Convolutional Neural Network-based medical checkup system for Pigmented Skin Lesions Classification.

School of Computing, Engineering and Mathematics
Coventry University

Bsc Computer Science
Project Supervisor: Dr.David Croft
Submission Date: 21/04/2020

Author Name: Vinayak Sareen
Student Id Number: 7651331

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Sign: **Vinayak Sareen**. Date: **07/03/20**

Project Details

FirstName:	Vinayak
LastName:	Sareen
Student ID Number	7651331
Ethics Application Number	P101878
1st Supervisor Name	Dr.David Croft
2nd Supervisor Name	Unknown

Abstract

Abstract should be a succinct and self-standing summary of the basis, context and achievements of the project. Minimally an abstract does three things: (1) It states the problem that you set out to solve, (2) It describes your solution and method, (3) It states a conclusion about the success of the solution. Be straightforward and factual and avoid vague statements, confusing details and "hype". Do not be tempted to use acronyms or jargon to keep within the half-page limit. Consider that search engines, librarians and non-computer scientists wishing to classify your Report rely on the abstract. You may if you wish provide a short list of keywords (2-6 is reasonable) at the end of the abstract.

Contents

Acknowledgements

I want to express my gratitude to my supervisor Dr David Croft for guiding me thought the investigations. The support of all medical professionals who contribute by providing data to the research is sincerely acknowledged. At last, I would thank my parents, who supported me finically and psychologically throught this journey of computer science.

Chapter 1

Introduction

1.1 Introduction to Problem

Skin cancer is categorized into two types: melanoma and non-melanoma skin cancer. Melanoma, is the most dangerous kind of skin cancer accounted for an estimated 16,000 deaths each year from 2014 to 2016 in the United Kingdom (Cancer Research UK, 2020). The melanoma tumour caused by melanocytes can result in uncontrolled and abnormal growth which can spread in the human body (Korotkov & Garcia 2012). Detection and classification of unknown pigmented skin lesions can result in early diagnosis of the medical problem. The research data provided by cancer research organisation in 2017 has shown that melanoma was the 20th most common disorder with new incidents of 81,00 and 83,00 in males and females respectively in the United Kingdom (Korotkov & Garcia 2012). Dermoscopy is a non-invasive method of examining the pigmented skin, which includes microscopic imaging of the surface structure of pigmented skin lesions (Korotkov & Garcia 2012). Early diagnosis of pigmented skin lesions is crucial to classify skin disorders to decrease mortality concerning particular skin disorders. Dermoscopy improves the detection of melanoma compared to detection of disease with naked eyes by analysing the pigmented skin lesion. Previous studies have shown that such tumours can result in higher chances of better treatment and cure of disease by removing the tumour (Celebi, Kingravi, Uddin, Iyatomi, Aslandogan, Stoecker & Moss 2007). The current diagnosis method of detection involves using ABCD rule which considers the Asymmetry, Border irregularity, Colour irregularities, Darmascopic structures respectively of common pigmented skin lesions (Loescher, Janda, Soyer, Shea & Curiel-Lewandrowski 2013). People working in busy work environments or less mobility can be victims of belated and slow diagnosis of such dangerous skin cancers. The automated analysis of pigmented skin lesions using artificial neural networks can be beneficial in optical analysis of microscopic images of pigmented skin lesions. The primary targeted audience who benefits from the outcome is the people who are working in busy work environments or people with less mobility

are best to use cases which can use such an automated system. Booking a prior appointment with medical professionals based on the urgency of detected medical problems can result in the immediate treatment of patients with more critical conditions. The people with less mobility such as older audiences or people with special needs can detect pigmented skin lesions through online systems in an inconvenient manner. Medical institutions can use such technologies to automate the process of pre-health checkups and overcome the problem of shortage of staff members in case of emergency. Such automated systems can also result in faster diagnosis of medical problems compared to a manual analysis by a clinician. Furthermore, manufacturing companies which supply the microscopic medical instruments can also use such intelligent models with their products to provide value to customers and medical institutions.

