Types of Neural Networks in Python



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# Abstract

The technology of all kind plays a significant role in society and technology can be considered an important, almost essential part of modern life. The advancements that are made in the last few years are phenomenal. In this project, I will build three different types of Neural Networks using the High-level programming language Python. Neural Networks have gained popularity in recent years even though much of the theory is being evolved since the 1950s. Platforms such as TensorFlow and Keras are allowing many developers to divulge into Neural Networks. These are end-to-end open source platforms that allow for easier machine learning. A decade ago we thought that getting a computer to tell the distinction between one object and another would be almost unbelievable. Now we have trained Neural networks that can tell the difference with a precision of greater than 80 percent accuracy. Neural Networks have been around since the 1950s and has increased in popularity every year. The Project aims to compare the different types of neural networks which would provide a clear image of the differences and similarities between them. This project is a research project which would allow me to better comprehend the different types of neural networks. In the dissertation, I will be assessing the tasks of planning and developing, as well as design and implementation of all the components that make up my project. This project supports for further development and insertion of new components such as more types of neural networks. The proposed solution will be comprised of a command line application, which will give the user the ability to test the neural network and train the neural network. The project will also implement the crud functionalities and allow the user to login and save the user details.

# Introduction

In the beginning of Year 4, We were given the opportunity to work in a team or individually to develop a final year project. In the past three years I have only done group projects and this time I wanted to challenge myself and try something new. Initially the idea of the project was to create a Convolutional Neural Network and use the Django Framework to make a web application. However due to time constrains and this being an individual project I decided to keep working on the neural network. Even though the initial idea was very interesting, but it became very clear that I did not have enough programming in it. So, I scraped the original plan and decided to build three different types of Neural Networks. The project is intended for the research purposes with a goal that would allow me to better understand how Neural Networks work.

## Idea Raised

This is a project about machine learning named Python Neural Networks. The project uses Keras which runs on top of TensorFlow. Keras was created with an attention on enabling fast experimentation. The idea for undertaking this project stems from me wanting to figure out how uniquely different Neural Networks work. There are various types of Neural networks that I could have utilized in my project yet I for the most part uncovered into three fundamental ones. Toward the beginning of the project it was extremely difficult to pick which kinds of neural networks to use. During my research the different types of Neural Networks I came across were Recursive neural network (RNN), Convolutional neural network (CNN), Multilayer perceptron, Recurrent neural network (RNN) and k-nearest Neighbours (KNN). The three Neural Networks I chose to work with were Multilayer perceptron, Convolutional neural network (CNN) and k-nearest Neighbours (KNN). The figures below show how each of the Neural Networks work. I will cover about Neural Networks more in dept later in my dissertation.

