Insert here your thesis' task.

FACULTY
OF INFORMATION
TECHNOLOGY
CTU IN PRAGUE

Bachelor's thesis

Gesture detector with Leap Motion sensor

Anh Tran Viet

Department of Theoretical Computer Science
Supervisor: Tomáš Nováček

November 17, 2020

Acknowledgements

THANKS (remove entirely in case you do not with to thank anyone)

Declaration

I hereby declare that the presented thesis is my own work and that I have cited all sources of information in accordance with the Guideline for adhering to ethical principles when elaborating an academic final thesis.

I acknowledge that my thesis is subject to the rights and obligations stipulated by the Act No. 121/2000 Coll., the Copyright Act, as amended, in particular that the Czech Technical University in Prague has the right to conclude a license agreement on the utilization of this thesis as a school work under the provisions of Article 60 (1) of the Act.

In Prague on November 17, 2020 . . . . . .

Czech Technical University in Prague
Faculty of Information Technology

Citation of this thesis

Tran, Anh Viet. *Gesture detector with Leap Motion sensor.* Bachelor's thesis. Czech Technical University in Prague, Faculty of Information Technology, 2020.

Abstrakt

V několika větách shrňte obsah a přínos této práce v českém jazyce.

Klíčová slova Replace with comma-separated list of keywords in Czech.

Abstract

Summarize the contents and contribution of your work in a few sentences in English language.

Keywords Replace with comma-separated list of keywords in English.

Contents

List of Figures

Introduction

LOREM IPSUM.

Chapter 1

Neural Networks

An artificial neural network (ANN) is a mathematical model mimicking biological neural networks, namely their ability to learn and correct errors from previous experience.[Chen, Yung-Yao; Lin, Yu-Hsiu; Kung, Chia-Ching; Chung, Ming-Han; Yen, I.-Hsuan (January 2019). "Design and Implementation of Cloud Analytics-Assisted Smart Power Meters Considering Advanced Artificial Intelligence as Edge Analytics in Demand-Side Management for Smart Homes". Sensors. 19 (9): 2047. doi:10.3390/s19092047. PMC 6539684. PMID 31052502.] ANN consists of a collection of nodes called neurons, and each node is linked to other nodes via connections called synapses. ANN is typically divided into an input layer, followed by several hidden layers and an output layer. [5M]
The ANN subject was first introduced by Warren McCulloch and Walter Pitts in "A logical calculus of the ideas immanent in nervous activity" published in 1943.[6 matous] But it was not until recent years when ANN has gained popularity with still increasing advancements in technology and availability of training data. ANN had become one of the default solutions for complex tasks which were previously thought be unsolvable by computers. [7M]
This chapter will briefly explore different types of neural units and their activation functions, along with some exemplary network architectures.

1.1 Artificial Neuron

As previously mentioned, artificial neurons are units mimicking behaviors of biological neurons. Meaning it can receive as well as pass information between themselves.

1.1.1 Perceptron

Perceptron is the simplest class of artificial neurons developed by Frank Rosenblatt in 1958.[Rosenblatt, F. (1958). "The Perceptron: A Probabilistic Model

For Information Storage And Organization In The Brain". Psychological Review. 65 (6): 386–408. CiteSeerX 10.1.1.588.3775. doi:10.1037/h0042519. PMID 13602029.] Perceptron takes several binary inputs, vector x = (x1, x2,...,xn), and outputs a single binary number.
To express the importance of respected input edges, perceptron uses real numbers called weights, assigned to each edge, vector w = (w1,w2,...,wn).

A step function calculates the perceptron's output. The function output is either 0 or 1 determined by whether its weighted sum w (SUM) is less or greater than its threshold value, a real number, usually represented as an incoming edge with a negative weight -1.

FIGURE
MATH

1.1.2 Sigmoid Neuron

Sigmoid neuron, similarly to perceptron, has inputs x and weights. The key difference comes in once we inspect the output value and its calculation. Instead of perceptron's binary output 0 or 1, a sigmoid neuron outputs a real number between 0 and 1 using a sigmoid function.
[http://neuralnetworksanddeeplearning.com/chap1.html][8M]
MATH
PLOTS

As shown in Figure xx and Figure xx, the sigmoid function is a smoothed-out version of the step function.

1.1.3 Activation Function

An artificial neuron's activation function defines that neuron's output value for given inputs, commonly being f: R->R [11 matous]. A significant trait of many activation functions is their differentiability, allowing them to be used for Backpropagation, ANN algorithm for training weights. Having derivative not saturating or exploding, heads towards 0 or inf, is necessary for activation functions.

For such reasons, the usage of step function or any linear function is unsuitable for ANN.

1.1.3.1 Sigmoid Function

The sigmoid function is commonly used in ANN as an alternative to the step function. A popular choice of the sigmoid function is a logistic sigmoid. Its

output value is in the range of 0 and 1.

MATH

One of the reasons being the simplicity of derivative calculation:

MATH

One of its disadvantages being the vanishing gradient. A problem where for a given very high or very low input values, there would be almost no change in its prediction. Possibly resulting in training complications or performance issues. [https://missinglink.ai/guides/neural-network-concepts/7-types-neural-network-activation-functions-right/]

1.1.3.2 Hyperbolic Tangent

1.1.3.3 Rectified Linear Unit

1.2 Types of Neural Networks

A B C

[1]

Bibliography

[1] WWW Consorcium. *Scalable Vector Graphics (SVG) 1.1 Specification [online]*. [cit. 2011-07-07]. Available from: `http://www.w3.org/TR/2003/REC-SVG11-20030114/`

Appendix A

Acronyms

GUI Graphical user interface

XML Extensible markup language

Appendix B

Contents of enclosed CD

- `readme.txt` ..... the file with CD contents description
- `exe` ..... the directory with executables
- `src` ..... the directory of source codes
  - `wbdcm` ..... implementation sources
  - `thesis` ..... the directory of LaTeX source codes of the thesis
- `text` ..... the thesis text directory
  - `thesis.pdf` ..... the thesis text in PDF format
  - `thesis.ps` ..... the thesis text in PS format