

# English Hand Written Letters Classification Using Various AI Techniques

COMP 4106 - Project proposal

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# **Proposal: English Hand Written Letters Classification Using Various AI Techniques**

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## **I. Motivation**

Artificial Intelligent(AI) is a very board branch of Computer Science with many real word applications. AI itself has many subfield, and one such interesting topic is Computer Vision. Thanks to advance AI technology, nowadays just a little camera on hour phone can provide a lot of information to users. In this project, I want to take the first step into the field by trying to recognize hand written English characters using different AI methods and compare their performances based on accuracy and time/space complexity.

## **II. Project description**

### **1. General**

The main purpose of the project is to develop various AI and machine learning techniques classify English hand written letters. Specifically, I will develop a software which allows the user to draw English lowercase alphabetical letters, and the program will use various AI methods to predict the letter from 26 total in the alphabet, and compare the performances between methods.

### **2. Software structure**

I will develop a simple web application that allows users to draw the hand written digits on the computer screen. In order to have the proper complexity for the duration of the project, I will only use a 28 x 28 pixels grid to allow user to draw the letters. The web client then sends the images to a back-end engine which contains the trained letter recognition AI models to perform predictions.

After the predictions has been computed, the result together with performances metrics will be returned back to the web client to be displayed to the users.

### **3. Building the AI models**

### **4. Training data**

In order to perform the predictions, training data is necessary for the task. We need to obtain a good source hand written letter images together with their labels (1 of the 26 character) in order to perform the classification task. The AI/machine learning model can then use these examples to predict the given pictures by the users

For this project, I have obtain the EMNIST dataset which contains 145,600 images of 28 x 28 pixels of handle written English letters, which is big enough to train my models.

### **5. Using existing library**

All of the models (except Neural network) will be implemented from scratch without directly use the existing opensource implementation available on the internet. However, to assist complex

mathematical calculations as quick performance measurements, I am going to use some existing library listed below.

- AI model development language: **python**
- Python library used:
  - **Numpy**: Support vector/matrix calculation in high dimensional array
  - **Pandas**: Library that helps working with big dataset
  - **emnist**: Support getting and reading the EMNIST dataset
  - **sklearn**: Provide various machine learning utilities. I will **not** use their machine learning models to perform the prediction
  - **tensorflow**: support building neural networks

### III. AI techniques

Below is the list of possible methods that I will implement and use to build the AI classification models. The number of methods to be implementations can be adjusted to suit the duration of the project.

#### 1. Nearest neighbors search

The nearest neighbor search (NNS) is an optimization problem of finding the point that is closest to the sets of points. In the letter classification setting, I can map each training images into a high dimensional vector, forming a search space for predictions. For new images given by user, the model can find the nearest neighbors and perform the classification using the labels from the nearest neighbors

#### 2. Logistic Regression

Logistic Regression is a probabilistic model which uses log-odds ratio to determine the decision boundary of the label classes. It directly models the log-odds with a linear function, thus we can maximize the likelihood to obtain a linear decision boundary, using gradient descent method.

#### 3. Linear Vector Machine (SVM)

Another method that we used was Linear Support vector machine (SVM). Linear SVM is another common classifier whose idea is to find a linear decision boundary that represents the largest separation between to classes, thus it increases the overall generalization. Formally, A support-vector machine constructs a hyperplane or set of hyperplanes in a high or infinite-dimensional space, in which a good hyperplane has the largest distance to the nearest training-data point of any class.

#### 4. Neural network (with Tensorflow)

Neural network is well-known in solving these classification problem. However, due to their complexity, I will use the tensorflow to build the network. The purpose of using the library is to compare which model performs the best.