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Beginner Guide to Machine Learning with micro:bit

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Agenda

1. What is the Machine Learning Tool?
2. The Difference between ML & AI
3. Using the micro:bit Machine Learning tool
4. Reflection
5. Social Emotional Learning
6. Real-life Connections

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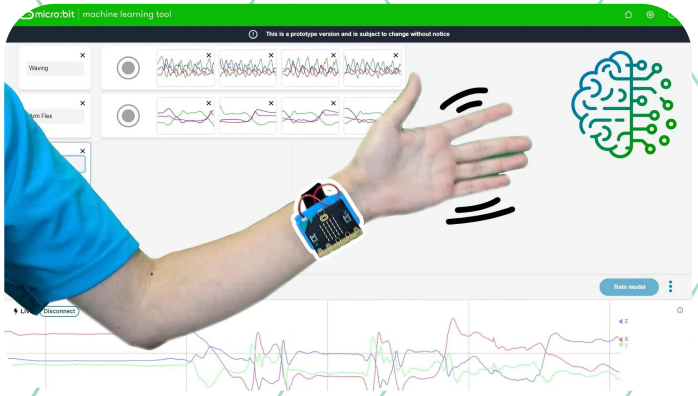
What is the Machine Learning Tool?

micro:bit Machine Learning Tool:

Train your micro:bit to recognize different movements and gestures.

By adding samples of physical actions, teach your micro:bit to understand those motions through a process called training.

Once the model is trained, test it in real time to see how well it identifies the different actions.



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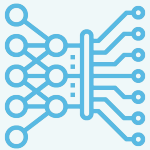
The Difference between **Machine Learning (ML) & Artificial Intelligence (AI)**

What's the difference?

It can sometimes feel like they're the same thing - but they're not!

Artificial Intelligence (AI)

- Broad field where computers are designed to do tasks that would normally require human intelligence
  - Recognising Images, Objects, Faces
  - Understanding and responding to language.



Machine Learning (ML)

- Part of AI - a computer learns to do specific tasks by finding patterns in data, rather than being told what to do step by step.
- Multi-step training and learning
  - Like how humans improve by practice.

Learning Goals

- Define **machine learning** and how it relates to **AI**
- Use the micro:bit Machine Learning Tool and 2 x micro:bits to add data samples for at least two unique gestures or actions
- Train the model on the data sets to recognize patterns or differences for various gestures or actions
- Test the model to see the accuracy of the Machine Learning Tool for the gestures that it has been trained on
- Add more or different data samples to increase the accuracy of the model
- Identify ways machine learning could be used in real-life situations

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Using the micro:bit Machine Learning Tool

To use the micro:bit Machine Learning Tool there are a few things we'll need to get started:

- Computer with access to the **micro:bit Machine Learning Tool**
- 2 x micro:bits
- 1 x USB cable
- 1 x CHARGE for micro:bit
  - Or another way to securely attach the micro:bit and battery pack to your wrist or ankle.

How it works

1

Add Data

Add samples of the gestures or actions you want the model to be able to recognize.

