COMS 4732
COMPUTER VISION II: LEARNING
HW 5

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Q1. After learning about neural networks at Columbia, Homer landed his dream summer internship at a self-driving car startup in New York City. Although the prototype autonomous car was pretty good, there was a major bug that was preventing launch: the car would often crash into plants! So, Homer's job for the summer was to train a neural network to detect plants, which would feed into the car's control algorithm. To train the neural network, Homer decided to collect training data by walking around Central Park, and taking pictures of different plants that summer. *What is wrong with Homer's plan and why?*

Answer:

Although Homer's idea on gathering images of plants from Central Park is a good idea since, the vast variety of plant species found in central park. However, the context i.e., background in the image in consideration (Trees) is important when training a CNN as it may misclassify a tree as something else when seen in different environment such as tree planted on sidewalks and dividers on freeways. Also, in places like Arizona where the types of plants would be different from the plants found in NYC. Thus, the model trained by Homer would be biased to trees found in the North Eastern region of the US.

Q2. After graduating from Columbia, Lisa founded her own startup. Her idea was to create an autonomous drone that would fly around Manhattan, and sell bagels to hungry pedestrians. However, Lisa wanted to maximize her profits, so she wanted to find a way to send the drones to areas where people like bagels. She decided to train a neural network that would input GPS coordinates and time of day, and output the expected profit for sending the drone there. So, she uses the neural network to estimate the best location, flies the drones there, and sells bagels. She then uses the actual sales data to train the neural network, and repeats this each day. *What is wrong with Lisa's plan and why?*

Answer:

Firstly, as per the FAA regulations, drones are not allowed in NYC for recreational and commercial use. Secondly, it is stated that the model will be re-trained each day, thus, as the training would occur every day, the model will start overfitting in

the regions of daily orders which would overlook potential orders from new places. Thirdly, the problem Lisa is trying to solve using neural network doesn't seem to be appropriate given the data she is using. It looks like she is trying to solve a regression problem for which classical machine learning algorithms such as Ridge regression, LASSO regression, SVRs and classical data analysis approach would give better results as well as be computationally cheaper.

Q3. Marge thinks machine learning is just hype, so she accepts a job at a startup that manufactures smart pet products. Marge's job is to create the smart cat door, which is a door that will only open when the owner's cat shows up, and no other animal. Marge decides she can put a camera on the cat door, and create a cat-face recognition system using a variety of classical computer vision techniques. Moreover, since there is no training set, the training set cannot possibly be biased. To help her debug, she takes a few photos of her own cat to use as a test set, and refines her system until it works very well on the test set. *What is wrong with Marge's plan and why?*

Answer:

Marge's plan of using classical computer vision techniques to solve the pet detector problem is flawed since, the task of the algorithm would be to make a judgement whether the cat belongs to the owner or is any other cat (someone else's pet or stray cat). Marge's code is biased to differentiate between her cat from the rest which would be fine for her case. However, when deploying the code on the device, it would be expected to learn for the owner's cat just as the Face ID in iPhones, which is not possible when using classical computer vision algorithms. Also, the dataset used by Marge is very small i.e., her own pet cat which means that the algorithm is biased to detect Marge's cat only or a cat with similar features or of same breed.

Q4. Bart landed a job at a hospital after graduating, and he wanted to put his Columbia computer science degree to good use. All the doctors kept commenting to him that, if cancer can be detected early, then the outlooks for patients is much better. So, he decided to create a phone app that would screen people for cancer automatically, which he would make available for free. Since he was at the hospital, he was able to collect a massive dataset to train a neural network that would input a medical scan and output the probability that a person is at risk for cancer. He was aware that neural networks often learn biases, so he was careful to test them for it. He empirically tested his model in many ways, for example showing that his model was not biased against race or gender. However, he found that his model was biased for age, and the model was more likely to predict older folks are at higher risk of cancer. *Why might Bart's plan be, ok?*

Answer:

According to researchers, people with weak immunity are at greater risk of getting cancer. Also, according to studies cancer cells take several decades to activate. Thus, considering the older people have weaker immunity and the fact the it takes many years to develop cancer, old people are generally at high risk of developing cancer. Hence, this corroborates Bart's model and it is safe to say that the bias for age learned by the neural network is a good generalization indeed.