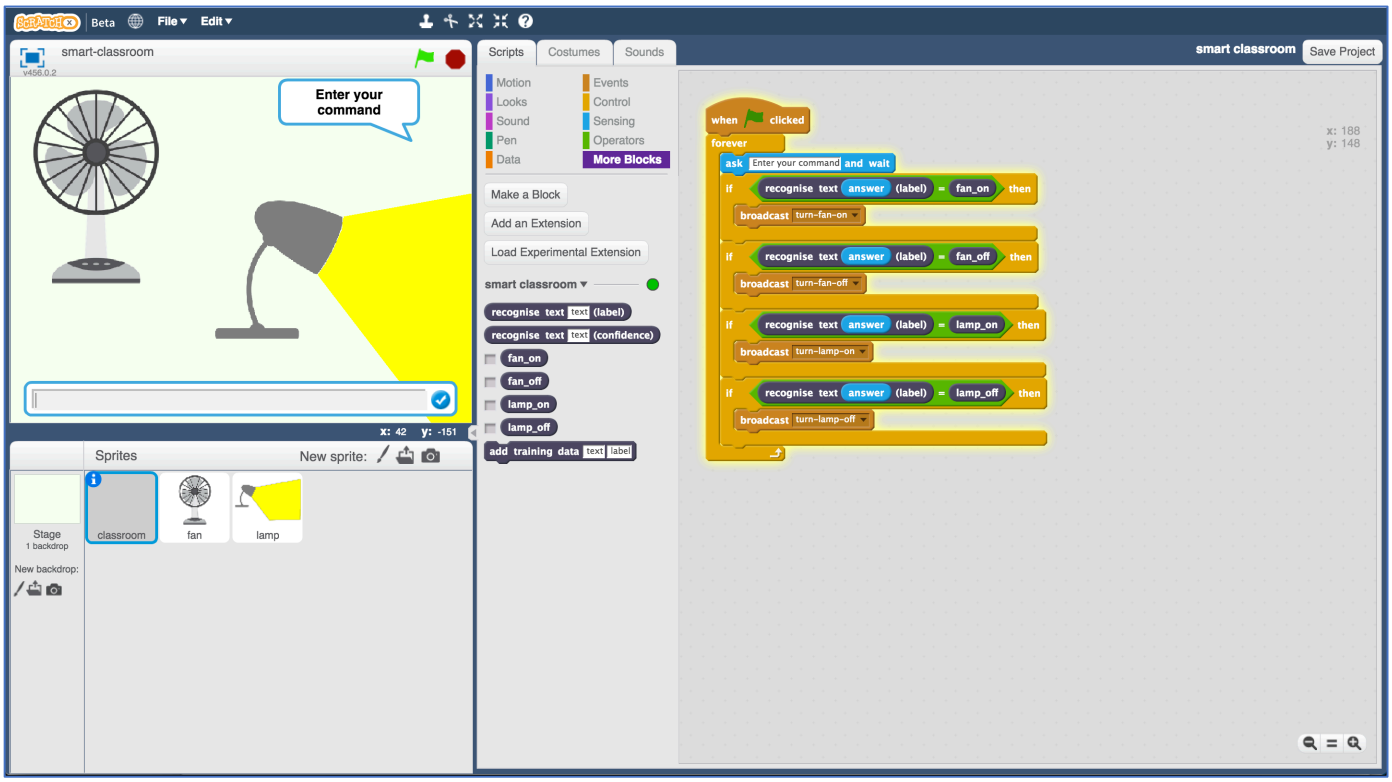
Smart Classroom

In this project you will make a classroom that can react to what you say to it.

You'll be able to control the devices in the classroom by saying what you want.

To start with, you'll program a list of rules for understanding commands, and learn why that approach isn't very good.

Next, you will teach the computer to recognise commands for different devices by giving it examples of each.



1. You'll need the **smart-classroom.sbx** starter file for this project.
If you haven't got this, ask your teacher or group leader.

2. Go to https://machinelearningforkids.co.uk/ in a web browser

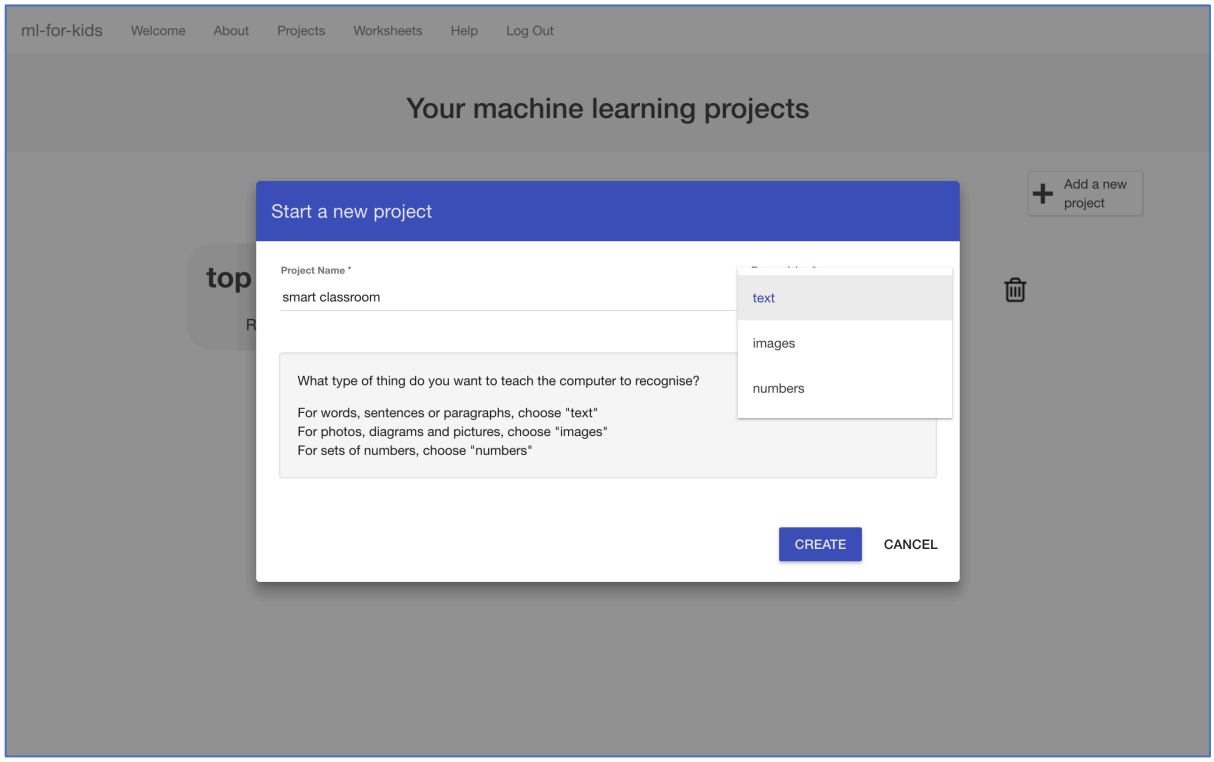
3. Click on "**Get started**"

4. Click on "**Log In**" and type in your username and password
If you don't have a username, ask your teacher or group leader to create one for you.
If you can't remember your username or password, ask your teacher or group leader to reset it for you.

