GRADES 6 AND UP

Argonne NATIONAL LABORATORY

RETHINK, RETRAIN, RECYCLE.
BE AN AI COMPUTER SCIENTIST!

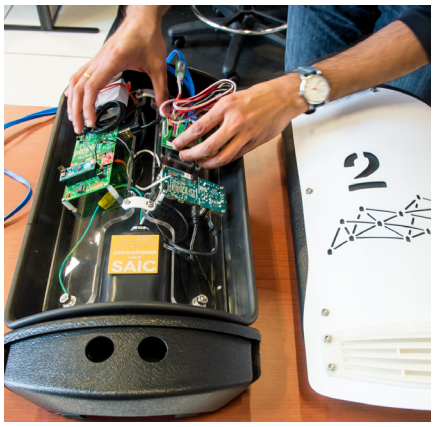
Instruction Sheet

Artificial Intelligence (AI) is one area in computer science that focuses on developing machines that are "human-like", meaning they can learn and make decisions.

Recently a team of Argonne researchers discovered a way to use AI to optimize a complicated manufacturing process that creates a wide range of industrial nanomaterials like those used in batteries. This is important not only to produce these important materials at a large scale, but also to ultimately develop greater technologies for society.

In order to achieve this accomplishment, the team of researchers needed to engage in **machine learning**. Machine learning is an application of AI that involves developing computer algorithms so that the computer is essentially "learning" or being trained. The purpose of machine learning is for the computer to learn from past data to continuously improve without human input.

Machine learning isn't just for researchers at Argonne. In fact, you can try it out for yourself! We all know that recycling is good for our environment, however it can be a more complicated process than we might think. For one, not all materials can be recycled and knowing which ones can and cannot is difficult to remember. For example, you can put paper bags in the recycling bin but not plastic. Can you make this process easier using AI and Machine Learning? How accurate can you make it?



Array of Things Sensor (Source: Argonne); Banner credit: Argonne.

ACTIVITY HIGHLIGHTS

- ☐ **Create and train a program to sort through a recycling bin**
- ☐ **Test and improve your program**
- ☐ **Share your project with Argonne Education**

Get Started

To start, COLLECT ALL YOUR MATERIALS.

Make sure you have permission to use the materials from an adult!
Follow the procedure below and the data sheet provided to complete this activity.

MATERIALS LIST

- ☐ https://machinelearningforkids.co.uk/#!/welcome
- ☐ Paper vs Plastic Bag AI Model Evaluation Sheet

Optional Materials:

- ☐ Web cam
- ☐ Plastic bags
- ☐ Paper bags

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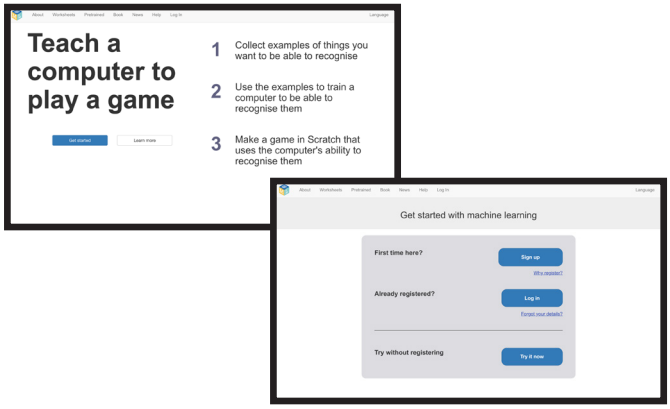
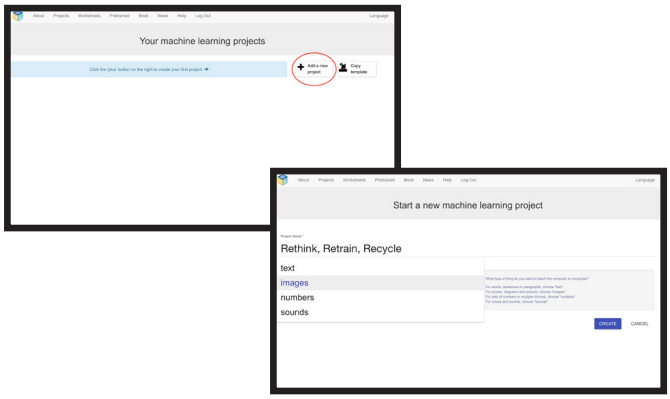
STEP ONE CREATING YOUR PROGRAM

