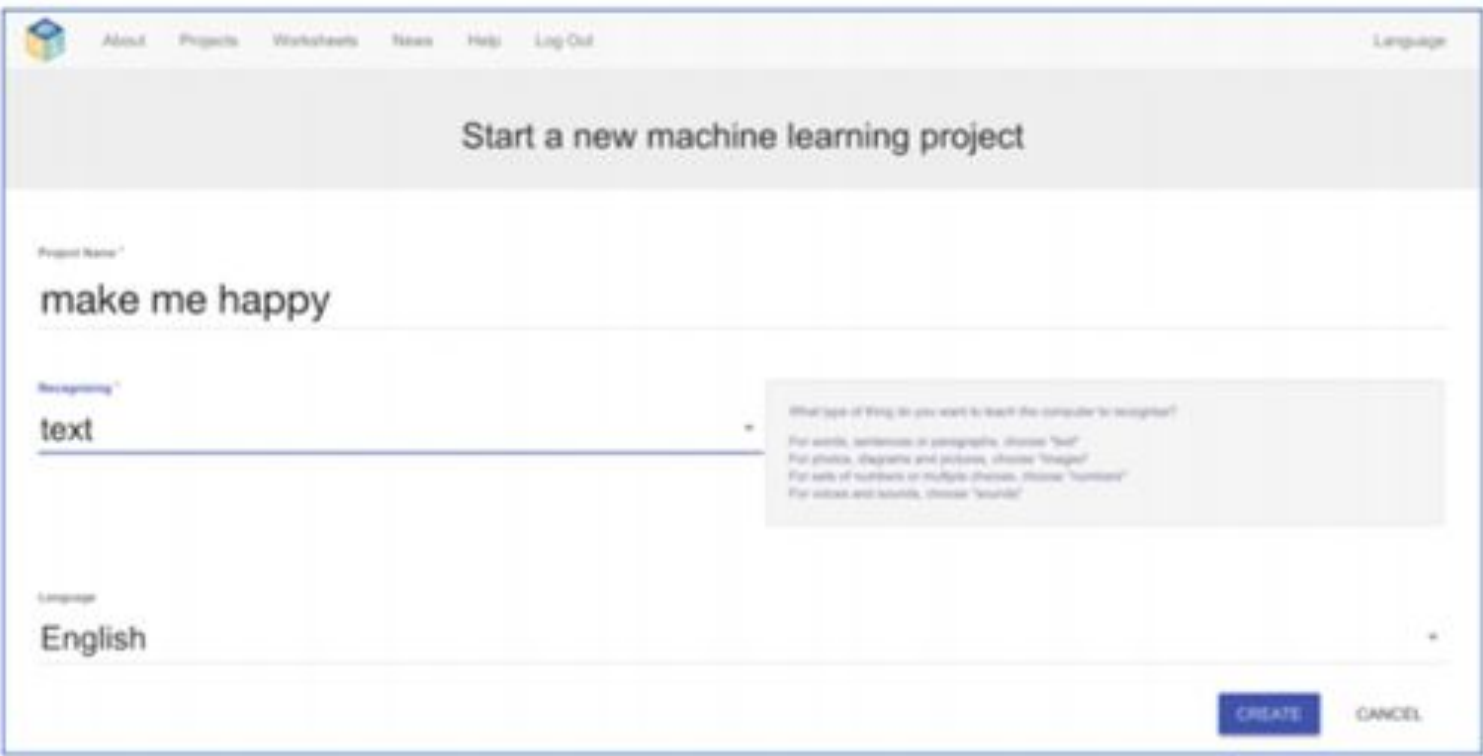
The problem with this approach is our Scratch model would need to have an IF statement for every possible message it might receive. This would be very time consuming to build and would probably still not cover all possible variations of text that people might type in.

Using machine learning, however, we can train a model by giving it lots of examples of kind and mean messages.

From this input, the model can learn to recognise whether a message **it has not seen before** is kind or mean.

6 – Instagram's anti-bullying AI

To get started building your model, click on *Add a new project*. Give the project the title 'Make me Happy' and set it to recognise text. Click on *Create* to set up your project.



The screenshot shows a web interface for creating a machine learning project. At the top, there is a navigation bar with links: About, Projects, Worksheets, News, Help, and Log Out. The main heading is "Start a new machine learning project". Below this, there are three input fields: "Project Name" with the text "make me happy", "Recognizing" with the text "text", and "Language" with the text "English". To the right of the "Recognizing" field, there is a tooltip box that says "What type of thing do you want to teach the computer to recognize?" and lists four options: "For words, sentences or paragraphs, choose 'text'", "For photos, diagrams and pictures, choose 'images'", "For sets of numbers or multiple choices, choose 'numbers'", and "For voices and sounds, choose 'sounds'". At the bottom right, there are two buttons: "CREATE" and "CANCEL".

6 – Instagram's anti-bullying AI

Click on the project's name to open it and select *Train*. Create two labels - 'Kind Things' and 'Mean Things' and add at least six examples (sentences or phrases) of each.