2

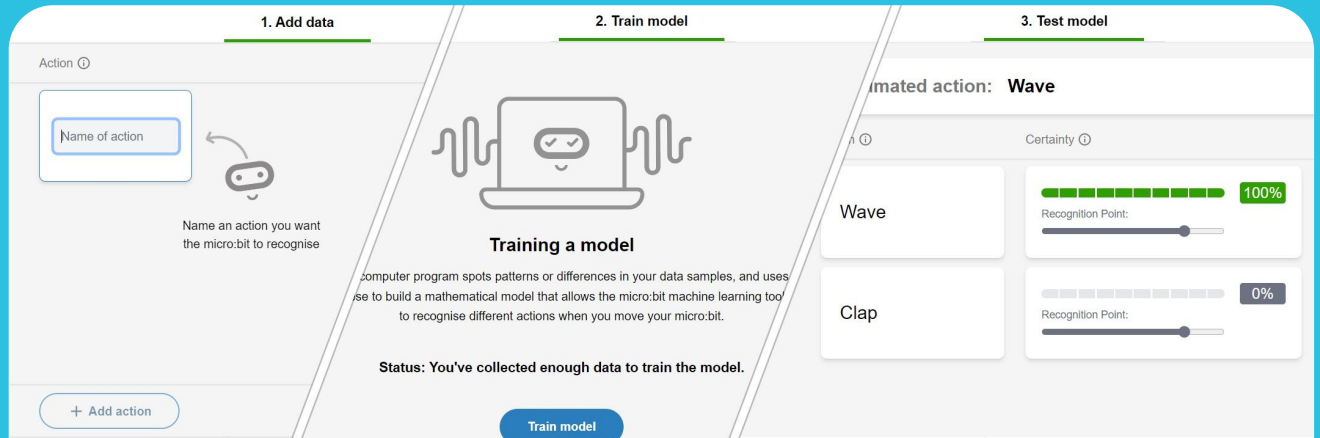
Train Model

Then ask the computer to use the samples to train the machine learning model to recognize different actions.

3

Test

Once trained, you'll be able to 'test' your model to see if it accurately recognizes the gestures or actions.



Preparation:

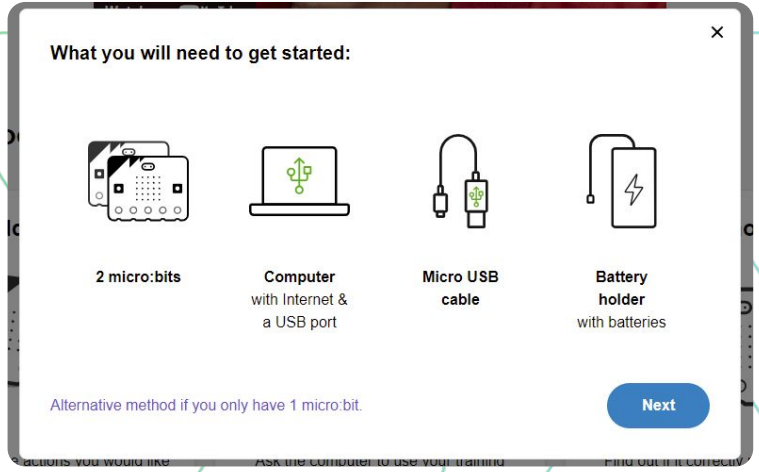
First, head over to the machine learning tool in a new window.

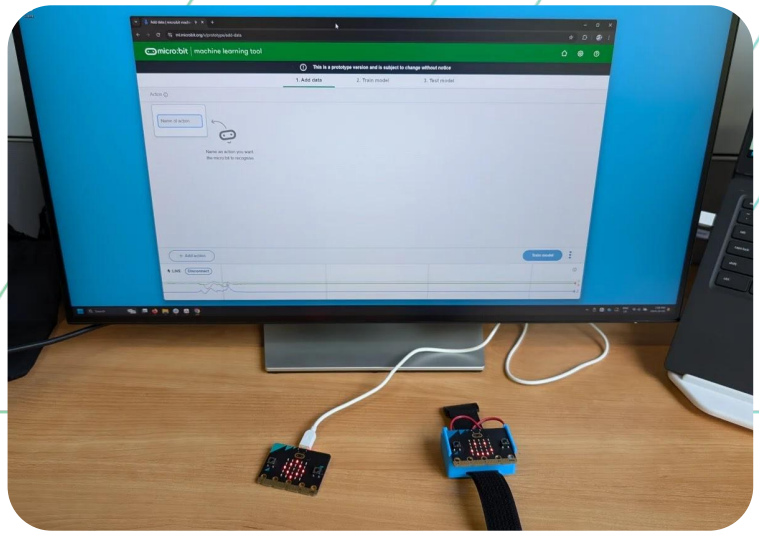
micro:bit machine learning tool

Click the button above or visit **ml.microbit.org/thenextgen**

Pair Your micro:bit

- Pair & download the code onto the first micro:bit
  - This will be the one you will gesture with.
  - Plug it into the CHARGE or wriststrap.
- Pair & download the second code onto the other micro:bit which will stay connected to the computer.

