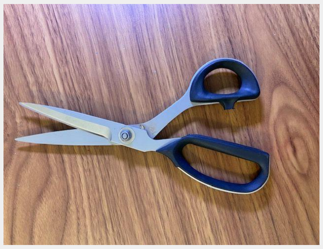
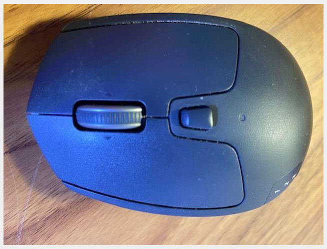
Exercise 1 - By Audrey Coulombe

PART A: The construction of a model with only your data.

1. Please provide a description of the initial data set you brought to class. What were the objects, how many … and why you chose those specific objects. Provide an image of each distinct object.

Object #1: Scissors (54 images)	
Object #2: Computer mouse (50 images)	
Noise objects: ● Slinky (14 images) ● Plant (8 images) ● Apple (10 images) ● Lemon (12 images) ● Hairy hat (12 images) ● Avocado (10 images) ● Bottle (9 images)	

2. What was the purpose of the task you were asked to do in class?

I think the task we were asked to do in class had multiple purposes. First, to learn how to train a machine learning model with Edge Impulse and understand that it's accessible. Second, to have a better understanding of how machine learning works. Third, in relation to the criticisms of data analysis seen in class and the biases associated with it, realize how much data is needed for the model to be accurate and understand the practice of eliminating "dirty data."

3. Describe in a series of steps what you did to complete the initial task in class

1. Go to https://studio.edgeimpulse.com/studio/149268 and create an account
2. Create a new project
3. Upload data. For each of the 3 images folder (scissors, mouse and noise):
    - Go to "data acquisition" tab, then go to the "upload data" tab and click on "collect data"
    - Choose "upload data" and select all the images from the appropriate folder
    - Enter the appropriate label name
    - Click on "Begin upload"
4. Explore data:
    - Go to "data acquisition" tab, then go to the "data explorer" tab
    - Select options "using a pretrained visual model" and "t-SNE"
    - Click on "generate data explorer"
5. Add a processing and a learning block:
    - Go to "Impulse design" tab
    - Add a processing block→"Image"
    - Add a learning block→"Transfer Learning (Images)"
    - Click on "save impulse"
6. Generate features:
    - Go to "Impulse design" tab, then go to to "image" tab and select the "generate features" tab
    - Click on "Generate features"
7. Transfer learning
    - Go to "impulse design" tab, then go to "transfer learning"
    - Click "Start training"
    - Analyse the results
8. Get a sense of how well the model is working:
    - Go to "live classification" tab
    - Under "classify existing test sample", pick an image and click on "load sample"
9. Test the model:
    - Go to "model testing" tab and click on "classify all"
    - Analyse results

4-5. How well did your dataset do in terms of Accuracy, Precision and Recall?

Take screen grabs of the graphs available through the Feature Explorer for both the training and test/ live classification sets. Discuss the graphs in detail.