The screenshot shows the TensorFlow Playground web interface. At the top, there's a navigation bar with links: About, Projects, Worksheets, News, Help, and Log Out. A 'Language' dropdown is on the right. Below the navigation bar, the main heading reads 'Recognising **text** as **Kind_things or Mean_things**'. A '< Back to project' link is on the left. On the right, there's a '+ Add new label' button. The interface is divided into two main panels: 'Kind_things' on the left and 'Mean_things' on the right. Each panel has a list of example sentences in grey boxes. The 'Kind_things' panel contains: 'I like you', 'Your hair looks nice', 'I think you are great', 'You have a great smile', 'You are so clever', and 'I love your outfit'. The 'Mean_things' panel contains: 'You smell', 'I hate you', 'That's dumb', 'Your hair looks terrible', 'What an idiot', and 'Slimeball'. At the bottom of each panel is a '+ Add example' button. A green circle with the number '6' is located at the bottom right of each panel.

6 – Instagram's anti-bullying AI

Now, click on the:

1. < *Back to project* link
2. *Learn & Test* button
3. *Train new machine learning model* button
(it may take a while to train)

As long as you've collected enough examples, the computer should start to learn how to recognise messages from the examples you've given to it.

Once the training has completed, a *Test* box will be displayed. Try testing your model to see what the computer has learned. Test it with examples that you haven't shown the computer before. If you're not happy with how the computer recognises the messages, go back to *Train* and add some more examples.

6 – Instagram's anti-bullying AI

What have you done so far?

You've started to **train** a computer to recognise text as being kind or mean. Instead of trying to write rules to be able to do this, you have done this by collecting examples. These examples are being used to train a machine learning '**model**'. This is called '**supervised learning**' because of the way you are supervising the computer's training.

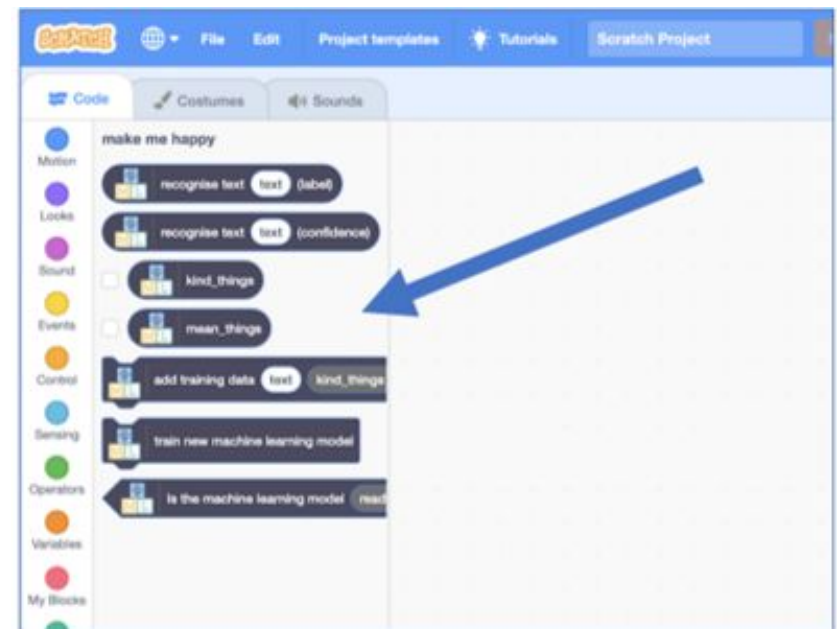
The computer will learn from patterns in the examples you've given it, such as the choice of words and the way sentences are structured. These will be used to recognise new messages.

6 – Instagram's anti-bullying AI

Click on the:

1. < *Back to project* link (at the top)
2. *Make* button
3. *Scratch 3* button

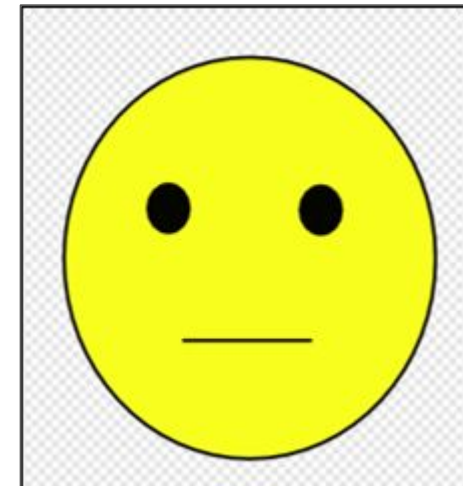
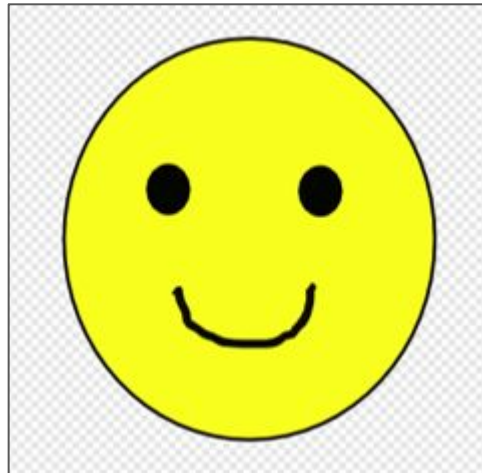
Read all the information about the Scratch blocks, then click the *Open in Scratch 3* button to launch the Scratch editor. You should see the new blocks from your project at the bottom of the code list in Scratch.



