Curriculum Guide
Coding Robots

Course Overview

This course immerses students in the world of robotics, leveraging the Finch robot to explore programming, sensors, and robot behavior. Students will learn about robotics through engaging in immersive activities like learning to drive the Finch, creating art, playing music, and developing mini-games, culminating in a final project that integrates various skills learned throughout the course. The course emphasizes development of coding skills in Python, hands-on learning, creativity, problem-solving, and shows them real-world applications of concepts that they've learned in a prior introductory CS class.

Target Learner

The target learner is a middle school student (7th-8th grade) or high school student (9th grade) who has already completed Kira's Middle School Introduction to Computational Thinking and Programming, or the equivalent.

Duration

30 hrs over ~9 weeks

Learning Targets

By the end of this course, students will understand:

- Demonstrate and apply fundamental concepts of robotics, including sensors and input/output mechanisms.
- Use Python to program the Finch robot to perform basic and advanced operations.
- Develop computational thinking and problem-solving skills through interactive projects using the Finch robot.
- Articulate the history and impact of robotics on society.

Course Structure and Delivery

Modes of Instruction and Evaluation

The course consists of instructional videos, online and offline activities, practice questions, formative and summative assessments, and projects.

Course Division

The course is divided into 4 **units**, each consisting of several **lessons**. Each lesson consists of steps.

Each step consists of an instructional video as well as a practice activity for the student. Each step is designed to take no longer than 8-10 minutes to complete and each lesson is designed to take no more than 60 minutes to complete.

Additionally, there are **projects** after some units, which allow students to build an application tying together concepts they have learned so far. Projects emphasize creativity and are based on applications of artificial intelligence. Projects are designed to be thoroughly scaffolded yet open-ended, providing structure for beginner students and inspiration for advanced students.

Assessments and Projects

Every lesson concludes with a lesson assessment, and many units conclude with a project.

Course Outline

Unit 1: Introduction to Robotics and the Finch	Lesson 1: Introduction to the History of Robotics
	Lesson 2: Robots Today
	Lesson 3: Overview of the Finch Robot
	Lesson 4: Basic Movement Commands: Forwards and Backwards
Unit 1 Assessment	
Unit 2: Sensors and Input/Output With the Finch	Lesson 1: Introduction to Sensors
	Lesson 2: Buttons and LEDs
	Lesson 3: Sensor Data Collection
Project: Combining Inputs and Outputs	
Unit 2 Assessment	
Unit 3: Get Creative With Finch	Lesson 1: Drawing With Finch
	Lesson 2: Musical Finches
	Lesson 3: Dance, Finch!
Project: Combining Art and Music	
Unit 3 Assessment	
Unit 4: Advanced Robotics Concepts	Lesson 1: Line-Following Basics
	Lesson 2: Accelerometers
	Lesson 3: Sensor Integration
Project: Obstacle Course	
Unit 4 Assessment	

Standards Coverage

This course aligns to the CSTA Standards

Unit 1: Introduction to Robotics and the Finch

In this unit, students will explore key milestones in the history of robotics and gain hands-on experience with the Finch robot. They will learn how to set up and operate the Finch, using high-level commands like `move()` and `turn()` to program basic movements such as moving forwards, backwards, and pivoting. Students will also practice using the emulator environment to test and refine their movement commands, building foundational programming skills.

Learning Targets

Students will be able to:

- Describe key milestones in the history of robotics.
- Set up and operate the Finch robot.
- Learn how to use the emulator environment for the Finch robot in the Kira coding environment to test movement commands.
- Program the Finch to move forwards and backwards using high-level move() commands
- Program the Finch to turn and pivot using high-level turn() commands.

Unit 2: Sensors and Input/Output With the Finch

Students will dive into input and output programming by utilizing the Finch robot's buttons and LEDs. They will learn how to collect data from button inputs and program responses, such as creating unique visual outputs using the robot's LEDs. By linking inputs to outputs with conditionals, students will develop interactive programs, such as triggering visual messages when specific buttons are pressed, furthering their understanding of decision-making in robotics.

Learning Targets

Students will be able to:

- Use the Finch's buttons to collect data.
- Program the Finch to respond to button inputs.
- Program the Finch's LEDs to create unique visual outputs.
- Link inputs with outputs to apply conditionals (eg. if press button 1 LEDs spell "F-I-N-C-H")

Unit 3: Get Creative With Finch

This unit encourages students to unleash their creativity by programming the Finch to draw shapes, create patterns, and play simple tunes. Through the use of loops, students will choreograph Finch movements and repeat melodies, combining music, movement, and visual outputs to design entertaining robotic performances. By integrating multiple functionalities, students will develop more sophisticated and imaginative programs.

Learning Targets

Students will be able to:

- Program the Finch to draw shapes and patterns in the emulator environment.
- Create and play simple tunes using the Finch, applying loops to repeat melodies.
- Choreograph Finch movements.
- Combine multiple Finch abilities such as playing music with simultaneous movements.

Unit 4: Advanced Robotics Concepts

Students will explore advanced robotics concepts by working with line sensors and accelerometers to program the Finch for more complex behaviors. They will learn how to make the Finch follow lines, avoid obstacles, and react to accelerometer data, such as adjusting speed or displaying messages based on movement. By integrating multiple sensors, students will create programs that demonstrate dynamic and responsive robotic behaviors.

Learning Targets

Students will be able to:

- Articulate the use of line sensors.
- Program the Finch to follow a line and avoid obstacles.
- Explain the use of an accelerometer and how accelerometer data can be used in their programs.
- Integrate multiple sensors to achieve complex behaviors (e.g. if the accelerometer records speed above xx 1 LEDs spell “S-P-E-E-D” and Finch slows down).

Projects Overview

The projects are intended to enable students to create relevant and interesting applications by combining concepts they have learned so far in the course. They are designed to give students the opportunity to work with larger codebases in a collaborative way that will be similar to what they may have to work with in a real-world industry environment.

Mini Project 1: Picasso Finch

- Students will create an art piece using the Finch robot by programming it to draw shapes and patterns on paper.

Mini Project 2: Finch Talent Show

- Students will program the Finch to play a simple tune and choreograph its movements to the music.

Mini Project 3: Drive Safe, Finch!

- Students will create an obstacle course that mimics roads with stop lights, pedestrians, streets, and other cars on the road.
- Students will program the Finch to navigate through their obstacle course using its sensors safely (stopping at lights, avoiding obstacles).