CU6051NA - Artificial Intelligence

20 % Individual Coursework

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I understand that my coursework need to be submitted via Google Classroom under the final year project module page before the deadline for my assignment to be accepted and marked. I am fully aware that late submission will be treated as non-submission and marked as zero

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1. Introduction

1.1 Deep Learning with Convolutional Neural Network

Deep learning is a subset of machine learning where artificial neural networks, algorithms inspired by the human brain, learn from large amounts of data. Similarly to how we learn from experience, the deep learning algorithm would perform a task repeatedly, each time tweaking it a little to improve the outcome. We refer to 'deep learning' because the neural networks have various (deep) layers that enable learning. Just about any problem that requires "thought" to figure out is a problem deep learning can learn to solve.

Deep learning models are trained by using large sets of labeled data and neural network architectures that learn features directly from the data without the need for manual feature extraction. One of the most popular types of deep neural networks is known as convolutional neural networks (CNN or ConvNet). A CNN convolves learned features with input data, and uses 2D convolutional layers, making this architecture well suited to processing 2D data, such as images.

CNNs eliminate the need for manual feature extraction, so you do not need to identify features used to classify images. The CNN works by extracting features directly from images. The relevant features are not pre-trained; they are learned while the network trains on a collection of images. This automated feature extraction makes deep learning models highly accurate for computer vision tasks such as object classification.

CNNs learn to detect different features of an image using tens or hundreds of hidden layers. Every hidden layer increases the complexity of the learned image features. For example, the first hidden layer could learn how to detect edges, and the last learns how to detect more complex shapes specifically catered to the shape of the object we are trying to recognize.

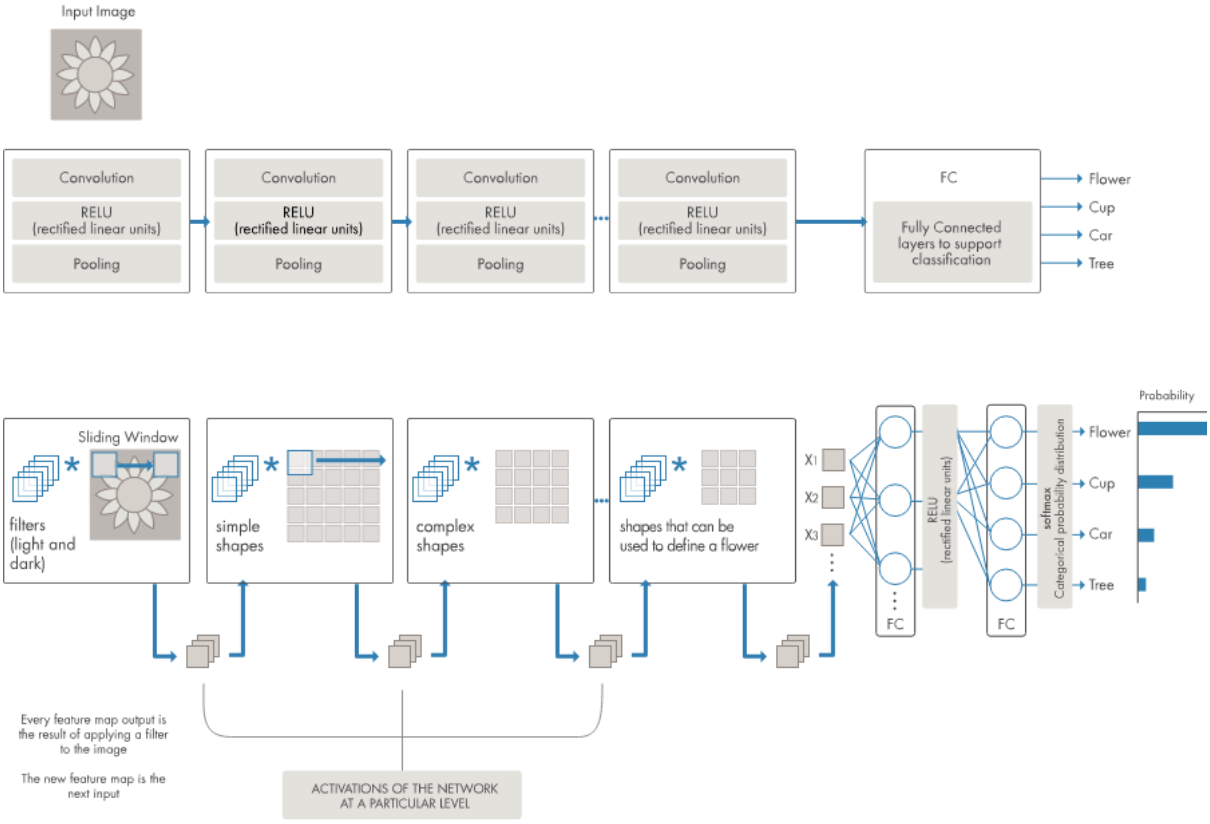

Figure 1: Convolutional Neural Network Architecture

1.2 Image Recognition and Classification

The recent advancement in artificial intelligence and machine learning has contributed to the growth of computer vision and image recognition concepts. From controlling a driver-less car to carrying out face detection for a biometric access, image recognition helps in processing and categorizing objects based on trained algorithms. The manner in which a system interprets an image is completely different from humans. Computer vision uses image processing algorithms to analyze and understand visuals from a single image or a sequence of images. An example of computer vision is identifying pedestrians and vehicles on the road by, categorizing and filtering millions of user-uploaded pictures with accuracy.

- A digital image represents a matrix of numerical values. These values represent the data associated with the pixel of the image. The intensity of the different pixels, averages to a single value, representing itself in a matrix format.
- The information fed to the recognition systems is the intensities and the location of different pixels in the image. With the help of this information, the systems learn to map out a relationship or pattern in the subsequent images supplied to it as a part of the learning process.
- After the completion of the training process, the system performance on test data is validated.
- In order to improve the accuracy of the system to recognize images, intermittent weights to the neural networks are modified to improve the accuracy of the systems.

2. Background

2.1 Research on chosen Domain

2.1.1 Selected Domain - Clothing Classification

Image classification is a very important topic in the field of AI. And clothing classification refers to the classification of the images of different types of clothes using artificial intelligence. The main purpose of the system to be built will be extracting features of specific cloth in the image, recognizing it and classifying it into one of the category that might be boot, shirt, trouser, coat or anything else.

The reason behind selecting this domain is that fashion has been growing day after day and people are so much concern about their clothing style. On the other hand, traditional method of buying and selling clothes in shops has all changed into online shopping. The new strategies of marketing are being implemented in order to provide better services to the customers and to raise the business. Also, customers wants to find the product in the best possible approaches like just from pictures.

So, the model to be built can be deployed in different systems from online shopping to fashion industry which will definitely ease the process that human has been doing traditionally.

Implementation of the model for different purposes in different area:

- Recommendations systems in online shopping
- Finding products using images from search engines
- Finding best match clothing style
- In Fashion Industry
- Online marketing

2.2.2 Problem Statement

With growing number of users it's becoming difficult to maintain all the things with traditional approaches. So why not to use advanced technology that can perform tasks in far better approach than human or any other methods.

