

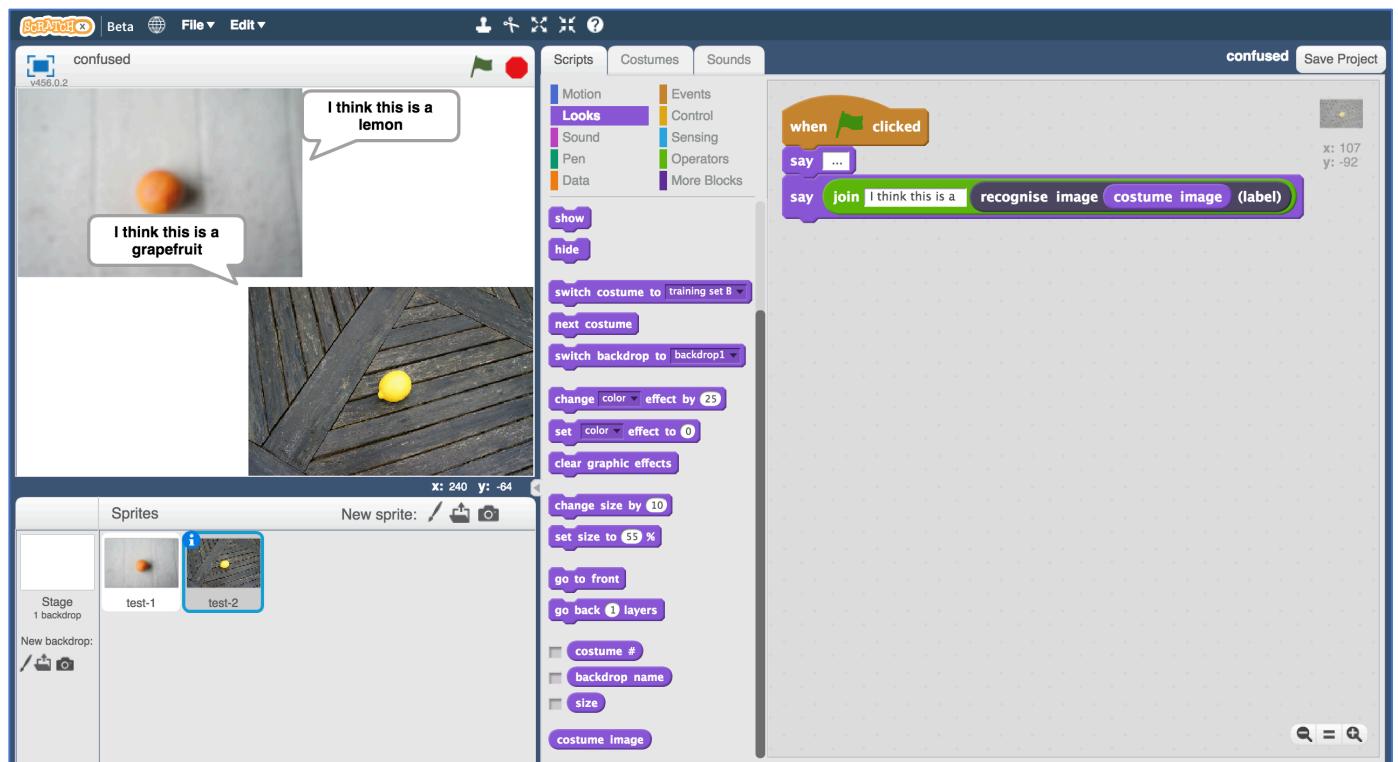
Confused

In this project you will learn about how machine learning can make mistakes.

You'll train a machine learning model to recognise lemons and grapefruits.

To start with, you'll train it badly so that it confuses the two.

When you understand why that happened, you'll train it again so that it is harder to confuse.



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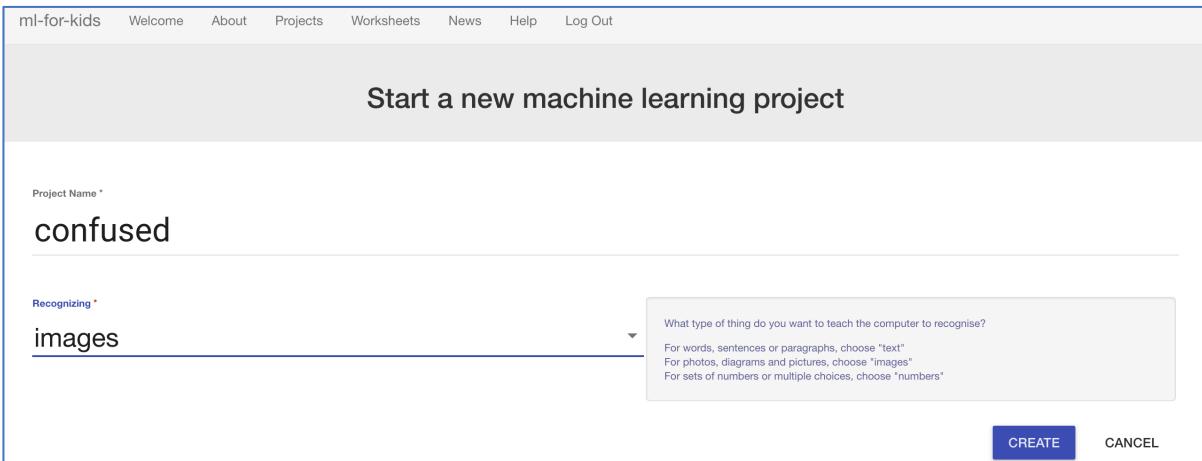
- 1.** Go to <https://machinelearningforkids.co.uk/> in a web browser

- 2.** Click on “**Log In**” and type in your username and password
*If you don't have a username, ask your teacher to create one for you.
If you can't remember password, ask your teacher to reset it for you.*

- 3.** Click on “**Projects**” on the top menu bar

- 4.** Click the “**+ Add a new project**” button.

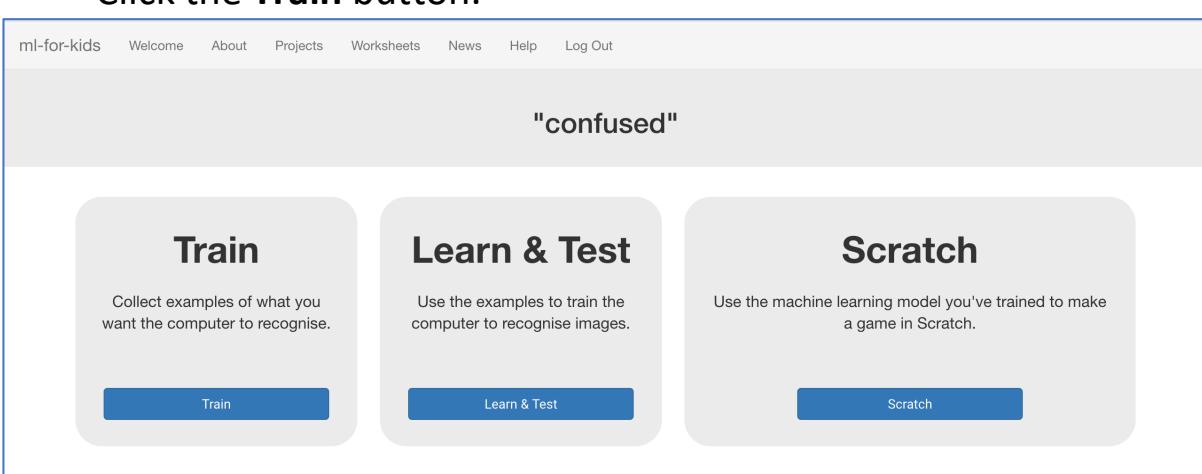
- 5.** Name your project “**confused**”. Set it to learn how to recognise “**images**”. Click the “**Create**” button