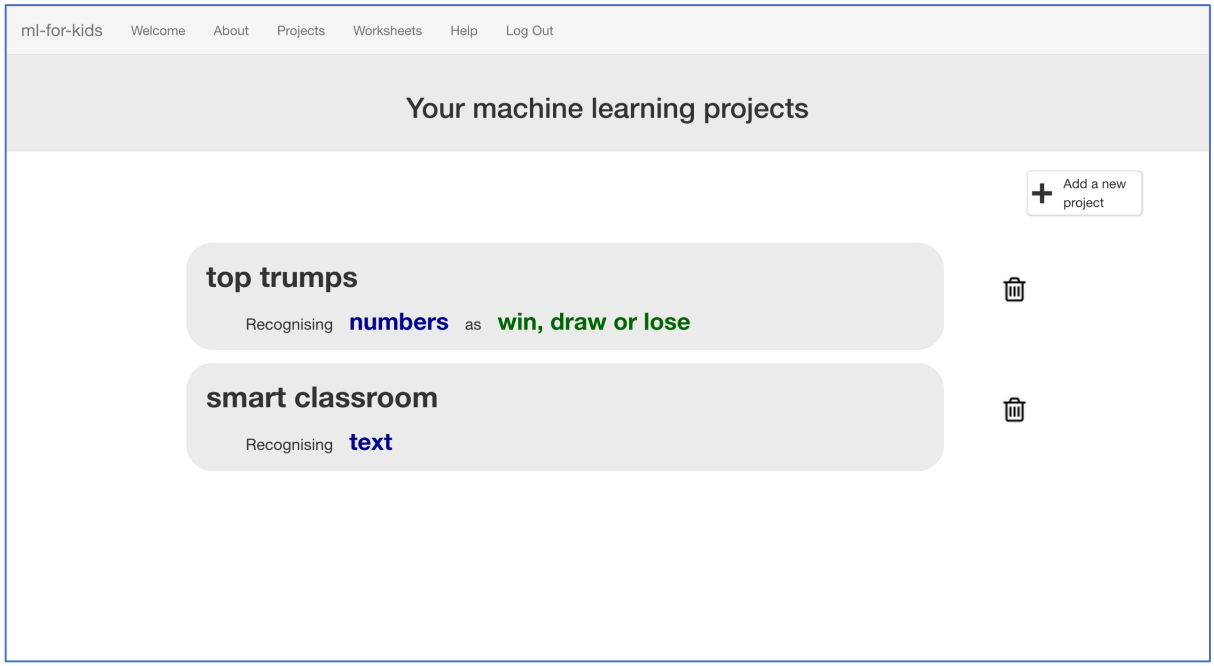
5. Click on "**Projects**" on the top menu bar

6. Click on the **"+ Add a new project**" button.

7. Name your project "smart classroom" and set it to learn how to recognise "**text**"

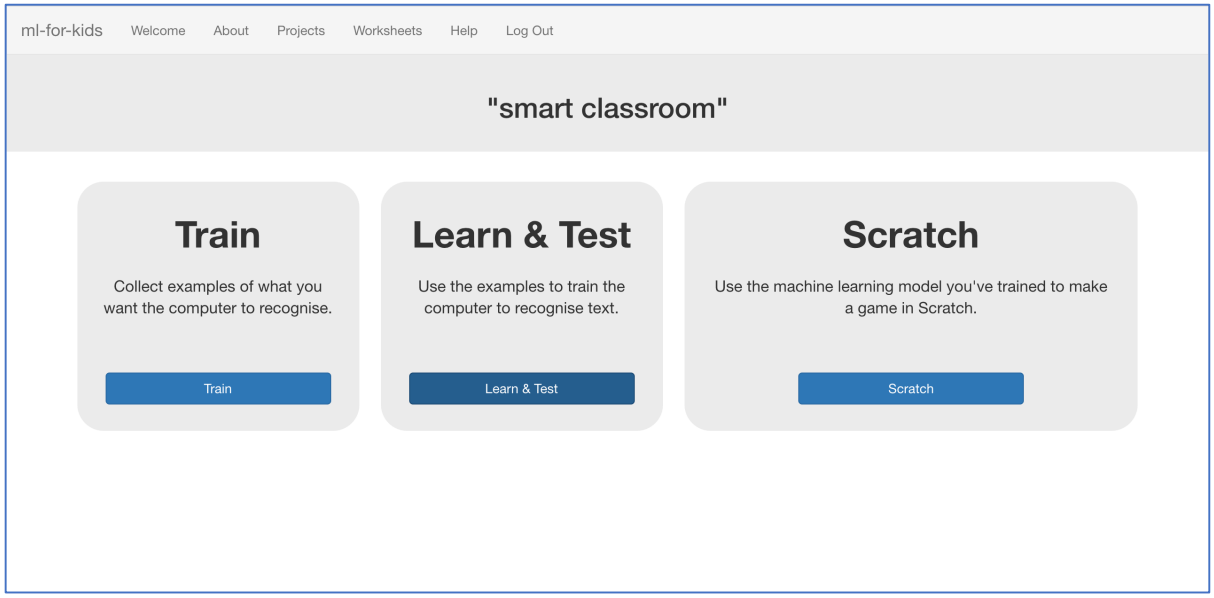


8. You should now see “smart classroom” show up in the list of your projects. Click on it.



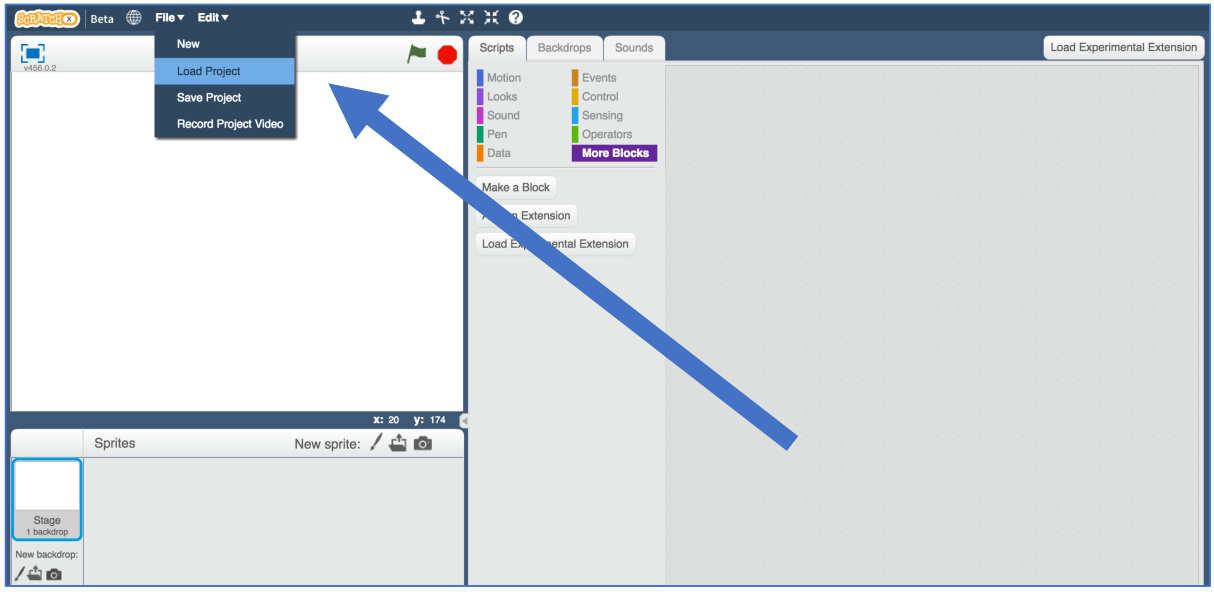
9. We’ll start by getting a project ready in Scratch. Click on the **Scratch** button.

*The next page will warn you that you haven’t done any machine learning yet, but clicking on **Scratch by itself** will launch Scratch.*



