

## Assignment #6

The goal of this assignment is to gain experience going through the entire lifecycle of developing a machine learning model. Your goal is to develop a CNN model that, given a cell phone image taken somewhere inside a building on HMC campus, can identify which building is being photographed. You may use any online resources that you find helpful, but you must cite your sources and indicate clearly what portions of your code have been copied and modified from elsewhere. You may work individually or with a partner on this assignment. Please submit your assignment as a single jupyter notebook on Sakai. If you work with a partner, make sure to indicate both partners' names clearly at the very top of your notebook.

## Part 1: Data Collection/Preparation (30 points)

In the first part of the assignment, you will do the following:

- Data Collection (15 points). Each student/team will collect 50 cell phone pictures taken of random locations inside a single building on campus. Please sign up for a building to photograph in this [spreadsheet](#), and upload your pictures to this [shared google drive](#). Since the data will be used by the entire class, please complete this portion of the assignment by Saturday 1pm (-5 points if not done by then). If there are more than 5 buildings represented in the class data, you may simply select 5 buildings to use for this assignment.
- Data Preparation (15 points). Download the class data onto your laptop. Prepare the data for use in PyTorch by ensuring image format compatibility, putting the images in a suitable directory structure, and creating train & validation partitions. Describe your data preparation process in your notebook.

## Part 2: Nearest-Neighbor Approach (30 points)

In the second part of the assignment, you will do the following:

- Feature extraction (15 points). Find a pretrained CNN model (e.g. ResNet) and use the penultimate layer activations as a feature representation. Your jupyter notebook should include code that demonstrates how to use the pretrained model to extract features from an image in the dataset.
- Nearest Neighbor Method (15 points). Extract features from all the images in the training set and store them in a single file along with the building labels. For each image in the validation set, use the pretrained CNN model to extract the feature representation, calculate which training image is closest in Euclidean distance, and use its label as the prediction. Report your classification accuracy.

## Part 3: Fine-tuning Approach (35 points)

In the third part of the assignment, you will do the following:

- Finetuning (25 points). Remove the output layer of the pretrained CNN model and replace it with a randomly initialized output layer that classifies among the 5 buildings of interest. Finetune the modified model on the training samples. Include your training/validation loss curves in your notebook, along with the final validation classification accuracy.
- Improvements (10 points). Experiment with different ways to improve the validation accuracy. Include any results or figures to document your progress.

An additional 5 points will be graded for the organization and clarity of your notebook. Your notebook should read like a tutorial and be understandable to others!