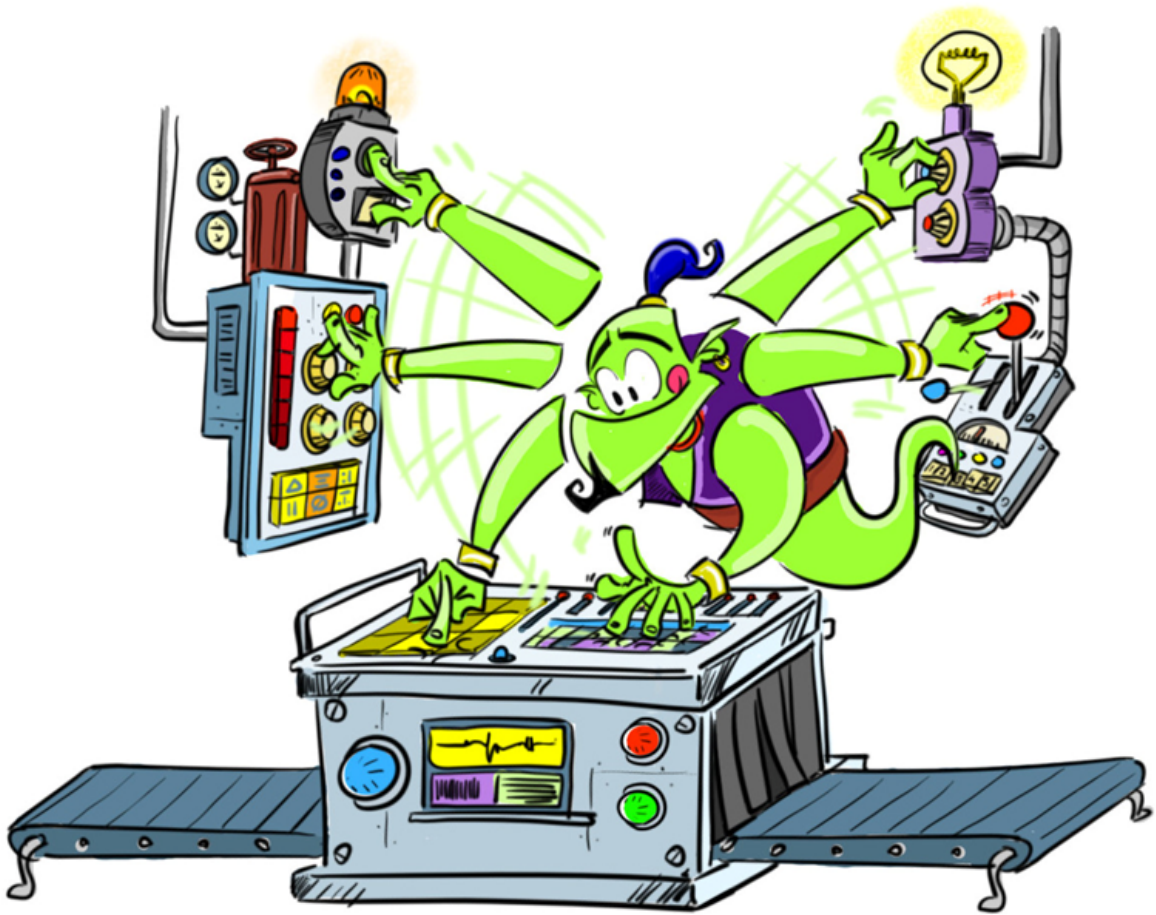


Learning ML User Manual



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1. Introduction

LearningML is a web platform for teaching and learning about Machine Learning. This platform consists of a complete tool that can be used to create models for Machine Learning and to program applications that use these models. Learning while doing is the main pedagogical idea on which LearningML is based.

2. Description

LearningML consists of 3 building blocks:

- A web page containing all information about the tool: <https://learningml.org>
- The application itself (the LearningML editor): <https://learningml.org/editor> or click “start” on the web page.
- A programming tool to create applications that use the models created by the LearningML editor: <https://learningml.org/scratch>

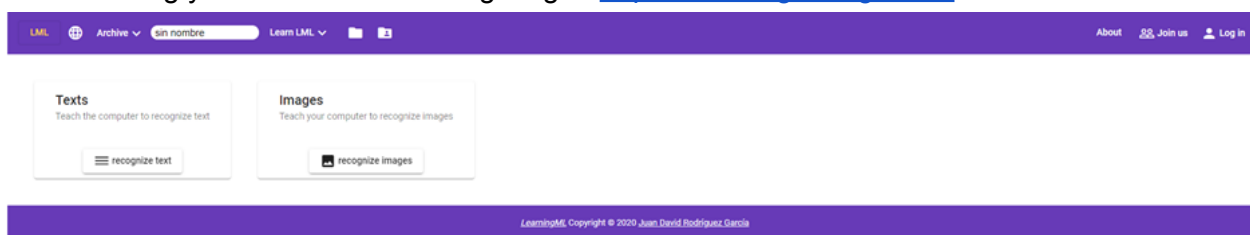
A beta version of the editor can be accessed from the web page or directly via <https://beta.learningml.org/editor/>.