The online shopping service providers are also facing lots of issues regarding providing best services to the customer. Fashion Industry in another side are looking for the pre-visualizing of the styles before bringing them into implementation. Also, people are looking for the easiest way of finding clothes online like finding similar clothes just by pictures.

So in all these cases the system that can automatically recognize the clothes without human intervention is lacking which can be solved using AI.

Fashion has always been the thing of priority for the people. What should they wear, how they should look, which style shoots them more, which outfit is better shoots them and so on. And the sense of fashion has always been changing with changing time. With the change of time the technology has also been changing. People used to go to the corner shops and mall back then now, they do online shopping from anywhere. Online shopping has been taking new heights in the market in recent years. The strategies followed to provide the better services to the customer has also been changed now. People has started believe in online marketing and keeping proper information of customers on what they really want.

Hence then clothing classification concept came in.

2.2 Research work on implemented AI concept

2.2.1 Artificial Intelligence

Artificial intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. Since the development of the digital computer in the 1940s, it has been demonstrated that computers can be programmed to carry out very complex tasks—as, for example, discovering proofs for mathematical theorems or playing chess with great proficiency. Still, despite continuing advances in computer processing speed and memory capacity, there are as yet no programs that can match human flexibility over wider domains or in tasks requiring much everyday knowledge. On the other hand, some programs have attained the performance levels of human experts and professionals in performing certain specific tasks, so that artificial intelligence in this limited sense is found in applications as diverse as medical diagnosis, computer search engines and voice or handwriting recognition.

AI programming focuses on three cognitive skills: learning, reasoning and self-correction.

Learning processes. This aspect of AI programming focuses on acquiring data and creating rules for how to turn the data into actionable information. The rules, which are called algorithms, provide computing devices with step-by-step instructions for how to complete a specific task.

Reasoning processes. This aspect of AI programming focuses on choosing the right algorithm to reach a desired outcome.

Self-correction processes. This aspect of AI programming is designed to continually fine-tune algorithms and ensure they provide the most accurate results possible.

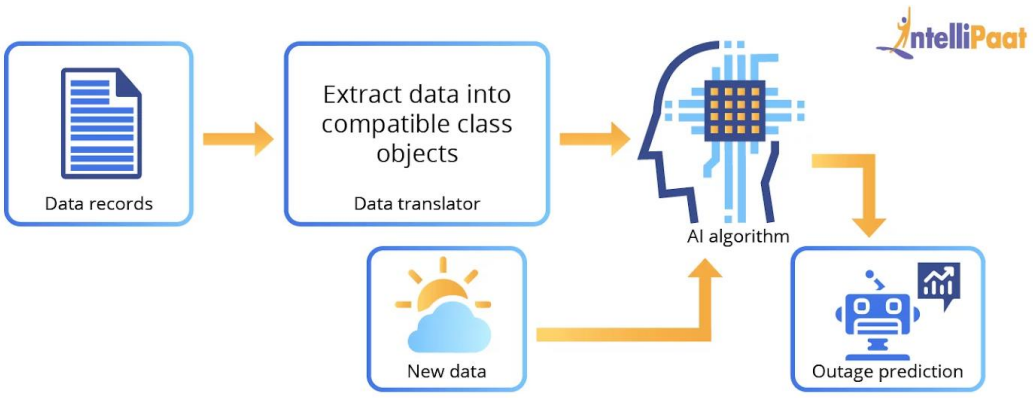

Figure 2: Working Mechanism of Artificial Intelligence

2.2.2 Machine Learning

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly.

Different Machine Learning Methods

1. Supervised Learning

Supervised machine learning algorithms can apply what has been learned in the past to new data using labeled examples to predict future events. Starting from the analysis of a known training dataset, the learning algorithm produces an inferred function to make predictions about the output values. The system is able to provide targets for any new input after sufficient training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.

- Classification
- Regression
- Forecasting

2. Unsupervised Learning

Unsupervised machine learning algorithms are used when the information used to train is neither classified nor labeled. Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabeled data. The system doesn't figure out the right output, but it explores the data and can draw inferences from datasets to describe hidden structures from unlabeled data.

- Clustering
- Dimension Reduction

3. Semi-Supervised Learning

Semi-supervised machine learning algorithms fall somewhere in between supervised and unsupervised learning, since they use both labeled and unlabeled data for training – typically a small amount of labeled data and a large amount of unlabeled data. The systems that use this method are able to considerably improve learning accuracy.

4. Reinforcement Learning

Reinforcement machine learning algorithms is a learning method that interacts with its environment by producing actions and discovers errors or rewards. Trial and error search and delayed reward are the most relevant characteristics of reinforcement learning. This method allows machines and software agents to automatically determine the ideal behavior within a specific context in order to maximize its performance.

- Q-Learning
- State action reward state action (SARSA)
- Deep Q Network (DQN)
- Deep Deterministic Policy Gradient (DDPG)

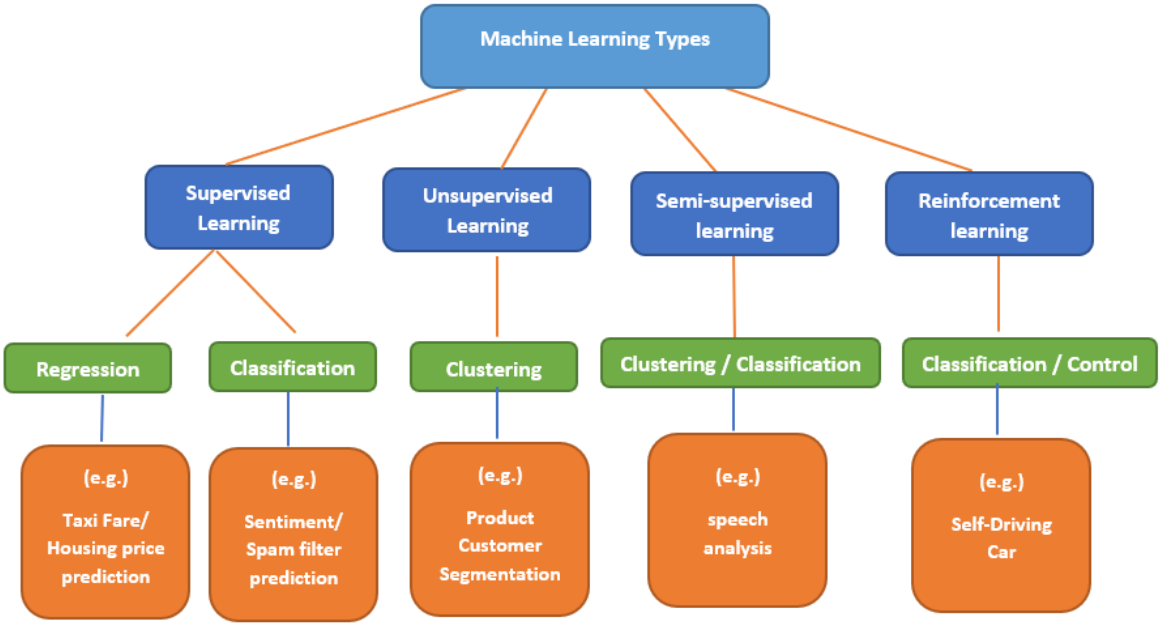

Figure 3: Different Learning Approaches in Machine Learning

2.2.5 Deep learning

Deep learning is a branch of machine learning. Unlike traditional machine learning algorithms, many of which have a finite capacity to learn no matter how much data they acquire, deep learning systems can improve their performance with access to more data: the machine version of more experience. After machines have gained enough experience through deep learning, they can be put to work for specific tasks such as driving a car, detecting weeds in a field of crops, detecting diseases, inspecting machinery to identify faults, and so on.

