Modern Education Society's Wadia College of Engineering, Pune-01

Department of Computer Engineering

Name of Student:	**Class:**
Semester/Year:	**Roll No:**
Date of Performance:	**Date of Submission:**
Examined By:	**Assignment No: 2**

Laboratory Practice – V (Deep Learning)

ASSIGNMENT NO: 02

AIM: **Classification using Deep neural network**

1. Multiclass classification using Deep Neural Networks: Example: Use the OCR letter recognition dataset https://archive.ics.uci.edu/ml/datasets/letter+recognition
2. Binary classification using Deep Neural Networks Example: Classify movie reviews into positive" reviews and "negative" reviews, just based on the text content of the reviews. Use IMDB dataset.

OBJECTIVES:

1. Students should be able to design and develop the OCR letter recognition system using multiclass classification using Deep Neural Network.
2. Students should be able to design and develop the Binary classification using Deep Neural Networks.

PREREQUISITE:

1. Basic of programming language
2. Concept of Neural Network
3. Concept of Multiclass Classification

THEORY:

Optical Character Recognition is a method of extracting text from image. Its main purpose is to make editable document from existing paper or image files. Optical character recognition task involves identifying simple edge detection technique and matching them with predefined patterns. It is a compartment of image recognition and is extensively used as a form of data entry with the input being some sort of printed document or data record like statements from bank, invoices, resume, business card and passport.

INTRODUCTION:

Nowadays obtaining information and altering the content in pictures which are present within background images are time consumable. Optical Character Recognition (OCR) idea emerges to take care of this issue. OCR works primarily utilizing the AI based computation and it is significant in developing and exploring in man-made brainpower. Optical character acknowledgment permits to change over the characters in printed archives, computerized picture and examined records with the word group. The conventional method for entering the information of the printed reports, checked records and picture into the PC is through console, which is inefficient when there is a huge volume of information. OCR is utilized to enter the information from those records electronically, without the intercession of people.

We live in times when any organization or company to scale and to stay relevant has to change how they look at technology and adapt to the changing landscapes swiftly.

We already know how Google has digitized books. Or how Google earth is using NLP (or NER) to identify addresses. Or how it is possible to read text in digital documents like invoices, legal paperwork, etc.

But how does it work exactly?

In this era of digitization, storing, editing, indexing and finding information in a digital document is much easier than spending hours scrolling through the printed/handwritten/typed documents. And moreover searching something in a large non-digital document is not just time-consuming but also, it is likely for us to miss the information while scrolling the document manually. Lucky for us, computers are getting better every day at doing the tasks humans thought only they could do, often performing better than us as well. Extracting text from images has found numerous applications.

