Lesson 9

In The Wild!

Teaching A Robot To See

STEAM · 45 minutes · Beginner

Today you teach your robot to recognize things with a camera.

You will train it yourself, by showing it pictures.

By the end

Your mBot2 becomes a mouse that hunts for food and flees from an eagle!

What You Will Be Able To Do Today

1

Add Machine Learning into your mBot2 programs

2

Make several of mBot2's features work together at once

3

Set up communication between the robot and the computer

4

Keep the robot running its own program while the computer talks to it

Machine Learning Learns From Examples

- Machine Learning is a weak form of Artificial Intelligence
- Artificial Intelligence means machines that copy human intelligence
- Instead of being given rules, the computer learns from data and probability
- You never write out the exact steps for deciding
- It works out the pattern from the examples you provide

The big idea

Normal code follows the rules you write. Machine Learning finds its own pattern.

How Training Actually Works

- You provide training data: pictures plus what each one shows
- The learning phase tries to tell the pictures apart and match each to the right category
- Then the learning is tested against new pictures and reinforced
- A normal sorting program needs a clear rule, like checking a color
- By learning from past data, the program adapts to changing situations

You know this

Face unlock is fuzzy at first, then gets better as it learns your face.

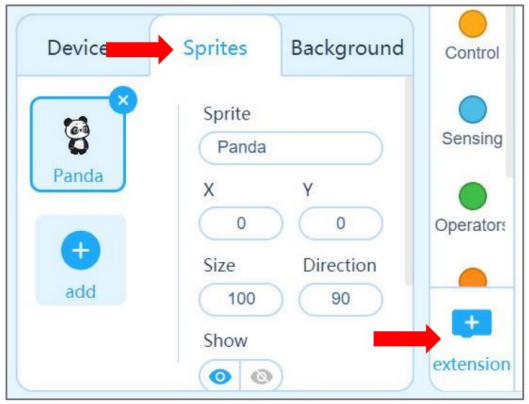
Weak AI Does Not Actually Think

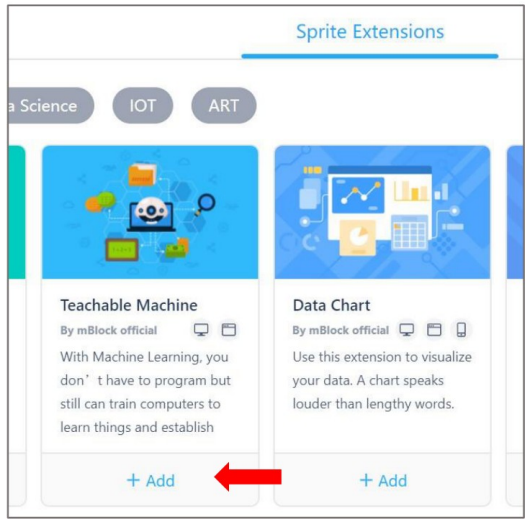
- Machine Learning is called “weak Artificial Intelligence”
- The program is not aware of itself
- It cannot think the way you and I do
- Its behavior is simply shaped by the data it collected and analyzed

Used everywhere

Image classification spots cats, dogs, furniture and people.

Add The Teachable Machine Extension





- Click on 'Sprites'
- Click on 'extensions' at the bottom middle of the screen
- At the top of the screen, click 'Sprite Extensions'
- Find the extension called 'Teachable Machine' and add it
- You will recognize it by the letters TM in green
- Make sure your webcam is working, then click 'Training model'

