Final Project Progress Report

Definitions

Team name: ***Licensed to Plate***

Team members: ***Gokul Ajith, Prithu Dasgupta, Spencer Greene, Daniel Park***
Note: Once one person uploads the report to Gradescope, please add all other team members to the submission within the Gradescope interface (top right on your submission).

TA name: ***Isabella Ting***

Project

- **What is your project idea?**
  Our project idea is to build an application that takes in images of cars with different backgrounds and orientations, detects if the car has a license plate, highlights where the license plate is, and reads its number if exists. We are hoping to first build a license plate detector using edge detection and feature extraction, then train a neural network model to read the plate input. Then, as a stretch goal, we will look to build a web application that allows users to input data for extracting license plate numbers using our model.

- **What data have you collected?**
  We have found online datasets to use for our project. This dataset contains plates and annotations from the US, Europe, and Brazil: https://github.com/openalpr/benchmarks/tree/master/endtoend/. It contains several hundred data points total.

  If we find that this is not enough data, we also found an API online at https://dataturks.com/projects/devika.mishra/Indian_Number_plates. This API can be used easily to access hundreds of images of Indian license plates that are already labelled for plate detection before being entered into the model.

- **What software have you built or used?**
  For this checkpoint, we have worked on the preprocessing code to be passed to the model and the model itself. For preprocessing we iterate through every image that is labeled with its license plate number. We currently do not use the detector in our preprocessing, but that is an inevitable step. We then take the image and resize it to 100 by 100 pixels with three color channels. Our training data is a four dimensional tensor with dimensions (-1, 100, 100, 3). For each label, we use a NLP approach. The max length of any license plate in 8 characters so each label is a vector of length 8. Each letter and character is mapped to a unique id plus a padding token, resulting in 37 unique tokens. For each character in a license plate, we look up its id, and store that id in the tensor at that index. If the license plate is less than 8 characters, we leave the remaining indices as padding tokens.

The model is fairly similar to project four. The initial steps consist of a combination of convolution and max pooling. The more complex part is our classification head and loss calculation. We flatten the output of our last convolution layer and after a series of dense layers and ReLU, we use a dense layer with sequence length times number of character units (8 * 37). We then reshape this output to be batch size by sequence length by number of characters (-1, 8, 37) and apply a softmax on the last dimension. This represents a probability distribution for each index of the license plate across the 37 possible different characters. For the loss given a set of logits that are (batch-size, 8, 37) and labels (batch-size, 8), we flatten both to be (batch-size * 8, 37) and (batch-size * 8,) and use sparse categorical crossentropy to try to maximize the probability of the correct character at a given index.

For the next checkpoint, we will begin integrating the detector with the model and fine-tuning the model relative to its hyperparameters. We also may need more labeled data.

- **What has each team member contributed thus far?**
  The team has continued to work together on this project incrementally. Every member has added to the model design and preprocessing approach.

- **What intermediate results have you generated?**
  Results of the detector on sample images was shown in the last checkpoint. We do not have any tangible results for this checkpoint because the majority of our time was spent on data prepossessing and designing our neural network. But by next week once we integrate the detector and the model, we should be able to see our performance visually.

- **What problems have you faced or still have to consider?**
  The main problems from last week persist. They will be easier to resolve once we integrate the model with the detector.

  We were not able to find a dataset of only American license plates, and so our current dataset is a mix of plates from many different countries. While this may pose a problem, we feel that it also creates room for experimentation and another challenge area for our model to overcome.

  Also, our detector finds license plates fairly well as is, but sometimes we receive several false negatives. We will need to do some tweaking with our parameters in order to improve this.

  We will also be working to better test and improve the model once we get more data. A potential problem is if the model itself does not perform as well as we hoped, in either efficiency or accuracy, due to lack of data or the difficulty of the task.

- **Is there anything that we can do to help? E.G., resources, equipment.**
  Not at the moment!