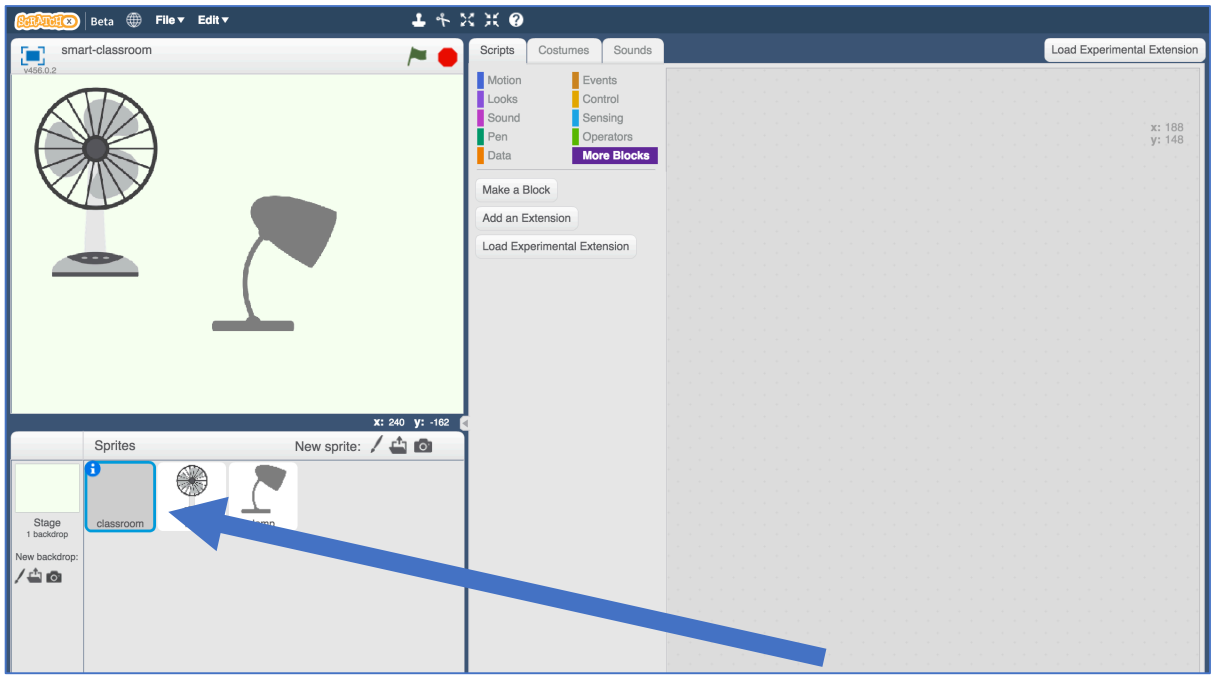
10. Load the smart-classroom.sbx file

Use File -> Load Project as shown below

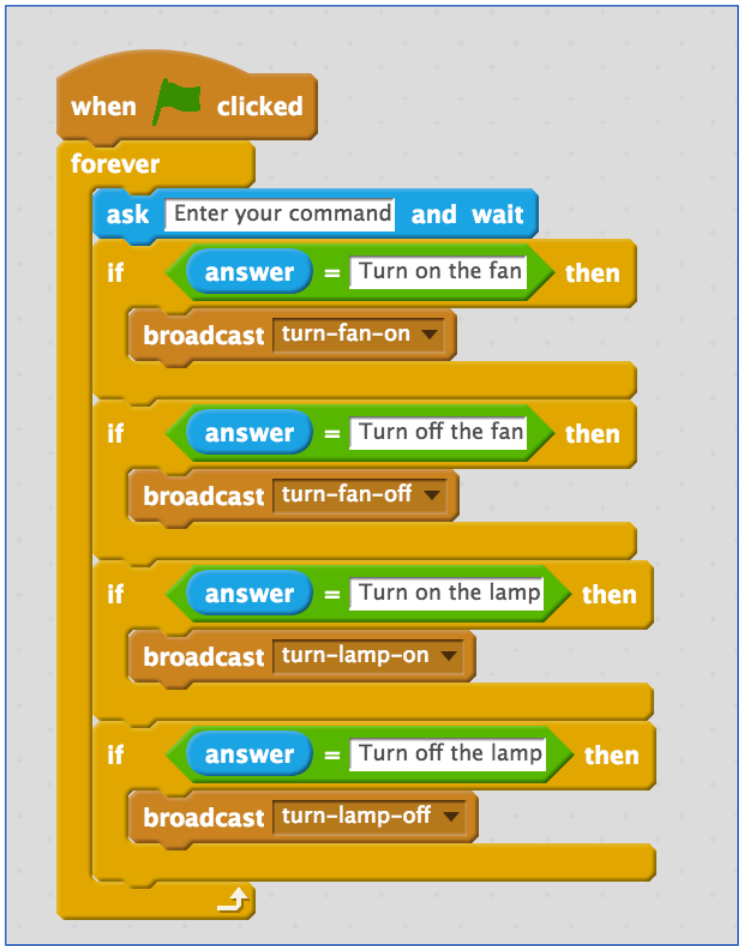


11. You should see two sprites on the stage (fan and lamp) with a third invisible sprite called “classroom”.

Click on the “classroom” sprite so that it is selected as shown below.



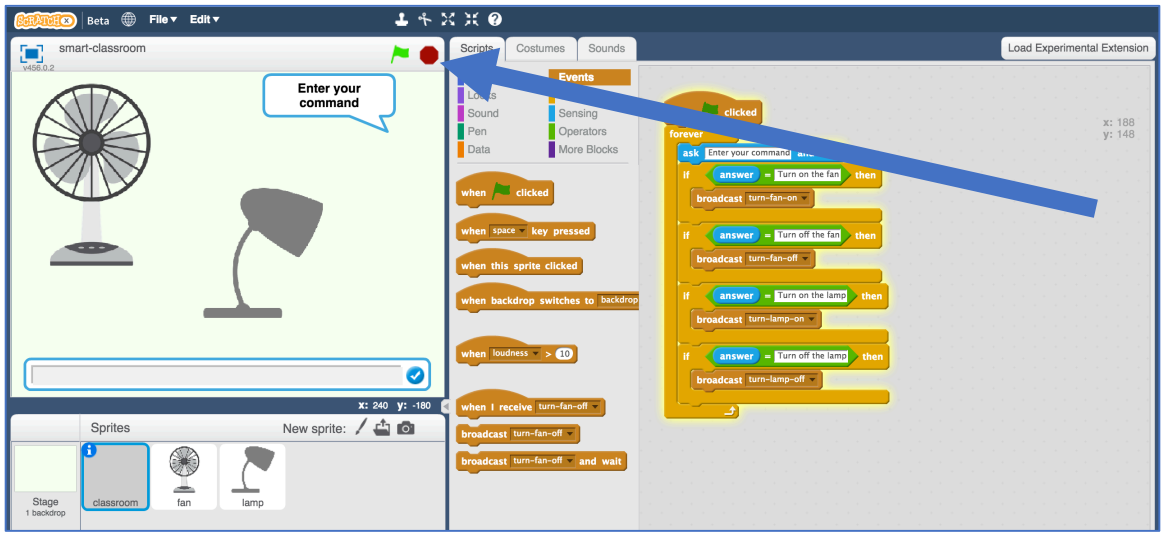
12. Click on the **Scripts** tab and enter the following script.



13. Save your project.

*Click on **File** -> **Save Project** to save the project to a file.*

14. Click on the **green flag** to test.



15. Type in a message and watch it react!

Type "Turn on the lamp" and press enter. The lamp should turn on.
Try "Turn off the lamp", "Turn on the fan", and "Turn off the fan".
They should all work.
Type anything else, and nothing will happen. Even if you just change a capital letter to a lower-case letter, or just make a small spelling mistake.
If you don't get it exactly right, nothing will happen.

What have we done so far?

You've programmed the classroom to react to commands using a simple rules-based approach.

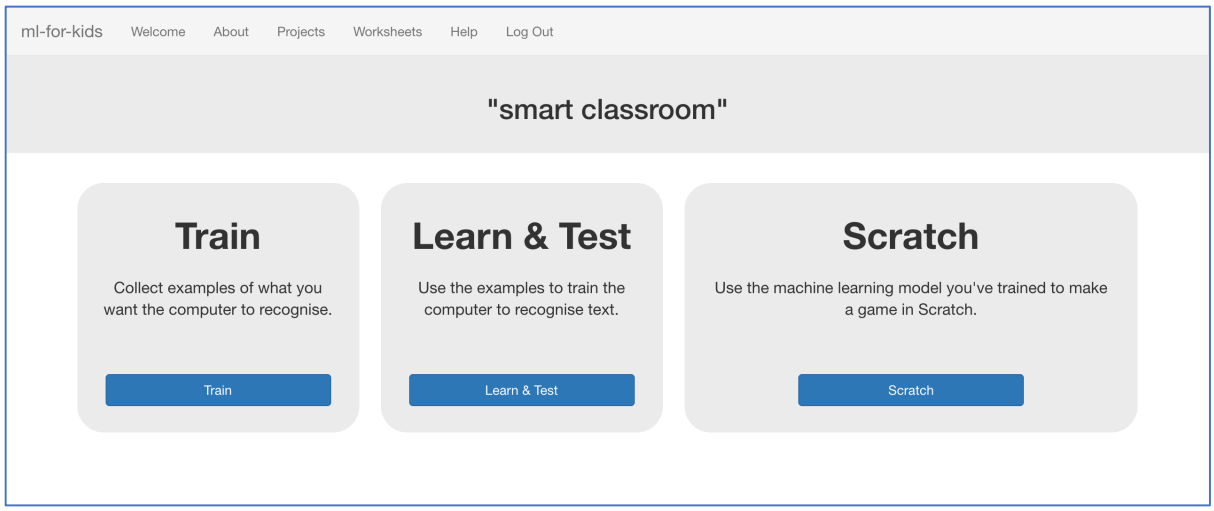
If you want it to react to commands phrased differently as well, you need to add extra **if** blocks.