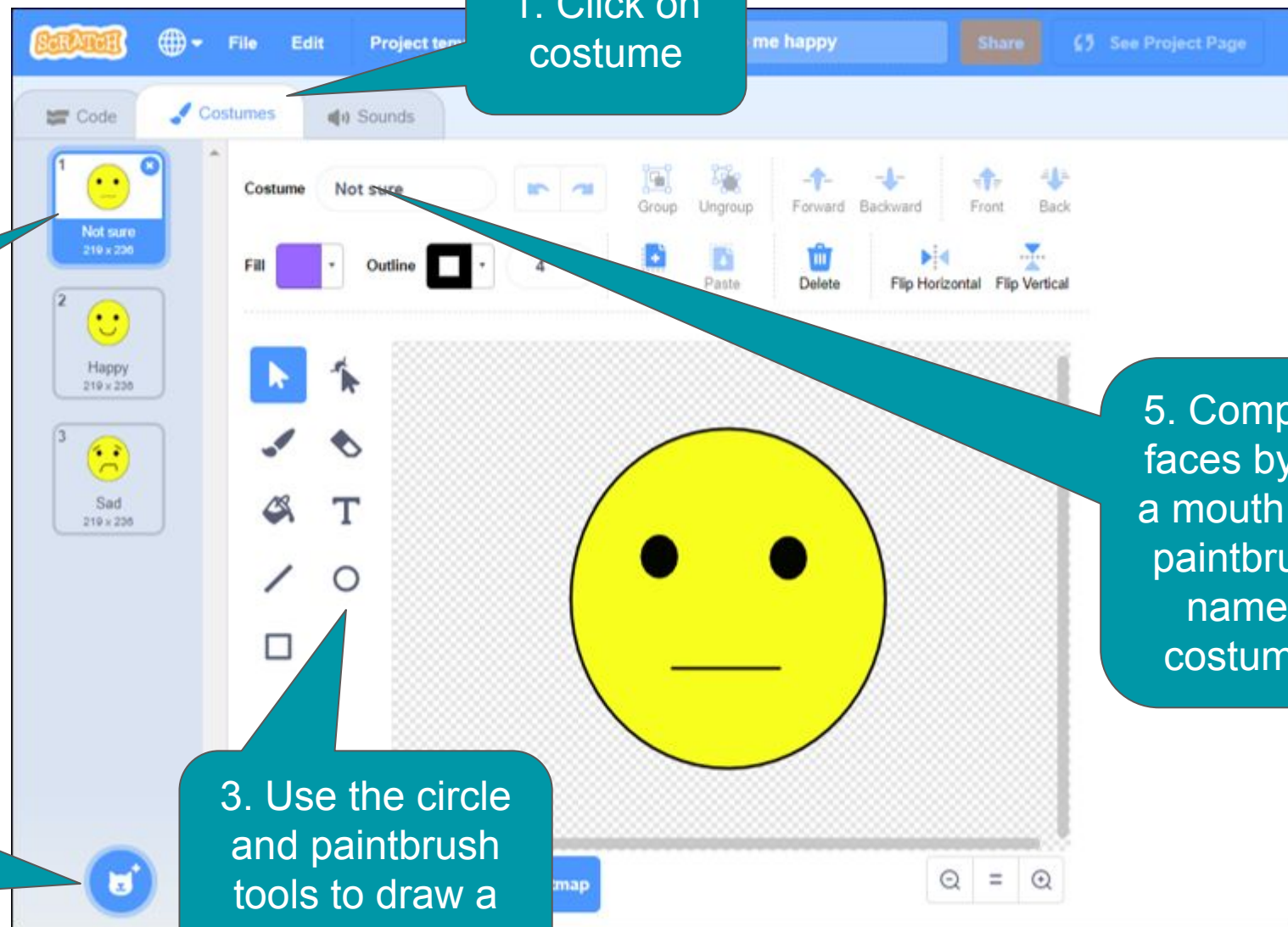
6 – Instagram's anti-bullying AI

Building your model in Scratch

Follow the instructions on the next page to create a sprite with three costumes: a happy face, a sad face and an unsure face.



6 – Instagram's anti-bullying AI



1. Click on costume

4. Right click here and duplicate two more faces

2. Click on the cat and select paint

3. Use the circle and paintbrush tools to draw a face and eyes

5. Complete the faces by adding a mouth with the paintbrush and name each costume here

6 – Instagram's anti-bullying AI

Click on the *Code* tab and create the script to use your machine learning model.

The **Scratch 3 Top Tips!** document will help you do this.

Click on the green flag to run your script.

When you enter your 'message', your model will return either 'kind things' or 'mean things' using the training you've given the computer. Based on this output, a happy face or a sad face will be displayed.



6 – Instagram's anti-bullying AI

It's time to test your model with examples that you haven't shown the computer before.

- If your original example for training was “What an idiot”, try testing the model with “You are an idiot” or “I think you are an idiot”.

Try your new message in Scratch and note down the result in Activity E in the workbook. Did the model correctly carry out your instructions? Why? Why not?

If you're not happy with how the computer recognises the instructions, add some more examples in ML4K. Make sure you run '*Train new model*' with the new examples though!

ACTIVITY SHEET E

TESTING AND IMPROVING YOUR MODEL

COURSE

MACHINE LEARNING SHORT COURSE

Test message	Outcome	Correct Y/N?

Try new instructions and note down the result. Did the model correctly carry out your instructions?
Why do you think your model did or didn't understand?

NAME

6 – Instagram's anti-bullying AI

Leave Scratch open, return to Machine Learning for Kids and go *< Back to Project*.

Open the *Learn & Test* page in the training tool. Type a message into the *Test* box that has nothing to do with kind or mean messages.

The confidence score should be very low. The computer is telling you that it's not certain it understands your command, because what you typed doesn't look like what it learned from your earlier examples.

Try putting in some text to see how it is recognised based on your training.