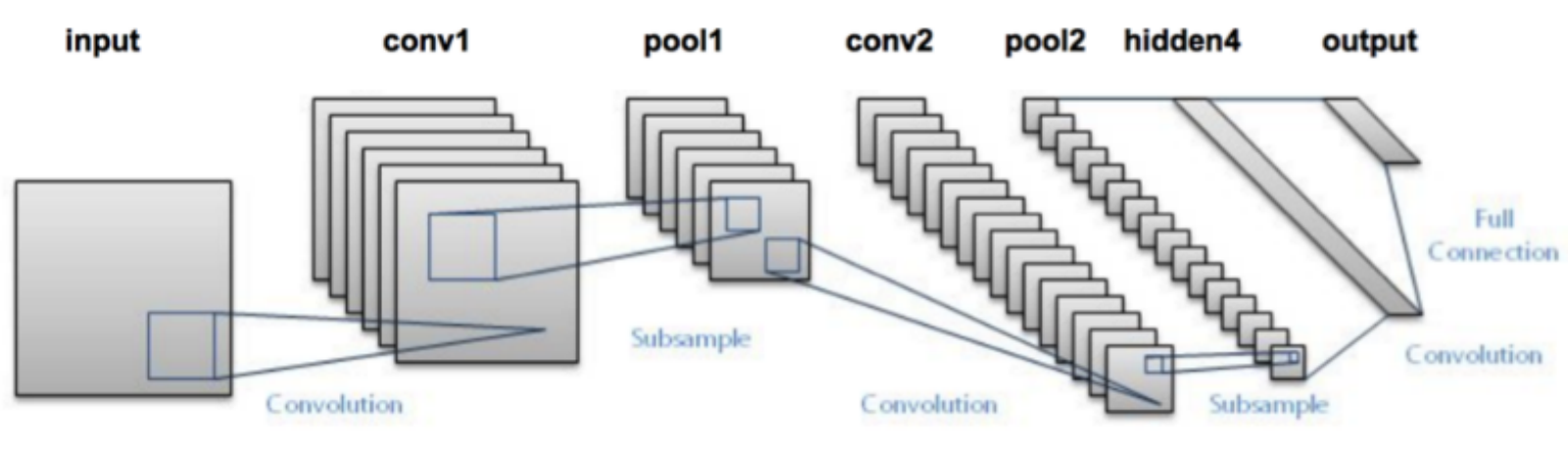


Figure 1.1: Convolutional neural network (CNN)

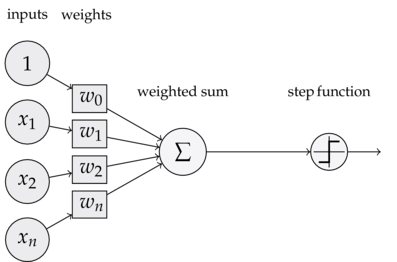


Figure 1.2: Multilayer Perceptron

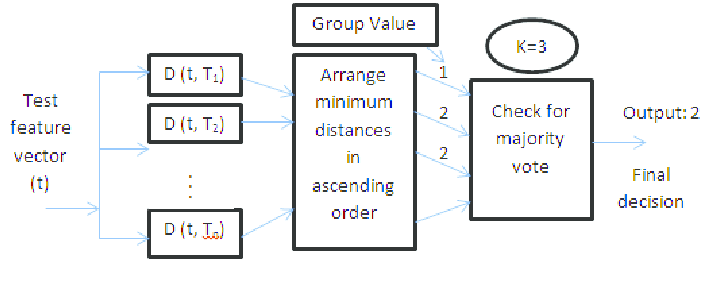


Figure 1.3: k-nearest Neighbours (KNN)

## The Solution

Neural Networks in Python is a project involving APIs, Python, MongoDB and cloud technology. The Implementation of the project is a command line interactive project that trains and tests the three types of neural networks with the support of a log in service. The log in service authenticates a user and allows to be able to train and test the Neural Networks. You can create a user which is saved in MongoDB in cloud. At the point when the client is logged you can see the three diverse choices for testing the distinctive sorts of neural networks. Each option leads into a different menu. For example, if you select the multilayer perceptron then this would lead into another menu. This menu allows you to test the multilayer perceptron with your own unique set of values.

Furthermore, the context of this project revolves around the user being able to test the different types of Neural Networks and perceive how each type of Neural Network produces an outcome.

## Objectives

The undertaking of this project will require several objectives to be attained in order to provide a solution that works and is high-performing.

* The first objective will be to build the Convolutional neural network (CNN). The dataset I will use is the MNIST Fashion Dataset. To start the project the first thing I will do is to train and test the dataset. This Neural Network will be able to recognise clothes from an image.
* After building the Convolutional neural network (CNN) I will start the Multilayer Perceptron. The dataset I will use to train my Multilayer Perceptron is the Iris Dataset. The user will be able to enter unique values to test the trained Neural Network.
* Finally, I will have to start the k-nearest Neighbours neural network. This will be for the colour detection in an image. I will have to make my own dataset of colours and train the Neural Network.
* MongoDB database will be used to store the images and user data i.e. their username and password. The MongoDB database must be setup on cloud so its easily accessed from anywhere.
* To store the passwords, I will be using the Hashing Algorithm SHA256. This allows for safe storing of passwords. The hashed string of the password will be stored in the MongoDB. When the user enters the password the it will be hashed and compared with the string from the database.
* Lastly, I will make the command line application more interactive by adding more GUI.

## Project Links

Link to Repository

* https://github.com/nakster/FashionNeuralNetwork.git

## Overview

As this being a final year project, it required something more intricate than anticipated, that is the reason I endeavour to undertake this project. The dissertation is structured in chapters, each one containing different aspects of the project. The following is a breakdown of what is examined in every section.