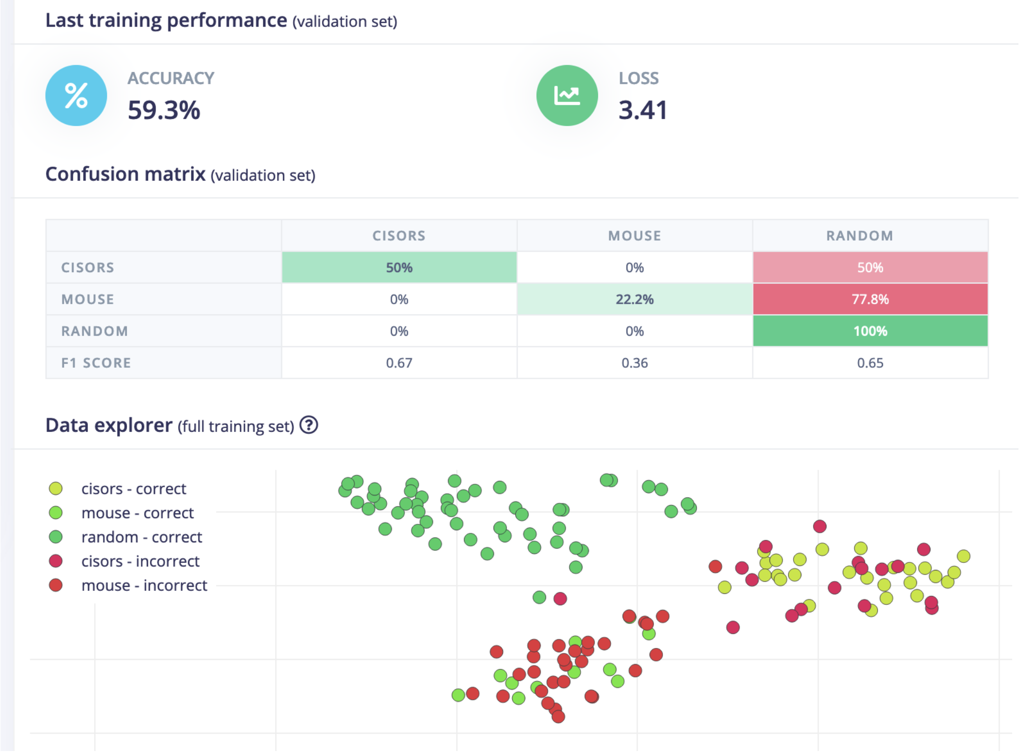
Precision and recall calculations for the training set (equations taken from this blog)

Precision = true positive/(true positive + false positive)
Recall = true positive/(true positive + false negative)

Scissors precision = 0.5/(0.5+0) = 100%
Scissors Recall = 0.5/(0.5+0.5) = 50%

Mouse precision = 0.222/(0.222+0) = 100%
Mouse recall = 0.222/(0.222+0.778) = 22.2%

Random precision = 1/(1+0.5+0.778) = 43.9%
Random recall = 1/(1+0) = 100%



Last training performance (validation set)

ACCURACY
59.3%

LOSS
3.41

Confusion matrix (validation set)

	CISORS	MOUSE	RANDOM
CISORS	50%	0%	50%
MOUSE	0%	22.2%	77.8%
RANDOM	0%	0%	100%
F1 SCORE	0.67	0.36	0.65

Data explorer (full training set) ⓘ

According to the training set, my dataset has an accuracy of 59,3%, which is very low. Apparently, 50% of “scissors” images and 77.8% of “mouse” images were incorrectly identified as “random”. However, if my calculations are right, the precision level for recognizing “scissors” and “mouse” is 100% for both, which is good. On the other hand, their recall level is low, with 50% and 22.2% respectively. For recognizing random objects, the model had a low precision (43.9%), but a high recall (100%).

Precision and recall calculations for the testing set (equations taken from this blog)

