Lab Six: CNNs

Due Apr 29 by 11:59pm   **Points** 10   **Submitting** a file upload

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Lab Assignment Six: Convolutional Network Architectures

In this lab, you will select a prediction task to perform on your dataset, evaluate a deep learning architecture and tune hyper-parameters. If any part of the assignment is not clear, ask the instructor to clarify.

This report is worth 10% of the final grade. Please upload a report (**one per team**) with all code used, visualizations, and text in a rendered Jupyter notebook. Any visualizations that cannot be embedded in the notebook, please provide screenshots of the output. The results should be reproducible using your report. Please carefully describe every assumption and every step in your report.

Dataset Selection

Select a dataset identically to lab three. That is, the dataset must be image data. In terms of generalization performance, it is helpful to have a large dataset of identically sized images. It is fine to perform binary classification or multi-class classification.

Grading Rubric

- Preparation (**30 points total**)
  - [**15 points**] Choose and explain what metric(s) you will use to evaluate your algorithm's performance. You should give a **detailed argument for why this (these) metric(s) are appropriate** on your data. That is, why is the metric appropriate for the task (*e.g.*, in terms of the business case for the task). Please note: rarely is accuracy the best evaluation metric to use. Think deeply about an appropriate measure of performance.
  - [**15 points**] Choose the method you will use for dividing your data into training and testing (*i.e.*, are you using Stratified 10-fold cross validation? Shuffle splits? Why?). **Explain why your chosen method is appropriate or use more than one method as appropriate**. Convince me that your cross validation method is a realistic mirroring of how an algorithm would be used in practice.
- Modeling (**60 points total**)
  - [**15 points**] Create a convolutional neural network to use on your data using Keras. Setup the training to use data expansion in Keras. Explain why the chosen data expansion techniques are appropriate for your dataset.
  - [**20 points**] Investigate at least two different convolutional network architectures (and investigate changing some parameters of each architecture). Use the method of cross validation and evaluation metric that you argued for at the beginning of the lab. Visualize the performance of the training and validation sets per iteration (use the "history" parameter of Keras).
  - [**15 points**] Visualize the final results of the CNNs and interpret the performance. Use proper statistics as appropriate, especially for comparing models.

- [**10 points**] Compare the performance of your convolutional network to a standard multi-layer perceptron (MLP) using the receiver operating characteristic and area under the curve. Use proper statistical comparison techniques.

- Exceptional Work (**10 points total**)
  - You have free reign to provide additional analyses.
  - One idea (**required for 7000 level students**): Use transfer learning to pre-train the weights of your initial layers of your CNN. Compare the performance when using transfer learning to training from scratch in terms of classification performance.