### Methodology

This section describes the steps that were taken in order to secure an effectively successful project. In this chapter I will diagram the distinctive Methodologies that were considered to design and implement the solution. It will mainly discuss the Agile Methodology, version control and testing. I will cover why I chose python and different technologies and the problems I encountered during the development of the project.

### Technology Review

This section will be about the technologies that I came across during my research. I will plot and evaluate the different technologies such as MongoDB and SHA256. I will talk about how to set up and use the technologies.

### System Design

This section of the dissertation deals with how each component of the project is achieved. I will also review each component with detailed discussion on how each component contributes to the whole system in the project. Alongside the detailed review, I will also provide code snippets for my project as well as working screenshots.

### System Evaluation

This section of the dissertation will outline the system performance, Robustness and Scalability. I will discuss advantages and limitations in doing the project.

### Conclusion

This section I will conclude the goals and objectives that were set. I will discuss the outcome of the project and the issues that were experienced. I will likewise talk about how I came up with the solutions for the problems encountered.

# Methodology

In this section I discuss the methodologies I used in my project to prevent contingencies. Before a project is started, it is very important to plan and control the development process of a piece of software. The reason for this is it refrains us from start coding with a poorly planned project, as this might result in goals not being achieved.

## Planning Phase

During the initial planning phase I set out the scope of my project and decided to use an Agile like approach to the research, design and implementation of my project. I investigated the different types of methodologies such as the waterfall model but at the end decided to use the Agile methodology. The reason I chose Agile over Waterfall is due to the fact waterfall model lacks flexibility. Where as Agile offers flexibility, incremental delivery and continual development of the software we are developing. I assigned myself the responsibilities to completing a final year project, the most important being carried out first. Before commencing any development of the project, I carried out some research about technologies that I was going to use. After evaluation of different technologies, I decided to use the programming language Python, MongoDB and Visual Studio Code. The reason I selected python is because of python’s easy to learn syntax. Python looks like a human readable language that is easy to learn. During the planning phase I drew up the architecture of my project and presented it to my supervisor. After help from my supervisor I decided to make a command line application and if I have time, I will make it into a Django application.

## Requirements Analysis

When commencing a new project determining the requirements is a key factor. These steps allow for the requirements to be analysed and broken down in to stories. These stories are then used to resolve the priority of each task. Therefore, at the start of the research I did a project requirements analysis based on few things. I had to use my own personal experience to gather a set of requirements that would help me design the implementation of the project.

These requirements include the following.

* First to have a software application that works and returns a correct outcome to the input entered.
* Secondly, having a complete login registration system implemented. I will need to use a database that can store the user information effectively.
* Thirdly I need to allow the user to test their own set of values, this could be their own input or from online url.
* Each of the Neural networks must have a menu that tests and trains each type of Neural Network.
* Lastly if I have enough time, I will use the Django framework to make my application a web app.

## Meetings

On accounts of me being a single person developing the final year project I did not have group meetings. As I started my project, I met up with my supervisor during college time to keep in check that I was developing a software product with the quality expected from a fourth-year student. I presented my supervisor with weekly progress and achievements and asked for guidance for the future development of my project. During the meeting the suggestion given by my supervisor were implemented during the successive week. The meeting normally took place every Tuesday or Thursday of each week.

## Development

I divided the attainable tasks into sprints. So, when I started the development progress the issues that become apparent were either resolved or taken in account in the next iteration. Continuous Integration is achieved in this project by completing the sprints and testing if they work and continuously adding more.

## Testing and Validation

Testing is an important part of a software project and during the life cycle it provides benefits to overall quality and reliability of the code in a project. I used terminal command line to perform testing and verification of the project during the development. I also performed Black Box Testing; this is where functionality of a piece of software is tested without the need to check the internal workings of the project.

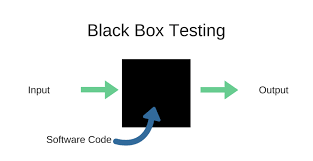


Figure 2.1: Black Box Testing

An example of this would be when the user enters the user name and password to login into the application. The Black Box Testing checks if the user is logged in when the correct input is entered. This type of testing is very useful to check if the piece of software is performing and returning what is expected.

## Problems

During the development phase I encountered only a handful number of problems or minor bugs. Most of my problems were from taking in the input from the user and making it compatible to test against the trained Neural Networks. These problems were dealt with during the development by means of research and getting to the root of the problem.