Starting a project on Machine Learning for Kids

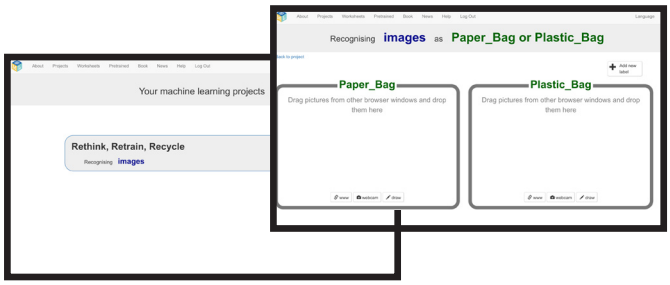
1. **Go to https://machinelearningforkids.co.uk/**
2. **Click “Get Started”.**
3. **Click “Try it Now”.** You do NOT need to register an account to do this activity. It may be a good idea to register if you want to work on multiple projects or save your work for later.



4. **Click “Add New Project”.**
5. **Give your Project a Name of your choice.** Some suggestions: “Paper vs Plastic”, “Recycle App”, “Rethink, Retrain Recycle”.
6. **Click “Recognizing”.**
7. **Click “images” on the dropdown list.**
8. **Click Create.**

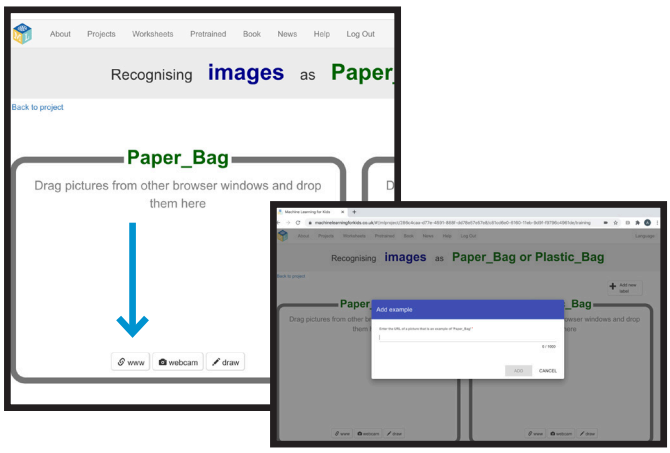


9. **Click on your project.**
10. **Click “Train”.**
11. **Click “Add new label”.**
12. **Make your first label “Paper Bag”.**
13. **Make another label called “Plastic Bag”.**