3. Learning ML editor

The LearningML editor (accessible via <https://learningml.org/editor>) is the online tool for building Machine Learning models using labelled data.

Main menu

The first thing you will see when navigating to <https://learningml.org/editor> is



The taskbar contains the following elements:

- **LML:** At any time this button will take you back to the initial screen, shown in the screenshot.
- **Choose language:** Change language.
- **Archive:**
 - **New:** Create new projects.
 - **Save your account:** Save the project in your LearningML account.
 - **Save a copy to your account:** Save a copy of the project in your LearningML account. This is useful when someone has shared a project with

you. This way you can have your own copy on which you can work without modifying the original project.

- **Upload from your computer:** Open a project that is saved locally on your computer.
- **Save to your computer:** Save the project locally on your computer.
- **Textbox:** Shows the name of the project you are working on.
- **Learn LML:** Contains links (tutorials, manuals).
- **Open my projects:** Open your projects saved in your LearningML account.
- **Open shared projects:** Open shared projects saved in your LearningML account.
- **About**
- **Join us:** Create a LearningML account.
- **Log in:** Log in to your LearningML account.

In the beta version you will also find a button to toggle the advanced mode. In this mode some interesting graphs will be shown that give more insight into how the algorithms work.

You can create two (three in the beta version) types of Machine Learning models:

- Models that recognize text
- Models that recognize images
- Models that recognize numbers (only in beta version)


The tool can be used without creating an account. The main restriction is that you can only save projects locally on your computer. If you want to save projects in the cloud or use shared projects, you will need a LearningML account.

Create an account

To create an account you click on “Join us”. The application will ask for a user name, a password, an email address, your birthday and gender.

Username and password

Choose a username and password to create your account. Make sure it doesn't match your real name.



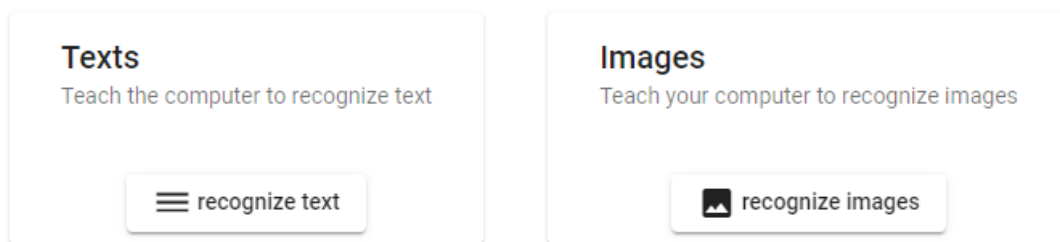
- 1 That username is already taken
- do not use your real na...
- password *
- Following
- 2 Your email address
- 3 When you were born?
- 4 Girl or boy?
- 5 Ready!

It is recommended to not use your real name as a user name. On the other hand, a valid email address is mandatory since it will be used for activating your account and also to contact you if there are any problems with your account. The data on gender and age are used for research on the use of the tool.

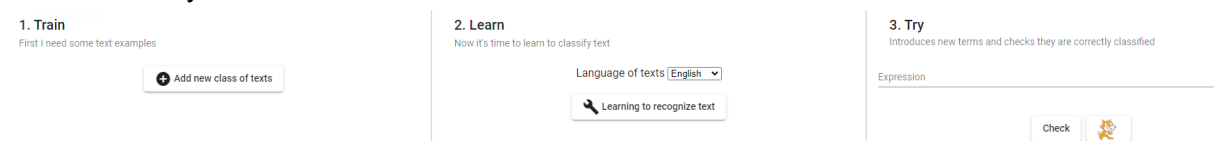
Once you have registered you can save your projects in the cloud and you can use all functionality of the application.

Text recognition

If you want to create models for text recognition, you have to click on “recognize text”.



This will take you to the next view:



You can see three sections which correspond with the three phases in Machine Learning:

1. Train
2. Learn
3. Try

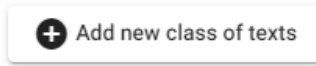
Train

Train means adding examples of texts you want to be able to recognize. This is the first step in creating a Machine Learning model. Here you can add classes or labels: the names of the types of texts you want to recognize. For example if you want to detect whether statements are pro or anti vaccine you add one label for each class: “pro-vaccine” and “anti-vaccine”

To create a new class, you click on “Add new class of texts”

1. Train

First I need some text examples



You can now add a new class:

Enter the label

Okay

Cancel

After creating the different classes, you have to add examples for each class. Using these examples the application will learn how to classify new but similar phrases.