Recognised as **Mean_things**
with 14% confidence

6 – Instagram's anti-bullying AI

Use the **Scratch 3 Top Tips!** document to help you add the confidence score to your code.

1. Go back to Scratch and modify the script so that it uses this confidence score.



2. Try typing commands that have nothing to do with kind or mean messages. Check that your model reacts in the right way - a happy face if the message is kind and a sad face if it is mean.

6 – Instagram's anti-bullying AI



Ideas and extensions

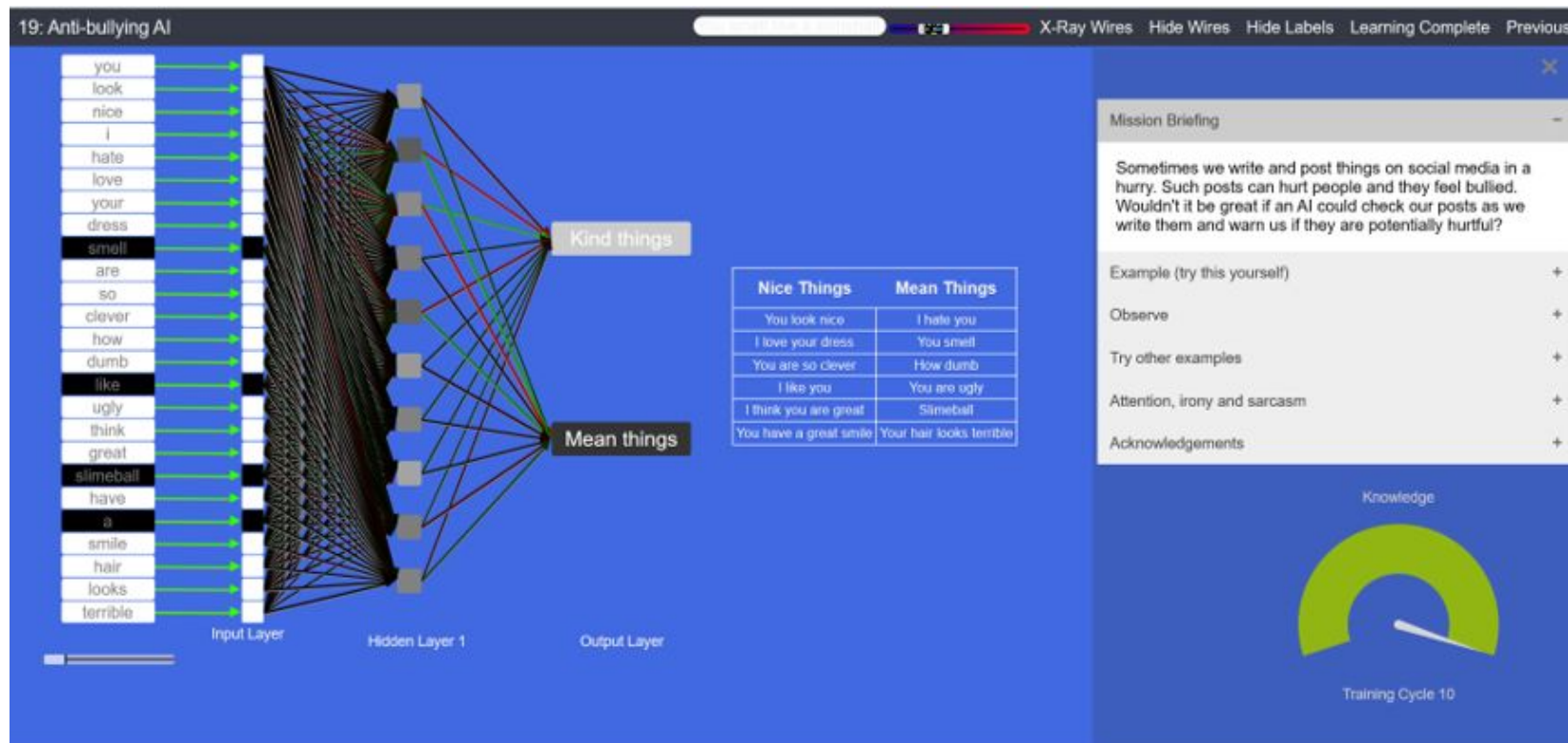
Instead of just kind and mean messages, can you add another category?

Is 75% the right threshold to use to decide whether the computer has recognised the command?

- Experiment with different values until you have a value that works well for your machine learning model.
- If you choose a number that is too high, the computer will say “Sorry I’m not sure what you mean” too often. If you choose a number that is too low, the computer will get too many decisions wrong.

