Faculty of Science and Engineering

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Mathematics

Neural Networks with Python and TensorFlow

February 19, 2020

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Abstract

Artificial Intelligence (AI) still remains as one of the greatest challenges in scientific research to this date, but much progress in the field has been made using artificial neural networks. The design of artificial neural networks is loosely inspired by that of biological brains, and serves as an expansion of an earlier concept called the perceptron (Rosenblatt, 1958). By using multiple layers of these artificial neurons, we can form a highly connected system that is referred to as a neural network, these networks can then be trained on a large data set to predict the output with high accuracy.

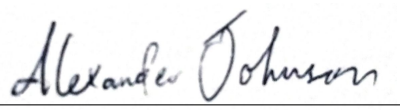
The range applications for neural networks is wide: they can be used to classify data, predict future states of chaotic systems, apply stylisations to images, and control physical/physically-based system in real-time.

TODO: *Abstract.*

Declaration

With the exception of any statement to the contrary, all the material presented in this report is the result of my own efforts. In addition, no parts of this report are copied from other sources. I understand that any evidence of plagiarism and/or the use of unacknowledged third party materials will be dealt with as a serious matter.

Signed



Contents

Chapter 1

Introduction to Neural Networks

TODO: *Chapter: Introduction*

Biological Neurons

TODO: *Section: Biological Neurons*

Artificial Intelligence

TODO: *Section: Artificial Intelligence*

Perceptrons

TODO: *Subsection: Perceptrons*

Backpropagation

TODO: *Subsection: Backpropagation*

Types of Neurons

TODO: *Section: Types of Neurons*

CNN

RNN

LSTM

Chapter 2

Neural Networks in Python

Python is a general-purpose programming language designed by Guido van Rossum, with an emphasis on readability and reusability (Rossum, 1996). It comes with an extensive standard library and is one of the most popular programming languages.

There are multiple options for interacting with Python, these include:

- typing commands into an interpreter,
- writing files and running them with an interpreter,
- using an online service such as Google Colab.

`TODO`: *Chapter: Neural Networks in Python*

Single Perceptron Boston Housing Data

`TODO`: *Section: Single Perceptron Boston Housing Data*

Multi Layer Perceptron Boston Housing Data

`TODO`: *Section: Multi Layer Perceptron Boston Housing Data*

XOR Gate

`TODO`: *Section: XOR Gate*

Chapter 3

Introduction To TensorFlow

TensorFlow TODO: *Chapter: Introduction To TensorFlow*

Linear Regression

TODO: *Section: Linear Regression*

XOR

TODO: *Section: XOR*

Boston Housing with Keras

TODO: *Section: Boston Housing with Keras*

Chapter 4

Deep Learning

TODO: *Chapter: Deep Learning*

Recurrent Neural Networks

TODO: *Section: Recurrent Neural Networks*

Convolutional Neural Networks

TODO: *Section: Convolutional Neural Networks*

Image Processing

TODO: *Subsection: Image Processing*

Supervised Learning

TODO: *Section: Supervised Learning*

Unsupervised Learning

TODO: *Section: Unsupervised Learning*

Autoencoding

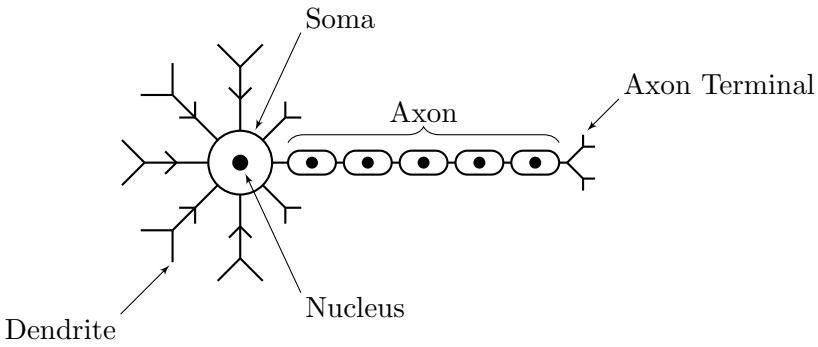
TODO: *Section: Autoencoding*

Reinforcement Learning

TODO: *Section: Reinforcement Learning*

Chapter 5

Null



TODO: *Decide parent chapter for CNN, RNN, and LSTM sections*

Bibliography

Rosenblatt, Frank (1958). "The perceptron: a probabilistic model for information storage and organization in the brain." In: *Psychological review* 65.6, p. 386.

Rossum, Guido van (1996). *Foreword for "Programming Python" (1st ed.)* URL: `https://www.python.org/doc/essays/foreword/` (visited on 02/07/2020).