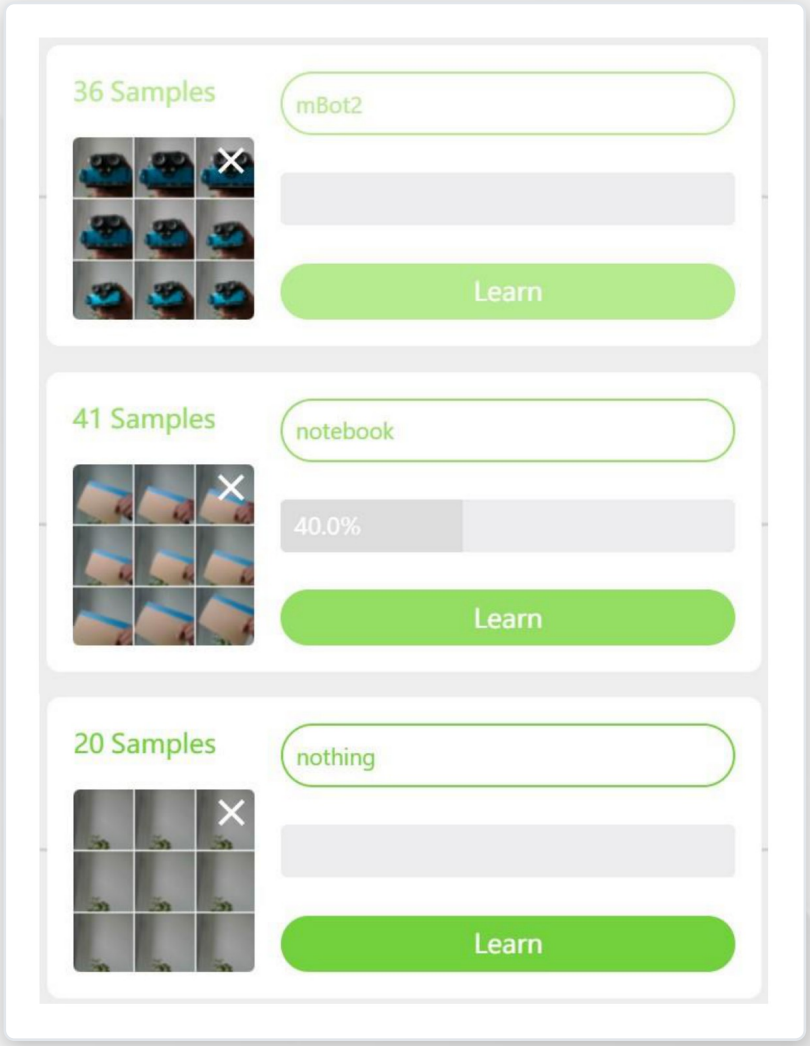
Plan Your Categories Before You Start

- The basic model has 3 categories
- Want more? Click “build a new model” and choose how many
- You cannot add a category later — you would start over completely
- Keep the background simple, still, and clearly different from your objects

Pro tip

Always add one extra “background” category. Otherwise the model must pick cat or dog even in an empty room.

Teach It Three Things



- Place the mBot2 in view of the camera, then click and hold 'Learn'
- Hold until at least 20 samples are recorded, then name the category “mBot2”
- Now hold up something else, like a notebook, and record 20 samples
- Name that one “notebook”
- Finally record the empty background and name it “background”
- The pictures are analyzed only on your computer and are never kept