The problem with this approach is that you need to predict exactly what command the classroom will receive, and making a list of every possible message would take forever.

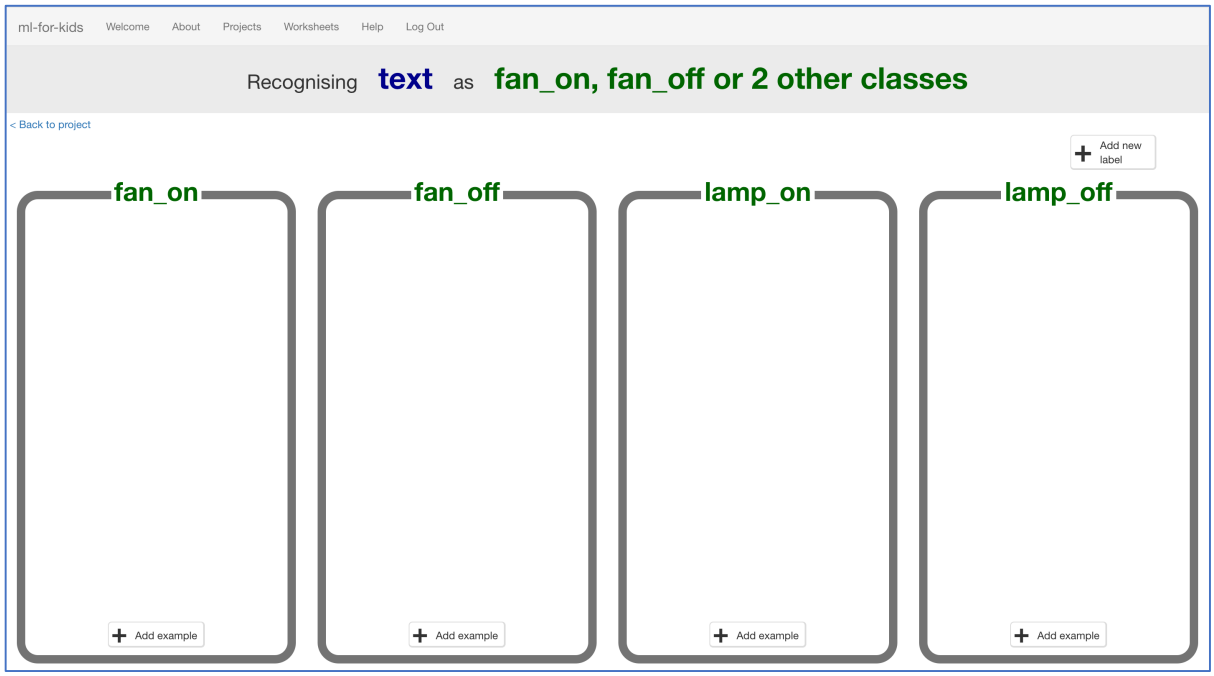
Next, we'll try a better approach – teaching the computer to recognise the commands for itself.

16. Close the Scratch window and go back to the Training tool. Click on the **< Back to project** link.

17. The first thing we need to do is collect some examples we can use to train the computer. Click on the **Train** button.



18. Click on **"+ Add new label"** and call it "fan on".
Do that again, and create a second bucket called "fan off".
Do that again, and create a third bucket called "lamp on".
Do that again, and create a fourth bucket called "lamp off".

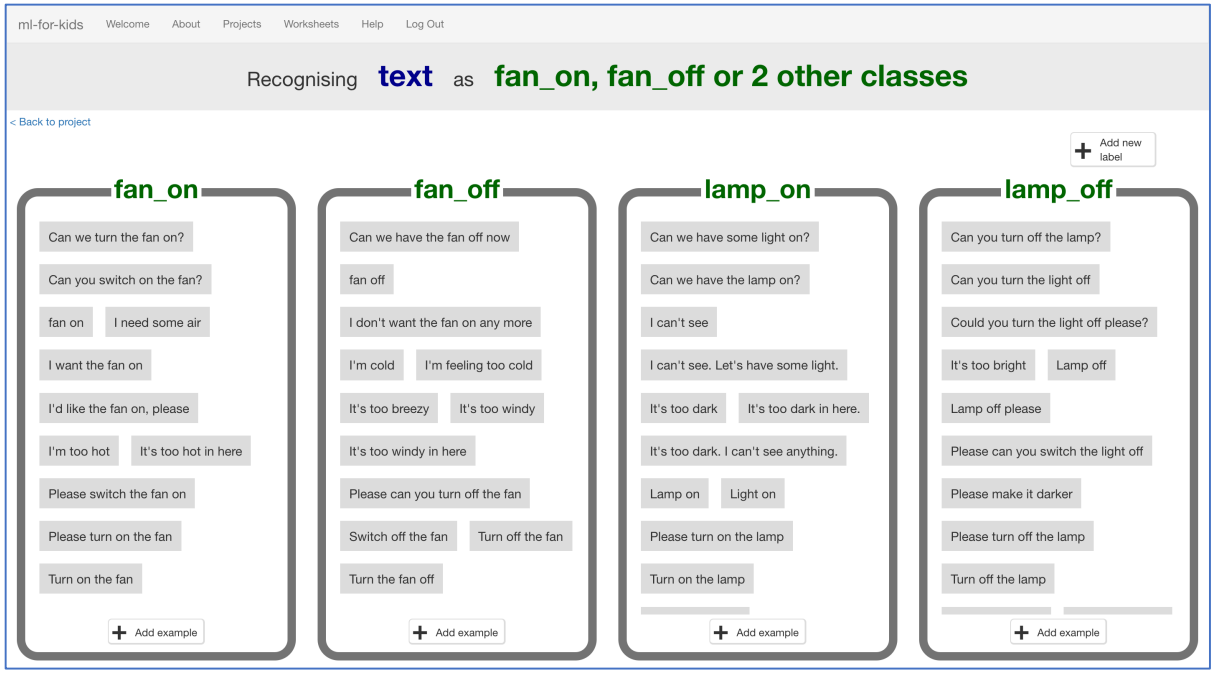


19. Click on the "**Add example**" button in the "fan on" bucket, and type in a way to ask for the fan to be turned on.
For example, you could type "Please can you switch on the fan".

20. Click on the "**Add example**" button in the "fan off" bucket, and type in a way to ask for the fan to be switched off.
For example, you could type "I want the fan off now"

21. Do the same for the "lamp on" and "lamp off" buckets.

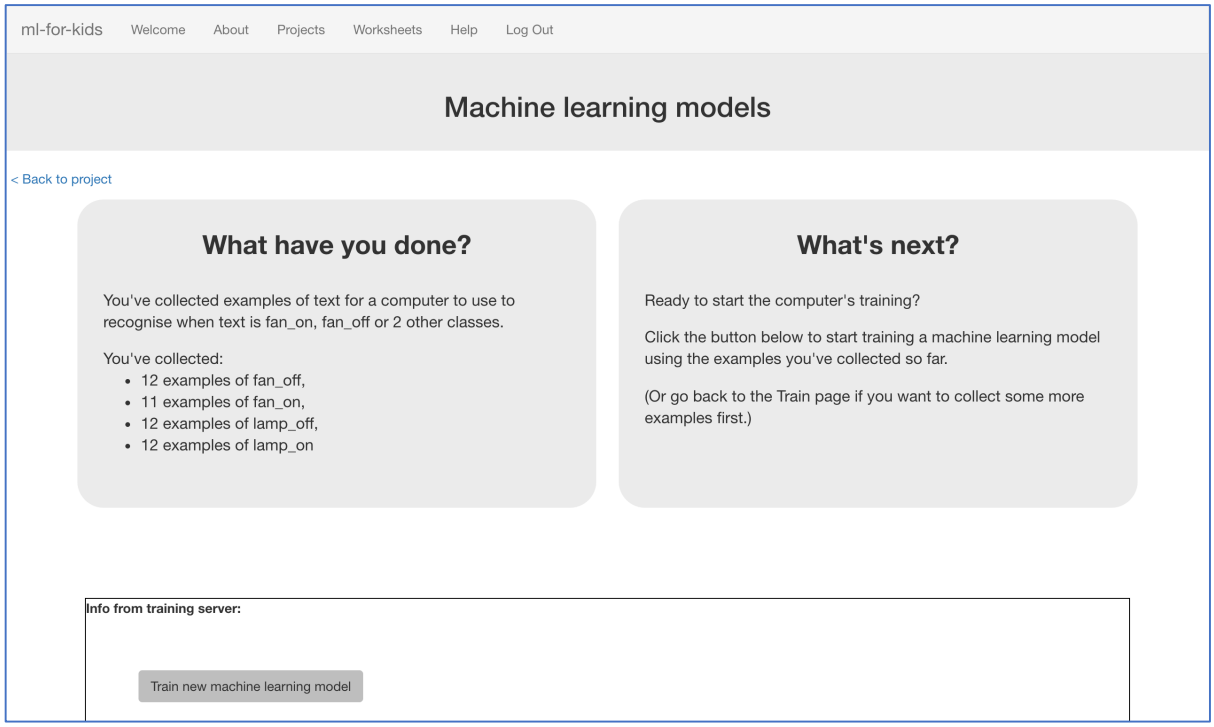
22. Repeat steps 19-21 until you've got at least six examples of each.
Be imaginative!
Try and think of lots of different ways to ask each command.
For "fan on" you could complain that you're too hot.
For "fan off" you could complain that it's too breezy.
For "lamp on" you could complain that it's too dark or that you can't see.
For "lamp off" you could complain that it's too bright.