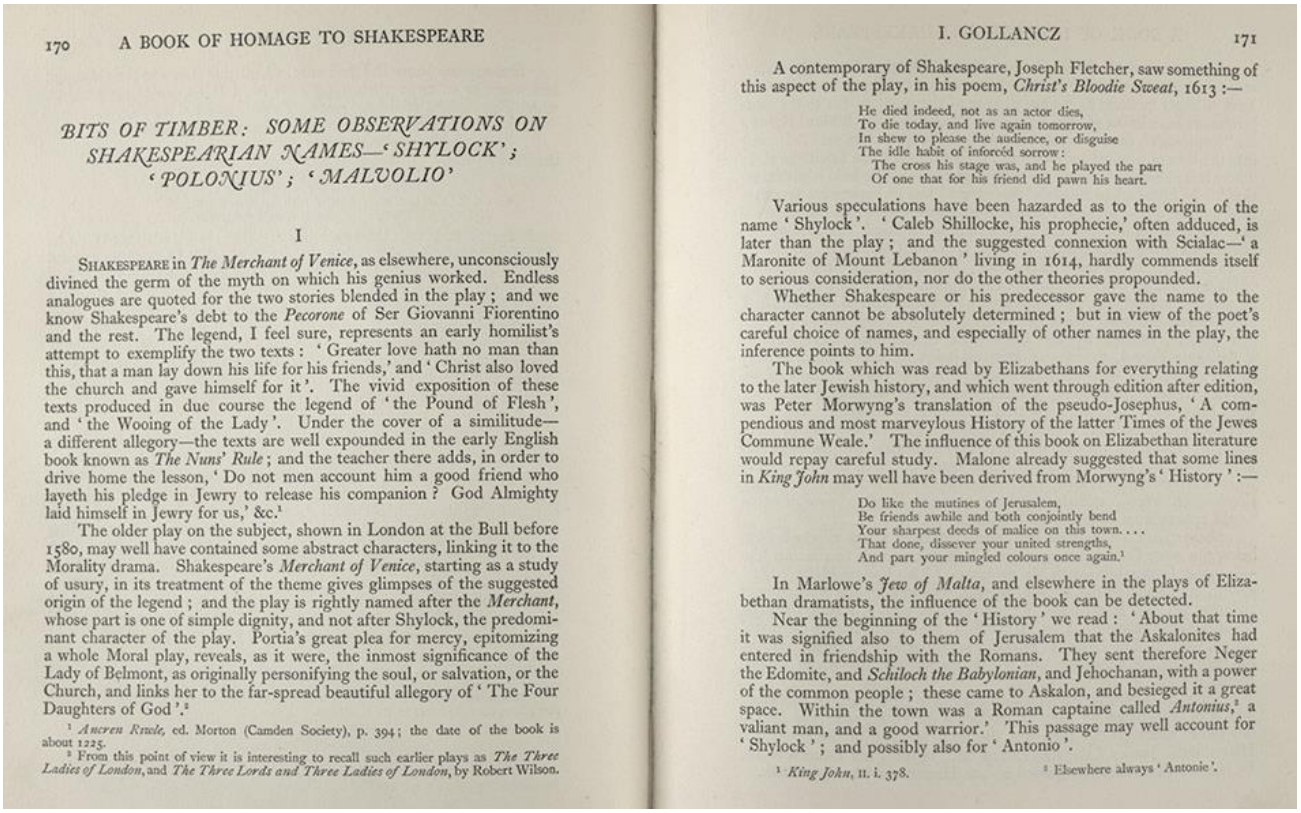
Some of the applications are Passport recognition, automatic number plate recognition, converting handwritten texts to digital text, converting typed text to digital text, etc.

Before going through how we need to understand the challenges we face in OCR problem.

Many OCR implementations were available even before the boom of deep learning in 2012. While it was popularly believed that OCR was a solved problem, OCR is still a challenging problem especially when text images are taken in an unconstrained environment .for e.g complex backgrounds, noise, lightning, different font, and geometrical distortions in the image.

It is in such situations that the machine learning OCR (or machine learning image processing) tools shine. Challenges in the OCR problem arises mostly due to the attribute of the OCR tasks at hand. We can generally divide these tasks into two categories:

Structured Text- Text in a typed document. In a standard background, proper row, standard font and mostly dense.



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BITS OF TIMBER: SOME OBSERVATIONS ON SHAKESPEARIAN NAMES—'SHYLOCK'; 'POLONIUS'; 'MALVOLIO'

I

SHAKESPEARE in *The Merchant of Venice*, as elsewhere, unconsciously divined the germ of the myth on which his genius worked. Endless analogues are quoted for the two stories blended in the play; and we know Shakespeare's debt to the *Pecorone* of Ser Giovanni Fiorentino and the rest. The legend, I feel sure, represents an early homilist's attempt to exemplify the two texts: 'Greater love hath no man than this, that a man lay down his life for his friends,' and 'Christ also loved the church and gave himself for it'. The vivid exposition of these texts produced in due course the legend of 'the Pound of Flesh', and 'the Wooing of the Lady'. Under the cover of a similitude—a different allegory—the texts are well expounded in the early English book known as *The Nuns' Rule*; and the teacher there adds, in order to drive home the lesson, 'Do not men account him a good friend who layeth his pledge in Jewry to release his companion? God Almighty laid himself in Jewry for us,' &c.[1]

The older play on the subject, shown in London at the Bull before 1580, may well have contained some abstract characters, linking it to the Morality drama. Shakespeare's *Merchant of Venice*, starting as a study of usury, in its treatment of the theme gives glimpses of the suggested origin of the legend; and the play is rightly named after the *Merchant*, whose part is one of simple dignity, and not after Shylock, the predominant character of the play. Portia's great plea for mercy, epitomizing a whole Moral play, reveals, as it were, the inmost significance of the Lady of Belmont, as originally personifying the soul, or salvation, or the Church, and links her to the far-spread beautiful allegory of 'The Four Daughters of God'.[2]

[1] *Ancren Riwle*, ed. Morton (Camden Society), p. 394; the date of the book is about 1225.