1. Train

First I need some text examples

+ Add new class of texts

Anti-vaccine (9)

Vaccines are bad.

Vaccines do not protect us.

Vaccines are not effective.

Vaccines are not safe.

Vaccines are dangerous.

▲
▼

+ -

Pro-vaccine (11)

Vaccines are not bad.

Vaccines do not cause hepatitis.

Vaccines do not cause autism.

Vaccines do not cause AIDS.

Vaccines do not cause fatal side effects.

▲
▼

+ -

It is recommended to add at least 10 examples for each class in order for the algorithm to construct a good model.

You can remove texts by clicking on one and confirming that you want to remove the text.


Learn

When you have a sufficient number of examples, you can execute the Machine Learning algorithm which will learn how to classify similar texts as the ones in the examples. You can do this by clicking on “Learning to recognize text”. This step might take some time since it is computationally hard. During the learning phase, you will see an animation. The application will send a notification when it has ended.

2. Learn

Now it's time to learn to classify text

Language of texts

 Learning to recognize text

Learning from data

wait please



Try

You have trained a model that can classify texts that are similar to the ones you added as examples. You can now test it by simply writing a text and clicking on “Check”. The tool will classify the text and will also show for each class the probability that the text belongs to that class.

3. Try

Introduces new terms and checks they are correctly classified

Expression

Vaccines are safe.

Check



Believe belongs to the class Pro-vaccine, but I am not sure

- Pro-vaccine (61.15 %)
- Anti-vaccine (38.85 %)

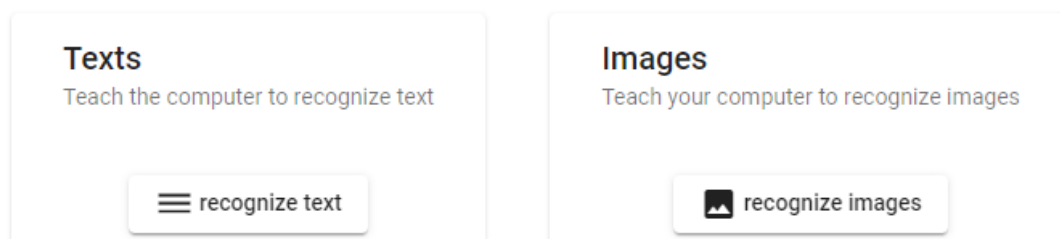
You can always improve the model by adding more examples and retrain the model. You can repeat this process as many times as you want.

In order not to lose the data, you can save the project locally on your computer or in the cloud using your LearningML account. Once you have saved it, you can repeat the three steps and keep improving your model.

Once you have a model, you can also create a program that uses it. We will explain how to do that in the section [Programming Platform](#).

Image recognition

To create models for classifying images, you can go back to the start page (button “LML”) and click on “recognize images”.



The process of creating such a model is analogous to text recognition. It comprises the same three phases: train, learn and test. The only difference is that here we are not uploading text but images. You can add images to classes in two ways: by uploading images from your computer or by using your webcam. You can add both types of images to the same class.

Once you have added the images, you will notice that the learning phase takes longer than for text. This is normal, the computational cost is even higher than for text.

Finally, you can test your model using images uploaded from your computer or by using the webcam.

Recognition of numbers

In the beta version you can also work with numeric data: data in tabular form like in a spreadsheet. On the LearningML startpage you choose “recognize numbers”.

The steps are the same as for the previous types of models: you provide examples (train), then the Machine Learning algorithm is executed (learn) and then you test the model (test). Optionally, you can create a program that uses the model.

Let us consider an example in which we want to recognize flowers that belong to three different iris species: “iris virginica”, “iris versicolor” and “iris setosa”. To create such a model we will use a dataset¹ containing information about sepal length, sepal width, petal length,

¹ This dataset was used in R.A. Fisher’s classic 1936 paper The Use of Multiple Measurements in Taxonomic Problems.

petal width. It includes 50 samples of each iris species and has been added in [Appendix A](#), you can also download it from the [UCI Machine Learning Repository](#).

Take a look at the dataset: each example contains four columns for the so-called features (sepal length, sepal width, petal length, petal width) and one label or class (iris virginica, iris versicolor and iris setosa):

SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
5.1	3.5	1.4	0.2	iris-setosa

In the LearningML app you need to specify the number of columns you want to learn from, in this case we have four.