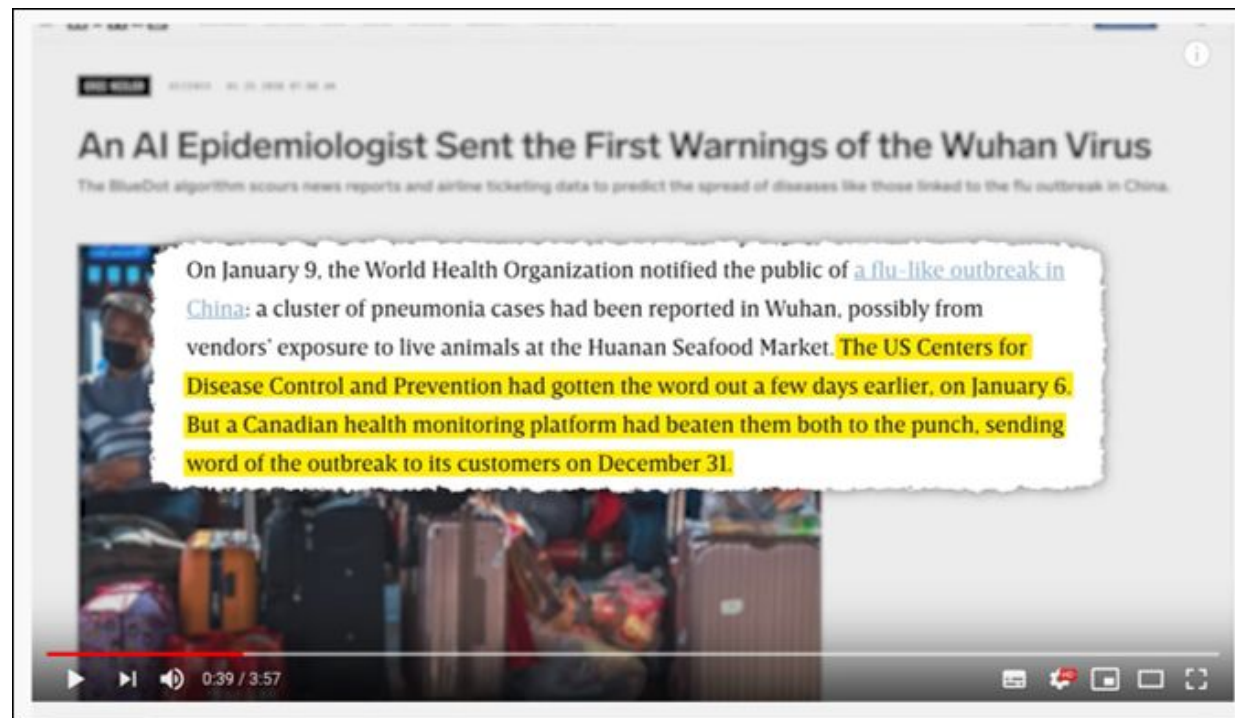
6 – Instagram's anti-bullying AI

This Digital Technologies Institute [experiment](#) shows how a neural network is trained to understand the difference between kind and mean comments. Work through the steps outlined on the right hand side of the webpage to explore how this works.



7 - Uses of machine learning

Now we've seen how machine learning models are trained and built, let's explore some ways they are being used to solve current problems in real-life. This [video](#) (3 mins, 57s) explains how machine learning is being used to track the Coronavirus pandemic and diagnose illnesses.



7 - Uses of machine learning

Problem

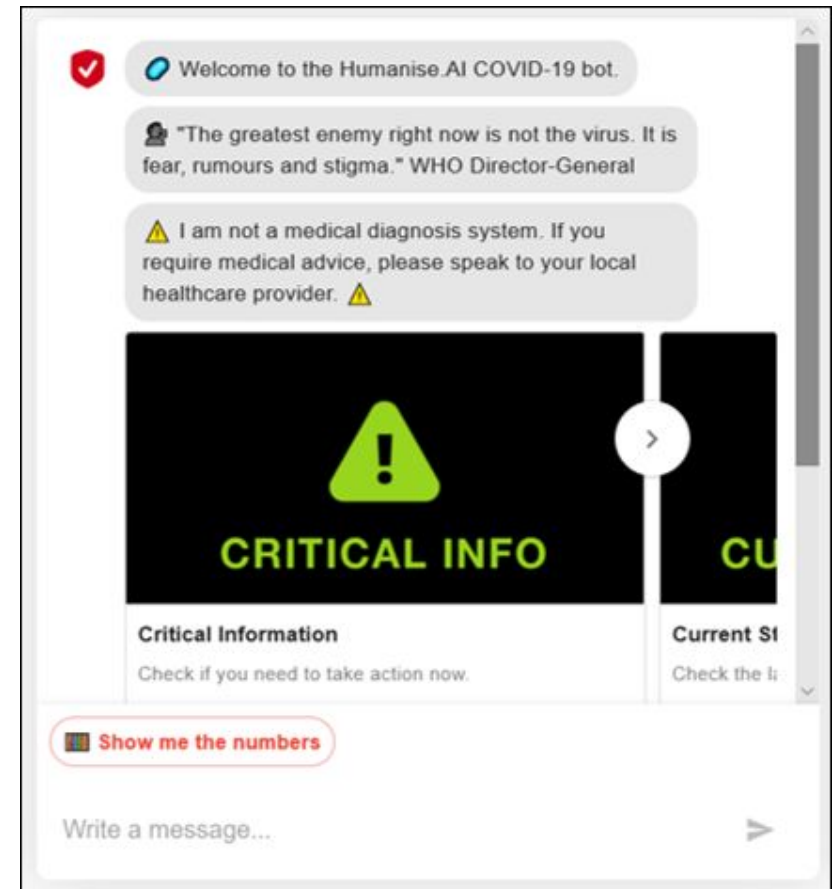
People have lots of questions about Coronavirus and don't know who to ask

Solution

This chatbot:

<http://covid19bot.com>

uses natural language processing to answer questions about the Coronavirus.



7 - Uses of machine learning

Problem

Many people suffering with dementia still keep a lot of their conversational abilities even as their illness gets worse. However, the shame and frustration that many dementia sufferers feel often makes it hard for them to have normal, everyday talks with even close family members.