The screenshot shows a web page titled "Start a new machine learning project". At the top, there is a navigation bar with links: ml-for-kids, Welcome, About, Projects, Worksheets, News, Help, and Log Out. Below the title, there are two input fields: "Project Name *" containing "confused" and "Recognizing *" containing "images". To the right of these fields is a dropdown menu with the following options:
What type of thing do you want to teach the computer to recognise?
For words, sentences or paragraphs, choose "text"
For photos, diagrams and pictures, choose "images"
For sets of numbers or multiple choices, choose "numbers"
At the bottom right of the form are two buttons: "CREATE" and "CANCEL".

- 6.** You should see “**confused**” in the list of your projects. Click on it.

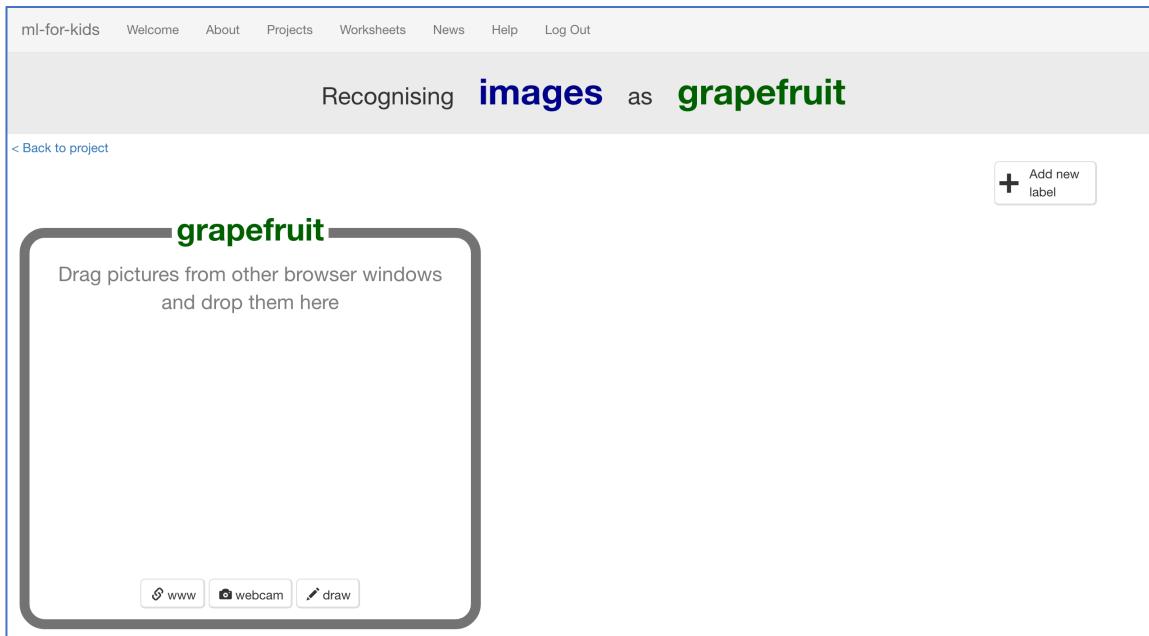
- 7.** Click the **Train** button.



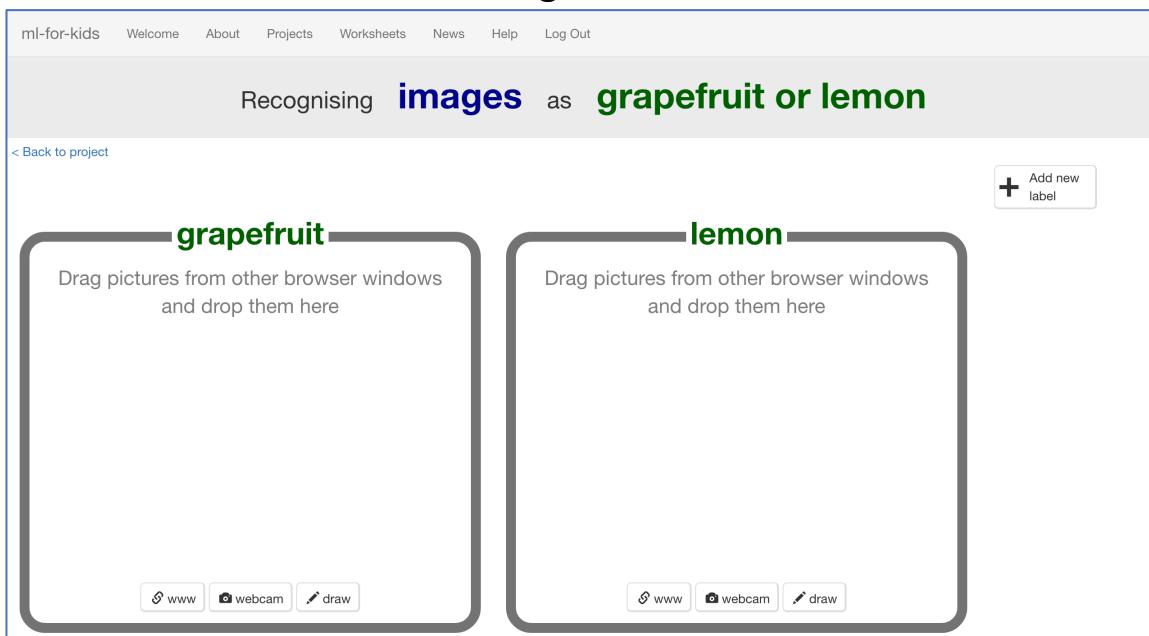
The screenshot shows the project details page for "confused". At the top, there is a navigation bar with links: ml-for-kids, Welcome, About, Projects, Worksheets, News, Help, and Log Out. The project name "confused" is displayed prominently. Below the project name are three buttons in rounded rectangles: "Train", "Learn & Test", and "Scratch". The "Train" button has the following text:
Collect examples of what you want the computer to recognise.
The "Learn & Test" button has the following text:
Use the examples to train the computer to recognise images.
The "Scratch" button has the following text:
Use the machine learning model you've trained to make a game in Scratch.

8. Click the “+ Add new label” button.

9. Create a new label called “grapefruit”



10. Click “+ Add new label” again and create a label called “lemon”



11. Open a new browser window

How to do this will depend on what web browser you're using, but it's probably going to be a menu like “File -> New Window”

12. Go to <https://machinelearningforkids.co.uk/datasets> in the new window.

That's the same web address as before, with "data" "sets" on the end.

Training Sets for Machine Learning for Kids projects

Use the links below to get training sets for [Machine Learning for Kids projects](#).

- [Confused](#)

13. Click on the “Confused” link

14. Choose “Training Set A” or “Training Set B” and click on it

You can use either. Don't pick “Final Training Set”—you'll use that later.