[2] From this point of view it is interesting to recall such earlier plays as *The Three Ladies of London*, and *The Three Lords and Three Ladies of London*, by Robert Wilson.

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A contemporary of Shakespeare, Joseph Fletcher, saw something of this aspect of the play, in his poem, *Christ's Bloodie Sweat*, 1613:—

He died indeed, not as an actor dies,
To die today, and live again tomorrow,
In shew to please the audience, or disguise
The idle habit of inforcéd sorrow:
The cross his stage was, and he played the part
Of one that for his friend did pawn his heart.

Various speculations have been hazarded as to the origin of the name 'Shylock'. 'Caleb Shillocke, his prophecie,' often adduced, is later than the play; and the suggested connexion with Scialac—'a Maronite of Mount Lebanon' living in 1614, hardly commends itself to serious consideration, nor do the other theories propounded.

Whether Shakespeare or his predecessor gave the name to the character cannot be absolutely determined; but in view of the poet's careful choice of names, and especially of other names in the play, the inference points to him.

The book which was read by Elizabethans for everything relating to the later Jewish history, and which went through edition after edition, was Peter Morwyng's translation of the pseudo-Josephus, 'A compendious and most marveylous History of the latter Times of the Jewes Commune Weale.' The influence of this book on Elizabethan literature would repay careful study. Malone already suggested that some lines in *King John* may well have been derived from Morwyng's 'History':—

Do like the mutines of Jerusalem,
Be friends awhile and both conjointly bend
Your sharpest deeds of malice on this town....
That done, dissever your united strengths,
And part your mingled colours once again.[1]

In Marlowe's *Jew of Malta*, and elsewhere in the plays of Elizabethan dramatists, the influence of the book can be detected.

Near the beginning of the 'History' we read: 'About that time it was signified also to them of Jerusalem that the Askalonites had entered in friendship with the Romans. They sent therefore Neger the Edomite, and *Schiloch the Babylonian*, and Jehochanan, with a power of the common people; these came to Askalon, and besieged it a great space. Within the town was a Roman captaine called *Antonius*,[2] a valiant man, and a good warrior.' This passage may well account for 'Shylock'; and possibly also for 'Antonio'.

[1] *King John*, II. i. 378.

[2] Elsewhere always 'Antonie'.

Figure 1: Structured Text: Dense, readable standard fonts; Image source: https://pixabay.com

Unstructured Text- Text at random places in a natural scene. Sparse text, no proper row structure, complex background, at random place in the image and no standard font.

Figure 2: Unstructured Texts: Handwritten, Multiple fonts and sparse; Image source: https://pixabay.com

Any Typical machine learning OCR pipeline follows the following steps shown in Figure 3:

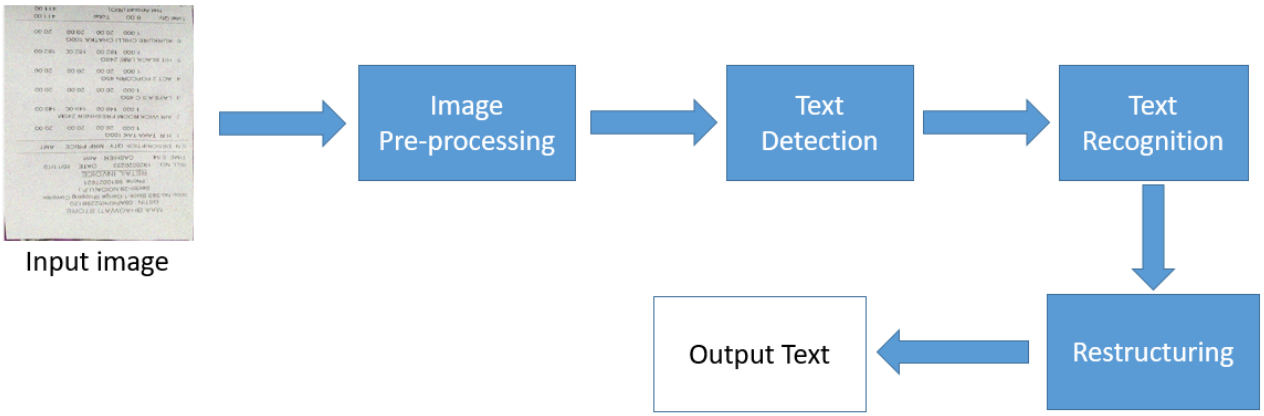

Figure 3: OCR Flow

Preprocessing

Remove the noise from the image

Remove the complex background from the image

Text Detection

Text detection techniques required to detect the text in the image and create and bounding box around the portion of the image having text. Standard objection detection techniques will also work here.

Text Recognition

Once we have detected the bounding boxes having the text, the next step is to recognize text. There are several techniques for recognizing the text.

Types of OCR are shown in the Figure 4.

