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ČVUT V PRAZE**

ZADÁNÍ BAKALÁŘSKÉ PRÁCE

Název: Rozpoznávání souvislé řeči s využitím neuronových sítí
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Studijní obor: Teoretická informatika
Katedra: Katedra teoretické informatiky
Platnost zadání: Do konce letního semestru 2018/19

Pokyny pro vypracování

Provedte rešerši metod pro rozpoznávání souvislé řeči s využitím neuronových sítí. Uvažujte rekurentní neuronové sítě a zvažte také možnost použití neuronových turingových strojů. Na základě rešerše a po dohodě s vedoucím práce vyberte vhodné řešení pro robota NAO. Maximálně využívejte existujících knihoven s implementacemi potřebných metod. Navržené řešení otestujte na reálných datech. Rozsah práce upřesněte po dohodě s vedoucím práce.

Seznam odborné literatury

Dodá vedoucí práce.

doc. Ing. Jan Janoušek, Ph.D.
vedoucí katedry

doc. RNDr. Ing. Marcel Jiřina, Ph.D.
děkan

V Praze dne 13. února 2018

CZECH TECHNICAL UNIVERSITY IN PRAGUE
FACULTY OF INFORMATION TECHNOLOGY
DEPARTMENT OF THEORETICAL INFORMATICS



Bachelor's thesis

Continuous Speech Recognition by Neural Networks

Adam Zvada

Supervisor: Ing. Miroslav Skrbek Ph.D

April 16, 2018

Acknowledgements

THANKS

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.

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In Prague on April 16, 2018

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Czech Technical University in Prague

Faculty of Information Technology

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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

In my bachelor thesis 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.

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Introduction

Introduction to Speech Recognition

Introduction to Speech Recognition

TESTIK

TESTIK

Neural Network

// TODO: Why ANN are awesome :)

While artificial neural networks (ANN) have been around since the 1940s, it is only in the last several decades where they have become a major part of artificial intelligence.

An artificial neural network (ANN) is mathematical model, heavily inspired by the way how biological neural networks process information in the human brain. In general we can view ANNs as function of $f: X \rightarrow Y$ where X is the input to neural network and Y is approximation of our target function. In general we can view ANNs as function that maps

It's achieved by gradule from

What do they do? How do they do it? Supervised learning

How its structured?

While neural networks have been around since the 1940s, it is only in the last several decades where they have become a major part of artificial intelligence.

In general we can view ANNs as function of $f: X \rightarrow Y$

high level of versatility

ANNs aim to reach high level of versatility as our brain does.

In general ANNs are able to reach high level of versatility as our brain because they are approximating

Inspired by biological nervous systems, artificial neural networks (ANNs) aim at reaching their versatility through learning

While neural networks have been around since the 1940s, it is only in the last several decades where they have become a major part of artificial intelligence.

3.1 Inspiration in Nature

Artificial neural network (ANN) is heavily inspired by the way how biological neural networks process information in the human brain. Even though our

3. NEURAL NETWORK

brains are extremely complex and still not fully understand, we just need to know how information is being transferred. The basic building block is nerve cell called *neuron*. It receives, processes, and transmits information through electrical and chemical signals. It's estimated that an average human has 86 billion neurons.

