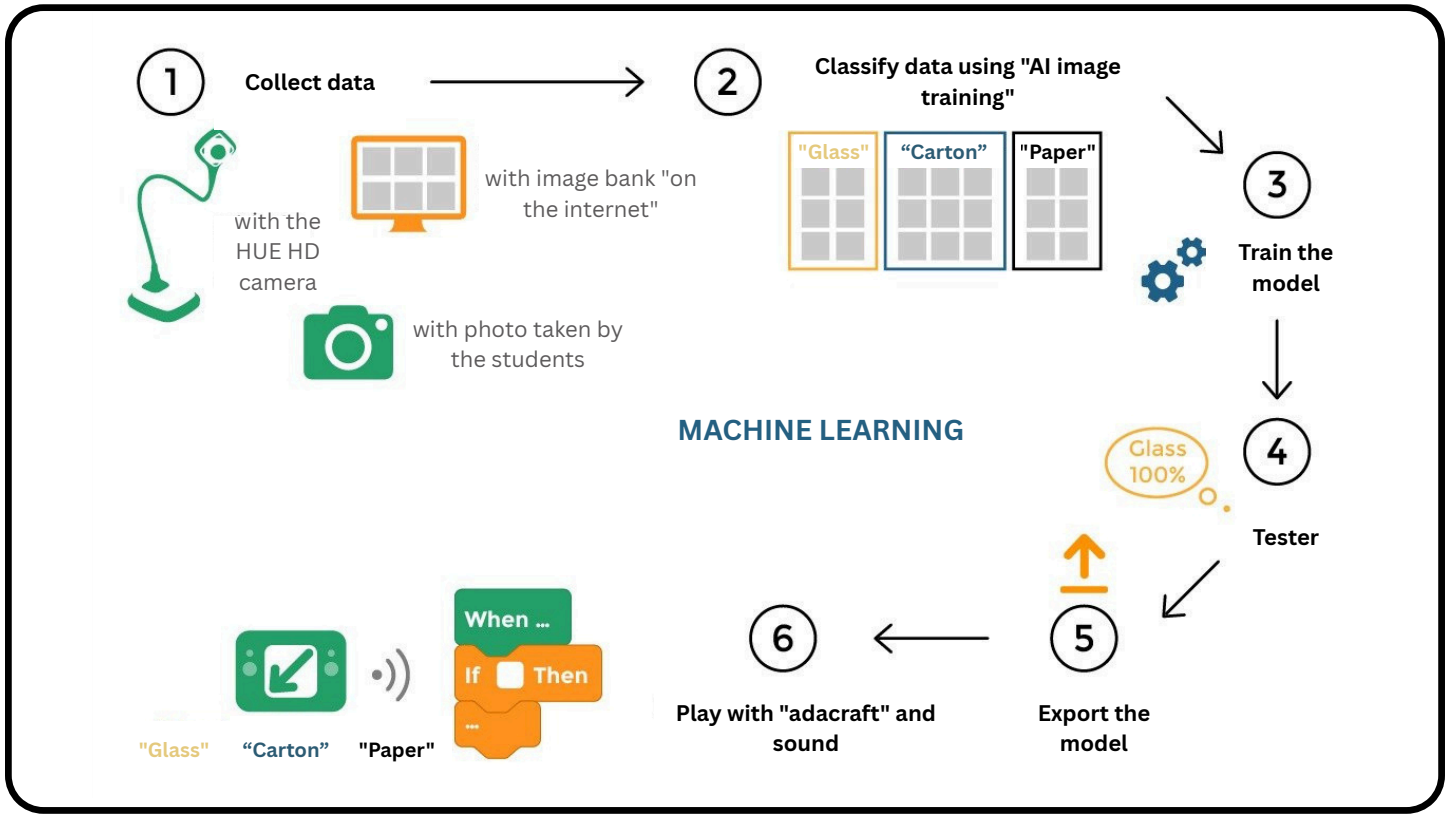
Fact Sheet - Artificial Intelligence - Tools

Sort items using AI and analyze learning models

Objective: to analyze and categorize different types of elements (in our example waste) using computer vision

Go further:

- *Understand that AI systems use statistics and algorithms to process (analyze) data and generate results (e.g., predicting which video the user might like to watch).*
- *Know that AI today generally refers to machine learning, which is just one example. What distinguishes machine learning from other types of AI (e.g., rule-based AI and Bayesian networks) is that it requires enormous amounts of data.*



Materials and tools needed

Vittascience – AI Images is an online platform that allows you to easily train an artificial intelligence model using photographs captured live via a webcam. The principle is based on supervised learning: the user creates categories, provides visual examples for each, then trains a model capable of making predictions in real time. This tool is designed for education and requires no installation. It works directly from a web browser.