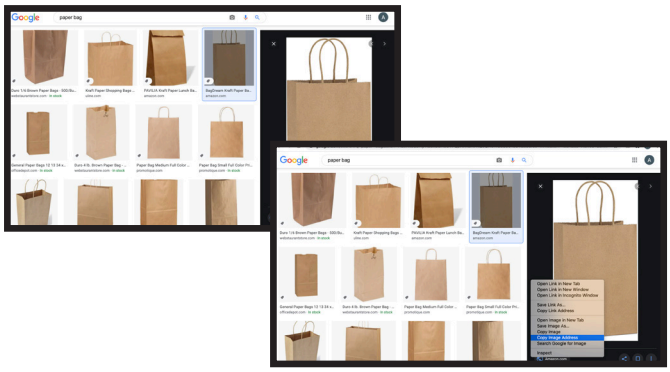


STEP TWO TRAINING

Option 1: Using images on the web

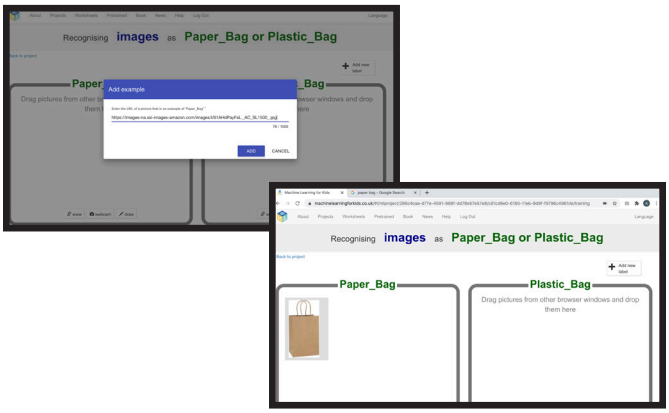


1. **Click the “www”icon** located in the Paper_Bag bucket.

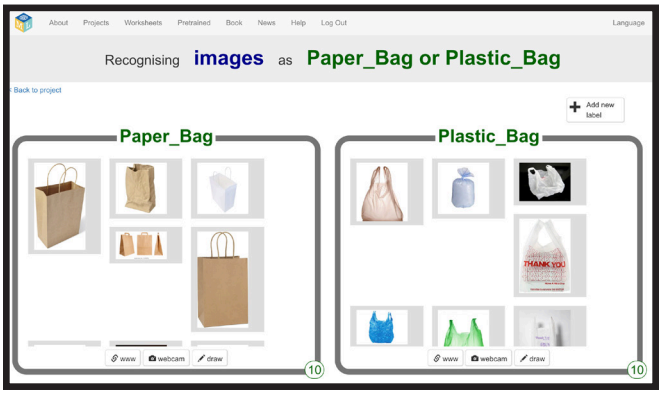


2. **Open a new tab** and search for “paper bag”.

3. **Select an image** and then right click on an image and select copy image address.



4. **Go back to the Machine Learning for Kids tab** and paste image address in the “Add example” box.

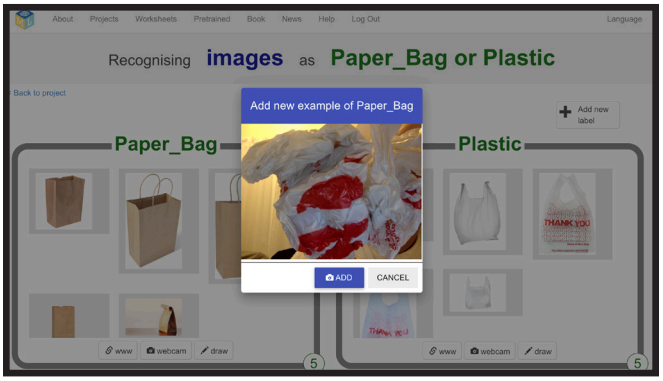


5. **Repeat steps 1-5 to add 5 more images** (you should have at least 5 images).

   Do the same thing for the Plastic_Bag bucket but search for plastic bag images (you should have at least 5 images).

   Things to think about when selecting images are: angle, lighting, color, and size.

Option 2: Webcam



1. **Gather paper bags and/or plastic bags you have at home.**

2. **Determine how and where you will take the image.**

   Things to consider: position, angle, lighting and background/backdrop.

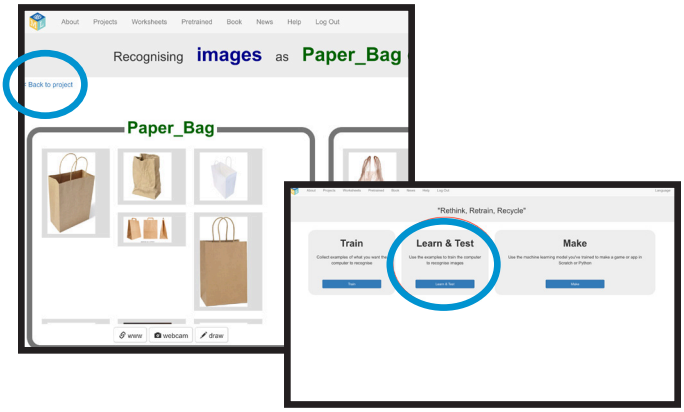
3. **Click the "webcam" button and click "add" to take picture.**

   Note: If you want to delete an image simply hover over the image and a small red x will appear in the top right corner. Click the red x to remove it.