15. You should see pictures of grapefruits and lemons that you can use to train the computer.

Click on the “Display thumbnails” checkbox so you can see them all.

16. Arrange the two web browser windows so they're side by side

"Confused" - Training Set A

This is a set of training images for the Machine Learning for Kids project "Confused". Instructions for how to use it are in the [project worksheet](#).

Display thumbnails (instead of full-size pictures)

Grapefruits

grapefruit

lemon

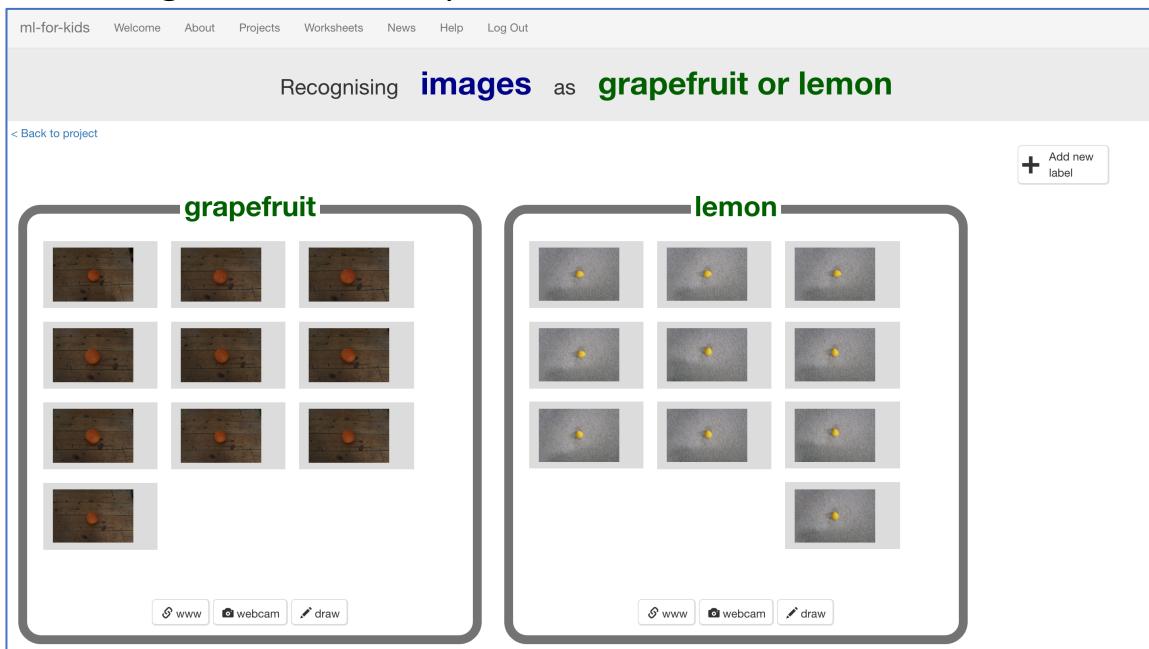
Drag pictures from other browser windows and drop them here

Drag pictures from other browser windows and drop them here

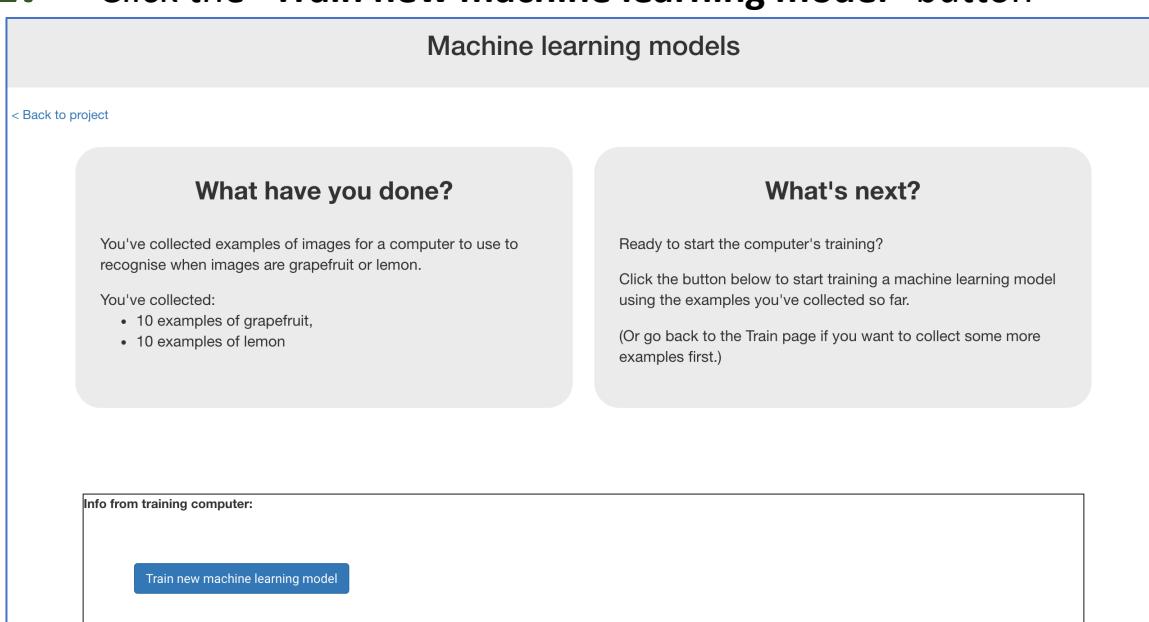
www webcam draw

www webcam draw

- 17.** Drag the ten grapefruit pictures into the “grapefruit” bucket.
- 18.** Drag the ten lemon pictures into the “lemon” bucket.



- 19.** Click the “[< Back to project](#)” link
- 20.** Click the “**Learn & Test**” button
- 21.** Click the “**Train new machine learning model**” button

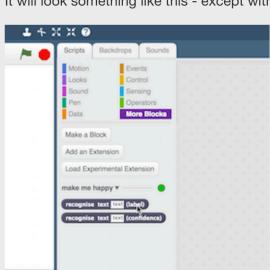


22. Wait for the training to complete. This might take a few minutes.

23. Click the “< Back to project” link, then the “Scratch” button.

*This page has instructions on how to use the new blocks in Scratch.
Keep the page open if you need to check back on how to use them.*

