Samuel Thomas Project Freedom Summary

Notebook

For my project, I decided to explore and classify weather images using different methods that we have learned in MAS4115. In particular, data exploration with tSNE and comparison of different CNN's used for transfer learning will be conducted. The dataset is a collection of 6862 images of 11 different weather phenomena that are split into files named by classification. The classes are the following: Dew, fogsmog, frost, glaze, hail, lightning, rain, rainbow, rime, sandstorm, and snow. The dataset was found on Kaggle. The goal of the project is to classify weather based on an image using Transfer Learning. Images will be classified using 3 different pre-learned CNN's: EfficientNetB0, MobileNetV2, and ResNet50. The highest predictive performance, while balancing efficiency, is desired.

The first major step was data processing. To begin, the dataset was loaded from Kaggle onto Colab. This was fairly straightforward using the opendatasets package. The only requirement was to input a Kaggle username and API key when prompted. After that, I extracted each image from the 11 files into the notebook. This got pretty technical and messy. It involved running through every file folder and uploading each image while also creating vectors that tracked the file name and classifications for each image. See the notebook for more details. Finally, I split the data into a training set and a testing set.

Next, I visualized the dataset by plotting the images on a 2D surface using tSNE to see how they cluster. Note that tSNE only separates images by color of the whole image. There are a few very distinct sets of images. There were a couple main takeaways. First, many of the dew images are up-close images of grass and other plants which will likely lead to very good classification due to their uniqueness. Next, many of the sandstorm images are uniquely orange. However, there are some images that appear very similar in both color and shape. There are 3 types of ice in this image dataset: Frost, Glaze, and Rime that appeared extremely similar. Further, many of the snow images appear to be very similar in style to the ice images. For this reason, I believe that the models will have difficulty classifying between the three types of ice, and possibly snow.

Finally, I used the three different transfer learning models to classify the images. The structure of each model was as follows: Input, data augmentation to help generalize models, data preprocessing to rescale images correctly for each CNN, frozen CNN, two additional layers, dropout layer, and a top layer to classify the images. Additionally, each model was fit over 5 epochs with a batch size of 128. Each model performed very well:

Model	Train Accuracy	Test Accuracy	Time
EfficientNetB0	90.72%	85.49%	76s
MobileNetV2	86.20%	82.76%	59s
ResNet50	91.84%	83.83%	113s

There were a few common places of misclassification in every model: Sandstorm vs FogSmog, Frost vs Glaze vs Rime, and Snow vs (Glaze/Rime). Overall, the results were very good. The best model when balancing accuracy and efficiency is the EfficientNetB0 model. It produced the highest accuracy while also maintaining good efficiency.

As far as next steps, it would be interesting to see performance of each model when unfreezing the top 30% of layers in each CNN. I believe this would lead to improvement across the board, especially if batch size and epochs were tuned.

Please refer to the notebook for more details about everything discussed here. Hope you enjoy!