Access to the tool: 👉 https://fr.vittascience.com/ia/images.php?localId=loc637b12c40c27a8

Steps and coding

1 Create a photo database

In this sheet, we'll use the example of waste sorting in relation to SteamCity protocols. However, you can adapt the activity to any item you want to categorize using a template.

The first step is to create a photo database of the waste you want students to sort. You have two options:

- Find matching images in a royalty-free image bank.
- Photograph the waste to be recycled. This option has increased educational value.

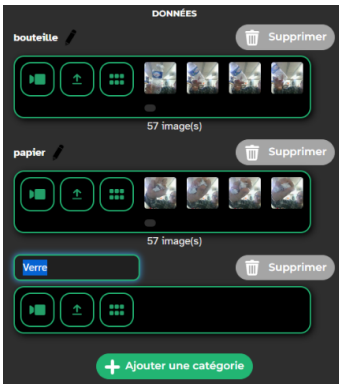
So you need to create 3 folders: “Glass”, “Packaging” and “Paper” in which to place the images you are going to capture.

2 Creation of a waste recognition model

Waste Recognition TrainingOn the Vittascience interface, go to “AI Training”.

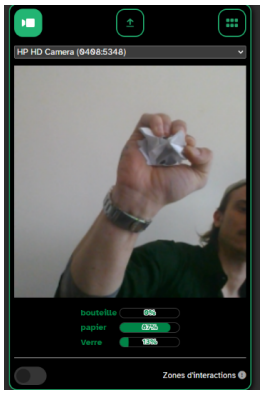
1. Create 3 categories in the “data” section: “Glass”, “Packaging” and “Paper”.
2. Drag and drop the collected images.
3. Once the dataset is created, click on “Train”.
4. Test the model with different objects (a plastic bottle, a glass beer bottle, an old newspaper, etc.). You can test it either by dragging and dropping a file or by turning on the webcam. The testing phase is important in AI, so take the time to check that the model is well trained. The model should be tested with objects provided as input and other objects for which it has not been trained.
5. Consider enabling interaction zones to understand what your model is using to predict a result. By clicking on "Interaction Zones," you can view the most relevant areas of the image that helped the machine provide its prediction. Enabling this zone can help you better explain the results provided by the machine.
   - Test with known and unknown transparent glass
   - Test with known and unknown paper
   - Test with a known and unknown PET bottle
6. Challenge your model: Did the AI recognize all objects 100% of the time? Where did the errors come from? What characterizes the glass? The packaging? The paper? Does the sample represent the majority of the waste?

Important: Once you have tested your model, if the results are not satisfactory, add more images and train it again to improve it.

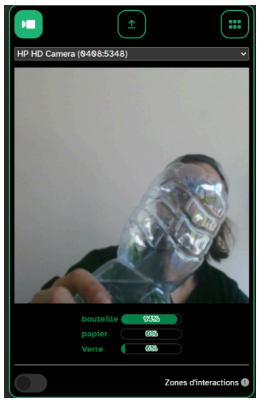


Create 3 classes: “Glass”, “Packaging” and “Paper”.