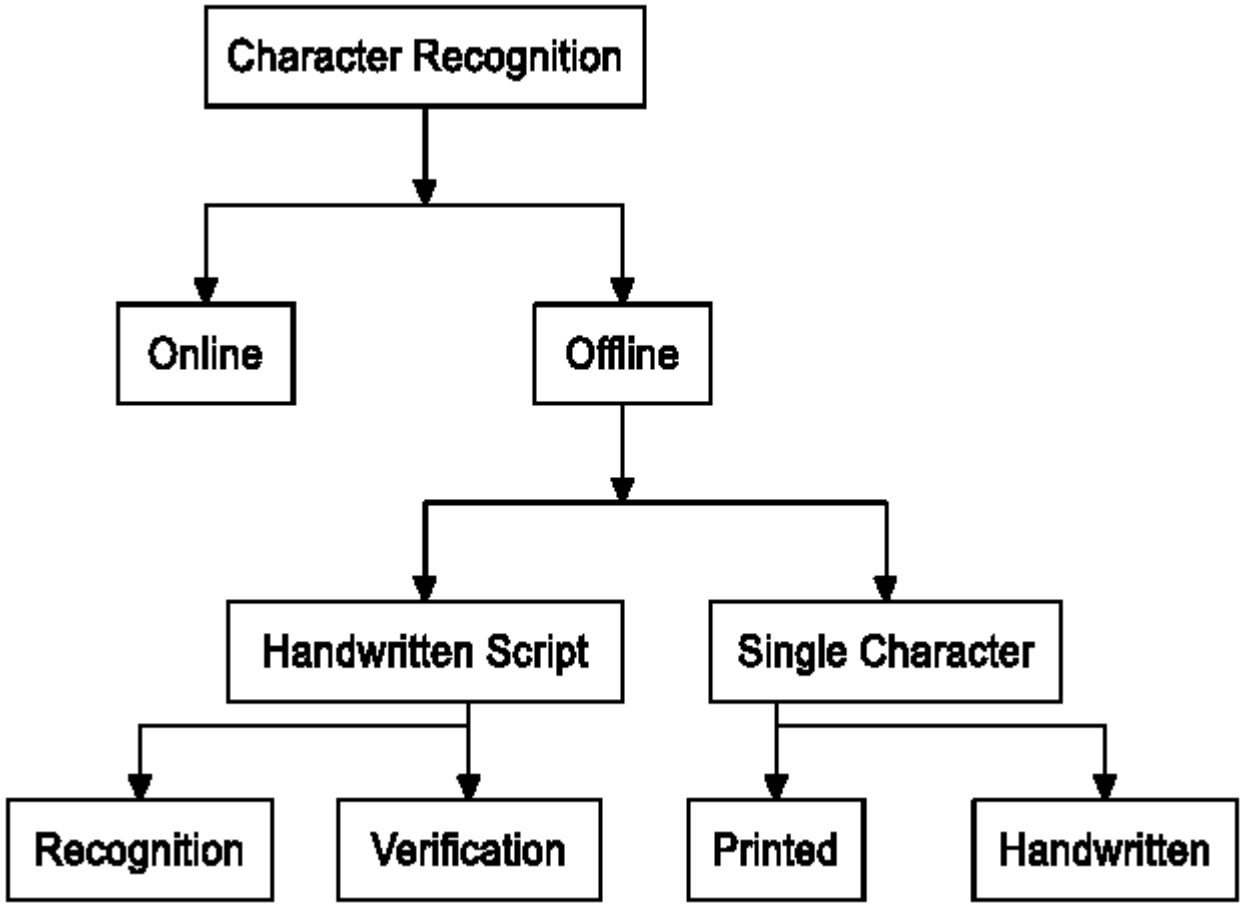

Figure 4: Types of OCR

DATA SET DESCRIPTION: (dataset https://archive.ics.uci.edu/ml/datasets/letter+recognition)

1. Title: Letter Image Recognition Data
2. Source Information

-- Creator: David J. Slate

-- Odesta Corporation; 1890 Maple Ave; Suite 115; Evanston, IL 60201

-- Donor: David J. Slate (dave@math.nwu.edu) (708) 491-3867

-- Date: January, 1991

3. Past Usage:

-- P. W. Frey and D. J. Slate (Machine Learning Vol 6 #2 March 91):

"Letter Recognition Using Holland-style Adaptive Classifiers". The research for this article investigated the ability of several variations of Holland-style adaptive classifier systems to learn to correctly guess the letter categories associated with vectors of 16 integer attributes extracted from raster scan images of the letters. The best accuracy obtained was a little over 80%. It would be interesting to see how well other methods do with the same data.

4. Relevant Information:

The objective is to identify each of a large number of black-and-white rectangular pixel displays as one of the 26 capital letters in the English alphabet. The character images were based on 20 different fonts and each letter within these 20 fonts was randomly distorted to produce a file of 20,000 unique stimuli. Each stimulus was converted into 16 primitive numerical attributes (statistical moments and edge counts) which were then scaled to fit into a range of integer values from 0 through 15. They typically train on the first 16000 items and then use the resulting model to predict the letter category for the remaining 4000.

5. Number of Instances: 20000

6. Number of Attributes: 17 (Letter category and 16 numeric features)

7. Attribute Information:

1.	lettr	capital letter	(26 values from A to Z)
2.	x-box	horizontal position of box	(integer)
3.	y-box	vertical position of box	(integer)
4.	width	width of box	(integer)
5.	high	height of box	(integer)
6.	onpix	total # on pixels	(integer)
7.	x-bar	mean x of on pixels in box	(integer)
8.	y-bar	mean y of on pixels in box	(integer)
9.	x2bar	mean x variance	(integer)
10.	y2bar	mean y variance	(integer)
11.	xybar	mean x y correlation	(integer)
12.	x2ybr	mean of x * x * y	(integer)
13.	xy2br	mean of x * y * y	(integer)
14.	x-ege	mean edge count left to right	(integer)
15.	xegvy	correlation of x-ege with y	(integer)
16.	y-ege	mean edge count bottom to top	(integer)
17.	yegvx	correlation of y-ege with x	(integer)

8. Missing Attribute Values: None

9. Class Distribution:

789 A	766 B	736 C	805 D	768 E	775 F	773 G
734 H	755 I	747 J	739 K	761 L	792 M	783 N
753 O	803 P	783 Q	758 R	748 S	796 T	813 U
764 V	752 W	787 X	786 Y	734 Z		

PERFORMANCE ANALYSIS: - To evaluate the performance of the system, four metrics have been used to assess device efficiency, namely precision, accuracy, recall and F-measure.

CONCLUSION:

We have successfully developed OCR letter recognition system (Multiclass classification) and Binary classification system using Deep Neural Networks.

QUESTIONS:

1. What is multiclass Classification?
2. Explain Binary classification with an example.