23. Click on the "**< Back to project**" link, then click on the "**Learn & Test**" button.

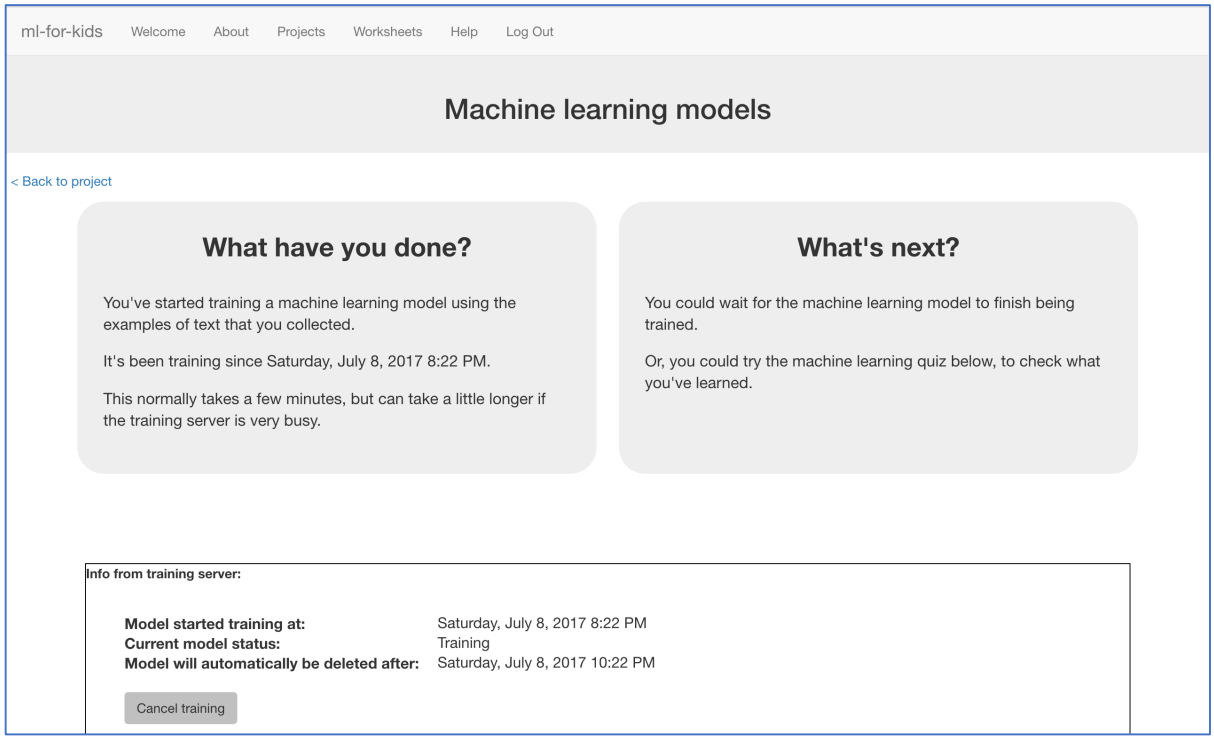
24. Click on the "**Train new machine learning model**" button.

As long as you've collected enough examples, the computer should start to learn how to recognise commands from the examples you've written.



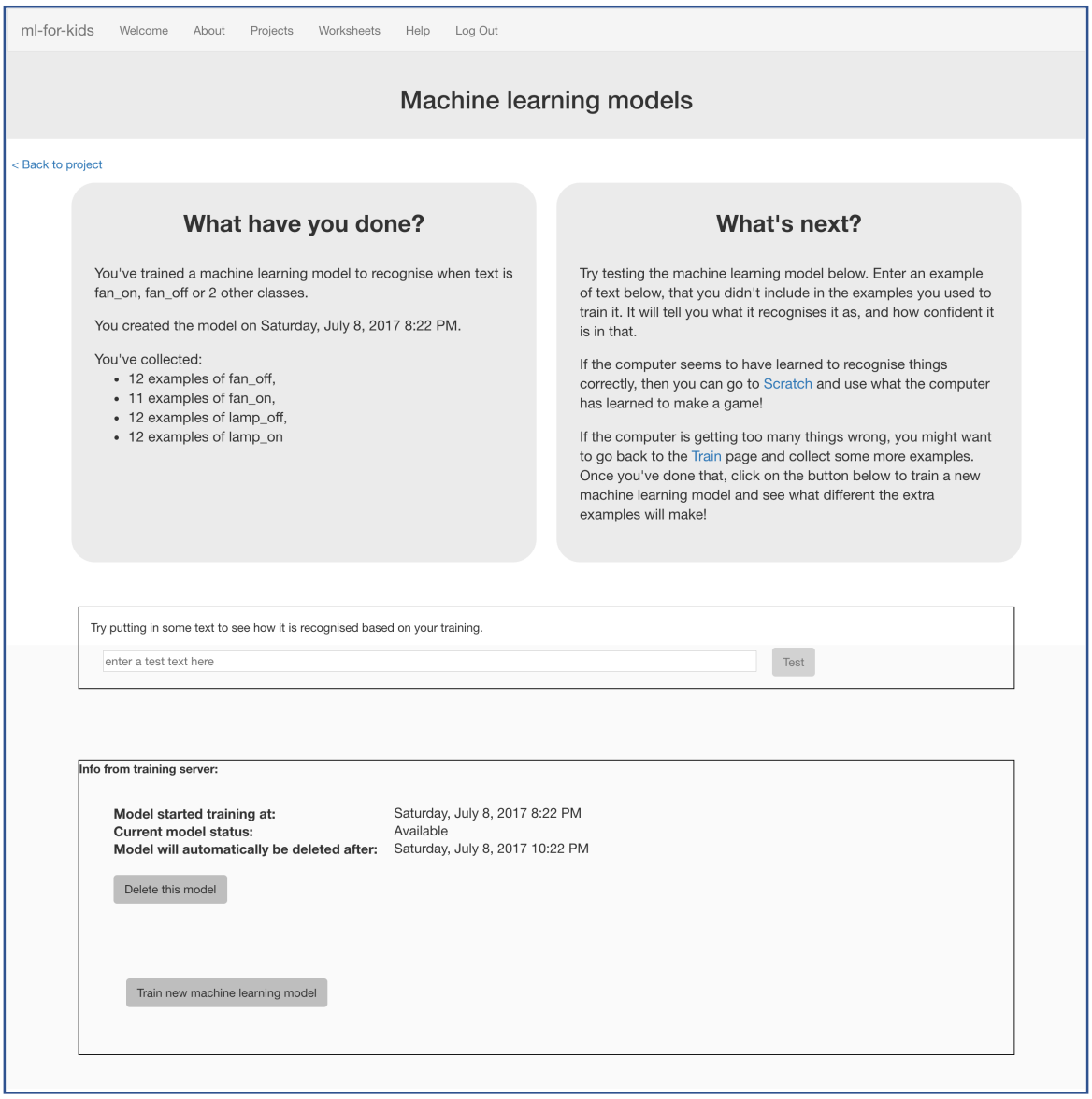
25. Wait for the training to complete. This might take a minute or two.

While waiting, try to complete the machine-learning multi-choice quiz at the bottom of the page.