Test with clear glass



Test with paper



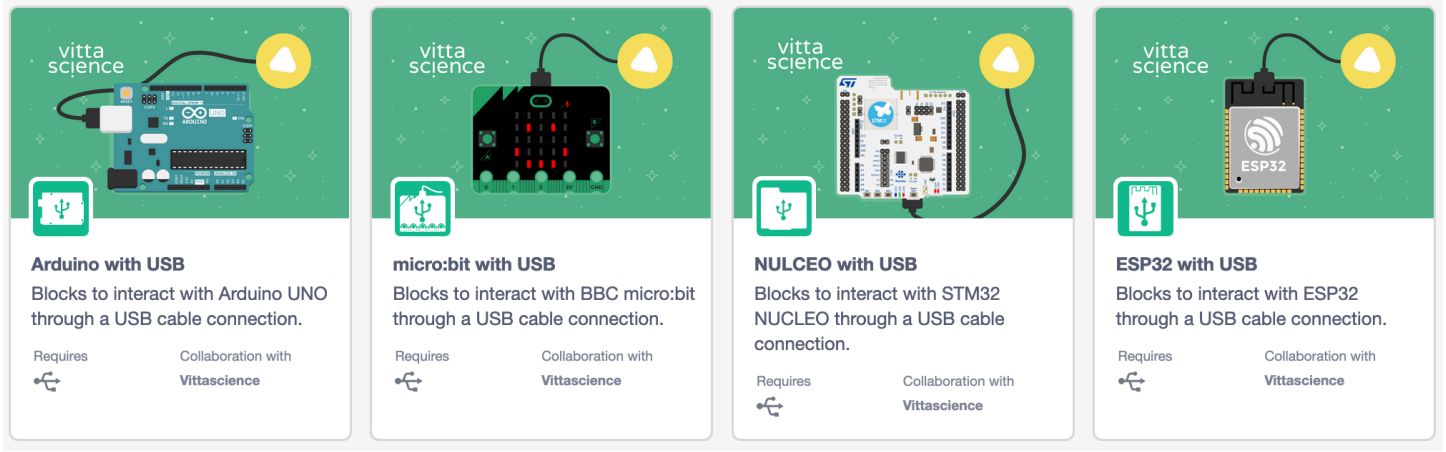
Test with a PET bottle

Connecting AI to hardware

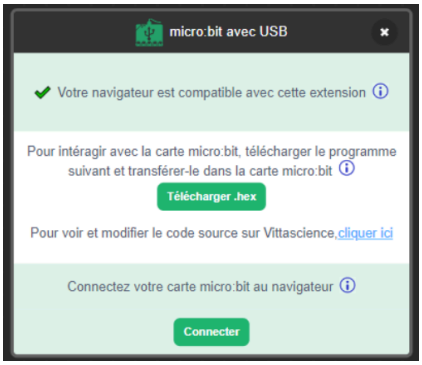
Use Adacraft to connect the output of our model to the input of a microcontroller such as an Arduino or a micro:bit programming board.

The card will be able to perform actions (move a servomotor, turn on/off an LED) each time a new detection is made.

To do this, click the Adacraft icon in the top right corner of the interface. You'll need to choose whether to save the model locally or in the browser. To create a program, add the blocks to communicate with a board. Click "Extensions" in the bottom right corner of the screen to select the board you want to use:



A pop-up window will appear, allowing you to download a program that you can drag and drop onto your board, allowing it to "talk" to Adacraft.



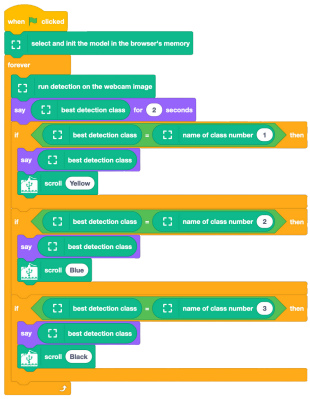
Once done, press “Connect” to create the serial connection with the board

You now have a recognition model ready to detect objects and blocks allowing you to communicate with a physical board.

Create Interactive AI Feedback

Create a program on Adacraft so that the Vittabot character says the detected class. Initialize the model. Start the detection. Choose to start a detection on a file available on the internet via a URL or directly via the webcam. Useful blocks are available in "AI Image". Then display a text on the micro:bit's LED matrix based on the detection.

The detection response is recorded in the block: "best detection class". The order in which the datasets are labeled during training is important and will be available in the "Class name number (1)" block. Be careful and memorize the order of the class names assigned during AI training. It is important to note that waste sorting varies from country to country, and even locally. For example, in Germany and Switzerland, sorting bins are of different colors (yellow, blue, and red), each color corresponding to a specific type of waste. It is therefore advisable to check the sorting guidelines in force in your region before proceeding with the proposed activity.



3 Analyze data and learn from it

Observe the different interactions between neurons in different layers when testing with an image from a file or a screenshot via the camera.

1. Click the next button, “Show Neural Network”.
2. Ask students, “What do you see?”
3. Based on their answers, provide additional explanations:
   - The "Simplified View" shows the neural network schematically, with each shape representing a layer, and the size of these layers evolving. At first, the images are large and few in number, then they become small and very numerous.
   - Click on "Detailed View." This view allows you to visualize all the neurons in the network—there are over a million of them! The first layer involves applying a red, blue, and green color filter. This filter only retains the red, green, or blue values of the pixels in the test image.
   - You can navigate the neural network by zooming in with your mouse or using the buttons in the bottom right corner. Clicking the "i" information button displays the size and number of neurons in each layer. Hovering over neurons displays the connections to the previous layer, which are frozen by clicking on the neuron. The "Open Information" button displays the number of images and their size in pixels in each layer. Clicking on pixels provides explanations of the calculations performed by the AI on the layers.
   - In the convolution layers, a 9-pixel square (3x3) is scanned over the filtered images. Several layers follow one another to identify "patterns," i.e., the characteristics of the object to be identified in the image. Neurons are activated if certain characteristics are identified (alignment of pixels giving rise to shapes, etc.) in correlation with the training data. The information is then propagated to the output layer, which provides a prediction.