1.2 Objective of Research

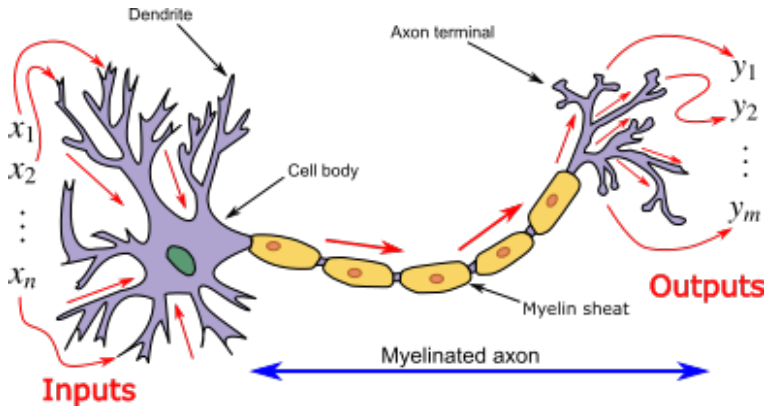
The research concentrates on developing a type of artificial neural network called a convolutional network to perform automated optimal analysis to identify the class of pigmented skin lesion. The research focuses on providing the quantitative analysis on comparing the results predicted by the automated intelligent machine are compared with medical professionals to identify the classes of pigmented skin lesions. The study employs different experiments by applying different model architectures and analysing accurate hyper-parameters for optimal performance. The research concentrate on analysing limited skin tumours such as melanoma, benign keratosis, melanocytic nevi and basal cell carcinoma. The investigation employs publicly available HAM10,000 dataset (Tschandl 2018). The extensive collection of 10,000 images of labelled data units were collected from a diverse population of subjects over twenty years. The outcome of the research project will to be analyse the effectiveness of the automated pigmented lesion system. Furthermore, the intelligent model will be deployed on web based system to provide interface to use the system to analyse by general audience.

1.3 Perceptron Model

1.3.1 Inspiration from biological Structure of Neurons

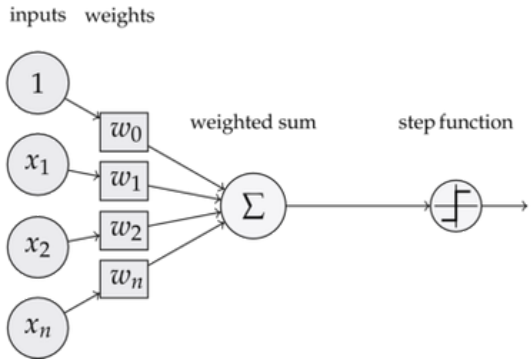
The human brain are componsed of millions specialised cell "neurons" which are interconnected to each other which carry electrical and chemical signals from neuron to another to function There are an estimated 500 trillion connections between neurons in the human nervous system which helps communicate signals (Patterson & Gibson 2017). The inspiration of artifical neural networks are taken from functioning of human brain and learn to recoganise patterns and relationship in the data (Agatonovic-Kustrin & Beresford 2000).

1.3.2 Neural Structure



The image above represents the biological structure of the neuron which includes three major parts of a neuron dendrite, nucleus and axon terminals. The dendrites are accountable for accepting the incoming signals from other neurons. Moreover, nucleus of the neuron is responsible for processing the information. Furthermore, the processed information gets passed to other neuron or organs through axon terminals in the human body (Agatonovic-Kustrin & Beresford 2000).

1.3.3 Perceptron Model



Preceptron model was proposed by Frank Rosenblatt in 1943 to design the model to mimic the human brain (Kussul, Baidyk, Kasatkina & Lukovich 2001). Preceptron model or single layered feed forwards network networks takes the vectors of inputs and multiply with a randomly initialised weights and add random bias to network and process the information by providing data to the activation function to process the information. There are various activation function such as step function sigmoid, relu, leaky relu and other activation functions and outputs the result (Agatonovic-Kustrin & Beresford 2000). Figure above represents the inputs x and weights w for which weighted sum of muliplication result of inputs and weights will be passed to step activation function.