Solution - Endurance

This chatbot is a virtual companion that can speak with senior people on general topics such as the weather and news. It can also monitor any deterioration in the person's condition.



7 - Uses of machine learning

Problem

Students find revision boring and struggle to concentrate.

Solution - Zoe (Zone of Open Education)

Zoe is a chatbot that talks to you about physics revision. This was the winning app in the Polish Apps for Good Awards. It helps you to revise faster, and in a more effective way for exams, but also acts as your friend.



8 – Spot possible problems

Activity

It's now time for you to identify problems that could be helped by machine learning. This might be a model that could tackle an issue related to the current pandemic situation. Alternatively, it might be something that could help your community more generally.

Activity F in your Student Workbook has some prompts to help you identify potential problems you might solve with your planned machine learning model.



ACTIVITY SHEET F
SPOT POSSIBLE PROBLEMS

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Think about issues that have been caused by the current coronavirus pandemic	Think through your average day – what frustrations or issues do you encounter?
Things that I would like to be different in my local community or my life	Things that I wish more people knew about or understood better

Use this sheet to jot down your ideas about possible problems.

NAME



9 - Explore your idea

Once you have decided on a problem to tackle, you need to make sure you fully understand what you are trying to solve. This will help you plan the right functionality for the model and make sure that there is a market for your model. Take some time to think through the problem you have identified and answer the following questions in Activity G in your workbook:

- Was there a time when this problem didn't exist?
- If so, what has changed?
- If not, how have people coped with the problem so far?
- Who is impacted most by this problem?
- What will happen if this problem is not solved?
- What will happen if it is solved?

ACTIVITY G
EXPLORE YOUR IDEA

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COURSE

Was there a time when this problem didn't exist? If so, what has changed? If not, how have people coped with the problem so far?

Who is impacted most by this problem?

What will happen if this problem is not solved?

What will happen if it is solved?

Think through the problem you have identified and answer these questions.

NAME

10 - Develop your idea

Next, it's time to start developing your ideas for how your machine learning model will work.

- Summarise the problem you are trying to solve
- Think about what your machine learning model will do and what data it will need
- Describe who will benefit from your model

Use Activity H in the workbook to make notes on your ideas.



ACTIVITY SHEET H
DEVELOP YOUR IDEA

COURSE
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COURSE

The problem I have identified	Who the problem affects
My proposed solution	Data I'm going to need

Use this sheet to jot down your ideas about possible problems.

NAME



11 - Design your model

What will your solution look like?

- Sketch out what your user interface will look like (e.g. the three faces used in 'Make me happy')
- If you are developing a chatbot, draft an example conversation between your user and the chatbot

Use Activity I in your workbook to make notes on your ideas.



ACTIVITY SHEET I
DEVELOP YOUR IDEAS

COURSE
MACHINE LEARNING SHORT
COURSE

Sketch of user interface

Example chatbot conversation

Use this page to sketch out your design ideas

NAME

12 - Explain your idea

The final task in your planning/prototyping is to explain your idea for a machine learning model to others. Think about all the different ways you could present your machine learning model design to potential investors. You could:

- Create a presentation or report detailing the problem and how you are going to use machine learning to tackle it
- Use an online tool such as [Powtoon](#) to create an animation to explain your ideas
- Create a video using your phone and an app such as [Splice](#) or [PowerDirector](#)
- Use a free online tool such as [Pixton](#) to create a comic strip

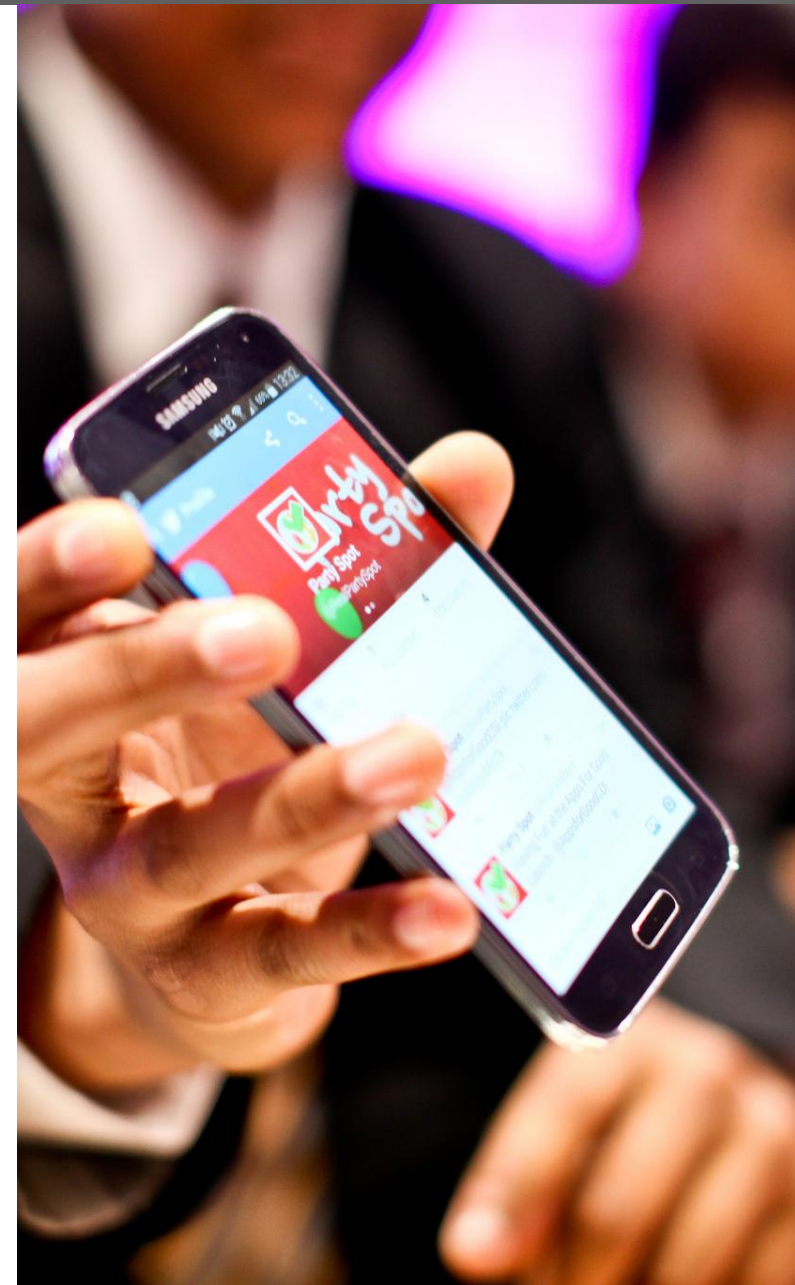
If you are entering our Awards a video or Powtoon would be the best options