26. Once the training has completed, a Test box will be displayed.
Try testing your machine learning model to see what the computer has learned.
Type in a command, and press enter. It should be properly recognised as one of the four commands.

Test it with examples that you haven't shown the computer before.
If you're not happy with how the computer recognises the messages, go back to step 19, and add some more examples.
Make sure you repeat step 24 to train with the new examples though!



What have we done so far?

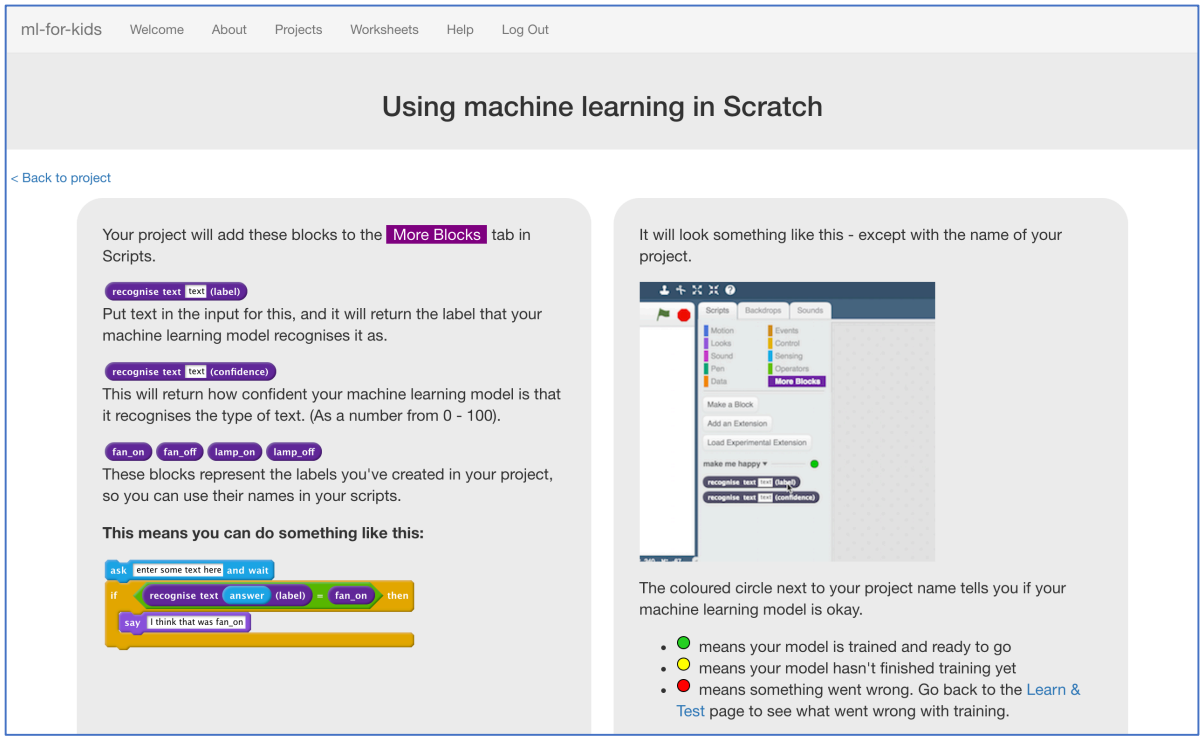
You've started to train a computer to recognise commands to control two classroom devices. Instead of trying to write rules to be able to do this, you are doing it by collecting examples. These examples are being used to train a machine learning "model".

This is called "supervised learning" because of the way you are supervising the computer's training.

The computer will learn from patterns in the examples you've given it, such as the choice of words, and the way sentences are structured. These will be used to be able to recognise new commands.

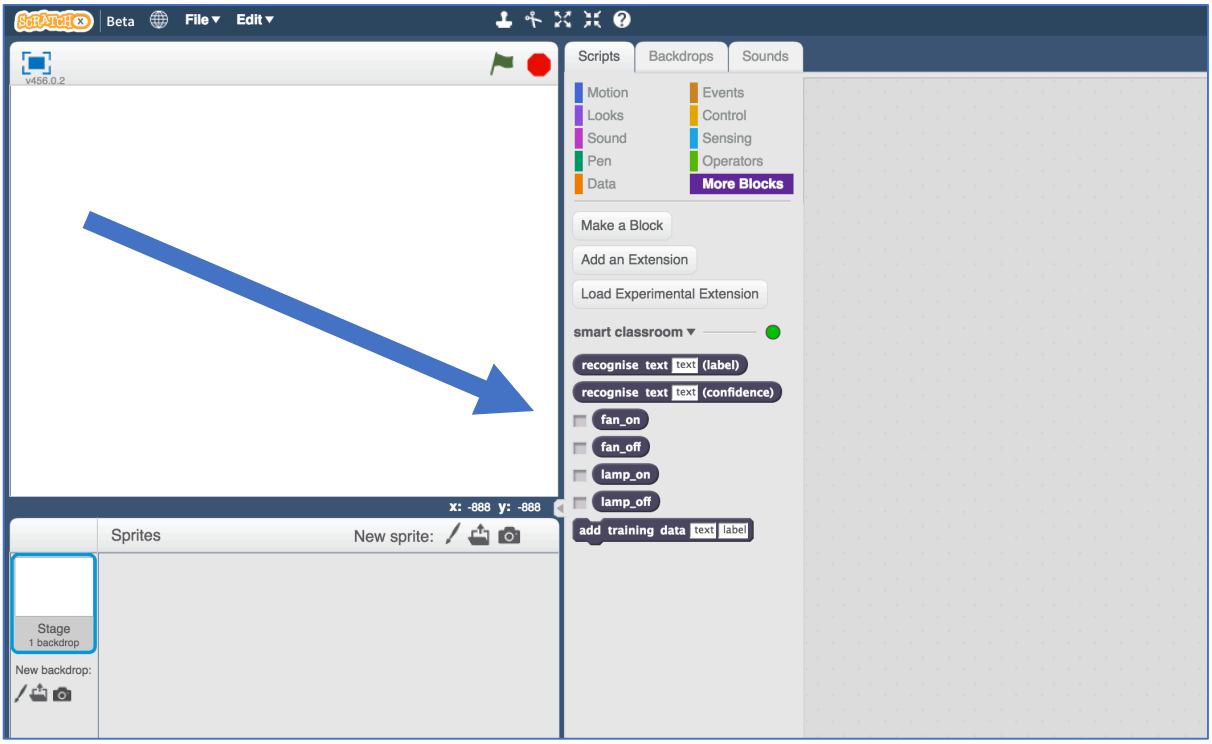
27. Click on the **"< Back to project**" link, then back to the "**Scratch**" button.

This page will be updated with instructions on how to use the new blocks in Scratch from your project. Keep this page open so can check back on how to use them.



28. Click on the "**Open in Scratch**" button at the bottom of that page to launch the Scratch editor.

You should see new blocks in the "More blocks" section from your "smart classroom" project.



29. Load the Scratch project you saved before.

*Click on **File** -> **Load Project***

Tips

More examples!

The more examples you give it, the better the computer should get at recognising your instructions.

