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CART 451
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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 the distinct object.

I decided to use a Yeezy foam sandal and a Nike water bottle as my two main objects. I intentionally chose 2 objects with a similar bright red color and a similar rubber/plastic-like material. The foam runner is vermillion and is shaped like a croc from an alien planet with more advanced technology than us. The bottle is a regular Nike sports water bottle with a black cap and designs on it.


I was curious if the differences in form, shape, and intricacies would be enough for the machine to identify and classify them as 2 distinct objects. I actively took pictures from certan distances and angles that would emphasize the similarity of the 2 objects, and actively took pictures that would emphasize their distinctions. I modified some of the

objects, such as taking the cap of the bottle, in certain pictures to see how that would affect how the machine would identify the object.

Most of the ‘other’ or ‘noise’ objects I used were random objects from around my apartment, but I still made sure to use some bright red objects to see if that would later interfere with the classification.

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

This exercise was a simple implementation of the concepts we discussed in the workshop about machine learning, specifically the process of classification; a supervised machine learning. By training a machine with images we took beforehand, we were able to implement a clear and concise example of it. We were given an idea of the step-by-step process required to initialize and run machine learning, with a lot of its complexities hidden through using a website that facilitated the process.

I believe that we were not given a clear idea of what we were going to do, or how exactly we should take the pictures beforehand in order to gain experience with the inherently faulty nature of machine learning and classification. Understanding the process of machine learning is not as simple and straightforward as figuring out how to create a website or design a game. It involves interacting with a separate entity that reacts according to our (the designer's) input instead of simply reacting based on it.

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

We first assembled three folders of images. Two based on our objects and choice, and another of various objects to serve the purpose of acting as ‘noise’. Using edge impulse, a platform that simplifies and facilitates the process of machine and transfer learning, we created an ‘impulse’ where we trained a model to make classifications from the three folders of images we had assembled.

Once the model acquired the data, we instructed it to use 80 percent of our object's images to train it, thus allowing it to interpret how we see/classify our objects based on the tag we provided with them. The other 20 percent of the images were used to test the model where its ability to classify the images was tested.

How the machine interpreted the images was presented to us on a data-visualizing graph that represented each image as hoverable points on it. The axis represented abstract metrics related to how features of the image. This formed clusters of points based on each image.

Once the unrecognizable/ more questionable images were removed from the model, we were returned with a training output table that returned the training's accuracy, loss, and confusion matrix. The confusion matrix represented the accuracy at which the model was able to attach the relevant tag to the image.

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

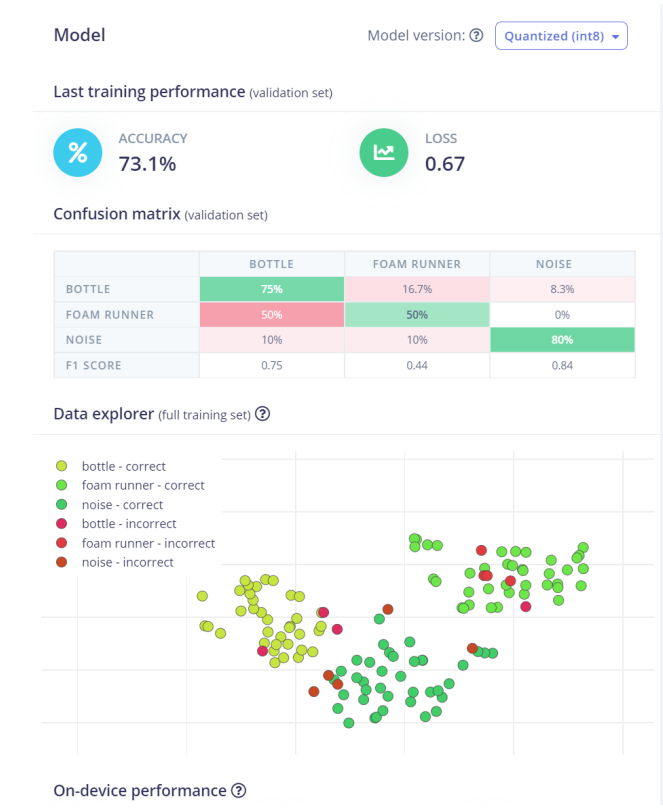
In terms of accuracy, my dataset underperformed compared to my peers, but still managed a respectable 73.1 training accuracy 76.92% testing accuracy.