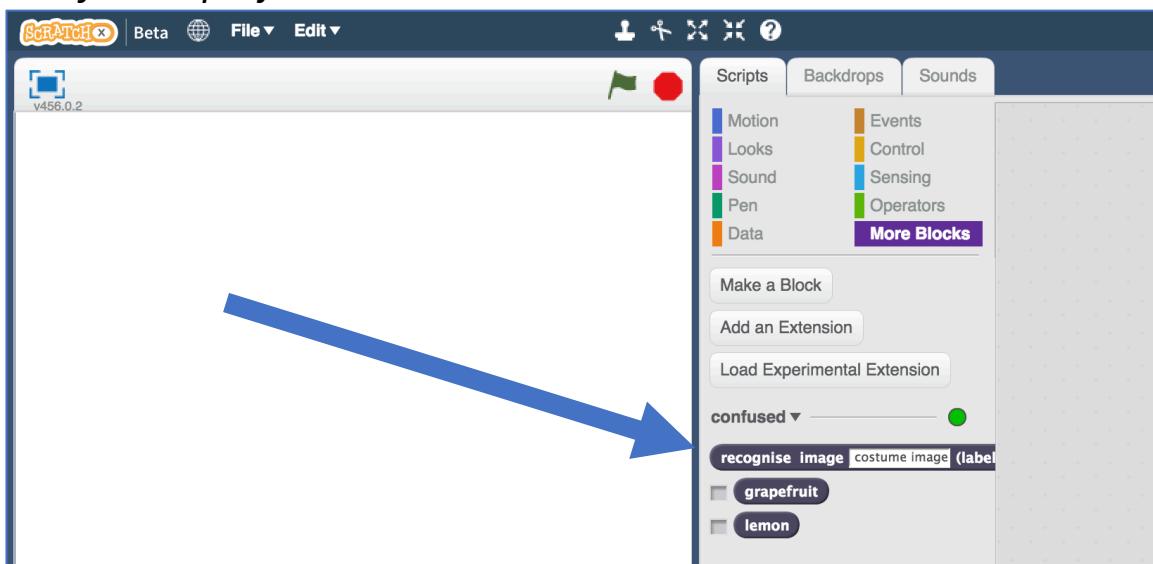
The screenshot shows a web page titled "Using machine learning in Scratch". At the top, there's a navigation bar with links for "ml-for-kids", "Welcome", "About", "Projects", "Worksheets", "News", "Help", and "Log Out". Below the title, there's a "Back to project" link and an "Open in Scratch" button. The main content area contains several sections of text and code examples:

- Your project will add these blocks to the "More Blocks" tab in Scripts.**
 - `recognise images [costume image] (label)`: Put images in the input for this, and it will return the label that your machine learning model recognises it as.
 - `recognise images [costume image] (confidence)`: This will return how confident your machine learning model is that it recognises the type of images. (As a number from 0 - 100).
 - `grapefruit` and `lemon`: These blocks represent the labels you've created in your project, so you can use their names in your scripts.
 - `costume image`: This block is in the Looks palette for Sprites and will return the image of the currently selected costume.
- It will look something like this - except with the name of your project.**

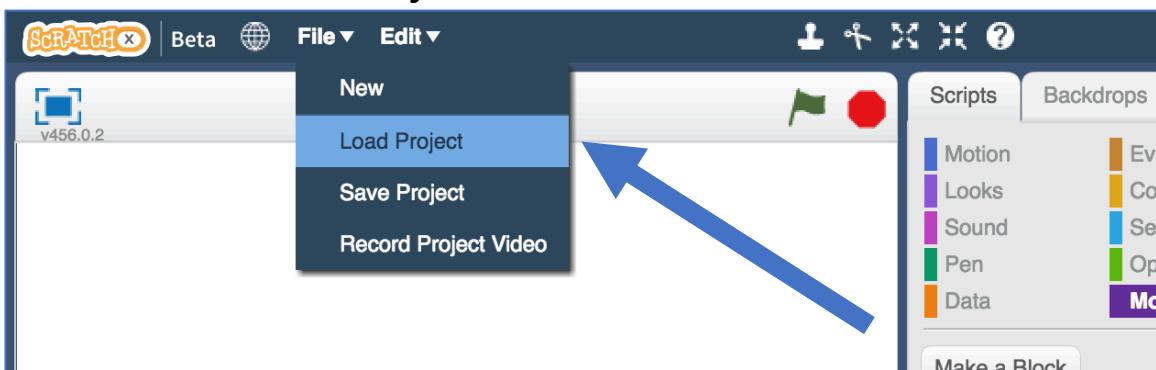
The Scratch editor interface is shown with the "More Blocks" tab selected. It displays the new ML blocks: `make me happy`, `recognise text [text] (label)`, and `recognise text [text] (confidence)`.
- The coloured circle next to your project name tells you if your machine learning model is okay.**
 - **green** means your model is trained and ready to go
 - **yellow** means your model hasn't finished training yet
 - **red** means something went wrong. Go back to the [Learn & Test](#) page to see what went wrong with training.

24. Click the “Open in Scratch” button to launch the Scratch editor.

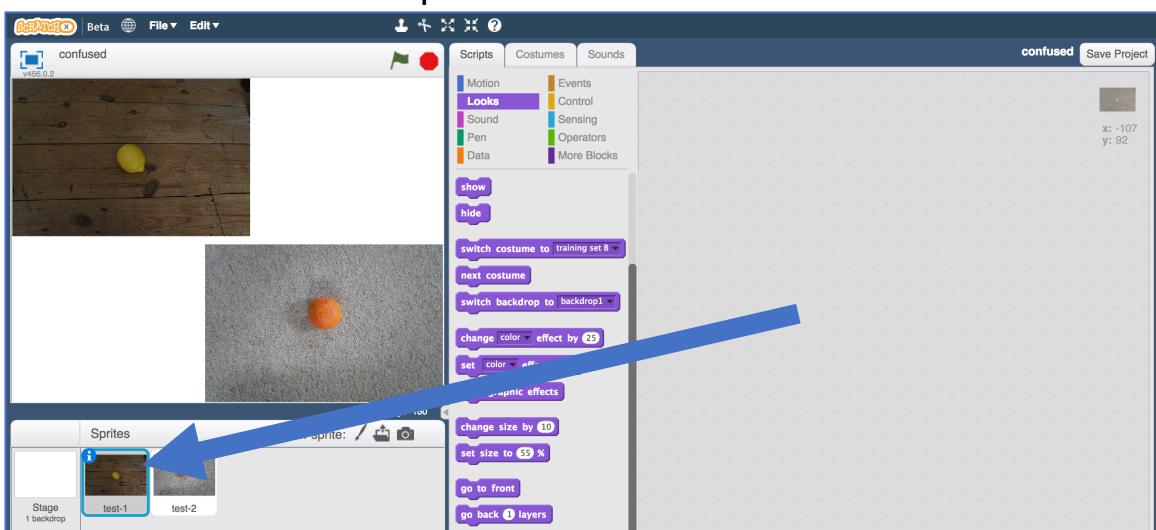
You should see three new blocks in the “More blocks” section from your “confused” project.



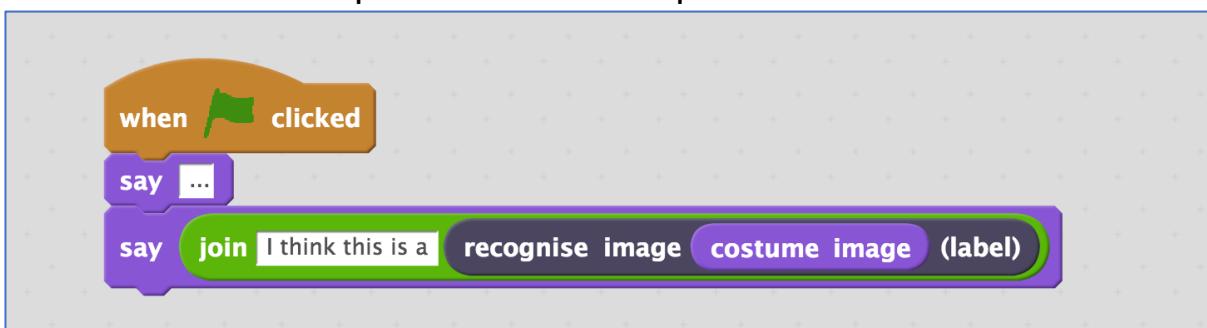
25. Open the Scratch project file “confused.sbx” from your teacher.
Click “File” -> “Load Project”