## Agile

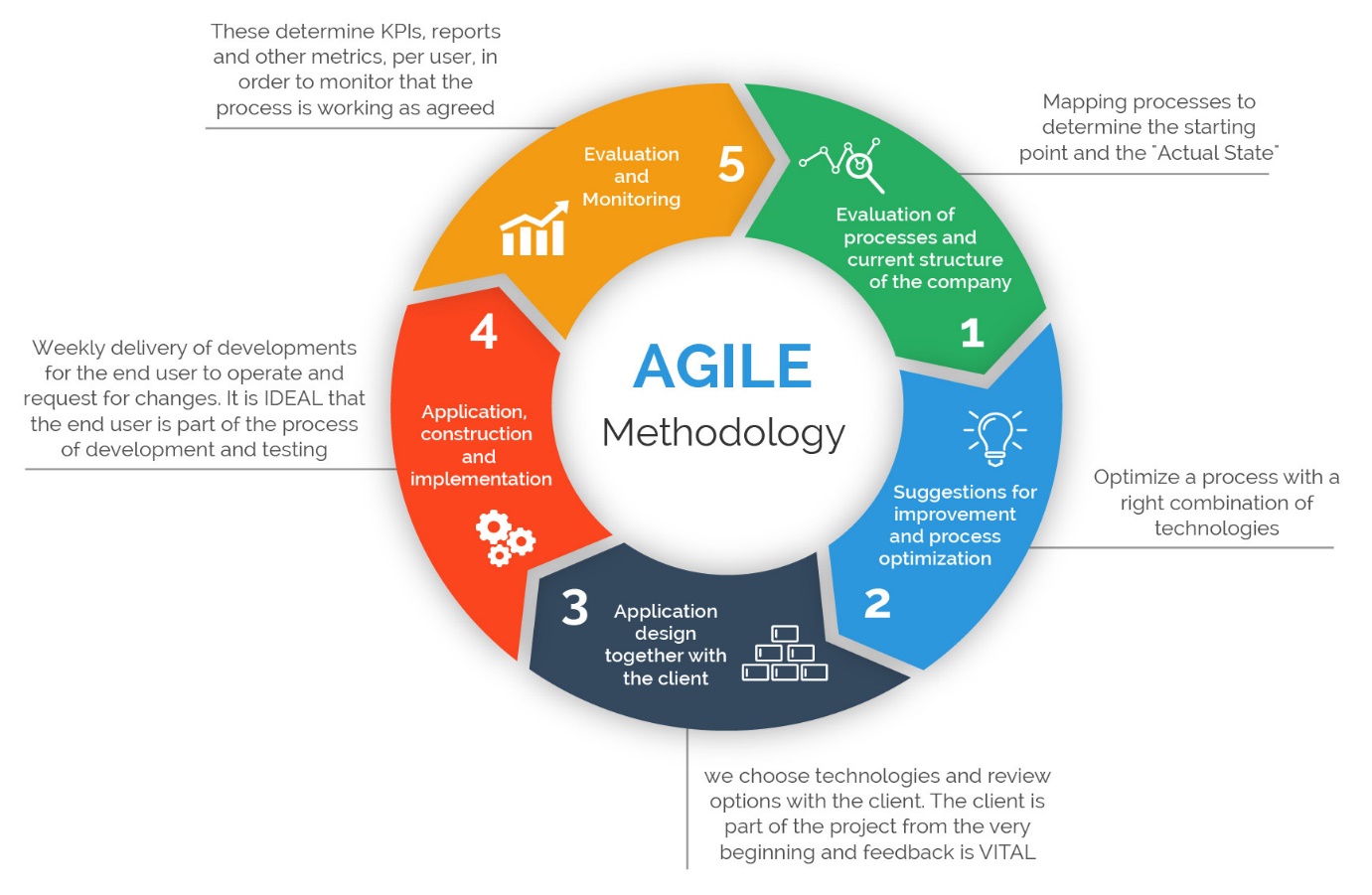


Figure 2.2: Agile

Agile is a development methodology which acknowledges that requirements can evolve and change over time.

## GitHub

## Project Management

# Links / Cite

[1]<https://www.techradar.com/news/what-is-a-neural-network>