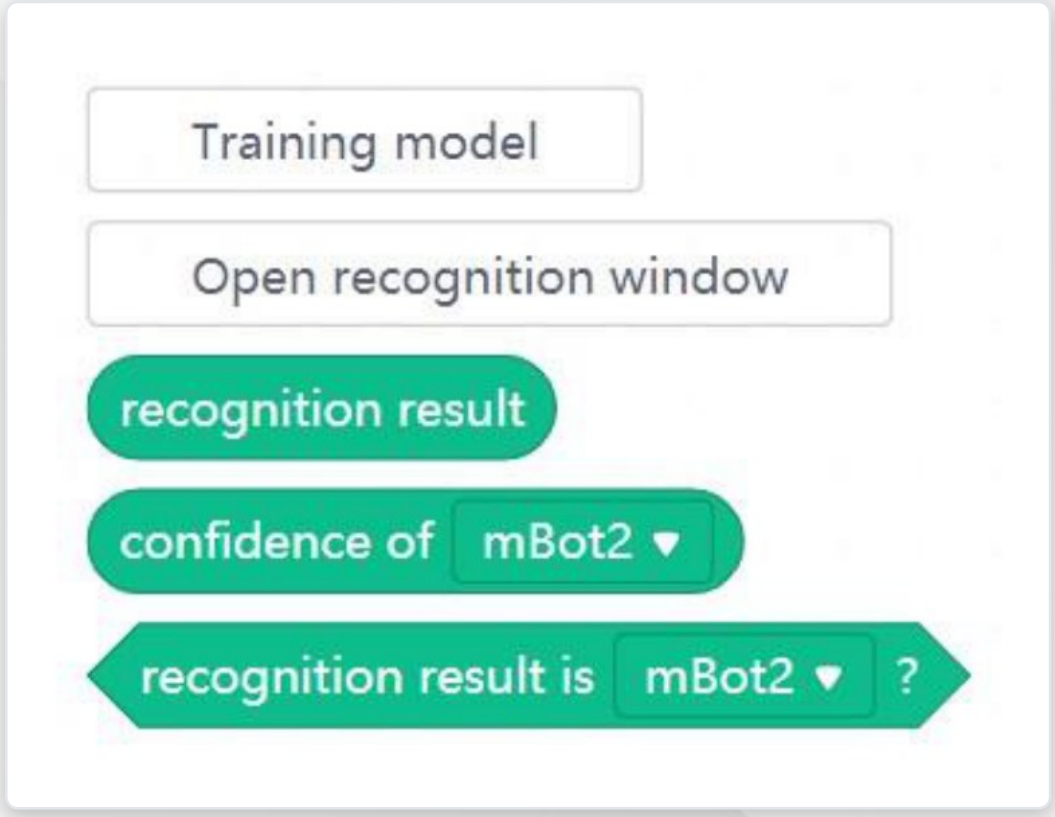
Confidence Tells You How Sure It Is

- Each category shows a bar with a percentage
- That percentage is how confident the algorithm is in its answer
- More samples means higher confidence
- Vary the angle of the object slightly to help it recognize better
- Test the recognition live, before writing any code at all

Aim high

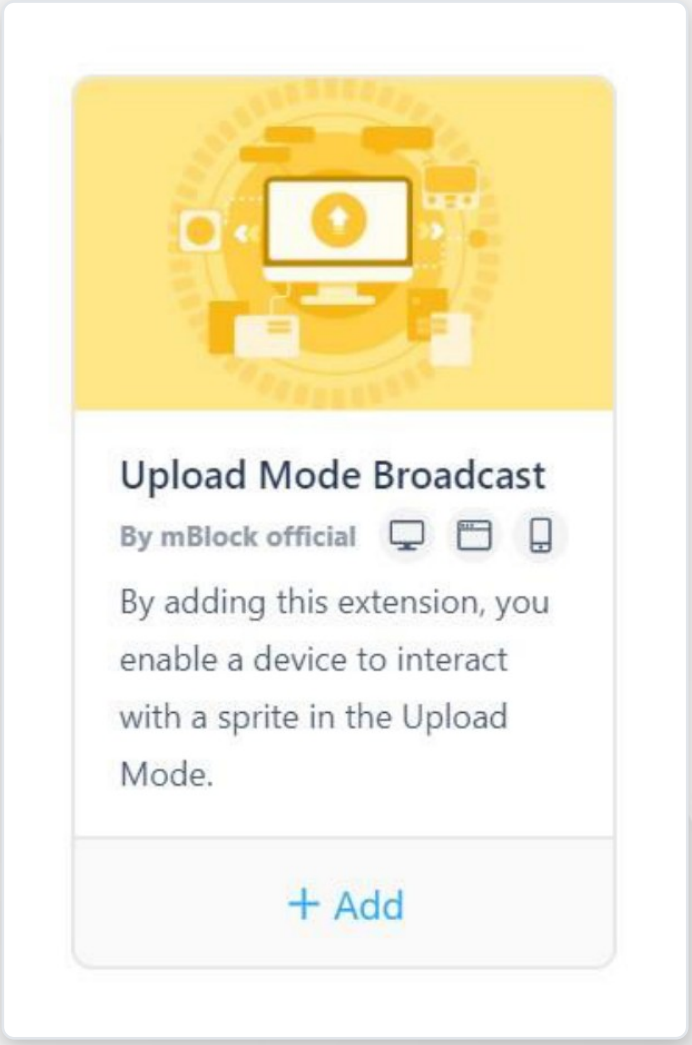
Go for fast, steady results above 90%, then click 'Use the model'.

Three New Blocks Appear



- One block reports the recognition result, using the names you typed
- One block gives the confidence for a category you choose
- One is a Boolean block for use inside if statements, with a dropdown menu
- Click any of them and the recognition window opens
- That window shows the camera image and the live result
- Your webcam is now a smart sensor

Make The Panda Talk When It Sees Something



- Use the recognition result like any other sensor value
- Use if statements to tell the objects apart
- Give each result its own separate action
- The panda sprite speaks when the webcam recognizes a learned object
- Build it, then investigate: can you make the panda jump or walk?

Now Let The Computer Talk To The Robot

- The robot must stay connected to the computer
- Use a USB cable, or the Bluetooth dongle
- On a cable, only allow small turns and short distances
- With the connection made, the sprite can send data to the mBot2
- The robot's own running program reacts to what it receives

Dongle wins

The dongle is much better — the robot can drive around freely.