Deep learning networks learn by discovering intricate structures in the data they experience. By building computational models that are composed of multiple processing layers, the networks can create multiple levels of abstraction to represent the data.

For many tasks, such as computer vision, speech recognition, machine translation, and robotics, the performance of deep learning systems far exceeds that of conventional machine learning systems. This is not to say that building deep learning systems is relatively easy compared to conventional machine learning systems. Although feature recognition is autonomous in deep learning, thousands of hyperparameters (knobs) need to be tuned for a deep learning model to become effective.

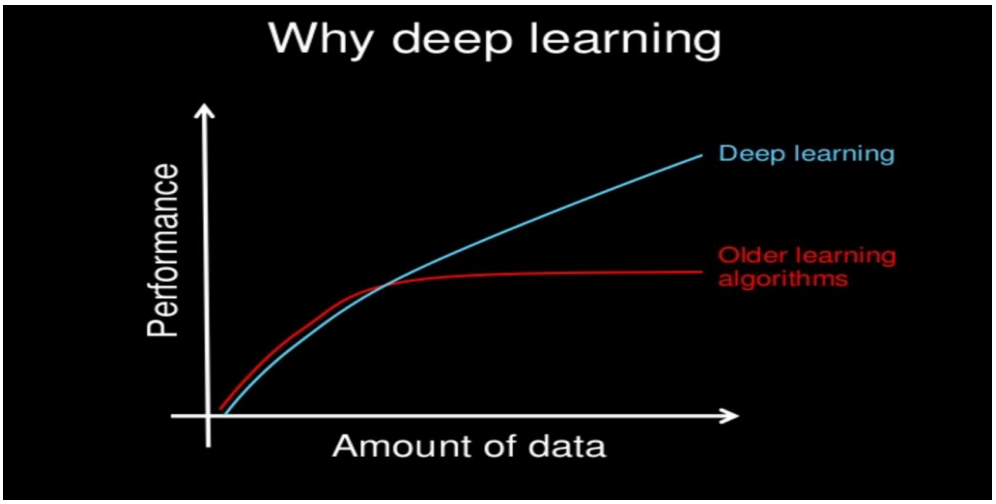

Figure 4: Deep Learning and Machine Learning performance on the basis of data

2.2.3 Neuron

The most fundamental unit of a deep neural network is called an artificial neuron, which takes an input, processes it, passed it through an activation function like the Sigmoid, return the activated output. Artificial-neurons are the core components of an artificial neural networks.

There are several different models of artificial neurons, but they all share the following core parts:

- **Inputs:** This is the data we "feed" a neuron to interpret. What kind of data it is, and how many inputs we have can vary greatly depending on what kind of NN we're training. Think of them as similar to the electro-chemical signals in our brain neurons.
- **Weights:** Every input has an associated weight that comes attached to it. These weights can be used to determine the importance of, or even simply the type of an input.
- **Bias:** This value represents an offset for the sum of our weighted inputs. It's used to ensure said sum is above or below a certain threshold value.
- **Activation function:** This is what determines the final output that the neuron "fires." It takes the sum of the previous parts, applies an algorithm, and sends off a value. Different activation functions are used depending on the kind of output we want.
- **Output:** The final output of the neuron. This output could feed another neuron or be the final output of the NN.

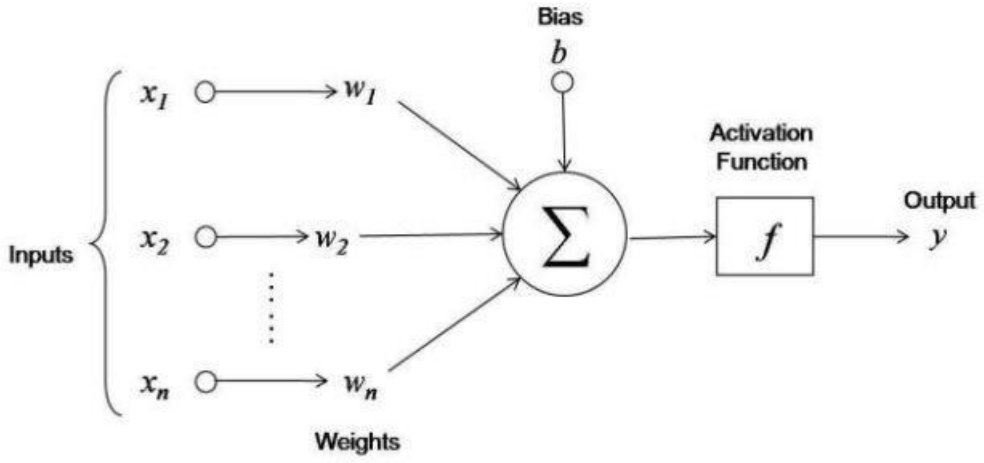

Figure 5: Single Neuron

2.2.4 Artificial Neural Networks (ANN)

An artificial neural network learning algorithm, or neural network, or just neural net, is a computational learning system that uses a network of functions to understand and translate a data input of one form into a desired output, usually in another form. The concept of the artificial neural network was inspired by human biology and the way neurons of the human brain function together to understand inputs from human senses.

The network consists of simple processing elements that are interconnected via weights. The network is first trained using an appropriate learning algorithm for the estimation of interconnection weights. Once the network is trained, unknown test signals can be classified. The class of neural networks used most often for classification tasks is the multilayer perceptron network.

Artificial NNs have a layered design:

- **Input layer:** The input layer is where we input our data. How that data is fed to the network will depend on the data. For example, let's say our data-set consists of 28x28 pixel images. We would then have 784 input neurons; one for every pixel.
- **Hidden layer(s):** These layers of neurons are for processing the data. These layers will have corresponding weights, a bias, and an activation function applied to the data that they are fed, unlike the input layer. There's a bit of artistry and science involved in deciding how many hidden layers to use. For now what's important to understand is that the data can go through one or more layers of understanding. Having more than one hidden layer, is what makes a neural network "deep," hence the term "deep learning."
- **Output layer:** The output layer, as you may have guessed, is the layer of neurons responsible for representing the output of our NN. For example let's say we wanted to classify our images into different categories A simple output layer setup would be to have 3 neurons, each representing one of the three labels.

The process of feeding data forward through these layers is called forward-propagation.