1. Train

First I need some example numbers

Number of columns

4

+ Add new class of numbers

Next we add the three different classes:

+ Add new class of numbers

Iris-setosa (0)

+ 

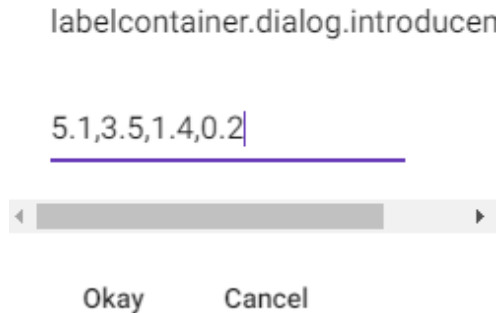
Iris-versicolor (0)

+ 

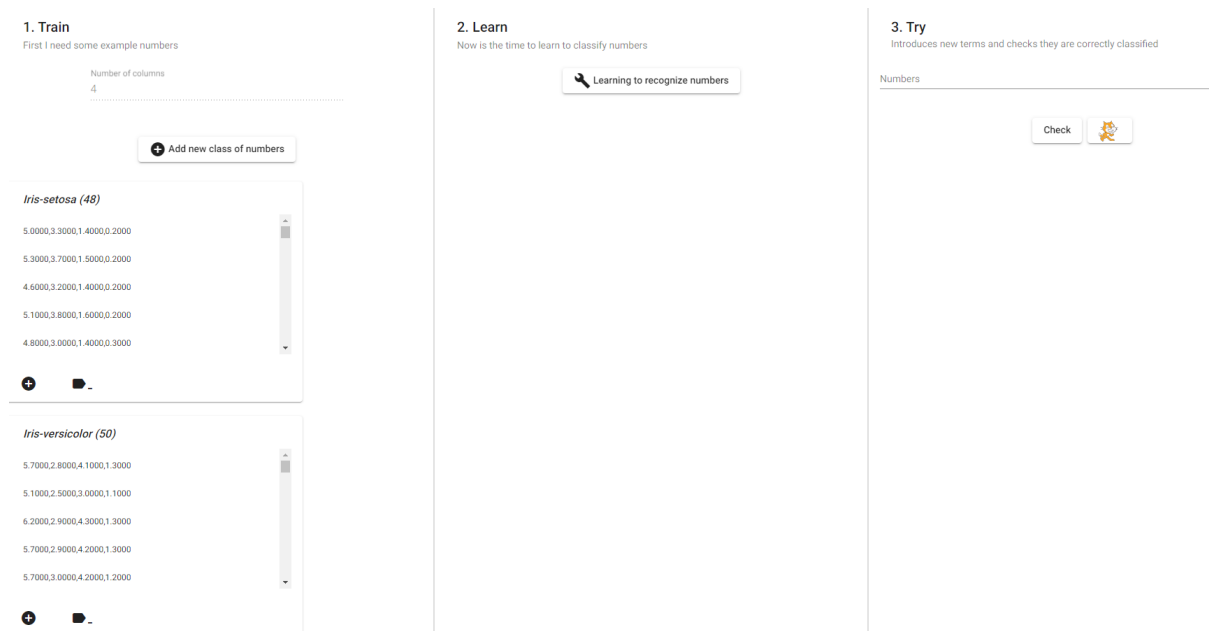
Iris-virginica (0)

+ 

Finally, we can add the different examples to each of the three classes. It is important that each example contains exactly four numbers. You have to separate these numbers using commas. For example, for the first example of iris setosa, you add:



When all data have been introduced we get something like this:



Note that duplicate rows have been automatically removed by the application.

You can now click on “Learning to recognize numbers” to train a model after which you can test the model on new unseen examples:

3. Try

Introduces new terms and checks they are correctly classified

Numbers

5.1,3.6,1.5,0.4

Check

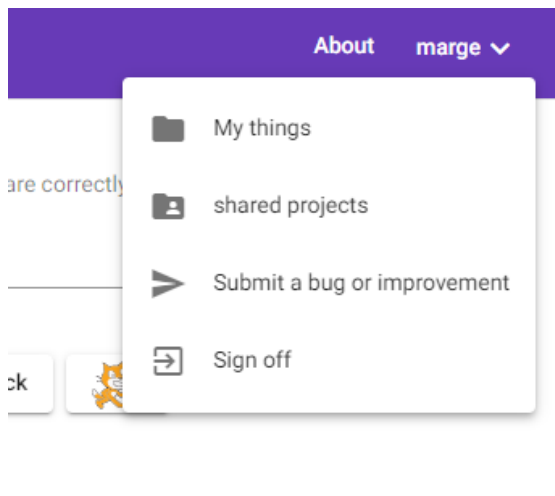


I am pretty sure that belongs to the class Iris-setosa

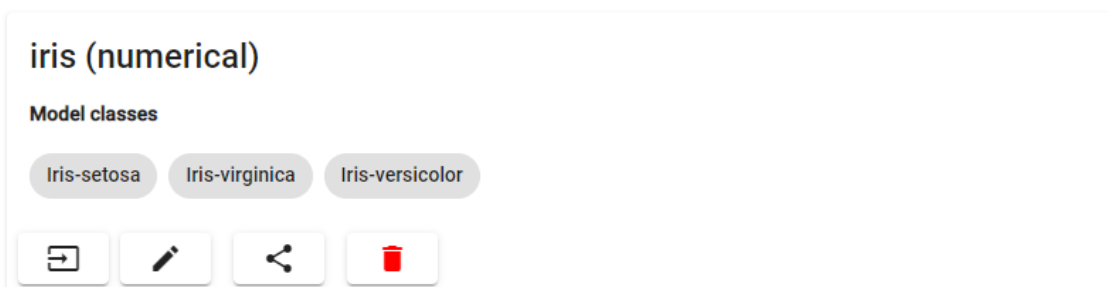
- Iris-setosa (99.89 %)
- Iris-versicolor (0.11 %)
- Iris-virginica (0.00 %)