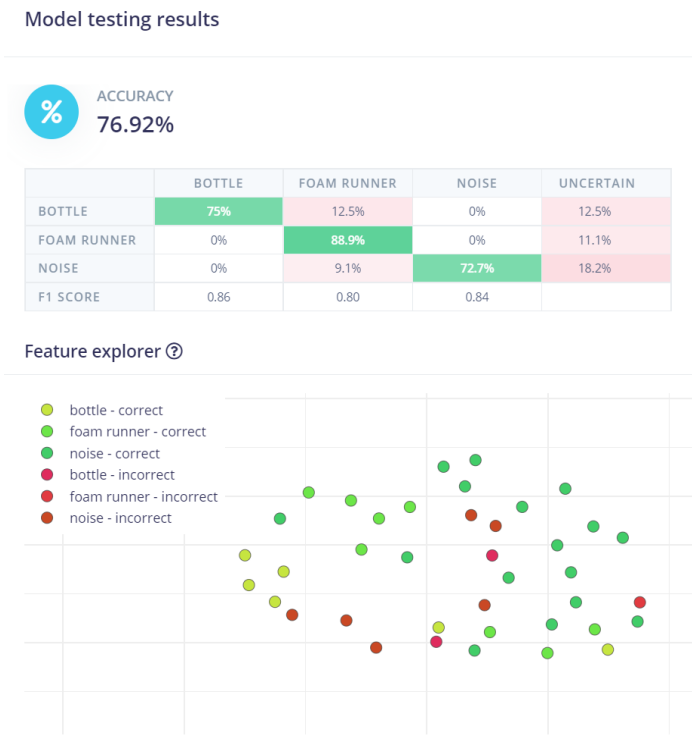
My model was relatively accurate, especially with the foam runner. At almost every angle and distance I would hold the phone runner in front of the camera. I imagine that the way the model is trained is heavily revolved around the form and shape of the objects, with the esoteric and unique form of the foam runner super easy to recognize.. It was surprisingly accurate with noise objects too. Even with the small sample set, it was able to recognize items such as my wallet flawlessly. There were not many instances where I saw the ‘uncertain tag’ regularly (false negative).

The model’s precision left a lot to be desired with how it behaved with my bottle. More than half the time, the model would recognize my bottle as being a foam runner, returning a false positive. This was not too surprising with how similar the objects I chose are.

Upon further testing, I came to the conclusion that my model's recall was relatively good with the foam runner and lacking with the bottle. The model was able to recognize a picture from my phone of a foam runner with a different color. However, the model would struggle to recognize my bottle unless I held it at a specific angle and distance.

5. 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.

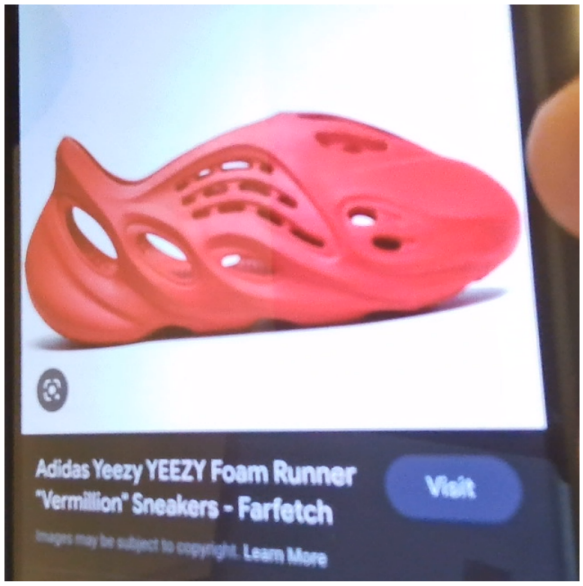




The points in my graph were a lot more scattered than those of my peers. For example, Sarah's use of distinct objects had her points tightly grouped in separate areas of the graph. Mine, however, was scattered and often interesting to each other at certain points. Again, this was to be expected based on the similarity of the objects I chose. Some of the noise objects were able to be tightly grouped at separate points, whilst the noise objects that I actively chose based on their similarity to my two main objects were closely joined to those points.