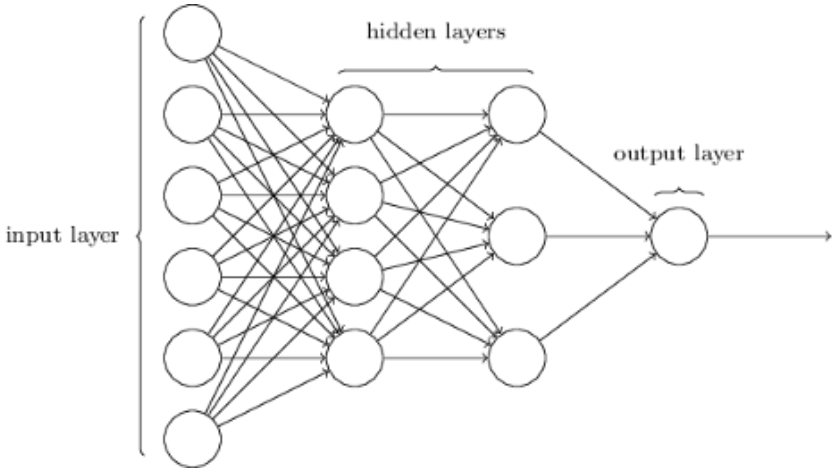

Figure 6: Artificial Neural Networks

2.2.6 Convolutional Neural Network

Convolutional Neural Networks (CNNs) is awesome for image classification problems. The basic principle of CNNs is to create many layers of feature detectors so it can take into account spatial arrangement from input image.

In CNNs, One uses receptive fields to connect the input layers to a so called feature map. One can considered these receptive fields as overlapping windows that slide over the pixels of the input image to create a feature map. The size of these feature detectors as well as the stride lengths are additional hyperparameters of the model which we need to be defined earlier. The process of creating the feature map is called convolutional. Note that the feature detectors are replicates, which means that receptive fields that map the features to the units in the next layer having the same weights. After creating a convolutional layer then one need to do sub-sampling (pooling layer). In this stage, one summarizes neighboring feature detectors to reduce the number of features to the next layer. In this stage, one basically does feature extraction where we take the average or maximum value of a patch of neighboring features and pass it on to the next layer. Finally, to create a deep CNNs, it is necessary to alternate between convolutional and sub-sampling layers before one connects to multi-layer perceptron for classification.

A classic CNN architect has following layers:

- Convolutional Layer
- Activation Operation Following each convolutional Layer
- Pooling layer especially Max Pooling layer and also others based on the requirement.
- Finally Fully Connected Layer

2.3 Review and Analysis of existing work in the same problem domain

2.3.1 Fashion Annotation Machine Learning Services

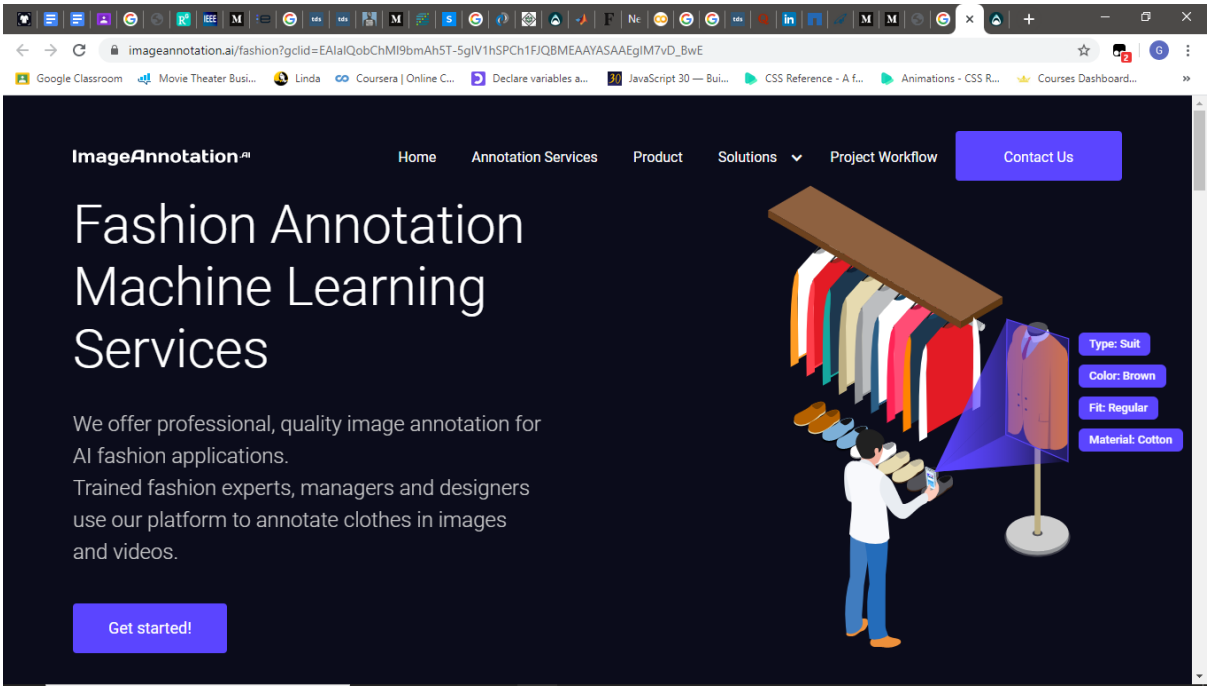

Figure 7: Fashion Annotation Machine Learning Services

ImageAnnotation.AI is the AI service provider company that offers professional, quality image annotation for AI fashion applications. The company provides the services annotation items like dresses, jackets, shirts and pants with bounding boxes and instance segmentation masks.

2.3.2 Skyl.ai

(ref: https://skyl.ai/models/fashion-clothing-images-classification)

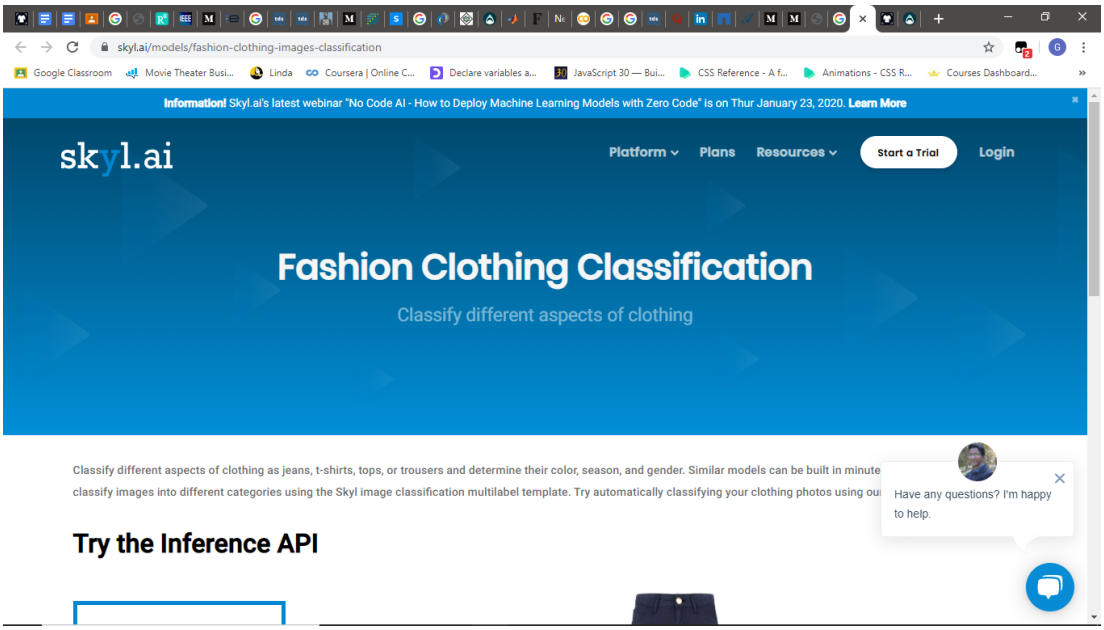

Figure 8: Skyl.Ai

Skyl.ai is the company that provides API services for classifying different aspects of clothing as jeans, t-shirts, tops or trousers and determine their color, season and gender. Similar model can be built for any other industry to classify images into different categories using Skyl image classification multi-label template.

