

Auburn University  
Assignment 3  
COMP 5630/ COMP 6630/ COMP 6630 - D01 (Fall 2025)  
Machine Learning  
Deadline: Nov 6, 2025, 11:59 PM CST

## Overview

In this assignment, you will:

- Implement a CNN for regression task
- Familiarize with regularization technique for training a CNN
- Reflect on learning rate, choice of activation function, number of neurons, regularization techniques and model performances.

## Part 1: Dataset and Preprocessing (10 points)

1. You have to predict the age of a person given facial images of people. Download the data from [here](#).  
Fcial Image Dataset.
2. The labels of each face image is embedded in the file name as below  
`[age]-[gender]-[race]-[date&time].jpg`.  
Preprocess the dataset to extract the age as class label from each image.
3. Split the dataset into training and testing sets using `train_test_split` from `sklearn.model_selection`, with 80% for training and 20% for testing. Use `stratify=y` to maintain class proportions and `random_state=15` for reproducibility.
4. Among the training, use 20% data for validation set..

## Part 2: CNN (40 points)

**Objective:** Implement CNN for regression. You can choose the number of neurons in each layer using your intuition. Train your network until convergence. You can use the Scikit-learn and Keras/ PyTorch and report the results.

1. What is the activation function that you will choose for the output layer? Justify your answer briefly.
2. How many neurons should there be in the output layer? Why?
3. Report the average MSE loss and the accuracy.
4. What is the effect of the learning rate on the training process? Vary the learning rate to be between 0.001 and 1.0 and plot the resulting accuracy as a function of learning rate.
5. What is the effect of the activation functions in the network? Explore two different activation functions other than sigmoid such as tanh, linear, or ReLU.
  - (a) Will you need to change the update rule?
  - (b) What is the change that you need to make to achieve this experiment?
  - (c) Report your observations by reporting the final loss and plotting the true labels and your predicted labels, along with a brief (2-3 lines) description.
6. Apply early stopping criteria as regularization
  - (a) How the training and validation loss changes as you change the “patience” in Early Stopping?
  - (b) Plot the training vs. validation loss curves. Justify whether your model overfits or underfits as the patience changes.
  - (c) Compare model performance with and without early stopping criteria

## Notes

1. If your code does not run on Colab, you will not get any credit for the code segment. We will only grade what is in your report.
  - a. This includes any syntax errors due to indentation, unnamed/unknown libraries that were not listed in the README file, etc.
2. Please submit code only in Python and in the IPython notebook format. You can write your answers as part of the notebook if you do not want a separate report file, but it must be comprehensive.
  - a. Any code not in Python will not be graded at all.

3. Please declare any use of GenAI usage. Your points will not be deducted for declaration. But if the TA or instructor discovers by themselves of GenAI usage and you don't declare, then your point will be deducted.