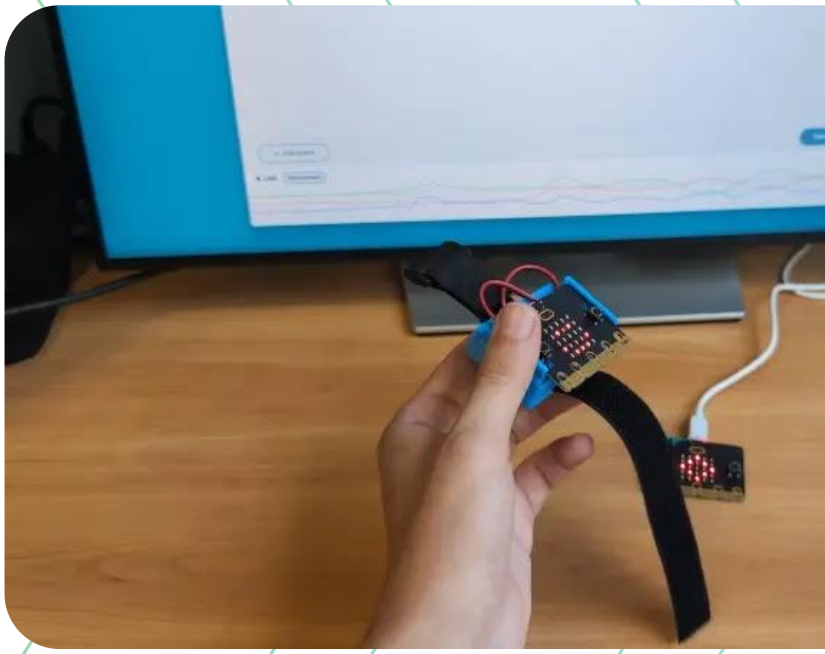




Test it works

You should see now that when you move the ‘gesture micro:bit’ that the lines on the graph move around.

This uses the accelerometer on the micro:bit to measure the acceleration (not position) in 3D space, along the X, Y, & Z axis.



Step 1: Add Data

Now decide what specific gestures or actions we want to be part of our model.

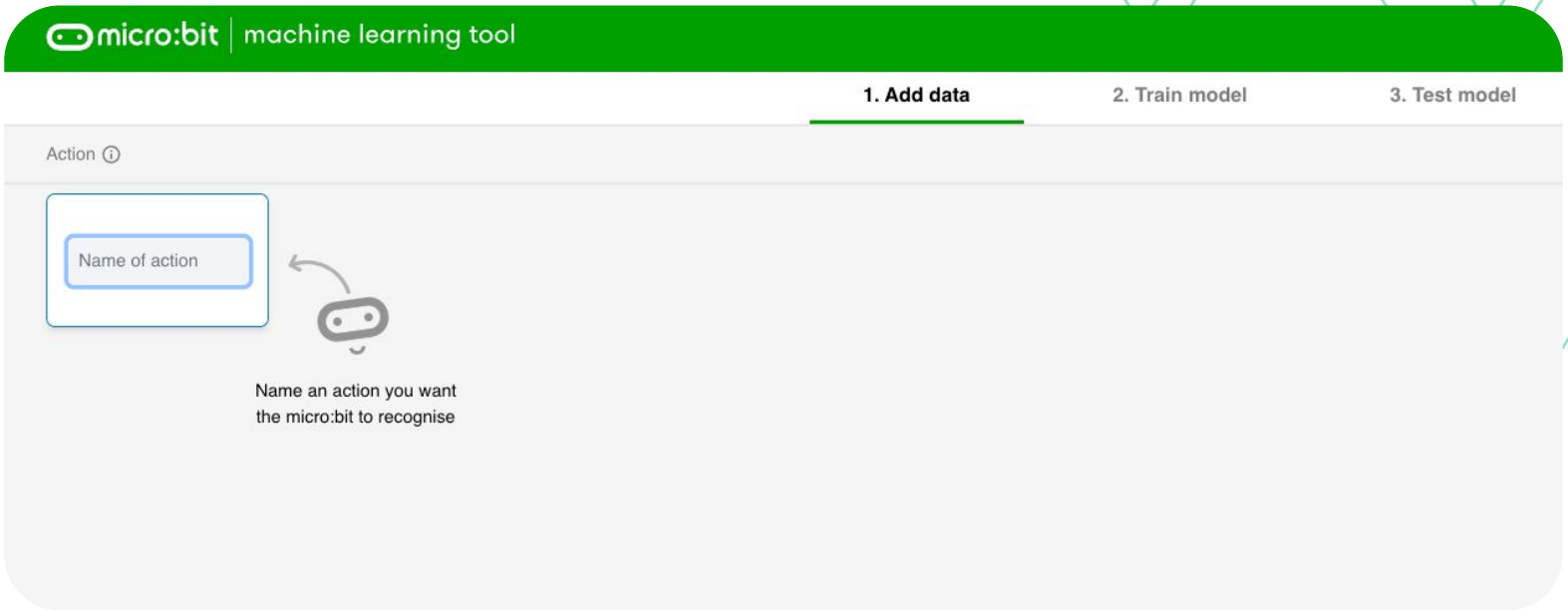
Choose gestures that are obvious enough for the micro:bit to detect. Small moves will be tricky to pick up. Also, you'll only have a few seconds to record the movement.