2.3.3 ASOS

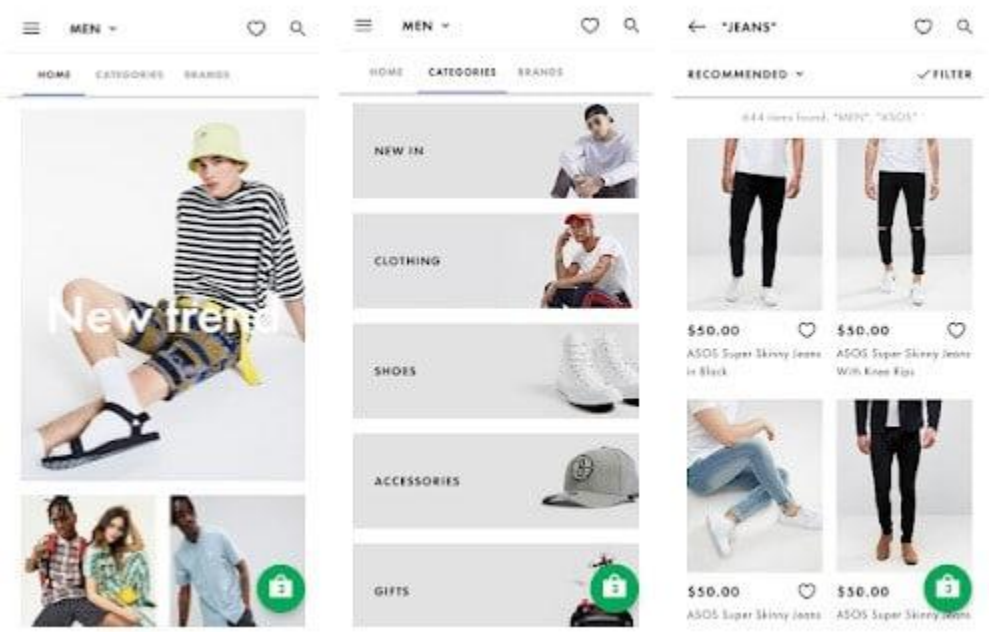

Figure 9: ASOS, British Fashion Retailer

ASOS is a British fashion retailer, and it also got an app. The latest version of ASOS got the ability to find your next outfit with a picture. The reverse image search option of ASOS is quite straightforward to use and it automatically fetches styles that most resemble the one you are looking for. But, again the image search option of ASOS is limited to the only ASOS retail shop.

2.3.4 Amazon's StyleNap

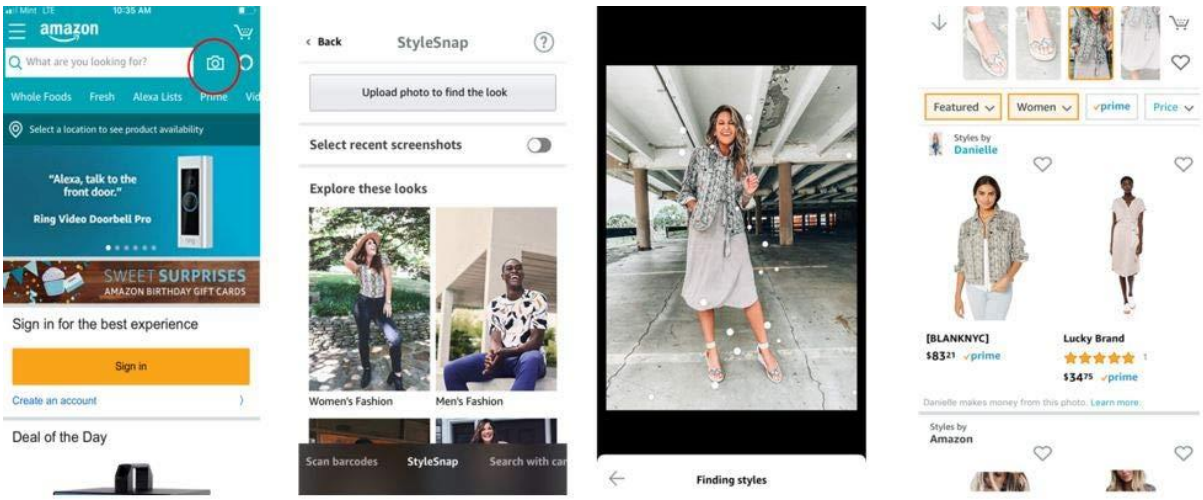

Figure 10: Amazon's StyleNap

StyleSnap is basically Shazam for clothes, built into the Amazon mobile app. Users can take a picture or upload an image and StyleSnap will use machine learning to "match the look in the photo" and find similar items for sale on Amazon.com. StyleSnap uses artificial intelligence (deep learning) to find similar clothes and styles.