My projects

If you have a LearningML account you can save your projects in the cloud and access them from different computers. You can find your projects under “My things”:



For every project you can see its name, type, description and its classes.



There are four operations:

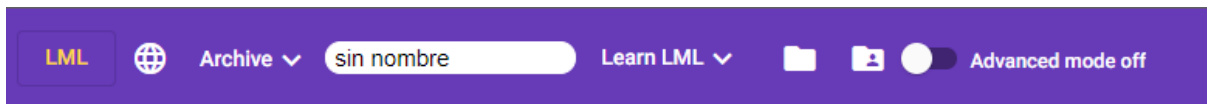
- Load the project
- Edit the project
- Share the project (if already shared, stop sharing). This allows you to share projects with anyone that has a LearningML account.
- Delete the project

Shared projects

If you have a LearningML account you can access projects shared by other users.

Advanced mode

Currently the advanced mode is only available in the beta version.



You can activate the advanced mode by clicking on the button. When advanced mode is turned on, you have more control of the Machine Learning algorithm.

Select Machine Learning algorithm

First of all you can choose the algorithm that will construct the model. The current options are “neural network” and “KNN” (K-nearest neighbours).

Every Machine Learning algorithm has specific parameters that can be set. You can play and test by setting these parameters to different values and see how it influences the performance of the resulting model.

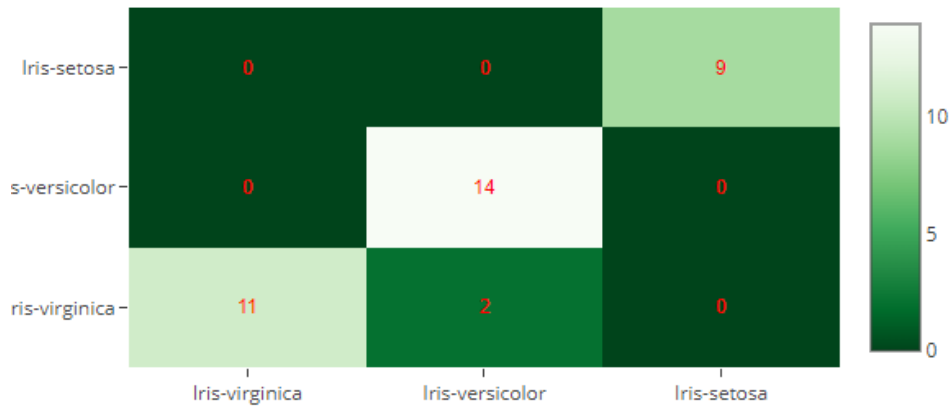
For “KNN” there is only one parameter: the number of nearest neighbours. If you choose neural network, the parameters are

- Epochs
- Batch size
- Learning rate

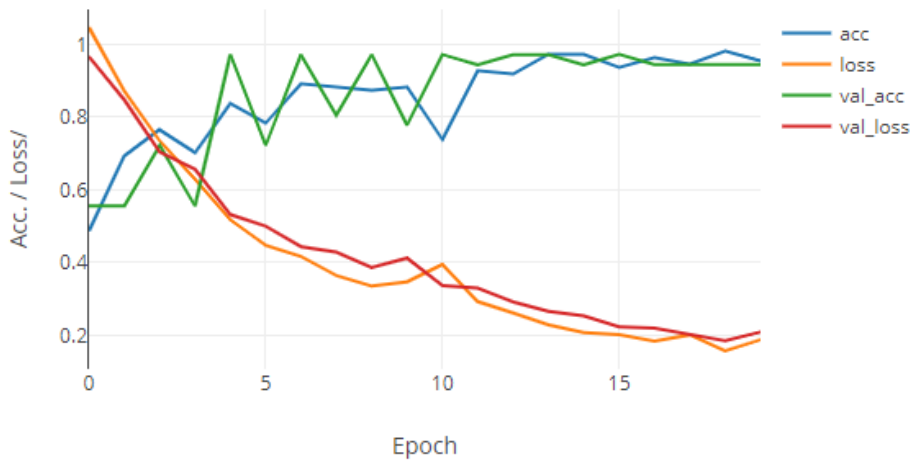
The meaning of these parameters lies outside of the scope of this manual.