Some suggestions to consider:

- Rotation of the wrist
- Bending the elbow
- Saluting
- Waving

Step 1: Add Data

Once you've decided on your gestures, you're ready to add data for that gesture. Start by entering in the name of the gesture in the box.

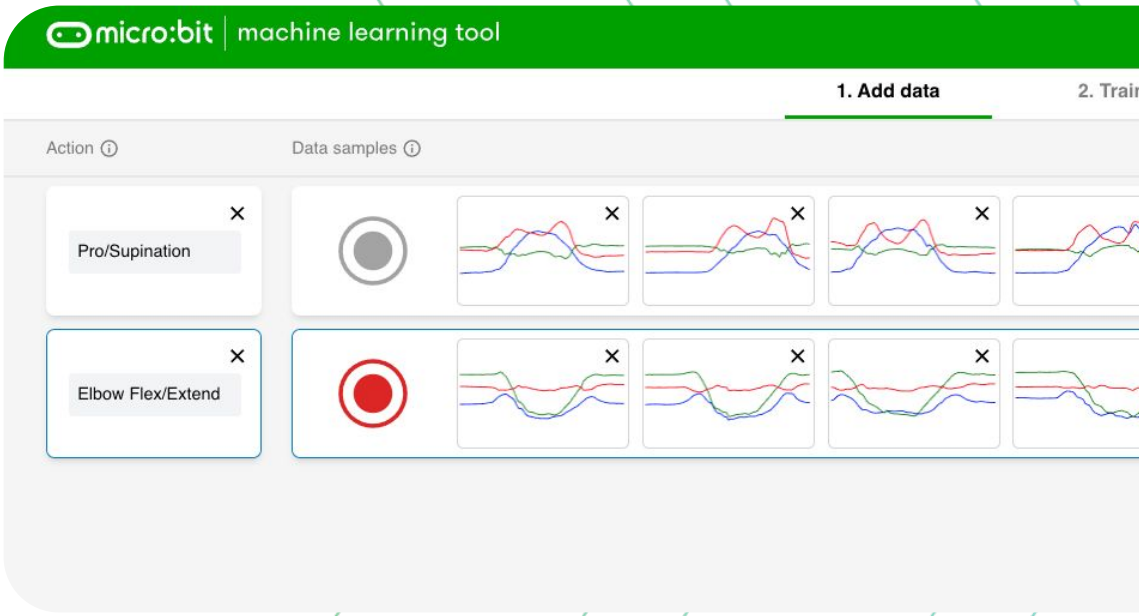


Step 1: Add Data

Securely attach the ‘gesture micro:bit’ to your wrist so it doesn’t move around and create inaccurate data samples.

When you’re ready, hit record, and after the countdown, perform your action.

Record 3-4 examples of the gesture, performing it the same way each time (i.e., the same starting and ending position).