Want to continue developing?

Ways to keep developing

Apps for Good can help you:

- Learn more about the application and ethical considerations concerning machine learning
- Develop your model using Machine Learning for Kids or program your solution using Python
- Explore problems that could be helped by image, voice or numerical based models
- Decide on your business model to monetise your idea



The Awards

The 2020 AfG competition – this year open to all students, UK and international, who take part in Apps for Good courses – gives students the chance to shine on a public stage.

The annual Apps for Good Awards recognise top apps, IoT devices and machine learning models created by students in our courses.

The closing date for this year's competition is **18 May 2020**. See the 'Preparing for the Awards' presentation for help completing the entry form.



Feedback

Please let us know what you think of this course.

Your feedback will be invaluable in making sure that we can adapt and improve our courses to help you continue your studies at home.

https://docs.google.com/forms/d/e/1FAIpQLSf2iv4FcyQWJU5JeQHca_UgXIP7G3RyKUGmD8uLBHCA56gLw/viewform



WELL DONE

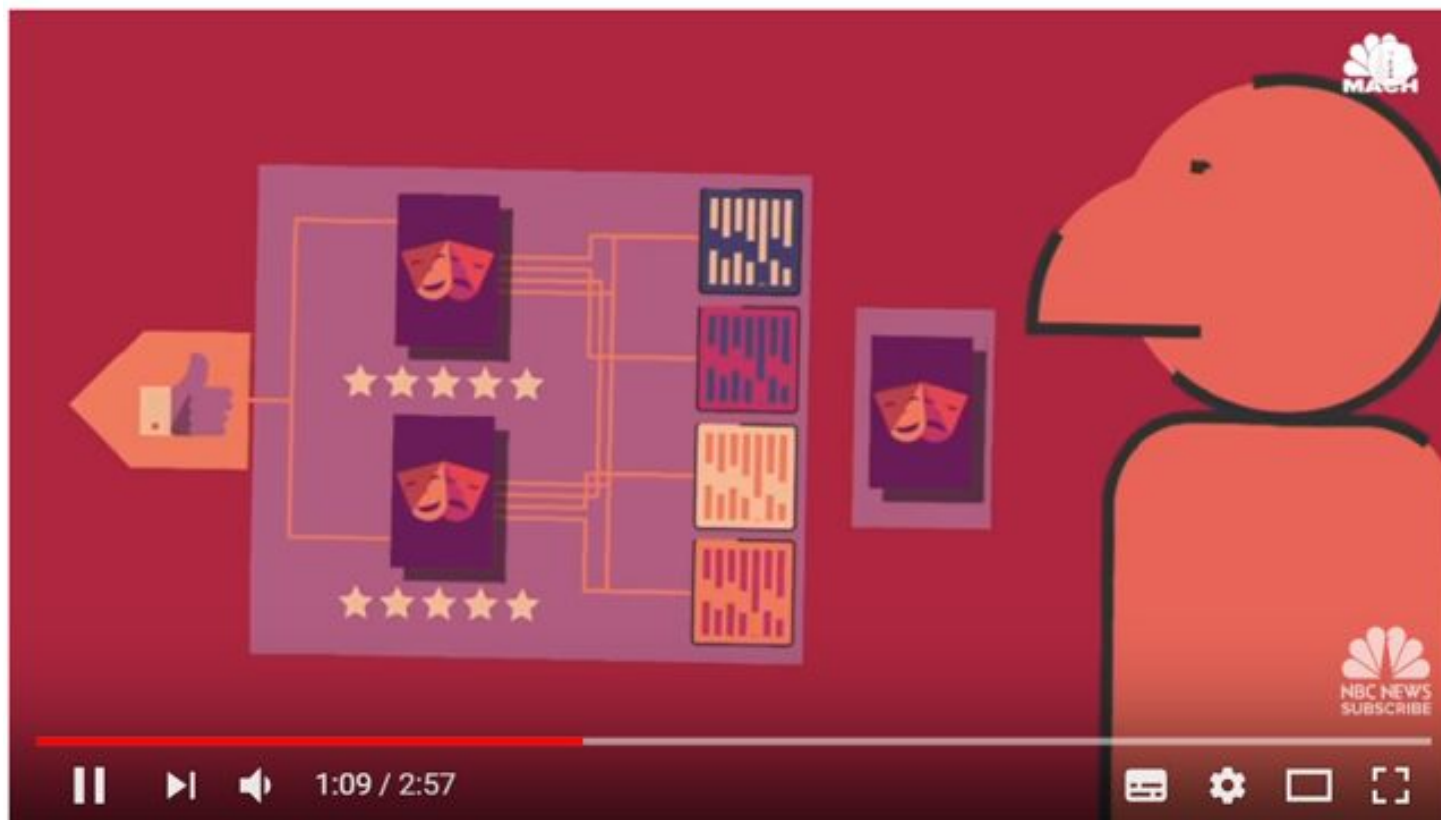


YAY!