If you set “Percentage of samples for validation” to a number higher than 0, after training the model you will see a confusion matrix. This matrix gives an idea of how well the model does: it has been created using a percentage of the samples as test samples and the results of real class vs predicted class are shown in the matrix. Additionally, when selecting a neural network, a graph with the evolution of the learning process is shown:

Confusion matrix



Learning evolution

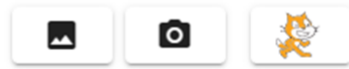


4. Programming platform

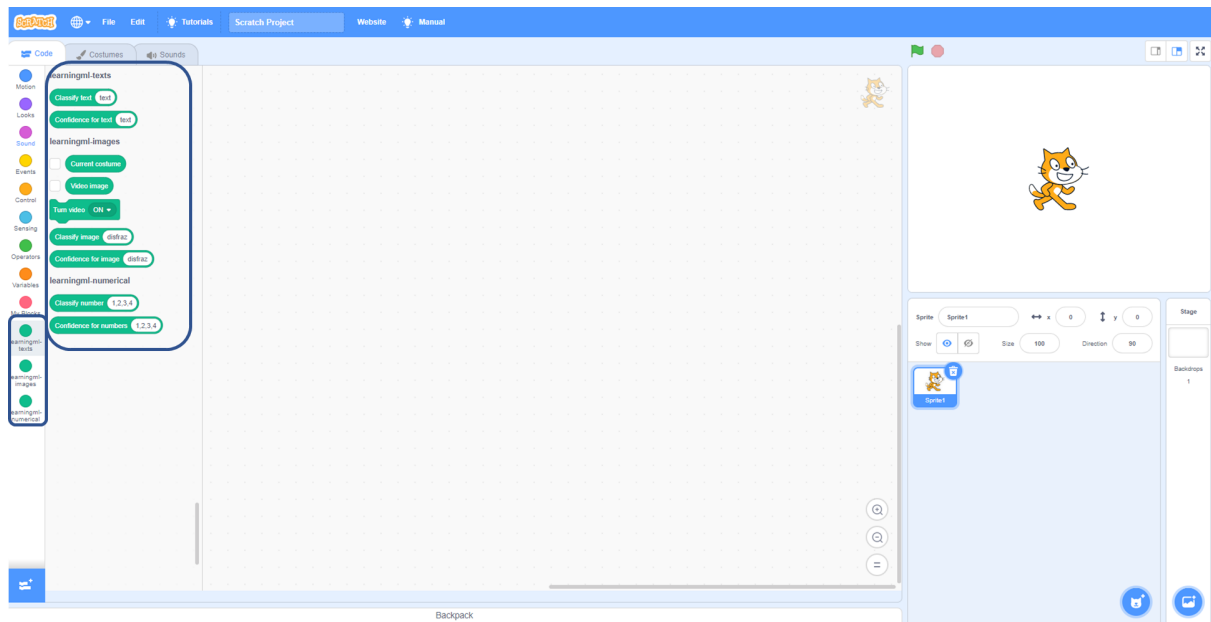
Our programming platform is a modification of Scratch (<https://scratch.mit.edu/>) in which we have added some new blocks allowing us to use models created in the LearningML editor. You access the platform by clicking on the Scratch icon once the model has been trained.

3. Try

Introduces new terms and checks they are correctly classified





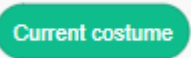

A new window will open and you will see extra blocks that have been added to Scratch in order to work with the trained model.



Blocks for recognition of images

These blocks can be found in “learningml-images”

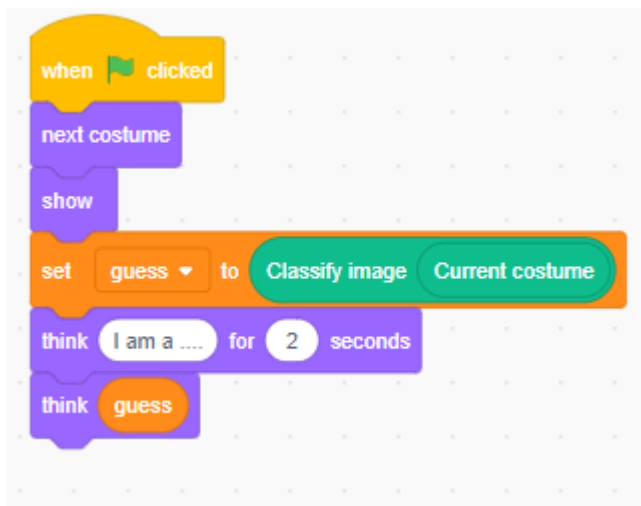
	<p>This block returns the classification for the argument “disfraz” (Spanish for “costume”) according to the model. The argument can be:</p> <ul style="list-style-type: none"> • The number of the costume you want to classify. • The current costume • An image taken by a webcam, represented by
	<p>This block returns the probability the model has for the classification of “disfraz”. The argument can be:</p> <ul style="list-style-type: none"> • The number of the costume you want to classify. • The current costume

	<ul style="list-style-type: none"> An image taken by a webcam, represented by 
	<p>With this command you can</p> <ul style="list-style-type: none"> Activate the webcam Activate the webcam but mirrored Deactivate the webcam
	This block returns the currently active costume.
	This block returns the image taken by the webcam.