1.3.4 Mathematical Representation

The equation below represents the preceptron model mentioned above in Mathematical notations.

$$y = \Big[\sigma(\sum_{k=0}^{n} x_k.w_k + b_k)\Big] \tag{1.1}$$

$$\sigma = Activation function, x = input, w = weights, y = prediction, b = bias$$

1.4 Multi Layered Feed Forward Neural Network

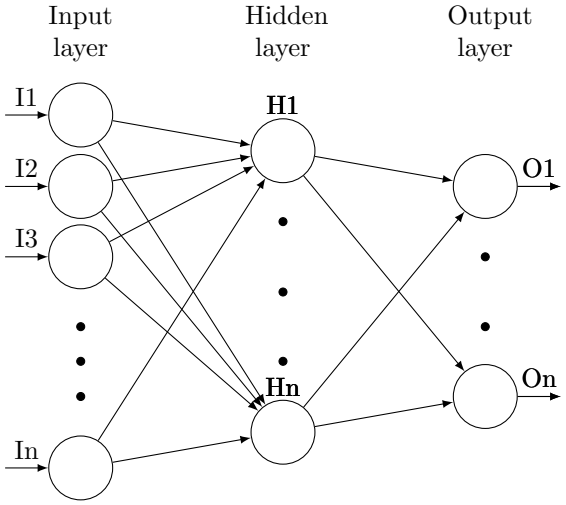


Figure 1.1: Multi Layered Neural Network diagram.

The preceptron model acts the base for all the functioning of modern multi-layered neural networks. The output of the single neuron described in the the above preceptron model is taken as the input in next layer of network. The above figure(1.1) shows an example of multi-layered neural where the first layer is known as input layer and intermediate layers are called hidden layer and last layer is known as output layer. The single neuron can performe limited computation but the computation power increases with inter-connected neurons in the network (Agatonovic-Kustrin & Beresford 2000) where at each layer information is processed through the appropriate activation function. Artifical neural networks are designed to learn the patterns and relationships in the data and requires enough amount of data to train and predict accurate outputs (Agatonovic-Kustrin & Beresford 2000). The training data is passed to the neural network to recoganise the patterns in data and in each iteration or epoch the model predection gets improved with the optimisation algorithm which propagtes through the network to update the weights and bias to increase the accuracy.

1.4.1 Cost Function and Backpropagation Algorithm

Chapter 2

Literature Review

This is a sample literature review content. BLAH BLAH BLAH ....

Chapter 3

Methodology

This is a sample methodology review content. BLAH BLAH BLAH .... This chapter should describe what you did to answer your research question (or to support your thesis, if you think of it that way), and how you went about it (essentially your research design). You should describe your research design in sufficient detail that another researcher could recreate your work to check your results.

Chapter 4

Evaluations and Results

In this chapter, you should evaluate what you have done, and say what answer (to your research question) you have arrived at. It may be that in your method you describe some experiments, and this section records your results and analysis of those results. This is an important section – most students gain or lose marks in either their literature review or evaluation. The key to producing a convincing evaluation is to plan very early in the project what information or results you will need to write this section.

Chapter 5

Project Managment

This is a discussion based chapter BLAH BLAH BLAH .... Your first supervisor may have a very good idea of how well you tackled your project - however second supervisors may not have any idea. For this reason you need to include an account of the conduct of the project. What problems you encountered, how you overcame them, how diligently you worked, how you sought advice, how you responded to feedback. This chapter will be evidence driven – which is why you need to keep a log or diary of your project, maybe a project management timeline with milestones, keep evidence of each supervision meeting (signed off by your supervisor), Keep notes of supervisor feedback to your presentation and reflect on them in this chapter.

Chapter 6

Reflection

This is dummy text for reflection

Chapter 7

Conclusion

conclusion can be drawn from these examples to be continued .....

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Appendices

This section should contain two following documents.

1.Supervisor meeting records. 2.Feedback notes from your presentation.