MACHINE LEARNING

*Developed for GIRLsmarts4tech in partnership with Athena Pathways*

<https://www.cs.ubc.ca/girlsmarts4tech/>

<https://athenapathways.org/>

# OVERVIEW

# In this lesson, participants will learn about the basics of machine learning. In particular, participants will learn what a machine learning model is, what a dataset is, and how machine learning models are trained on a dataset. This lesson plan is accompanied by a PowerPoint presentation with speaker notes. There are two activities detailed in the lesson plan and PowerPoint, both of which are hosted online and can be found at the links provided.

# LEARNING GOALS

* Understand what machine learning is
* Understand what a data set is
* Understand that machine learning models are trained on a dataset to accomplish tasks including making classifications
* Consider the implications of bias in machine learning

# OVERLAP WITH BC CURRICULUM

1. Computational Thinking
2. Algorithms
3. Impacts of Computers and Technology on Society

# TECHNICAL REQUIREMENTS

1. The instructor should have access to a computer and projector to show the powerpoint presentation.
2. Each student or small group of students should have access to a computer or device capable of running the Quick Draw and Teachable Machine activities.

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# FACILITATOR INSTRUCTIONS

* The instructor should read through the activities and preview the powerpoint to familiarize themselves with the content and key terms.
* The instructor should familiarize themselves with the websites used for the activities:
  + Activity 1: Quick Draw (https://quickdraw.withgoogle.com/)
  + Activity 2: Teachable Machine (https://teachablemachine.withgoogle.com/)

# INTRODUCTION: POWERPOINT

Start the lesson by presenting slides 1-4 of the powerpoint. Students will learn what a machine learning model is and how it is trained on a data set to identify things.

# ACTIVITY 1: QUICK DRAW

## OVERVIEW

In this activity, participants will play a game that uses machine learning to guess what they are drawing. After playing the game, participants will get to see an example of the data set used to train this particular machine learning model to identify drawings.

LINK

[Quick, Draw! with Google](https://quickdraw.withgoogle.com/)

REQUIRED MATERIALS (per student)

* Computer or device capable of running the Quick Draw game

## POWERPOINT

This activity is related to slides 4-8.

Slide 4:introduce the activity, discuss the questions in the speaker notes

Slide 5: briefly explain the steps of the activity. The activity itself will guide students through these steps as well.

Slide 6-8:these slides use an example to explain how Quick, Draw! works and more generally how a neural network machine learning model works.

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## ACTIVITY STEPS

Quick, Draw! provides instructions throughout the activity. The steps are as follows:

1. Go to Quick Draw (link)
2. Follow the steps provided:
   1. Quick Draw will give you a prompt.
   2. You have 20 seconds to draw the prompt.
   3. As you are drawing, a machine learning model will analyze your drawing and try to identify it.
   4. You will be given a set of 6 prompts, and then shown the model’s results and the dataset it used to identify your drawings.
   5. After completing your prompts, all six of your drawings will be displayed on screen. You may click on the drawings to learn more about how the machine classified it and what data it used.

# ACTIVITY 2: TEACHABLE MACHINE

## OVERVIEW

In this activity, participants will build their own machine learning model and will put into practice the steps outlined in the previous slides.

## REQUIRED MATERIALS (per student)

* Computer or device capable of running the Teachable Machine. The device should have either a web camera and/or a microphone.

## POWERPOINT

This activity is related to slides 14-15.

Slide 14:briefly explain the steps of the activity. The activity itself will guide students through these steps as well.

Slide 15:discuss the results of the activity. Prompts are provided on the slide and in the speaker notes.

## ACTIVITY STEPS

1. Direct students to go to <https://teachablemachine.withgoogle.com/> .
2. Click on the “Get Started” button.
3. There are three types of projects each student can choose from. The type of project corresponds to what type of data they will be inputting to train their models. Get each student to select one of the three project types (image, audio, pose) to try.
4. For the purposes of this exercise, the students will create two “classes” or types of data. Ask the students to decide on two objects, sounds, or poses that they want their model to be able to classify. Some examples are:

* Image: Classify cats and dogs
* Audio: Classify the sounds of a yawn and a sneeze
* Pose: Classify two different yoga poses

1. Once the students have decided on two classes, they can start generating their data for each. Teachable Machine offers two options for data generation. Students can either upload files, or photograph/record their own data.
2. Once training data has been generated, click the “Train Model” button. The model may take some time to complete training.
3. After the model has been trained, a “Preview” window will open up. Students can test how well their machine learning model works by inputting data (different than the data used to train the model in steps 5 & 6) and checking the model’s prediction on what class it belongs to in the “Output” section.
4. At this point, students can iterate and experiment with their machine learning models to see how changing different parameters will affect the model’s performance. Encourage students to change the type and amount of training data they give their model, and then retrain it and test it. Some questions to encourage the students to explore are:

* How does the accuracy of the model change when you give it more training data for one of the classes than the other?
  + Possible response: The model will be better at classifying objects from the class with more training data.
* What happens when you test your model on something that doesn’t belong to either of the classes you trained it on?
  + Possible response: It will output inaccurate predictions.
* What happens when you test your model on an object that **does** belong to one of your classes, but wasn’t included in the training data set? (For example, if your two image classes are 1) pictures mugs and 2) pictures of water glasses, how does the model respond to seeing a travel mug if it is only been trained on ceramic mugs?)
  + Possible response: It’s prediction will not be as confident or accurate.
* As a follow-up question, how could we make the model more resilient and able to classify objects it hasn’t exactly seen before?
  + Possible response: Include more variety in the training data.

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# BIAS IN MACHINE LEARNING

The last few slides of the powerpoint focus on bias in machine learning/AI. There are discussion prompts included in the speaker notes, but the depth and breadth of the discussion should be according to the instructor’s discretion. The following list contains resources regarding bias in machine learning and AI and may help to facilitate a class discussion.

* [7 Types of Data Bias in Machine Learning](https://lionbridge.ai/articles/7-types-of-data-bias-in-machine-learning/#:~:text=Data%20bias%20in%20machine%20learning%20is%20a%20type%20of%20error,accuracy%20levels%2C%20and%20analytical%20errors.)
* [Racial Bias in Machine Learning and Artificial Intelligence](https://www.credera.com/insights/racial-bias-in-machine-learning-and-artificial-intelligence/)
* [Millions of black people affected by racial bias in health-care algorithms](https://www.nature.com/articles/d41586-019-03228-6)
* [Dealing With Bias in Artificial Intelligence](https://www.nytimes.com/2019/11/19/technology/artificial-intelligence-bias.html)
* [Understanding Racial Bias in Machine Learning Algorithms](https://medium.com/better-programming/understanding-racial-bias-in-machine-learning-algorithms-1c5afe76f8b)
* [Joy Buolamwini: How I'm fighting bias in algorithms | TED Talk](https://www.ted.com/talks/joy_buolamwini_how_i_m_fighting_bias_in_algorithms?language=en)

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# THANK YOU!