# Machine Learning Engineer Nanodegree Program

Capstone proposal

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## Arabic Handwritten Characters Recognition

### domain background

The automatic recognition of text on scanned images has enabled many applications such as searching for words in large volumes of documents, automatic sorting of postal mail, and convenient editing of previously printed documents. The domain of handwriting in the Arabic script presents unique technical challenges and has been addressed more recently than other domains. Many different methods have been proposed and applied to various types of images. This paper provides a comprehensive review of these methods. It is the first survey to focus on Arabic handwriting recognition and the first Arabic character recognition survey to provide recognition rates and descriptions of test data for the approaches discussed. It includes background on the field, discussion of the methods, and future research direction

some related academic research relevant to this domain through this link

personal motivation for choosing this problem is there 420 million people

Speak Arabic and it's my mother language and there is no enough work at this problem we hope machine understand the Arabic text and its Sentence formulation

## Problem Statement

Handwritten Arabic character recognition systems face several challenges, including the unlimited variation in human handwriting and large public databases. In this work, we model a deep learning architecture that can be effectively applied to recognizing Arabic handwritten characters.

## Datasets and Inputs

The data-set is composed of 16,800 characters written by 60 participants, the age range is between 19 to 40 years, and 90% of participants are right-hand. Each participant wrote each character (from 'alef' to 'yeh') ten times on two forms.

The database is partitioned into two sets: a training set (13,440 characters to 480 images per class) and a test set (3,360 characters to 120 images per class). Writers of the training set and test set are exclusive. Ordering of including writers to test set are randomized to make sure that writers of the test set are not from a single institution (to ensure variability of the test set).

Kaggle is the dataset source: and we could download it from this link

## Solution Statement

A Convolutional Neural Network (CNN) is a special type of feed-forward multilayer trained in supervised mode. The CNN trained and tested our database that contains 16800 of handwritten Arabic characters

## Benchmark Model

In an experimental section, we showed that the results were promising with a 94.9% classification accuracy rate on testing images. In future work, we plan to work on improving the performance of handwritten Arabic character recognition.

Miss-Classification & correct-Classificationrate and number of wrongs and correct recognition

# Evaluation Metrics

## Generating a confusion matrix

for summarizing the performance of a classification algorithm. Classification accuracy alone can be misleading if you have an unequal number of observations in each class or if you have more than two classes in your dataset. Calculating a confusion matrix can give you a better idea of what your classification model is getting right and what types of errors it is making.

# Project Design

At first, I will import the necessary libraries such as Keras to build CNN, Visualizing tools and metric tools

As I mentioned I will use Arabic Handwritten Characters Dataset, and it's split to the training set and testing set I will make the needed preprocessing for the data and Visualizing it, then we preprocessing the data

- Encoding categorical variables
- Normalization

After that, I will build the CNN and make Optimization algorithms for the CNN

To helps us to minimize (or maximize) an Objective function (another name for Error function) E(x) which is simply a mathematical function dependent on the Model's internal learnable parameters which are used in computing the target values(Y) from the set of predictors(X) used in the model. For example — we call the Weights(W) and the Bias(b) values of the neural network as its internal learnable parameters which are used in computing the output values and are learned and updated in the direction of optimal solution i.e minimizing the Loss by the network's training process and also play a major role in the training process of the Neural Network Model .

the architecture of the CNN model :

- I will use 4 Conv2D layers the first two with 64 nodes and the second two with 32 nodes I guess it works well
- The activation function we will be using for layers is the ReLU
- In between the Conv2D layers and the dense layer, there is a 'Flatten' layer. Flatten serves as a connection between the convolution and dense layers

- ‘Dense’ is the layer type we will use in for our output layer. Dense is a standard layer type that is used in many cases for neural networks.

When the CNN is Ready its time to Fitting the CNN to the training data and Make the predictions, Generating a confusion matrix and Calculating the accuracy