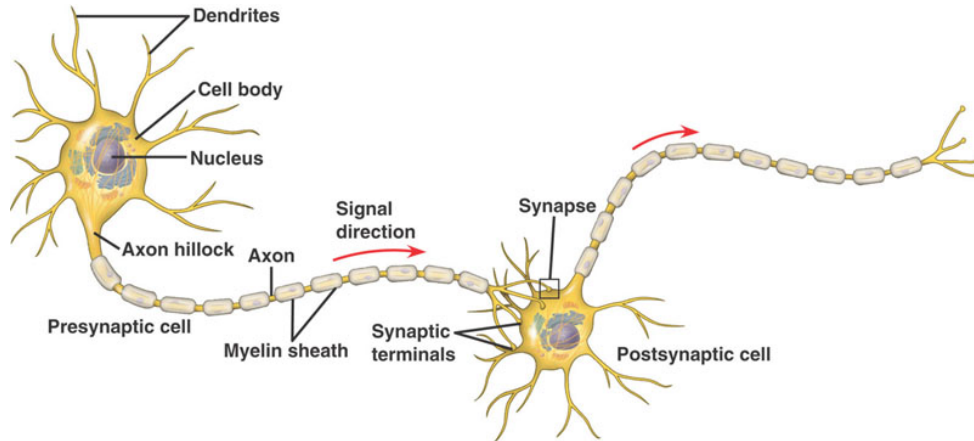


Figure 3.1: Illustration of nerve cell and communication flow

Dendrites are extensions of a nerve cell that propagate the electrochemical stimulation received from other neurons to the cell body. You may think of them as inputs to neuron, whereas neuron's output is called *axon*, a long nerve fiber that conducts electrical impulses away from the cell body. The end of axon is branched to many axon terminals which can be again connected to other dendrites. The connection is managed by *synapses* that can permit the passing of electrical signal to cell body. Once the cell reaches a certain threshold, an action potential will fire, sending the electrical signal down the axon to other connected neurons.

3.2 Artificial Neuron

Artificial neuron is a generic computational unit, basic building block for artificial neural network (ANN). It's simplified version of the biological counterpart and we are able to map parts of biological neuron with the artificial one. It takes n inputs represented as a vector $x \in \mathbb{R}^n$ which correspond to dendrites. Generally artificial neuron produces single output $y \in \mathbb{R}$ as biological neuron where we call it axon. Each neuron's input $i = 1, 2, \dots, n$ has assigned weight (synapse) $w_1, w_2 \dots w_n$, they refer to the connection strength between neurons. Weights and same as for synapse are the backbone of learning because in training phases, they keep changing to produce wanted output. (*In this chapter, we will elaborate further.) Inside the artificial neuron, input vector with their

weights are combined and run through an activation function producing some output y . This process is illustrated in *LINKPRECEPRTON*.

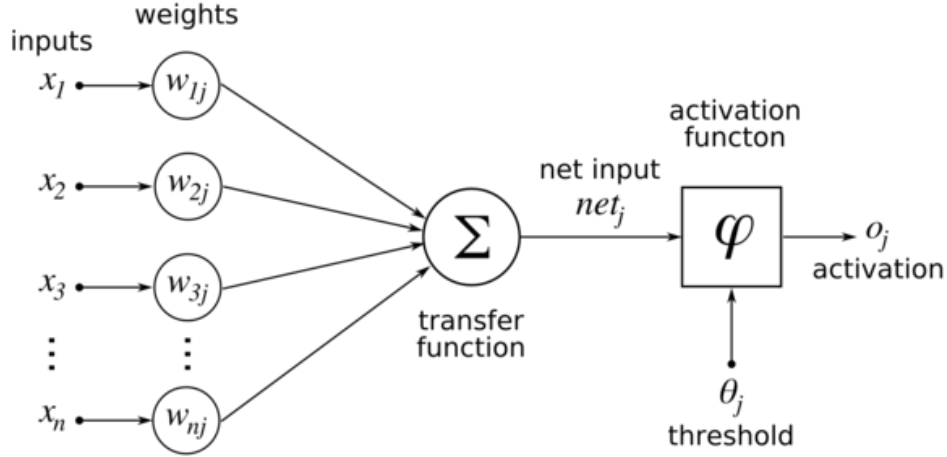


Figure 3.2: Illustration of nerve cell and communication flow

3.3 Perceptron

Perceptron is the simplest ANN with just one neuron and since we covered the basic intuition about artificial neuron we may proceed further and take a look at how output is actually calculated. The equation for a perceptron can be written as

$$y = \sigma\left(\sum_{i=1}^N w_i \cdot x_i + b\right)$$

where

- x - input vector
- y - predicted output
- σ - activation function
- w - weights
- b - bias

3.4 Artificial Neuron Network Topology

Since we know how artificial neuron works, now it's time to talk about the network topology. Before we do, from now on

3.5 Artificial Neuron

Artificial neuron is generic computational unit which takes n inputs and produces single output. Output has its own parameter and it's called *weight*.

Recurrent Nerual Networks

Recurrent Nerual Networks

Connectionist temporal classification

Connectionist temporal classification

Conclusion

Acronyms

GUI Graphical user interface

XML Extensible markup language

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