Example

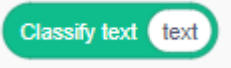
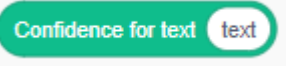
Suppose you have uploaded several images in costumes, the following script then does the following:

- Whenever the flag is clicked on
- A next costume will be taken randomly
- It will be placed on the screen
- A variable “guess” will be set to the classification of that costume
- A thought bubble “I am a ...” will be shown for 2 seconds.
- A thought bubble containing the value of “guess” will be shown



Blocks for recognition of text

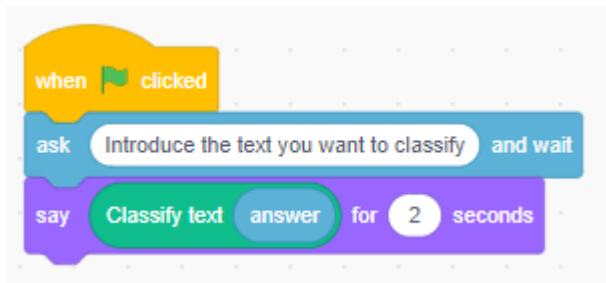
These blocks can be found in “learningml-texts”

	This block returns the classification for the argument “text” according to the model.
	This block returns the probability the model has for the classification of “text”.

Example

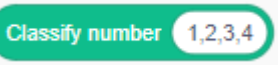
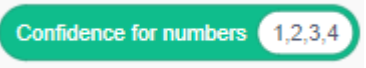
The following script then does the following:

- Whenever the flag is clicked on
- You will be asked to write a text
- A speech bubble will be shown with the classification for the answer given in the previous step during 2 seconds



Recognition of numbers

In the beta version you will also have a section “learningml-numerical” containing the following blocks:

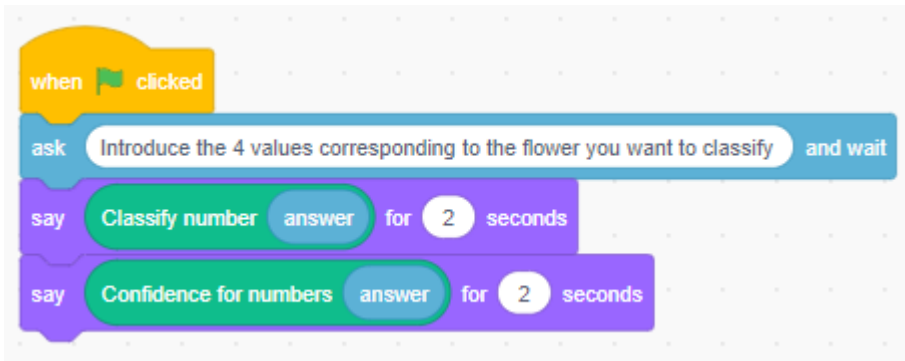
	This block returns the classification for an argument containing a vector of numbers according to the model.
	This block returns the probability the model has for the classification of a vector of numbers.

Example

The following script then does the following:

- Whenever the flag is clicked on
- You will be asked to give 4 values that represent a flower (here we are referring to the iris example we saw earlier)
- A speech bubble will be shown with the classification for the answer given in the previous step during 2 seconds

- A speech bubble will be shown with the probability of that classification during 2 seconds