2.3.5 ScreenShop

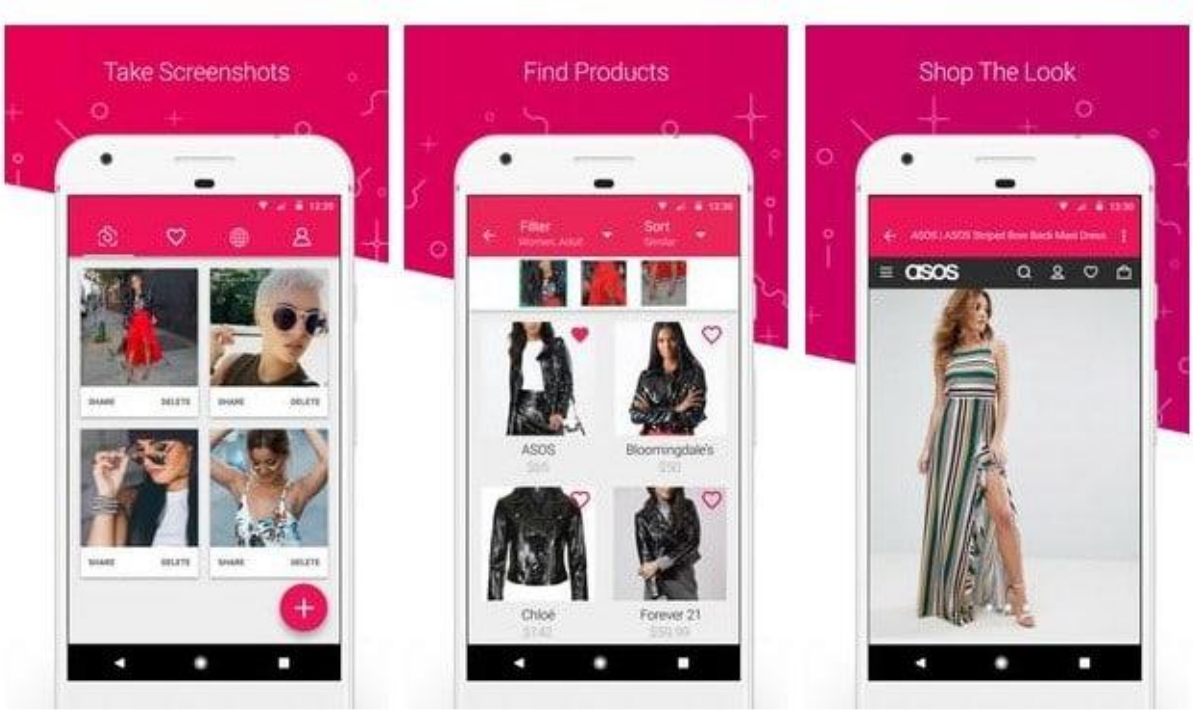

Figure 11: ScreenShop Mobile app for finding clothes from pictures

Screenshop is another best Android app that could help you to find clothes using a picture easily. With Screenshot, you need to import the image, and it will scan the outfit and will show you the results in different tabs. The underlying AI technology beneath this application helps to recognize the image, classify it to the specific class and find similar clothes of the same class.

Analysis

In all above mentioned systems and applications, AI's Image recognition and classification technology has been used. The algorithms and methodologies used may vary from how architect of the model has been defined.

Hence, my project is also about image recognition and classification of the clothes which can be deployed to different system for different business purposes. In fact, integrating AI for fashion marketing and recommendation system has taken huge height in the field of online shopping. It definitely provides huge support to retailers as well as to the customers.

3. Solution

3.1 Deep learning approach with Convolutional Neural Network for Clothing Image classification

It is easier for the human to see any clothes, identify them and classify them in different categories. But this is the same in case of computers. All a computer can understand is different set of numbers as the input data. So giving it an image of any type of clothes and expecting it to identify it is a kind of foolish. So image needs to process first into the form of data that computers can understand and then only perform certain operations in it.

So the first solution to this problem could be explicitly programming about the features of each and every clothes which is almost like an impossible thing in a world where there are millions of different types of clothes. And with the growing number of users of online shopping, it's becoming difficult to track the needs and interests of the users. On the other hand, the marketing strategies are also changing to establish better relations with customers as well as to deliver services in the best possible way.

Now here comes AI playing the biggest role in solving all these problems in the most efficient manner. So, in this project I'll be using deep learning with convolutional neural network to classify the images of clothes into different categories.

In order to build the classifier model, I'll be using Convolutional Neural Network (Feed Forward Neural Networks) algorithm with backpropagation. The model will be built on tensorflow backend using Keras library. Matplotlib will be used as the data visualization libraries. MNIST fashion dataset will be used to train the model.

Processes in building Model:

1. Import required libraries
2. Load the dataset for training and evaluation
3. Analyze the dataset
4. Normalize the dataset for inputting into CNN
5. Build the CNN model
6. Create the estimator
7. Train the model
8. Evaluate the model
9. Improve the accuracy of the model

Requirements for building model

Dataset	Libraries and Frameworks	Methodologies and Techniques	Algorithms	Programming language and platform
MINST-Fashion Dataset	Tensorflow Keras MatplotLib Numpy Pandas	Image Augmentation Dataset Splitting - Train, Test and Validation	Convolutional Neural Network Backpropagation	Python Google Colab Visual Studio Code

Table 1: Requiements for building Model

3.2 Algorithms Used

Convolutional Neural Network and Backpropagation are the two main algorithms to be used in building this image classifier model.

3.2.1 Convolutional Neural Network

A Convolutional Neural Network (CNN) is a multilayered neural network with a special architecture to detect complex features in data. Images are made up of pixels. Each pixel is represented by a number between 0 and 255. Therefore each image has a digital representation which is how computers are able to work with images.

The CNN model is built with the following different properties:

1. **Convolution**

   A convolution is a combined integration of two functions that shows you how one function modifies the other.

$$(f * g)(t) \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} f(\tau) g(t-\tau)\, d\tau$$
$$= \int_{-\infty}^{\infty} f(t-\tau) g(\tau)\, d\tau.$$

   There are three important items to mention in this process: the input image, the feature detector, and the feature map. The input image is the image being detected. The feature detector is a matrix, usually 3x3 (it could also be 7x7). A feature detector is also referred to as a kernel or a filter.

   The matrix representation of the input image is multiplied element-wise with the feature detector to produce a feature map, also known as a convolved feature or an activation map. The aim of this step is to reduce the size of the image and make processing faster and easier. Some of the features of the image are lost in this step.

However, the main features of the image that are important in image detection are retained. These features are the ones that are unique to identifying that specific object. For example each animal has unique features that enable us to identify it. The way we prevent loss of image information is by having many feature maps. Each feature map detects the location of certain features in the image.

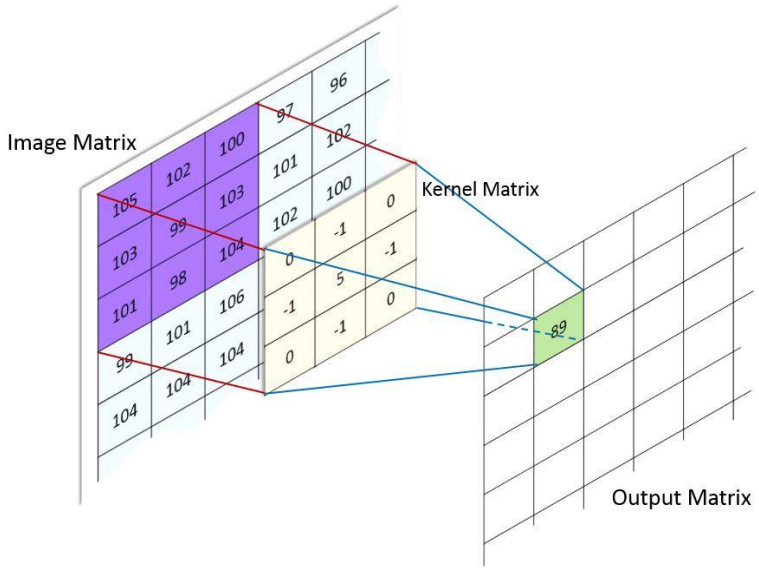

Figure 12: Convolution Layer

2. Activation Function Relu (Rectified Linear Unit)

In this step we apply the rectifier function to increase non-linearity in the CNN. Images are made of different objects that are not linear to each other. Without applying this function the image classification will be treated as a linear problem while it is actually a non-linear one.

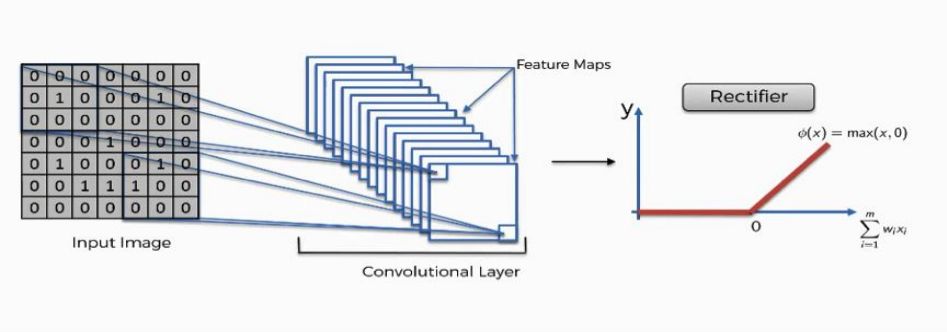

Figure 13: Activation Function

3. Pooling

Pooling enables the CNN to detect features in various images irrespective of the difference in lighting in the pictures and different angles of the images.