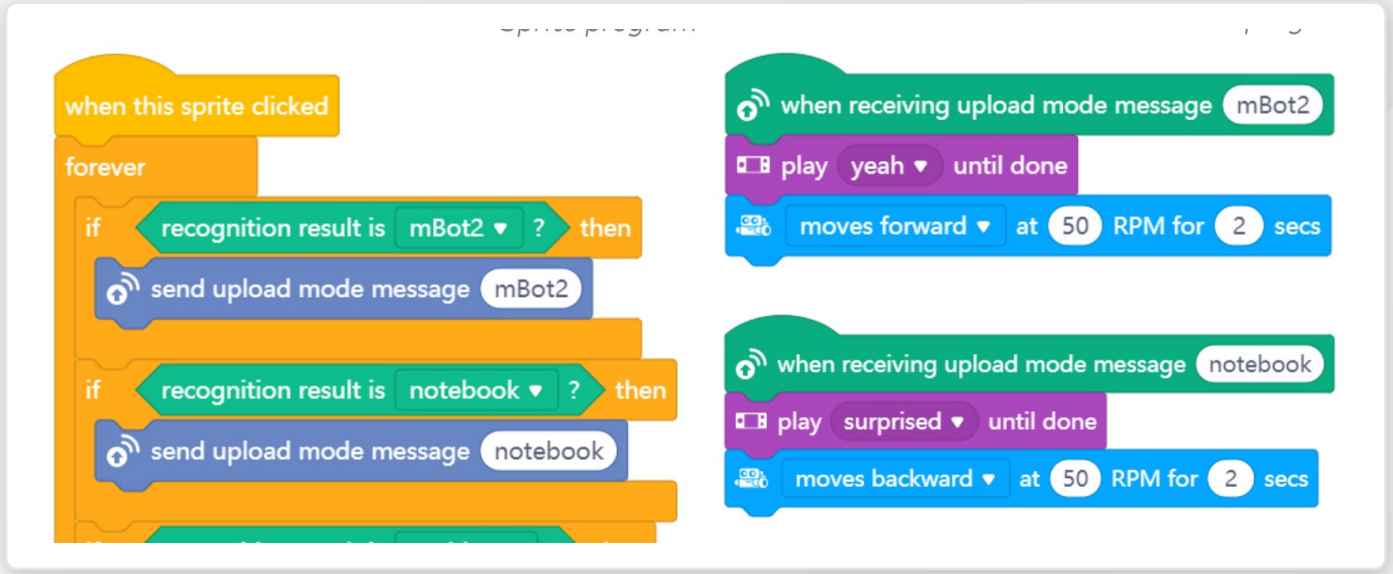
Add The Upload Mode Broadcast Extension

- For the sprite: Sprites → Extensions → Sprite extensions → add “Upload Mode Broadcast”
- For mBot2: Devices → Extensions → Device extensions → add the same one
- It might not be on the first page of the extension library
- In mBlock it appears in dark blue
- The extension adds a communication protocol

Add BOTH

Now sprite and robot can exchange messages while the robot is in Upload mode.

Two Programs Working Together



- You need two programs: one for the mBot2, one for the sprite with the ML add-on
- The recognition result travels over the connection to the robot
- The receiving code uses events, so it runs the moment a message arrives
- Events mean no checking in a loop — more efficient and easier to read
- Switch mBlock to Upload Mode, connect, and upload
- Using the dongle? Press its button to pair, and listen for the beep

Your Mission

The Ecosystem Of A Mouse

- A mouse lives in nature, searching for food and water, and faces dangers like predators
- Program mBot2 to act as a mouse: it hunts food and flees from predators
- Find a picture of corn for the food and a flying eagle for the hunter
- Show corn to the camera and the robot moves forward; show the eagle and it moves backwards
- Add more: it says “yummy” at the food, and you hear its heartbeat at the eagle

The Bluetooth dongle

10 minutes

Showtime and Wrap-Up

- Were you able to recreate the mouse ecosystem?
- Film a short, fun movie of your ecosystem
- Reflect: What are you most proud of? What would you improve?
- Which parts were easy, and which were tricky?
- What do you want more explanation about, and who could help you?

Today you learned

- What Machine Learning is
- How to train a model with examples
- How to make the sprite and robot work as one system