Try and be even

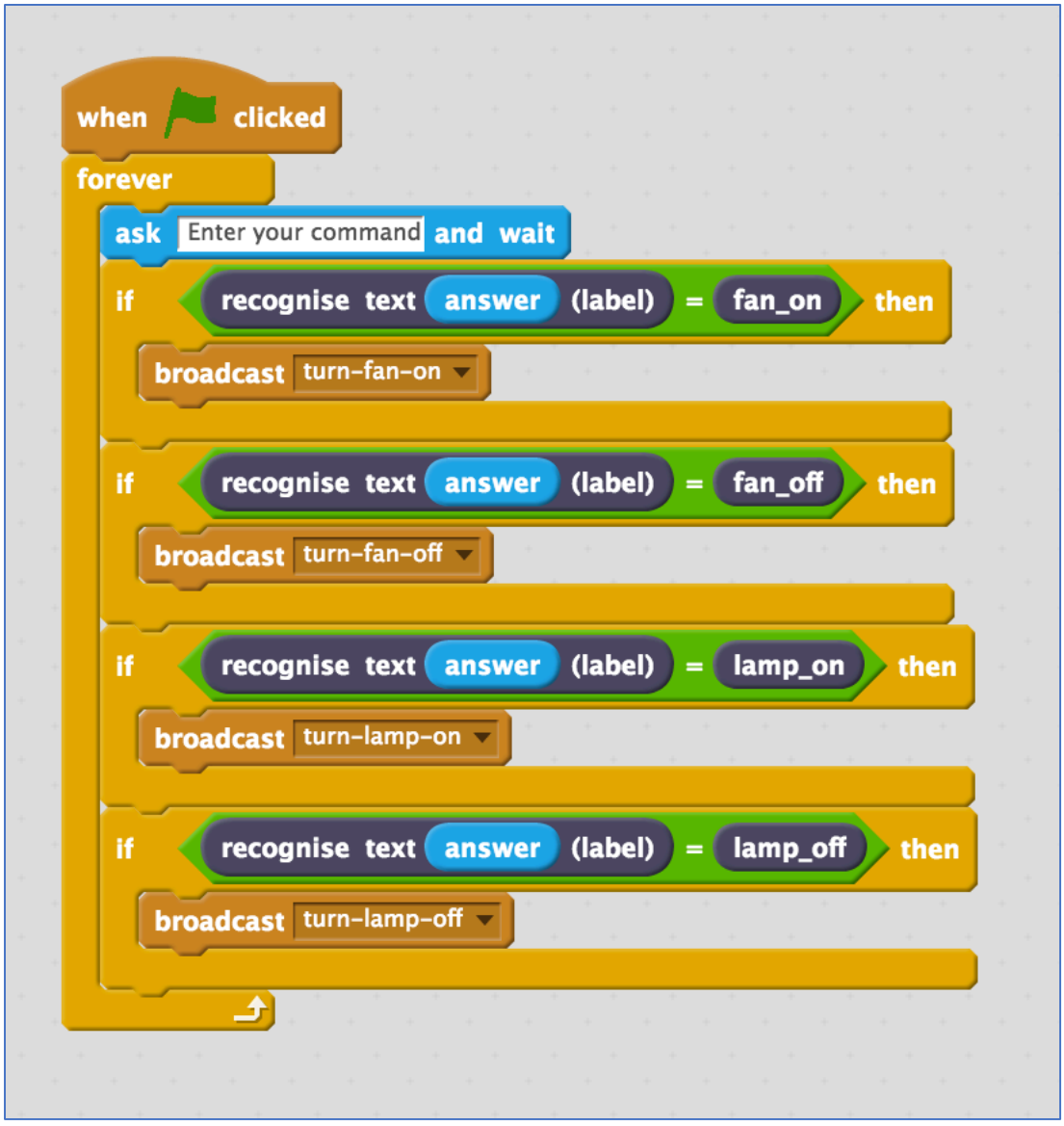
Try and come up with roughly the same number of examples for each command.

If you have a lot of examples for one command, and not the others, the computer might learn that command is more likely, so you'll affect the way that it learns to recognise messages.

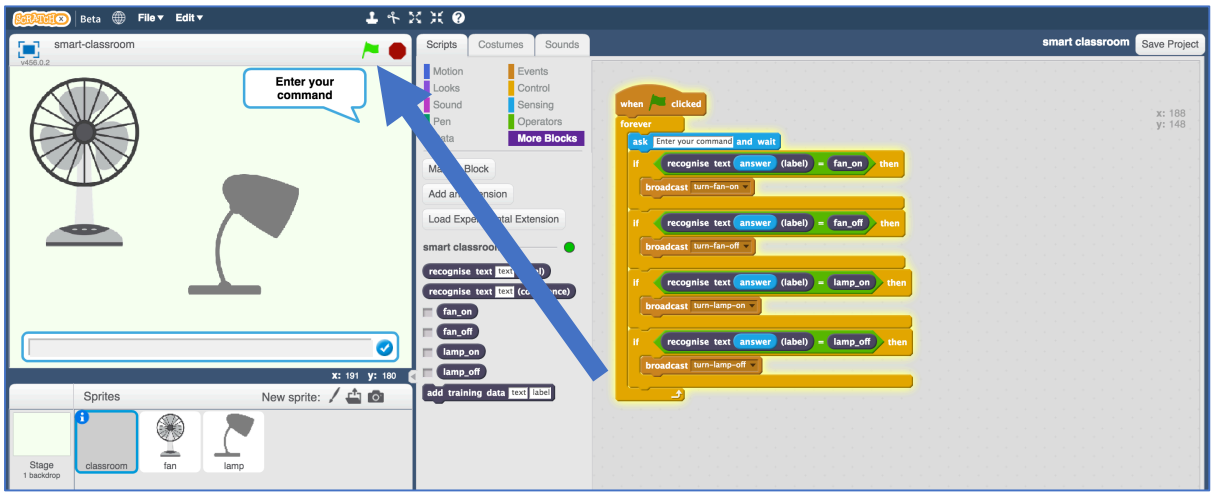
Mix things up with your examples

Try to come up with lots of different types of examples.
For example, make sure that you include some long examples and some very short ones.

30. Click on the "**Scripts**" tab, and update the script to use your machine learning model instead of the rules you made before.
The "recognise text … (label)" block is a new block added by your project. If you give it a text message, it will return the label for one of the four commands based on the training you've given to the computer.



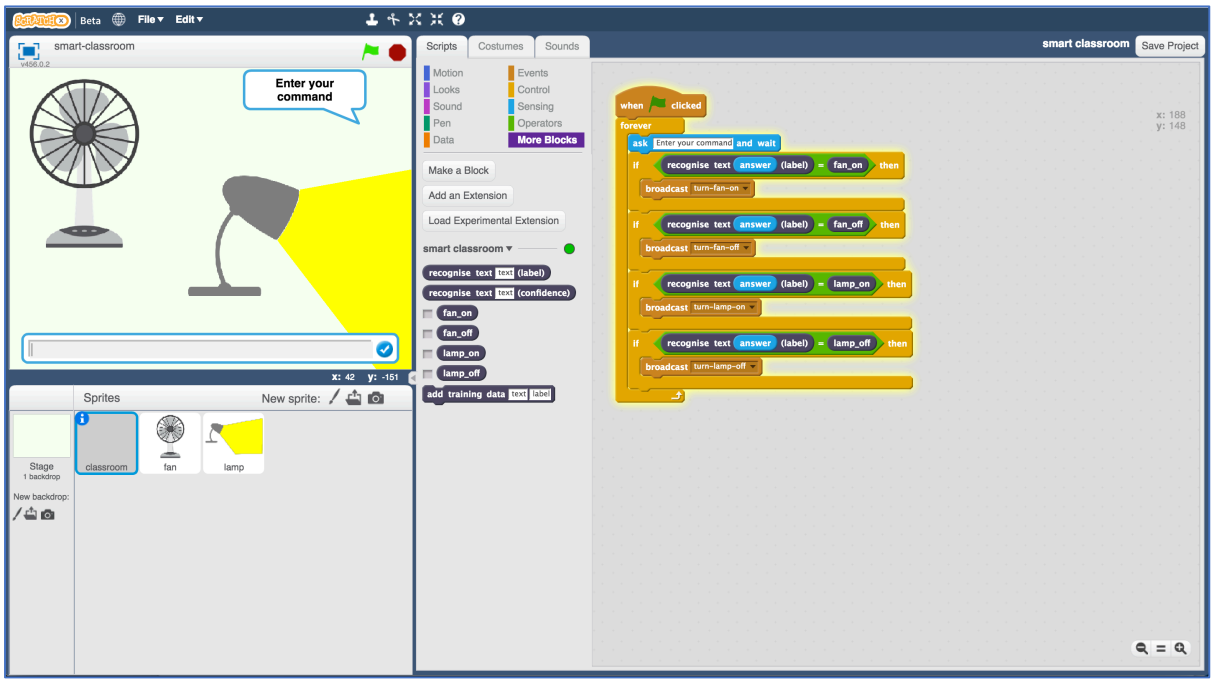
31. Click on the **green flag** to test again.



32. Test your project

Type a command and press enter. The fan or lamp should react to your instructions.