There are different types of pooling, for example, max pooling and min pooling. Max pooling works by placing a matrix of 2x2 on the feature map and picking the largest value in that box. The 2x2 matrix is moved from left to right through the entire feature map picking the largest value in each pass. These values then form a new matrix called a pooled feature map. Max pooling works to preserve the main features while also reducing the size of the image. This helps reduce overfitting, which would occur if the CNN is given too much information, especially if that information is not relevant in classifying the image.

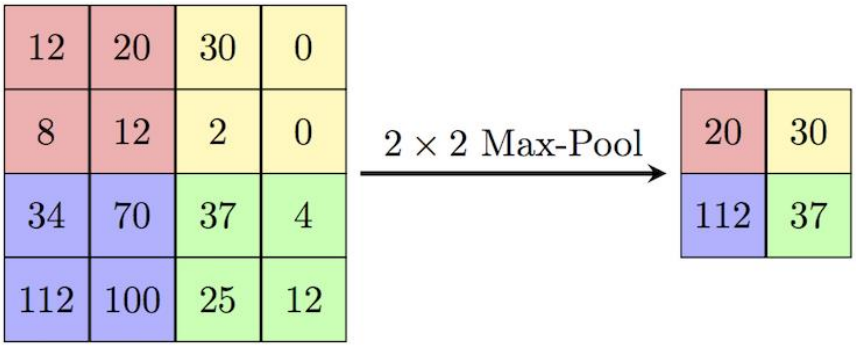

Figure 14: Pooling Layer

4. Flattening

Once the pooled featured map is obtained, the next step is to flatten it.Flattening involves transforming the entire pooled feature map matrix into a single column which is then fed to the neural network for processing.

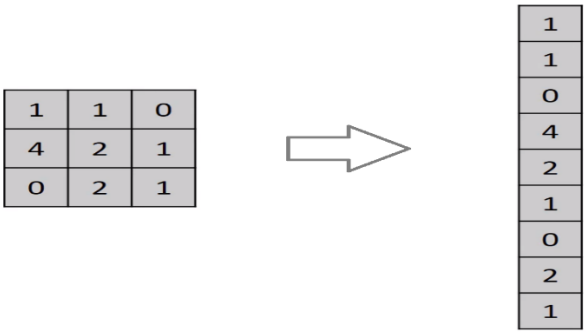

Figure 15: Flattening Layer

5. Full Connection

After flattening, the flattened feature map is passed through a neural network. This step is made up of the input layer, the fully connected layer, and the output layer. The fully connected layer is similar to the hidden layer in ANNs but in this case it's fully connected. The output layer is where we get the predicted classes. The information is passed through the network and the error of prediction is calculated. The error is then backpropagated through the system to improve the prediction.

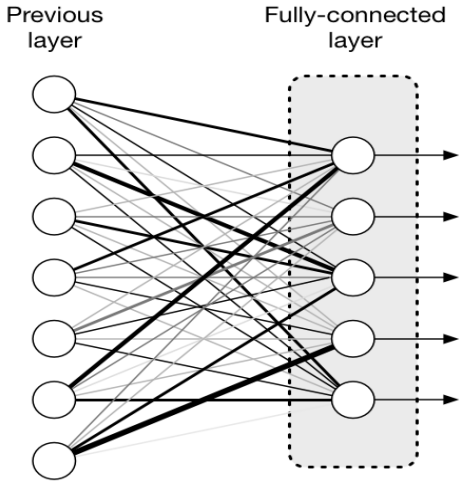

Figure 16: Fully Connected Layer

3.2.2 Backpropagation

Backpropagation algorithm is probably the most fundamental building block in a neural network. The algorithm is used to effectively train a neural network through a method called chain rule. According to the paper from 1989, backpropagation repeatedly adjusts the weights of the connections in the network so as to minimize a measure of the difference between the actual output vector of the net and the desired output vector. And the ability to create useful new features distinguishes back-propagation from earlier, simpler methods. In this way, backpropagation aims to minimize the cost function by adjusting network's weights and biases.

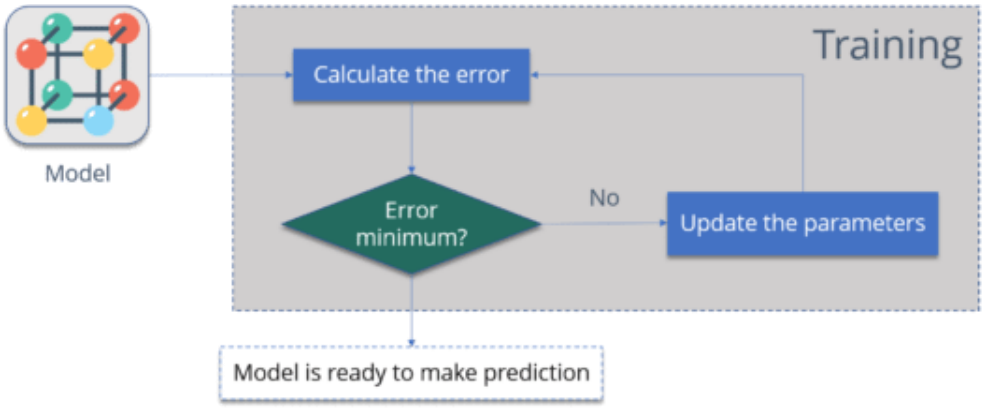

Figure 17: Mechanism of Back-propagation

Backpropagation steps:

1. Calculate the error – How far is model output from the actual output.
2. Minimum Error – Check whether the error is minimized or not.
3. Update the parameters – If the error is huge then, update the parameters (weights and biases). After that again check the error. Repeat the process until the error becomes minimum.
4. Model is ready to make a prediction – Once the error becomes minimum, feed some inputs to model and it will produce the output.