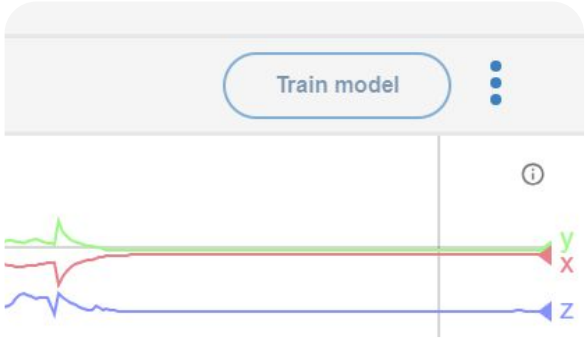


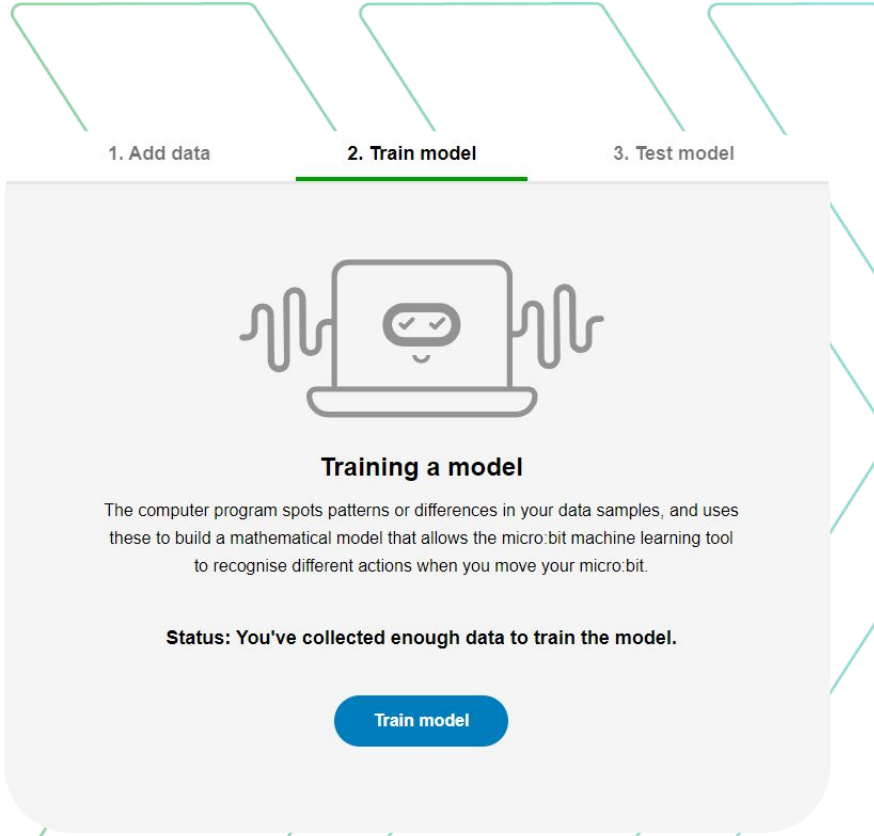
Click “+ Add Action” to add another data set for another type of gesture or action and repeat the same steps.

Step 2: Train Model

Click ‘Train Model’ in the bottom right corner.

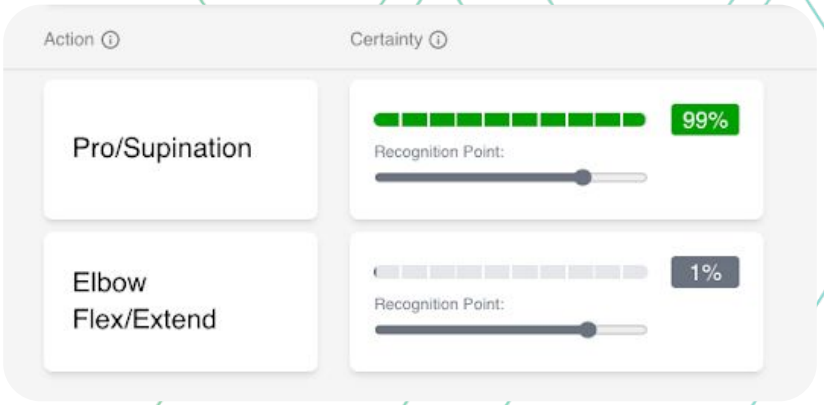
The computer program will now look at the data samples you’ve provided and analyze it for patterns or differences. It will use this data to build a mathematical model that allows the micro:bit Machine Learning Tool to recognise different actions when you move your micro:bit.





