Final Project

MIDS W281: Computer Vision

Overview

For your final project, you will work with a group (3-4 people) to build a custom image classifier using the tools you have learned in this class. The type of classification problem you solve will be up to you.

First, you will need to find an image dataset online. There are many popular datasets used for classification across many domains, including medicine, architecture, agriculture, satellite imagery, etc. Your dataset should be of at least moderate difficulty (more complicated than MNIST, for example), and should include any labels needed to answer your intended classification query (supervised learning only). Alternatively, you may choose to use the general animal classification dataset we have provided, but beware, it is rather challenging! You will most likely need to perform a variety of pre-processing steps on your images to ensure that they are all the right size, resolution, number of channels, appropriate contrast, etc.

You will turn in a proposal including information about your dataset and the intended classification question you hope to answer, along with a few other details described in the rubric below. **Your proposal must be submitted for approval by the instructors no later than Week 8.**

Next, you will design custom feature vectors using the filtering and image decomposition methods we covered in class. You must implement at least 2 non-learned features (e.g., multi-scale histogram of oriented gradients, as one example). Choose feature vectors that are well-suited to the type of images and classification question you are working on. For full credit, you should also include a third feature that is either library-based and/or learning-based (e.g., SIFT, DAISY, VGG, etc).

Finally, you will build and train at least two classifiers using two different classification methods that we have learned (for example, general least squares and convolutional neural networks). You should (again) use classification methods that are appropriate for your dataset and query. Consider working with a smaller subset of the data to test out your ideas for classifier design. During this step, you

should divide up your dataset into training, validation, and testing groups. For full credit, implement a hyperparameter search using subsets of the validation data. Avoid overfitting.

The final deliverable will be a notebook that includes well-commented code interspersed with written explanation describing your process and figures showing the results for each of these steps. We recommend that you start working on the project as early as possible, and we will have each group provide short status updates in the last few weeks of the semester.

Rubric

Total 100 pts

Proposal - 5 pts

Provide a link to the dataset, example image(s), a description of the variation in the dataset (e.g. categories, size/resolution, etc), a description of the intended classification problem (i.e., list of output categories), estimation of the approximate number of images expected to be in each category, and a guess of the types of image features that may be useful for this categorization (e.g. edges, histograms, etc)

Feature Extraction - 40 pts

This part should include the code to extract features, illustrations of the features extracted from example images, plots of the amount of variation in the dataset, as well as PCA decomposition and tSNE visualization of features. You must include at least two non-learned features and at least one feature that is either library-based and/or learning-based (e.g., SIFT, DAISY, VGG, etc).

Classification - 40 pts

This part should include code to perform classification using at least two methods learned in class, plots showing the results of classification per category, a discussion of possible reasons why the classifier might work better for some categories than others, and explanation of the limitations of the classifier.

Generalizability - 10 pts

Your data should be split into train, validation, and test groups before training the classifier, and you should do a hyperparameter search using parts of the validation set, ideally in a way that avoids over-fitting and maximizes generalizability. Lastly, you will report performance on the test set, and include a discussion of whether you achieved generalizability and how your training process might be improved.

Quality of Explanation - 5 pts

Overall quality of report, including readability of figures and code comments, quality of analysis, and discussion of limitations.