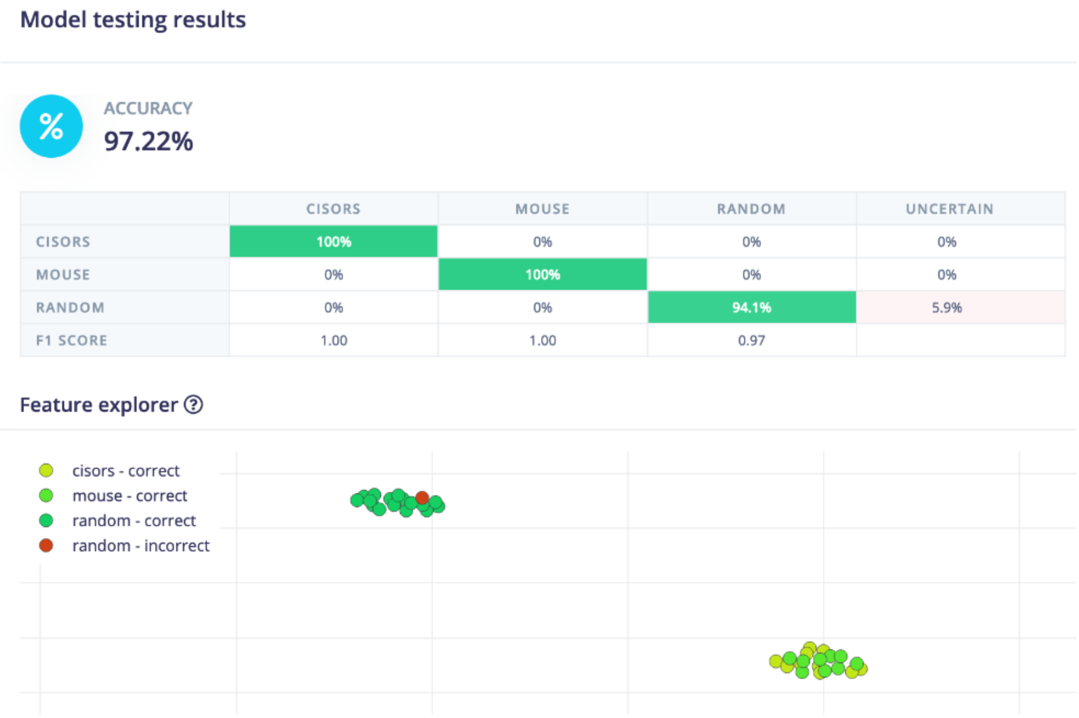
Precision = true positive/(true positive + false positive)
Recall = true positive/(true positive + false negative)

Scissors precision = 1/(1+0) = 100%
Scissors Recall = 1/(1+0) = 100%

Mouse precision = 1/(1+0) = 100%
Mouse recall = 1/(1+0) = 100%

Random precision = 0.941/(0.941+0) = 100%
Random recall = 1/(1+0.59) = 62.9%

“Random” image labeled as “uncertain”



Model testing results

% ACCURACY 97.22%

	CISORS	MOUSE	RANDOM	UNCERTAIN
CISORS	100%	0%	0%	0%
MOUSE	0%	100%	0%	0%
RANDOM	0%	0%	94.1%	5.9%
F1 SCORE	1.00	1.00	0.97	

Feature explorer ?

According to the testing set, my dataset has an accuracy of 97,33%, which is good. The big gap between the accuracy of the training and testing sets, however, appears strange to me. Maybe it has to do with the way data was split, like if images used in the training set were harder to identify?
In this set, 100% of “scissors” and “mouse” images were correctly identified, resulting in a precision and recall level of 100%. As for “random” images, 94.1% were true positive while 5.9% (equivalent of one image) was classified as “uncertain”. However, I only have one image identified as “uncertain” on a total of 68 “random” images.

6. Provide brief postulations for how you think you could get your model to perform better. What does better mean?

I think I could get better results by having more images and especially more diverse images for each category. Also, as I explored the various options in Edge Impulse, I realized that many of them (including several that I didn't use) were intended to refine the way the model analyzes images. So I guess these options would also have the potential to get my model to work better.
“Better” is hard to define as it depends on the intended use. Of course, having no false positive or false negative would be ideal, but, while trying to understand the difference between Precision and Recall, I also understood that there is no perfect algorithm: we need to make a choice whether to reduce the number of false positive and increase the number of false negative, or reduce the number of false negative and increase the number of false positive.

PART C : Think of how to integrate this task: Provide a written scenario: (not necessarily useful nor functional) – meaning you can dream up what you wish… without constraint... - for how and when such a task (Object Detection) could be used or embedded in … what, why, where, with whom.

Last summer I grew milkweed specifically to attract monarch caterpillars and hopefully witness the formation of chrysalises and be able to follow their development until butterflies emerge. I saw many monarch caterpillars, but once they were big enough to transform into a chrysalis, they all disappeared! The problem is that monarch chrysalids are so well camouflaged that it is extremely difficult to spot them because they look like a rolled up leaf. I would love to have an app that would allow me to scan my flower beds with my cell phone camera and could recognize potential chrysalis shapes to help me spot them!