STEP THREE **LEARN & TEST**

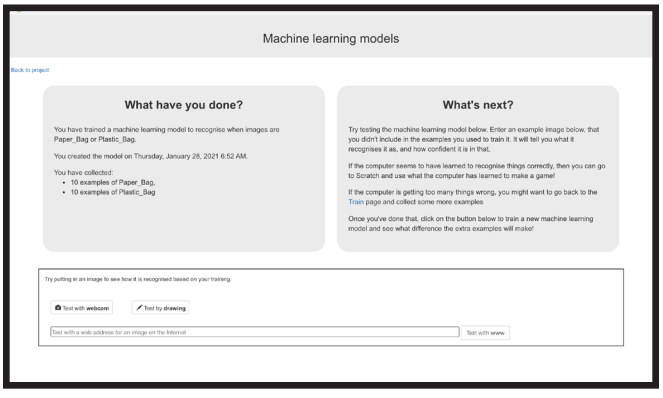
Now it is time to test your program!

For this portion of the activity, you will need to use the "Plastic vs Paper Evaluation" document. You will use the images on this document to determine how well your program is able to correctly identify paper bags vs. plastic bags.



1. **Click "Back to project".**

2. **Click "Learn and Test".**



3. **Click "Train new machine learning model".**

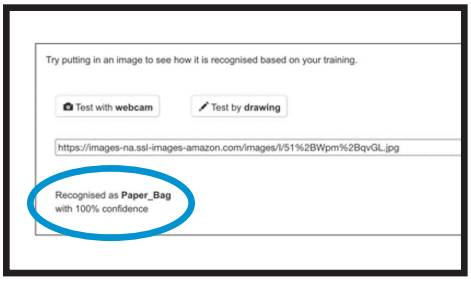
4. **Do a search for paper bag images.**
   Select an image you did NOT already use.

5. **Copy and paste the image address of the first image you see.**

6. **Paste the white bar where it says "Test with www".**

7. **Click "Test with www".**

8. **Beneath it, you will see if the program recognized the image as a plastic or paper bag.** It will also tell you the percentage of confidence. A 100% means the program is 100% confident it correctly identified the image. The higher the percentage, the better your program!



9. **Test your program on several different images** (again, make sure they aren't the ones you used in your program!).

10. **You can also test your program by using the webcam and taking photos of paper/plastic bags you have at home.**

11. **Log your results on the "Paper vs Plastic Bag AI Model Evaluation" sheet.**

RETRAIN

How well did your program correctly identify paper bags vs plastic bags?

Did it get some wrong or have a low confidence percentage? Was your program able to correctly identify a crumpled-up paper bag vs crumpled-up plastic bag? What about a white paper bag vs a white plastic bag?

Consider what types of images you need to add in order to improve your program. For example, do you need to include different color bags? Or, do you need more images from different perspectives/angles or different conditions?



OTHER IDEAS?

If your program was successful, what other programs could you create to classify other recyclable and non-recyclable items?
Give it a try!

STEP FOUR **SHARE YOUR PROGRAM WITH ARGONNE EDUCATION**

Take a screenshot of your program and send it to Argonne Education at **learninglabs@anl.gov**, or have an adult tweet it out to **@Argonne** and **#ArgonneAtHome**.

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Data Sheet

Name: _____

DATA TABLE 1 PAPER VS PLASTIC BAG AI MODEL EVALUATION

BAG DESCRIPTION (PAPER/PLASTIC) Also include descriptions like color, size, and angle	PAPER BAG	PLASTIC BAG	CONFIDENCE
	☐	☐	%
	☐	☐	%
	☐	☐	%
	☐	☐	%
	☐	☐	%
	☐	☐	%
	☐	☐	%
	☐	☐	%

Suggestions on what to test:

- ☐ Different color bags
- ☐ Crumpled bags
- ☐ Bags from different angles/perspectives
- ☐ Bags of different sizes

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