*Make sure you test that this works **even for messages that you didn't include in your training**.*



33. Save your project.

File -> Save Project

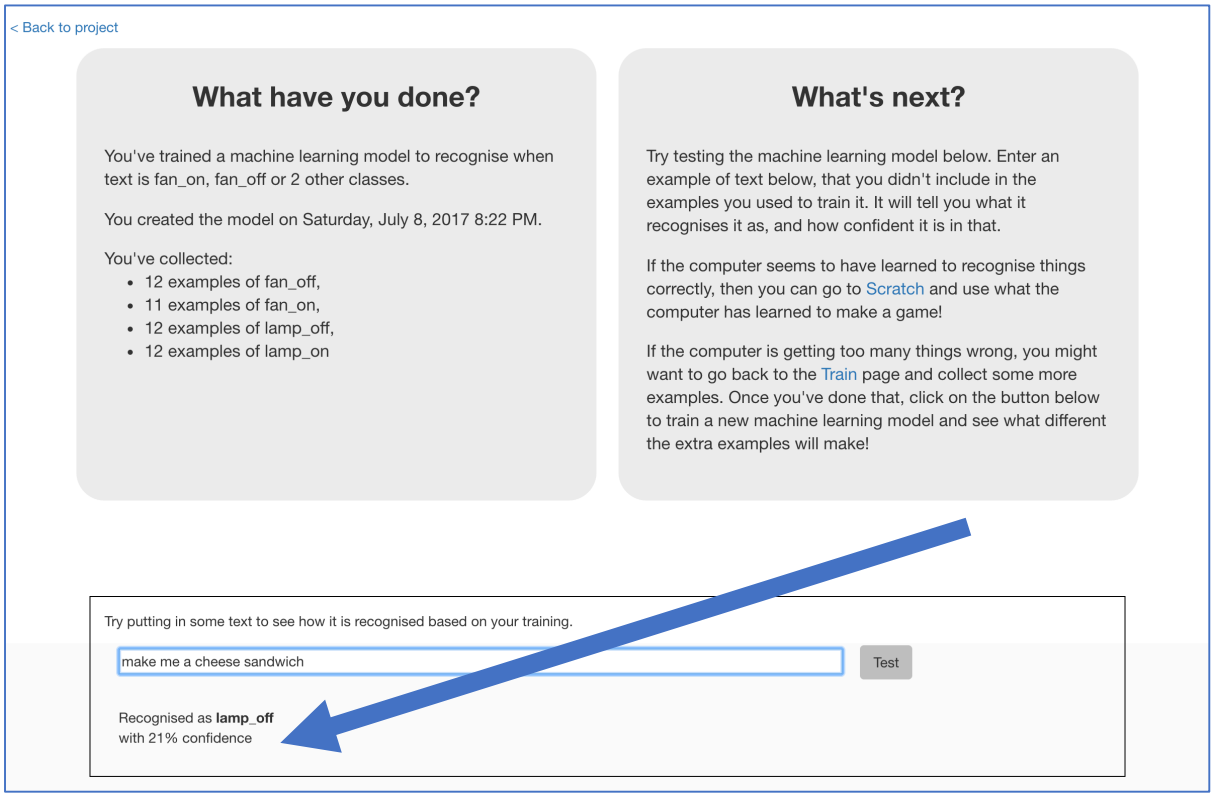
What have we done so far?

You've modified your Scratch smart classroom assistant to use machine learning instead of your earlier rules-based approach.

Training the computer to be able to recognise instructions for itself should be much quicker than trying to make a list of every possible command.

The more examples you give it, the better it should get at recognising instructions correctly.

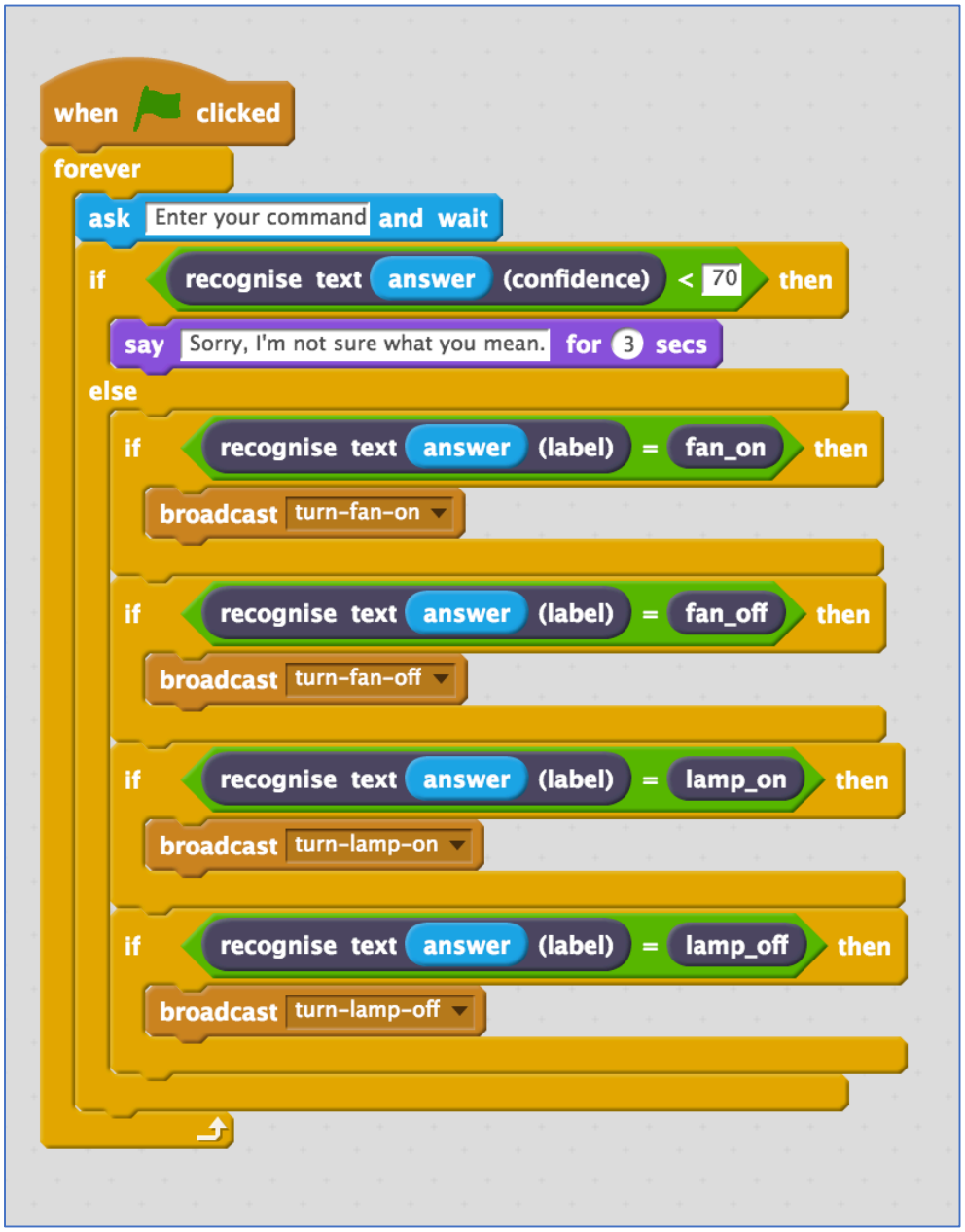
34. Leave Scratch open (we'll come back in a moment) but go back to the **Learn & Test** page.
Type a message into the Test box that has nothing to do with lamps or fans.
For example, "make me a cheese sandwich"



35. Look at the confidence score, and check it's very low. Compare this with the score you get from commands like "turn on the lamp".
This is the computer's way of telling you that it's not very certain it understands your command, because it doesn't look like what it learned from your examples.

36. Go back to Scratch.
Open your saved project from before if you closed the window.

37. Modify the script for the "classroom" sprite so that it uses this confidence score.



38. Save your project

You've finished!

What have we done?

You've trained a smart assistant – like a simple version of the assistants you can get on modern smartphones.

You've used it to create a smart classroom assistant in Scratch, using machine learning instead of your earlier rules-based approach.

Training the computer to be able to recognise instructions was hopefully much easier than trying to make a list of every possible command. And the more examples you give it, the better it gets at recognising instructions and the more confident it gets in doing that.

And in the meantime, while your system is still learning, if it's not sure what you mean, it will ask you to try again.

Ideas and Extensions

Now that you've finished, why not give one of these ideas a try?

Or come up with one of your own?

Try another device

Instead of just a fan and a lamp, can you add another device to your smart classroom?

Try different confidence limits

Is 70% the right threshold to use to decide whether the computer has recognised the command?

Experiment with different values until you have a value that works well for your machine learning model.

If you choose a number that is too high, the computer will say "Sorry I'm not sure what you mean" too often.
If you choose a number that is too low, the computer will get too many things wrong.