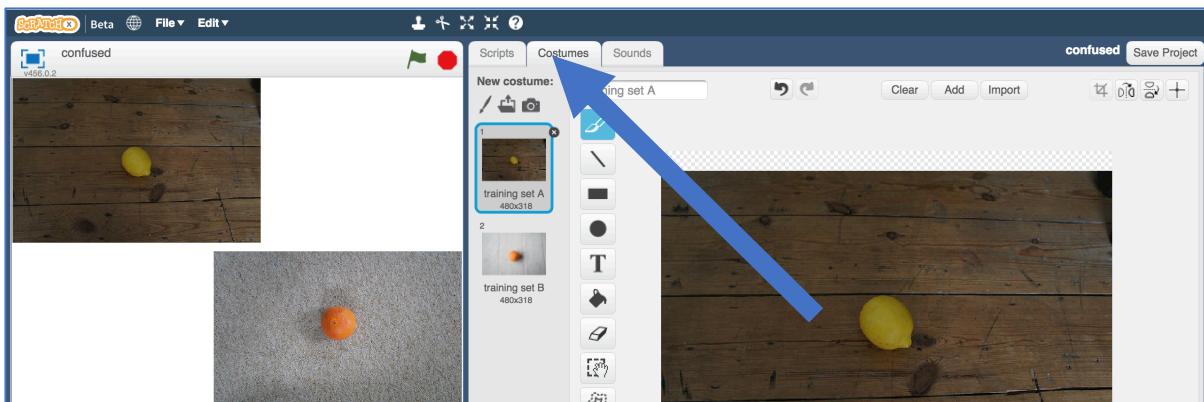
26. Click the “test-1” sprite



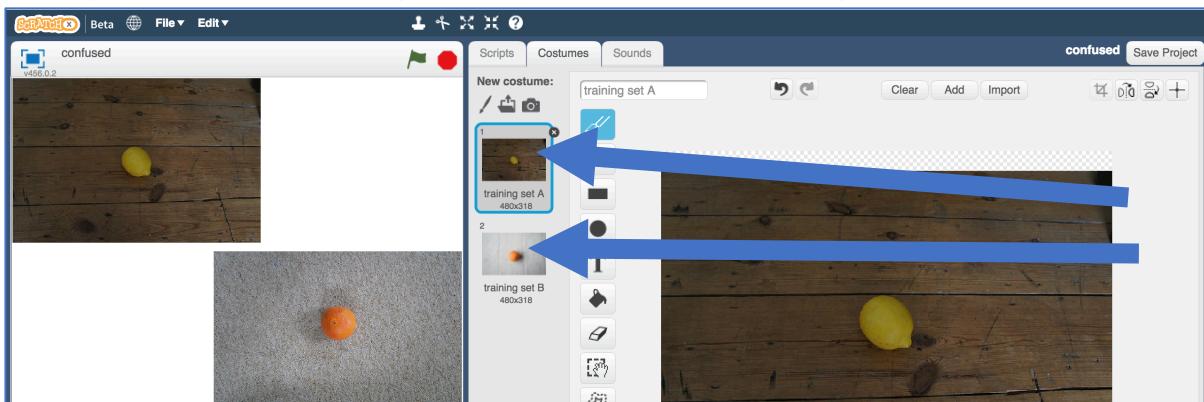
27. Create this script in the “test-1” sprite



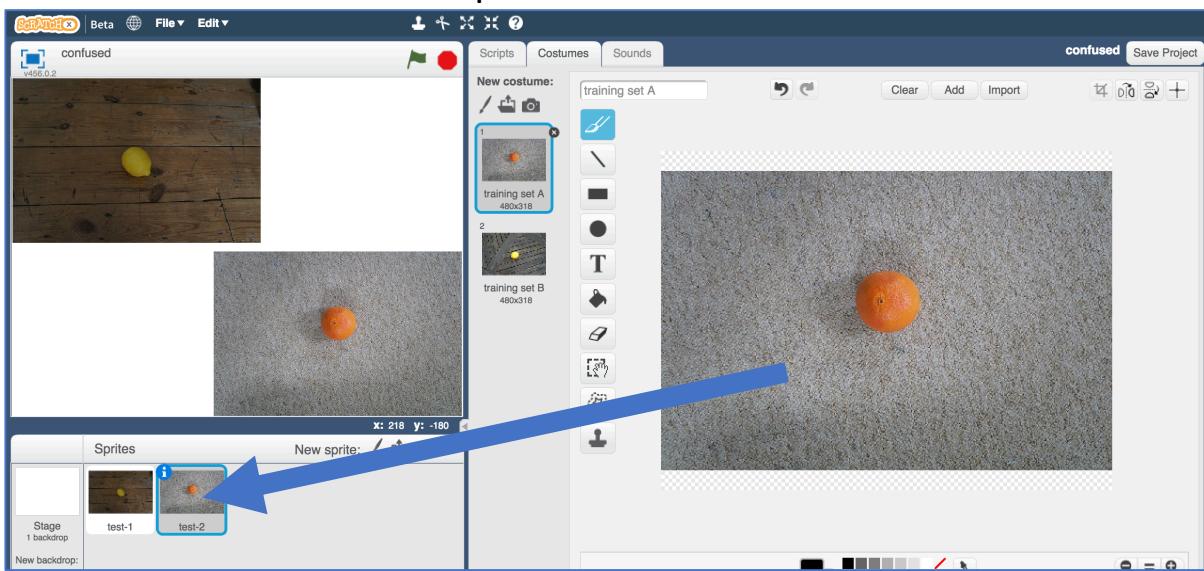
28. Click on the “Costumes” tab



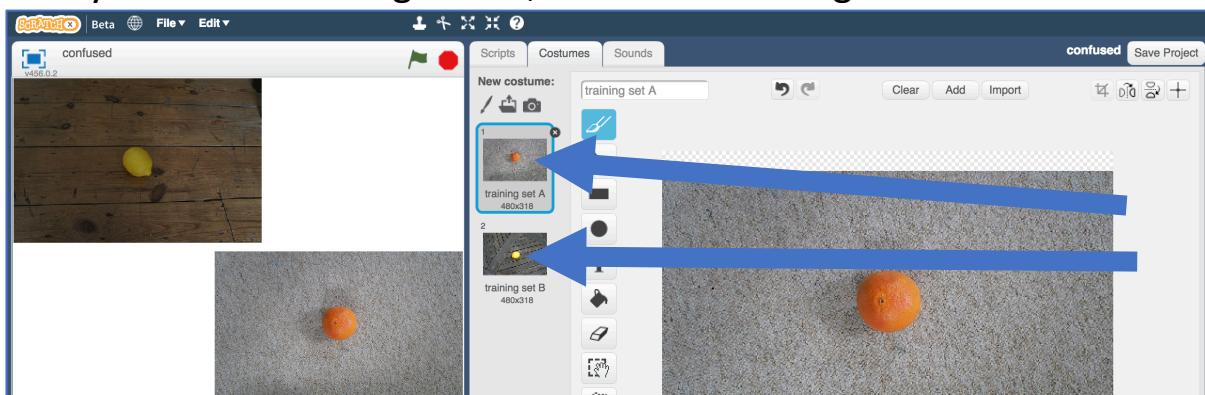
29. If you used “Training Set A”, then click the “training set A” costume
Or if you used “Training Set B”, click the “training set B” costume instead