Step 3: Test Your Model

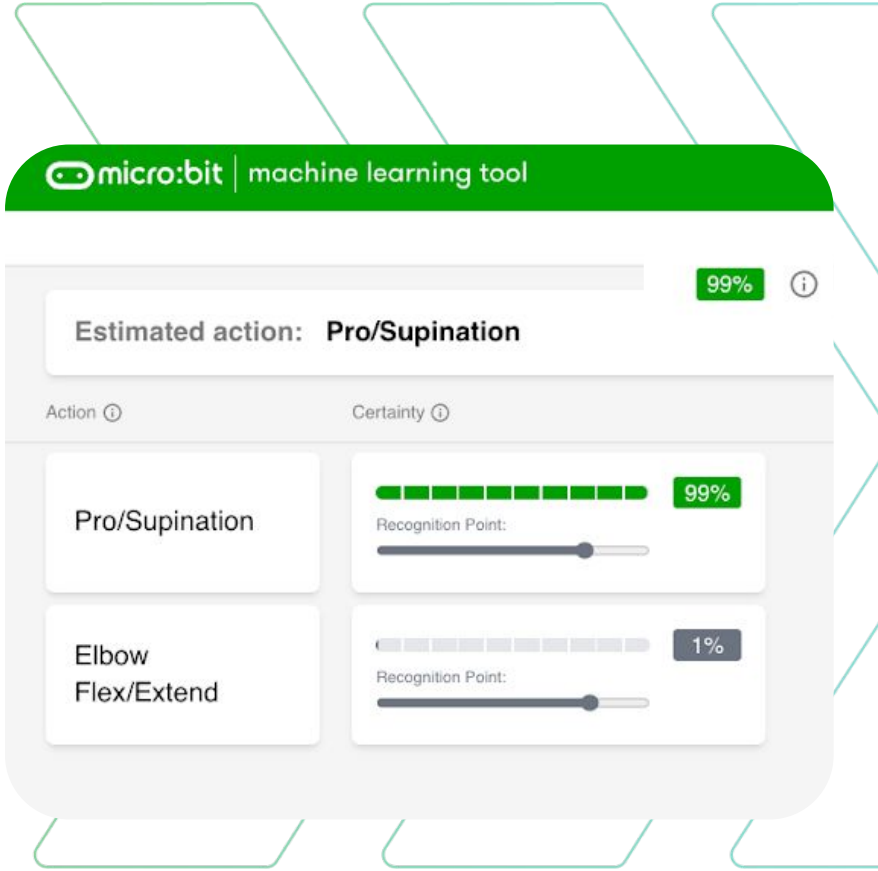
You'll see on this screen that here is a list of actions we trained our model on, as well as a scale from 0 to 100%. This scale represents how confident, or certain the model is about each action being performed. The higher the percentage, the more certain the model is that that particular action is happening on the 'gesture micro:bit'.



Step 3: Test Your Model

Above the scales is the model's prediction. Here, the program is going to indicate its best guess for which action is happening to the 'gesture micro:bit' based on the certainty percentages below.

Start performing your gestures to see if the model is able to identify your actions!



Step 4: Improve the Model

Not as accurate as you'd like? Add more data samples or try recording your samples again.

Discussing Machine Learning

It’s important to talk about how the data we use to teach a machine learning model can affect its accuracy and fairness.

Only one or two people providing gesture data tends to only recognize when *that* person is moving but may struggle to identify similar gestures made by others.

People move in different ways based on their size, strength, flexibility, or even habits.

Expand the Model

Let’s experiment by having multiple people record the same gesture! When you have a more diverse data set from different people, the model will be better at recognizing a wider range of gestures.

As you add more data, pay attention to how the graphs for the same gesture look slightly different person-to-person.

Reflection

- How did the accuracy of the model change as you added more data samples?
- What types of gestures performed best, and why do you think they worked better than others?
- What other gestures could you do if you attached the micro:bit to another part of your body, like your ankle?
- What was the most surprising or interesting thing you learned about machine learning through this activity?

Social Emotional Learning

How did you feel when the Machine Learning Tool didn’t work as expected?

What did you do to stay motivated and keep trying?

Real-Life Connections

- Can you think of other real-life examples where machine learning technology like this could be used? Why do you think machine learning would be valuable in these situations?
- In this activity, we used physical gestures or actions using the accelerometer in the micro:bit to train our model. What other types of inputs could we use to train a model?
    - Sound: Noises, voices, words
    - Visuals: Colours, Shapes, Light
- Think about the real-world applications of machine learning we've discussed. What would be some consequences of using limited or biased data samples in these situations?