3.3 Pseudocode of solution

import matplotlib library

import pandas library

import numpy library

load dataset

print loaded dataset shape and size

plotting few images from dataset

split dataset into test nad train dataset

reshape train dataset

reshape test dataset

one hot encoding target values for the different category of images in train dataset

one hot encoding target values for the different category of images in test dataset

rescale train images from integers to floats

rescale test images from integers to floats

normalize train images to range 0-1

normalize test images to range 0-1

define model

add convolutional layer

add max-pooling layer

add flatten layer

add dense layer

add optimizers

compile model

train mode in test dataset

save model

plot performance of model in train dataset

test model in test dataset

plot performance of model in test dataset

3.4 Diagrammatic representation of the solution

3.4.1 Flowchart

The flowchart of how the system will be built is shown below:

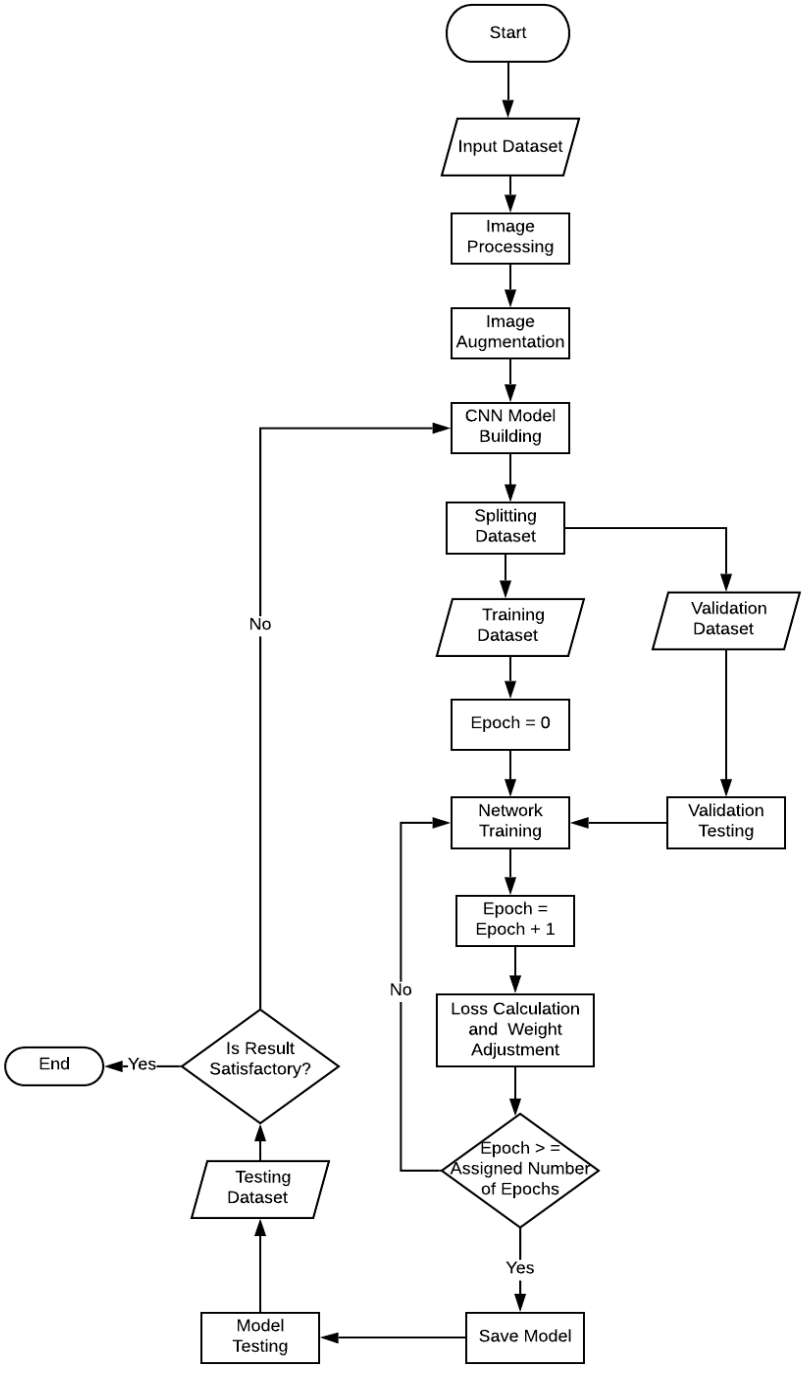

Figure 18: Flowchart of model building

4.Conclusion

4.1 Analysis of the work done

This is the very first AI project that I'm going to work in. I was really excited since I've always fascinated by the talks and succession on Artificial Intelligence and I've never thought that even I can do some basic project on it. So it was really a great opportunity for me to get involve in doing something that I'm really interested in.

I had really vague concepts regarding AI, Machine Learning and Deep Learning in the beginning. It took a lot of research and readings in order to get concrete idea on how all these things related to each other. Building AI model with Machine Learning and Deep Learning are very different approach of programming than the way we generally build programs, software or application. The traditional concept of explicitly programming is far left by AI. Building AI model is something like making computers learn all by itself.

Among the different branches in AI, I was really interested to work in computer vision because it was really joyful to play with images and objects. So I decided to grab any problem that can be solved using computer vision. Then came the idea of image classification.

Understanding image by the computer is itself a very interesting and fascinating thing. Because, human can recognize image and identify it naturally but in case of computers which understands only few numbers it is already a tough task for it to identify image and categorize it. So at very first I had to research on how images are processed in computers.

I did few research on how images can be classified using AI. It took a lot of research to understand the working of different types of image classification algorithms in Machine Learning and Deep Learning. And, finally I got to know how deep learning neural networks can solve this problem in the most efficient manner. I came to know how different type of neural networks can be implemented in solving different types of problems. Since my problem was related to image classification I found Convolutional Neural Networks as the best approach.

Meanwhile, I came to know only Convolutional Neural Networks itself doesn't complete the model, I realized that back-propagation algorithm also plays important role in building the model. After studying about the different architect of CNN I preferred to use general architect with convolutional, pooling, flatten and fully connected layers.

Across the research, I also came to know about different libraries and frameworks like Keras, Tensorflow, MatplotLib, Pandas, Numpy and so on that can be used to build the model.

4.2 Real world implementation of the solution

Fashion has always own the heart of the people as they are always concerned about their clothing style to have the best look. So, this AI Clothing Classifying model can play a very important role in the fashion industry. The built model can be deployed into different systems as per the requirements.

Here are few of the platforms where this classifier model can be deployed:

Fashion Industry: Fashion industry is really in need of automatic systems that can pre-visualize the styles before making the clothes. So in this case, they can use this clothing classification system that can automatically identify the cloth items and match them in the most attractive way.

Online Shopping: Another big platform where we can implement this model is online shopping. Online shopping are increasing day after day. People prefer to shop online rather than visiting to shops by themselves. So here, automated system of identifying different types of clothes that user prefer as well as to sort the pictures of images on the site can be useful.

Recommendation system: Recommendation systems on different shopping sites, youtube, web sites are increasing day by day. So, if we can deploy our model to these different platforms where we can track on what sort of clothes customers are buying, what sorts of style customer following, what sort of fashion tutorial people are following can be tracked easily and then similar recommendations can be given to the people so that they don't have to bother on going around and searching their stuffs.

Searching clothes using pictures from search engines: It can be the great implementation of this classifier model. We can't always explain the cloth we want in text so it would be great if we could search cloth items just by their pictures. So, we can implement this classifier model in the search engines where we can simply input the image then it will automatically recognize it and show us the similar products.

Fashion Industry: Fashion industry is the most important platform where this model can bring lots of changes. What if we can track the clothes worn by the models during fashion shows it would have been easier for everyone to know about different dresses and outfits that they are wearing. Also, the fashion specialists can deploy this model into the designing tools to find the best styles.

4.3 Further Work

Till now all the theoretical research regarding project is done. The next step will be starting the development work. From now on, the focus will be on building classifier model and complete the project within due time. The methodologies, techniques, algorithms and dataset for building the model have already been selected. In next all the installation will be done. Google colab or virtual studio will be used as coding tool. Hence, the next step will be start development.

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