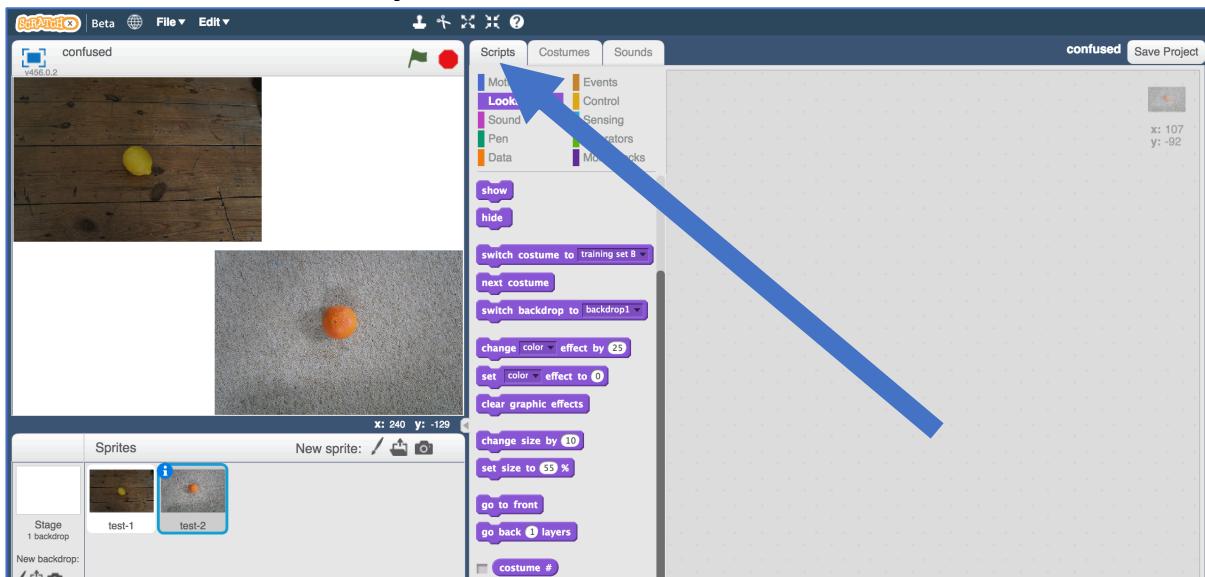
30. Click on the “test-2” sprite



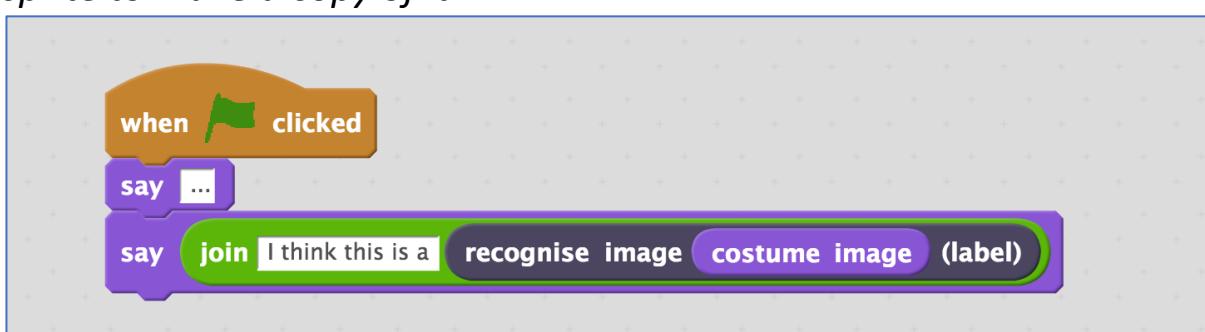
31. If you used “Training Set A”, then click the “training set A” costume
Or if you used “Training Set B”, click the “training set B” costume instead



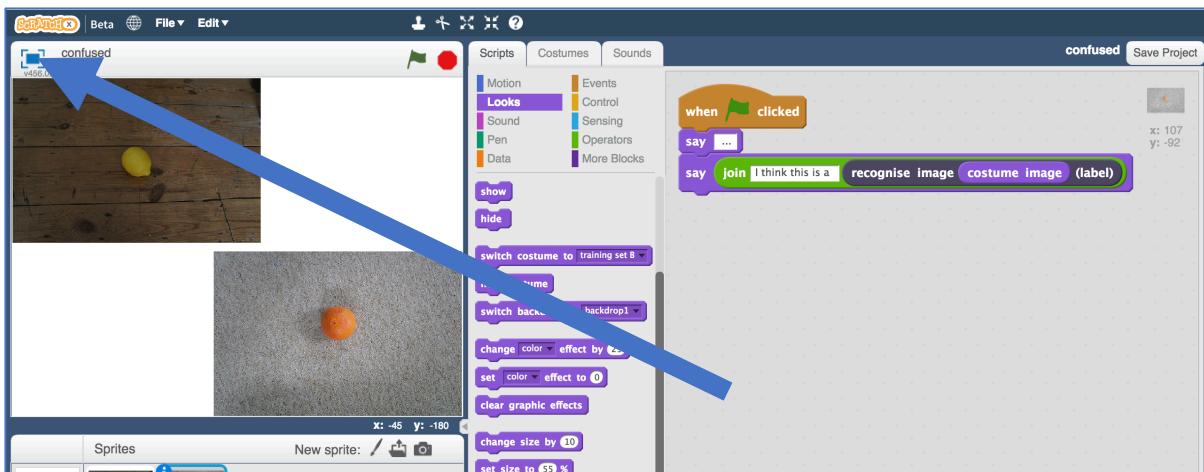
32. Click on the “Scripts” tab



33. Enter the same script as before, this time in the “**test-2**” sprite
You can save time by dragging the script you wrote before onto the test-2 sprite to make a copy of it.