Appendix A: Iris dataset

SepalLengthCm,SepalWidthCm,PetalLengthCm,PetalWidthCm,Species

5.1,3.5,1.4,0.2,Iris-setosa
4.9,3.0,1.4,0.2,Iris-setosa
4.7,3.2,1.3,0.2,Iris-setosa
4.6,3.1,1.5,0.2,Iris-setosa
5.0,3.6,1.4,0.2,Iris-setosa
5.4,3.9,1.7,0.4,Iris-setosa
4.6,3.4,1.4,0.3,Iris-setosa
5.0,3.4,1.5,0.2,Iris-setosa
4.4,2.9,1.4,0.2,Iris-setosa
4.9,3.1,1.5,0.1,Iris-setosa
5.4,3.7,1.5,0.2,Iris-setosa
4.8,3.4,1.6,0.2,Iris-setosa
4.8,3.0,1.4,0.1,Iris-setosa
4.3,3.0,1.1,0.1,Iris-setosa
5.8,4.0,1.2,0.2,Iris-setosa
5.7,4.4,1.5,0.4,Iris-setosa
5.4,3.9,1.3,0.4,Iris-setosa
5.1,3.5,1.4,0.3,Iris-setosa
5.7,3.8,1.7,0.3,Iris-setosa
5.1,3.8,1.5,0.3,Iris-setosa
5.4,3.4,1.7,0.2,Iris-setosa
5.1,3.7,1.5,0.4,Iris-setosa
4.6,3.6,1.0,0.2,Iris-setosa
5.1,3.3,1.7,0.5,Iris-setosa
4.8,3.4,1.9,0.2,Iris-setosa
5.0,3.0,1.6,0.2,Iris-setosa
5.0,3.4,1.6,0.4,Iris-setosa
5.2,3.5,1.5,0.2,Iris-setosa
5.2,3.4,1.4,0.2,Iris-setosa
4.7,3.2,1.6,0.2,Iris-setosa
4.8,3.1,1.6,0.2,Iris-setosa
5.4,3.4,1.5,0.4,Iris-setosa
5.2,4.1,1.5,0.1,Iris-setosa
5.5,4.2,1.4,0.2,Iris-setosa
4.9,3.1,1.5,0.1,Iris-setosa
5.0,3.2,1.2,0.2,Iris-setosa
5.5,3.5,1.3,0.2,Iris-setosa
4.9,3.1,1.5,0.1,Iris-setosa
4.4,3.0,1.3,0.2,Iris-setosa
5.1,3.4,1.5,0.2,Iris-setosa
5.0,3.5,1.3,0.3,Iris-setosa
4.5,2.3,1.3,0.3,Iris-setosa
4.4,3.2,1.3,0.2,Iris-setosa

Version of January 2023

5.0,3.5,1.6,0.6,Iris-setosa
5.1,3.8,1.9,0.4,Iris-setosa
4.8,3.0,1.4,0.3,Iris-setosa
5.1,3.8,1.6,0.2,Iris-setosa
4.6,3.2,1.4,0.2,Iris-setosa
5.3,3.7,1.5,0.2,Iris-setosa
5.0,3.3,1.4,0.2,Iris-setosa
7.0,3.2,4.7,1.4,Iris-versicolor
6.4,3.2,4.5,1.5,Iris-versicolor
6.9,3.1,4.9,1.5,Iris-versicolor
5.5,2.3,4.0,1.3,Iris-versicolor
6.5,2.8,4.6,1.5,Iris-versicolor
5.7,2.8,4.5,1.3,Iris-versicolor
6.3,3.3,4.7,1.6,Iris-versicolor
4.9,2.4,3.3,1.0,Iris-versicolor
6.6,2.9,4.6,1.3,Iris-versicolor
5.2,2.7,3.9,1.4,Iris-versicolor
5.0,2.0,3.5,1.0,Iris-versicolor
5.9,3.0,4.2,1.5,Iris-versicolor
6.0,2.2,4.0,1.0,Iris-versicolor
6.1,2.9,4.7,1.4,Iris-versicolor
5.6,2.9,3.6,1.3,Iris-versicolor
6.7,3.1,4.4,1.4,Iris-versicolor
5.6,3.0,4.5,1.5,Iris-versicolor
5.8,2.7,4.1,1.0,Iris-versicolor
6.2,2.2,4.5,1.5,Iris-versicolor
5.6,2.5,3.9,1.1,Iris-versicolor
5.9,3.2,4.8,1.8,Iris-versicolor
6.1,2.8,4.0,1.3,Iris-versicolor
6.3,2.5,4.9,1.5,Iris-versicolor
6.1,2.8,4.7,1.2,Iris-versicolor
6.4,2.9,4.3,1.3,Iris-versicolor
6.6,3.0,4.4,1.4,Iris-versicolor
6.8,2.8,4.8,1.4,Iris-versicolor
6.7,3.0,5.0,1.7,Iris-versicolor
6.0,2.9,4.5,1.5,Iris-versicolor
5.7,2.6,3.5,1.0,Iris-versicolor
5.5,2.4,3.8,1.1,Iris-versicolor
5.5,2.4,3.7,1.0,Iris-versicolor
5.8,2.7,3.9,1.2,Iris-versicolor
6.0,2.7,5.1,1.6,Iris-versicolor
5.4,3.0,4.5,1.5,Iris-versicolor
6.0,3.4,4.5,1.6,Iris-versicolor
6.7,3.1,4.7,1.5,Iris-versicolor
6.3,2.3,4.4,1.3,Iris-versicolor
5.6,3.0,4.1,1.3,Iris-versicolor
5.5,2.5,4.0,1.3,Iris-versicolor
5.5,2.6,4.4,1.2,Iris-versicolor

6.1,3.0,4.6,1.4,Iris-versicolor
5.8,2.6,4.0,1.2,Iris-versicolor
5.0,2.3,3.3,1.0,Iris-versicolor
5.6,2.7,4.2,1.3,Iris-versicolor
5.7,3.0,4.2,1.2,Iris-versicolor
5.7,2.9,4.2,1.3,Iris-versicolor
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