**COURSE
COMPLETE**

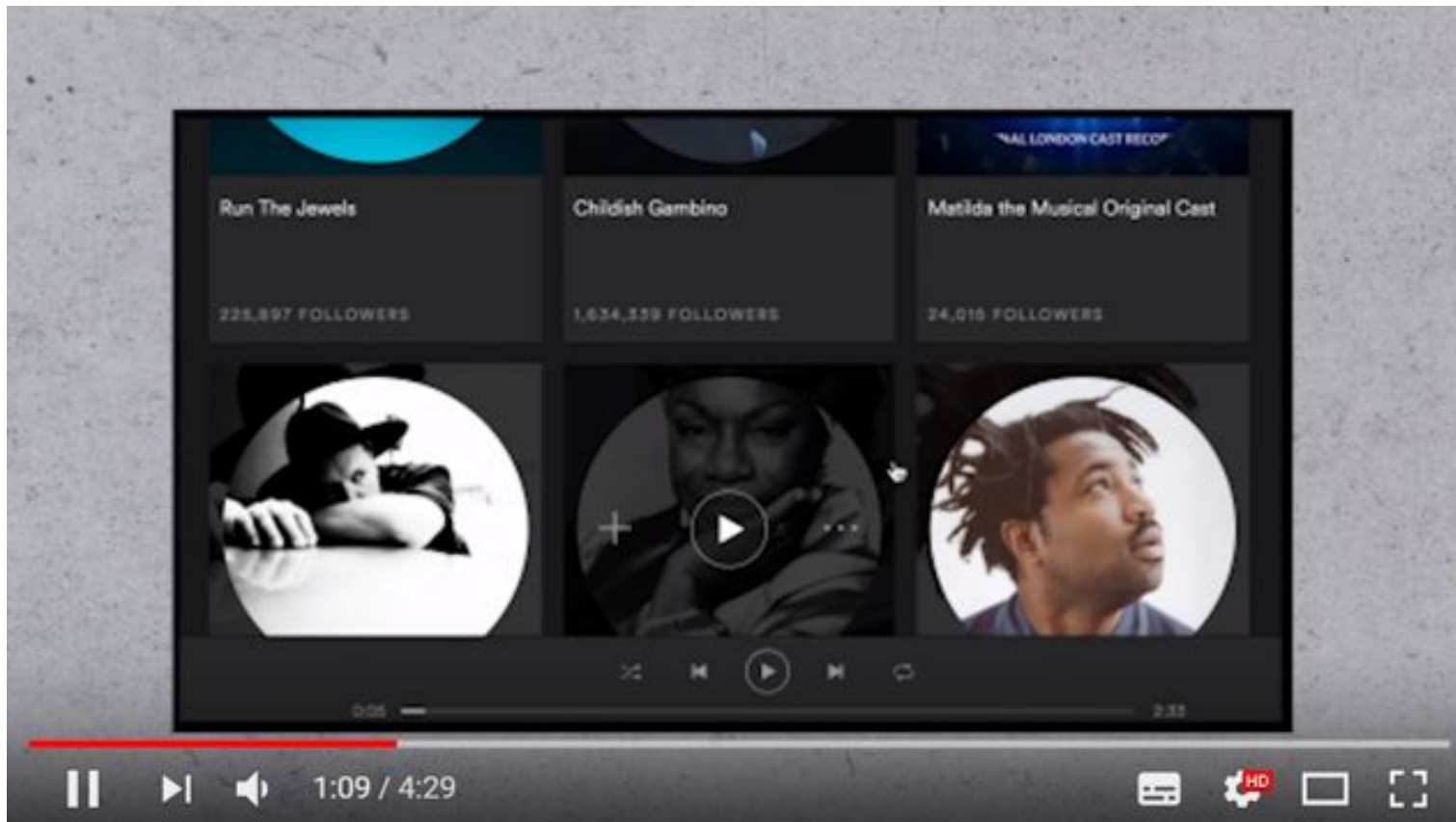
Optional activity – Recommendation systems

Watch this video [Why Netflix's Algorithm Is So Binge-Worthy](#) (2 mins, 57s). How does Netflix produce recommendations?



Optional activity - Recommendation systems

Watch this video [The Science Behind Spotify's Discover Weekly](#) (4 mins 29s). How does Spotify produce Discovery Weekly?



OPTIONAL ACTIVITY
RECOMMENDATION SYSTEMS

COURSE
MACHINE LEARNING SHORT
COURSE

How does Netflix produce recommendations?

How does Spotify produce Discover Weekly?

Can you think of any other machine learning recommendation systems?

Can you think of any drawbacks of recommendation systems?

How well do you think Spotify/Netflix or other recommendation systems know you? Why is this?

NAME

Using these materials



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