

Object Recognition with AI

Student guide, Hands-On AI for High School, grades 9 to 12

In this lab you use a pre-trained AI model called YOLOv8 to find and label objects in photos. You run it on a street photo, change how sure it must be before it reports something, try photos of your own, and look for photos that fool it.

Before you start

- You need a device with a web browser and a Google account.
- Open the course page, github.com/aalbata/ai-labs-for-high-school, and click the Open in Colab badge next to “Object recognition with YOLOv8”.
- Choose File, then Save a copy in Drive, so that your answers are kept.
- A notebook is a page of code cells. Click the play button on the left of a cell to run it, and wait until it finishes before you run the next one. You do not need to read the code.

Step 1: Load the model

Run the first cell. It installs a library and downloads YOLOv8 Nano, a small, fast model that recognizes 80 kinds of everyday object. The first run takes about a minute. If you see a list of 80 object names, it worked.

Step 2: Run it on a street photo

Run the next cell. The model draws a box around each object it finds, with the object’s name and a confidence score from 0% to 100%. Compare the original photo with the labeled one, and read the list printed below them.

Answer in the notebook:

- What did the model get right?
- Did it miss anything you can see in the photo?
- Is every box correct? Look closely at the boxes with low scores.

Step 3: Change the confidence threshold

Find the line `CONFIDENCE_THRESHOLD = 0.05`, change the number, and run the cell again. Try at least three values, for example 0.05, 0.25, 0.5, 0.75 and 0.9.

Answer in the notebook:

- At 0.05, which new boxes appear? Are they real objects?
- At 0.9, how many objects are left?
- If this model helped a car decide when to brake, would you set the threshold high or low? Why?

Step 4: Try your own photo

Run the upload cell, click Choose Files and pick a photo. Then run the cell below it to analyze the photo.

Answer in the notebook:

- How many objects did the model find?
- What did it miss or get wrong?

Step 5: An engineering scene

Before you run the cell, predict what the model will find in a photo of a construction site.

Answer in the notebook:

- How close were your predictions?
- Name two things on a construction site that are not among the model's 80 kinds of object.
- What could go wrong if this model were used for safety on a real construction site?

Step 6: Confidence in the dark

This cell takes the street photo from Step 2 and makes it darker in three steps. Only the light changes. Most of the photos the model learned from were taken in good light. One study estimated that only about 0.2% of the photos in COCO, its training collection, are low-light images.

Answer in the notebook:

- What happens to the number of boxes and to the confidence scores as the photo gets darker?
- Does the model ever report something that is not there?
- How is this like the face-analysis example in the opening demo?

Step 7: Compare two model sizes

This cell runs YOLOv8 Nano and the larger YOLOv8 Small on the same photo. It reports how many objects each model finds and how long each one takes, in milliseconds.

Answer in the notebook:

- How much slower is the larger model?
- Did it find more objects or fewer? Were its confidence scores higher or lower?
- For a small chip inside a sensor on a bridge, which model would you choose? Why?

Step 8: Try to fool it

Paste an image link into the cell, or upload another photo, and look for a photo where the model is confidently wrong. Try at least two ideas, for example:

- a drawing of an object instead of a photo of it
- an object seen from a strange angle
- two objects of very different sizes side by side
- an object that is partly hidden
- equipment the model has probably never seen

Final reflection

Answer these in the reflection cell at the end of the notebook.

1. What was the most surprising thing the model got right?
2. What was the most surprising thing the model got wrong, especially when it was confident?
3. The model learned from COCO, a collection of everyday photos of 80 kinds of object, very few of them taken in low light. Name one engineering job where this training data would make the model fail in a predictable way.
4. Imagine using object recognition on a construction site to spot workers, equipment and hazards. Name three things you would change about how the model was trained.
5. What is the difference between a model that is right 95% of the time in testing and a model that is safe to use on a real construction site?

Words to know

Term	Meaning
YOLOv8	A fast object-detection model released by Ultralytics in 2023. YOLO stands for “You Only Look Once”.
Bounding box	The rectangle the model draws around an object it finds.
Confidence score	How sure the model is about a box, shown as a percentage. A high score does not guarantee a correct answer.
Confidence threshold	The lowest score a box needs before the model reports it. You can change it.
COCO	Common Objects in Context, a collection of about 330,000 photos with 80 kinds of labeled object. The model learned from it.
Out-of-distribution input	A picture that looks different from the training photos, such as a very dark one. Models often make mistakes on it.
Inference time	How long the model takes to process one photo, measured in milliseconds (ms).
Precision and recall	Precision is the share of reported boxes that are correct. Recall is the share of real objects that are found. Raising one usually lowers the other.

If something goes wrong

Problem	What to do
“Runtime disconnected”	Colab stops after a while without use. Reconnect and run the cells again from Step 1.
“No module named ultralytics”	Run the Step 1 cell again. It needs to run once in every session.
A cell runs but shows nothing	Look for a red error message under the cell and read its last line.
The upload button does not appear	Make sure you opened the notebook in Google Colab in a browser.
An image link does not work	Some websites block downloads. Upload your own photo or try a different link.