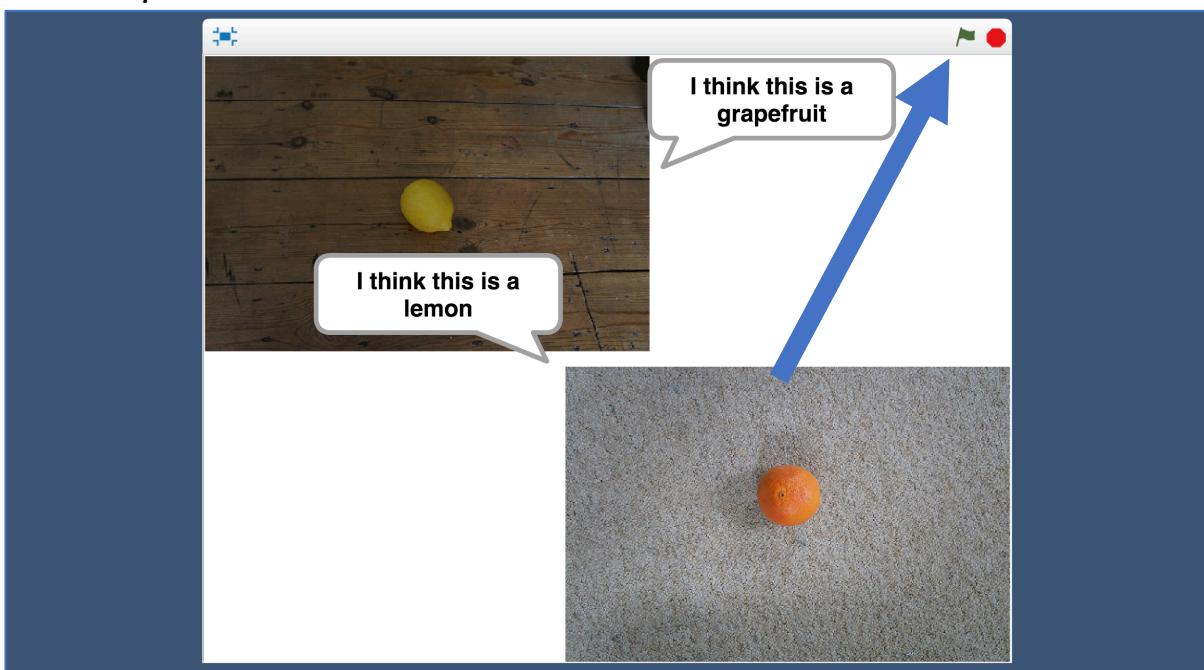


34. Click the “full-screen” button



35. Click the green flag

Your script will use the machine learning model you trained to recognise the two photos.



Why do you think the computer is getting this wrong?

Try to think of a reason for yourself before you read the next page!

You might find it helpful to look back at the training set you used and compare it with the test images in the Scratch project.

What is happening?

When you train a machine learning model, you're asking the computer to look at sets of photos for patterns.

It looks for what photos in each set have in common, and learns to recognise those patterns in new photos it is given.

You might want it to have recognise fruits, but the computer doesn't know that. It could spot patterns about the colour of the background, or whether the photo is blurry or focused, or whether the lighting is dark or bright, or many other things.

When it makes decisions based on recognising those patterns in new photos, it can get the wrong answer.

Training Set A

“grapefruits” – a set of **dark** images on a **wooden** background

“lemons” – a set of **light** images on a **cream** carpet background

Confused by testing with:

- A **dark** photo of a lemon on a **wooden** background
- A **light** photo of a grapefruit on a **cream** carpet background

Training Set B

“grapefruits” – a set of **sharp** focused images on a **wood** background

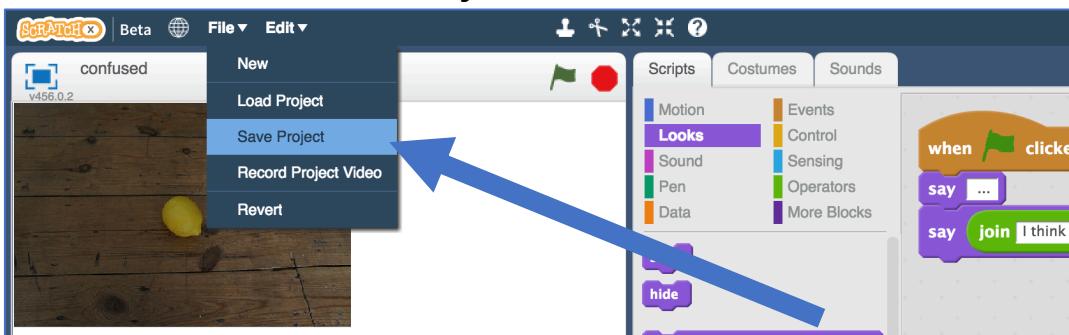
“lemons” – a set of **blurry** images on a **white** rug background

Confused by testing with:

- A **blurry** photo of a grapefruit on a **white** rug background
- A **sharp** focused photo of a lemon on a **wooden** background

36. Save your Scratch project

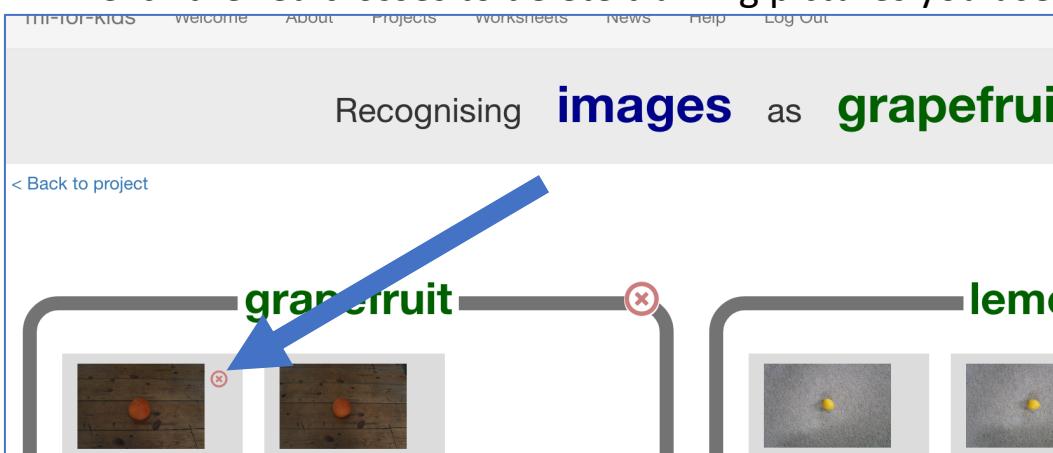
Click on “File” -> “Save Project”



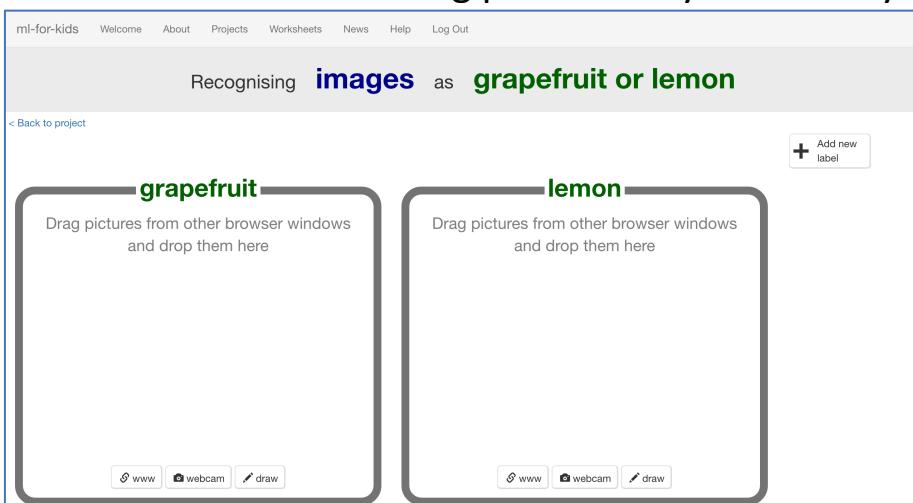
37. Close the Scratch window

38. Click the “< Back to project” link and then click the “Train” button

39. Click the red crosses to delete training pictures you used before



40. Delete all the training pictures so you’re ready to start again



41. In the browser window with the training set pictures, click Back.

This time, choose “Final Training Set”

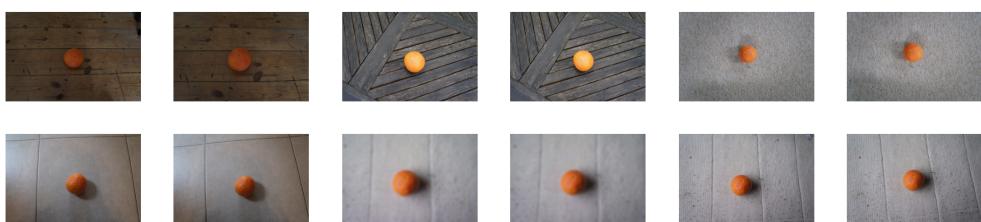
If you didn’t leave the window open before, open a new window now, go to <https://machinelearningforkids.co.uk/datasets> and go to “Confused”

"Confused" - Final Training Set

This is a set of training images for the Machine Learning for Kids project "Confused". Instructions for how to use it are in the [project worksheet](#).