There were a fair amount of incorrect interpretations that occurred during the transfer learning process of the two main objects, with how similar they were, whilst they were very few incorrect interpretations of the noise objects. The individuality of the noise objects made it very hard for the model to interpret them as the big red bottle and foam runner.

Upon closer inspection, I found that most of the incorrect interpretations of the bottle and foam runner occurred in the pictures I took from a distance. Pictures with a closer, holistic view of the object were almost always correctly interpreted. This carried over to the testing phase too, as the less clear pictures I had taken from a distance all returned 'uncertain.'



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

There are 2 main solutions in my head if I want my model to perform better. For it to be better, I believe we would need to see a slight increase in accuracy and a sharp increase in precision. For an increase in its general accuracy, I would need to be paying more attention to how I take and frame the pictures of my objects. For this model, I was just chaotically circling my objects, taking pictures in quick succession in order to get as many different pictures as possible. Next time I take my pictures, I would take a more organized approach as Elio did for his. I would determine which distances and angles were import, and take as many pictures of that with minor adjustments between each (such as rotating the object).

More a higher precision, I would either use objects less similar than I did. Perhaps using a different colored bottle or foam runner would have allowed the model to better identify the differences between the two. Perhaps using a different type of shoe made with a different material would have allowed it to be better at interpreting the difference between a red shoe and a red bottle.

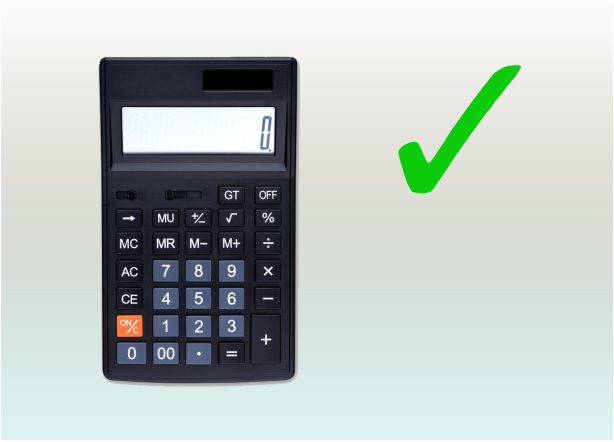
Provide a written scenario: (not necessarily useful nor functional) – meaning you can dream up what you wish… without constraint… - for how and when such a task (Object Detection) could be used or embedded in … what, why, where, with whom.

Back in high school, my final exams were conducted through the Cambridge Board of Education. They had very strict protocols and procedures that we had to follow in order for how exam results to be recognized internationally.

One thing that they paid close attention to was the items that we were allowed to bring into the exam hall. Many students were always looking for any advantage they could get, whether it would be a hidden note with formulas written on it or a calculator that could execute calculations that students were meant to do on their own.

I imagine that a good object-detecting model could help make this process a lot more streamlined, secure and consistent. The biggest and most important input of images that it would receive would be pictures of different calculators within 2 categories, legal and illegal. Since there are such a vast array of calculators and new models being made every day, it's impossible for a human to go through each without any assistance. A machine would be great at identifying brand icons and buttons which could possibly hint towards features that the student should not have access to.

The machine could also be fed with images of objects that invigilators should examine further before being let in. For example, certain pencil sharpeners and erasers come with compartments that could be used to store notes (Don't ask how I know this). Instead of invigilators needing to check each individual object, they'd only have to further examine ones the machine deems as potentially problematic.



Check stapler
for notes