Display thumbnails (instead of full-size pictures)

Grapefruits



Lemons



42. Drag the new training images into your “lemon” and “grapefruit” buckets, like you did before.

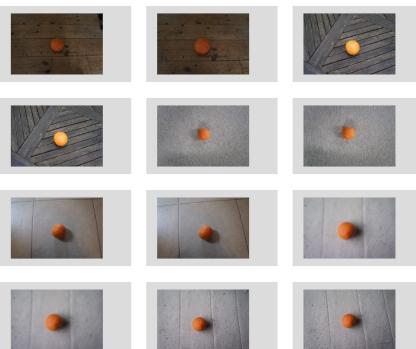
[ml-for-kids](#) [Welcome](#) [About](#) [Projects](#) [Worksheets](#) [News](#) [Help](#) [Log Out](#)

Recognising **images** as **grapefruit or lemon**

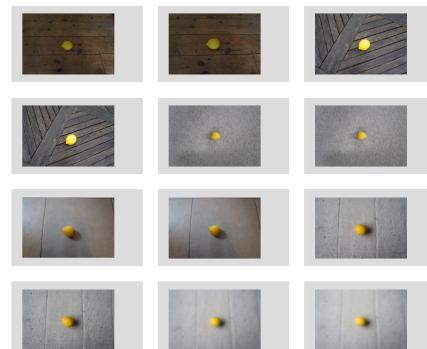
[< Back to project](#)

[**+** Add new label](#)

grapefruit



lemon



43. Click the “< Back to project” link

44. Click the “Learn & Test” button

45. Click the “Train new machine learning model” button to train a new machine learning model, using the new training set.

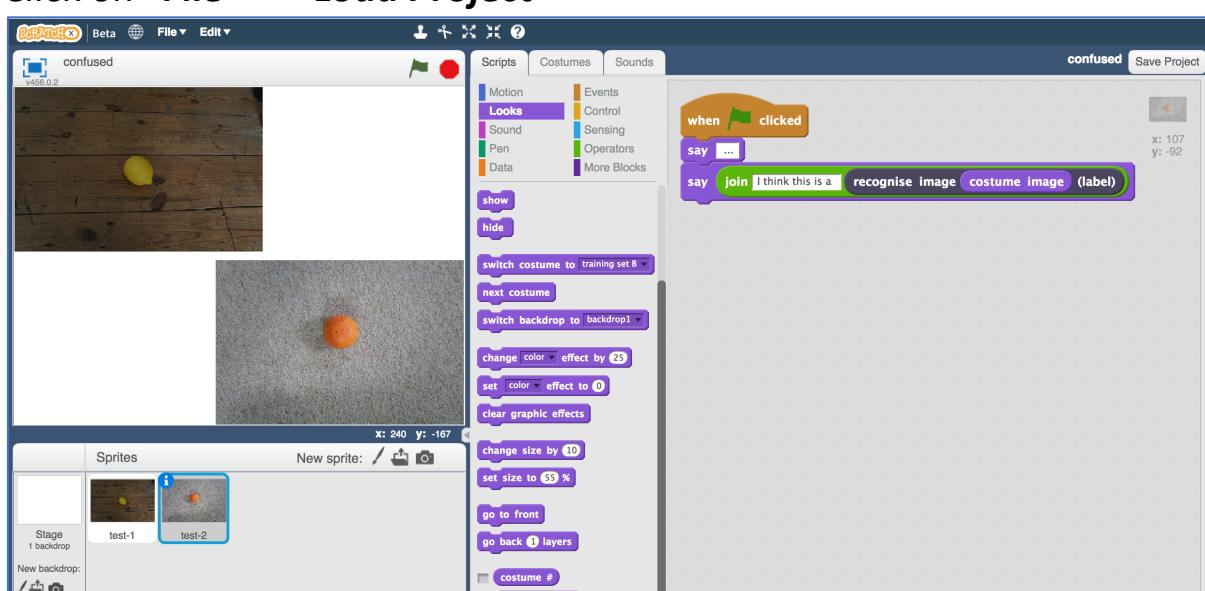
46. Wait for the model to finish training

47. Click the “< Back to project” link

48. Click the “Scratch” button

49. Click the “Open in Scratch” button

50. Open the Scratch project you saved before
Click on “File” -> “Load Project”



51. Run the scripts again with the new model
Click full-screen, and then click the Green Flag

52. Does it get the right answer this time?

What have you done?

Machine learning models will learn to recognise patterns in what you use to train it.

If all the photos in a set have the same background, or the same lighting, or the same type of focus – then those can be patterns that the machine learning model uses to recognise pictures.

This time, you used a wider variety of photos to train the model.

For example, the “lemon” training photos were taken on different backgrounds, taken inside and outside, in light and dark, some in focus and some blurry. The only thing they all had in common was that they all had a lemon in there.

This meant it was much more likely that the pattern the computer spotted in the training photos was that there was a yellow fruit in the middle.

Variety in training data is essential when training a reliable machine learning model.

The “Russian Tank” problem

This worksheet is based on an old story told to Artificial Intelligence students called “The Russian Tank problem”.

It's unclear whether or not it's a true story, as there are many different versions. Whether or not it's true, it's a useful way to teach an important lesson in training machine learning systems.

Here are two examples of how the story is told:

Spotting camouflaged Russian tanks

Once upon a time, the US Army decided to use machine learning to recognize tanks hiding behind trees in the woods. Researchers trained a machine learning model using photos of a woods without tanks, and photos of the same woods with tanks sticking out from behind trees.

It seemed to work, but in tests the model didn't do better than random guesses.

It turned out that in the researchers' training data set, photos of camouflaged tanks had been taken on cloudy days, while photos of plain forest had been taken on sunny days. The machine learning model had learned to recognise cloudy days from sunny days, instead of recognising camouflaged tanks.

Recognising American and Russian tanks

Once upon a time, the US Army tried training a computer to tell the difference between Russian and American tanks by the way they look. Researchers trained a machine learning model using photos they took of American tanks, and spy photos they collected of Russian tanks.

But when they tested it in the field, the machine learning model didn't do any better than randomly guessing.

It turned out that the researchers had photos of American tanks which were large, high-resolution and high-quality. But the long-distance spy photos of Russian tanks they were able to get were all blurry, low-resolution and grainy.

The machine learning model had learned to recognise the difference between grainy photos and high-quality photos, instead of Russian or America.