

On-line recognition of handwritten mathematical symbols

Bachelor's Thesis of

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I declare that I have developed and written the enclosed thesis completely by myself, and have not used sources or means without declaration in the text.

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(**Martin Thoma**)

Acknowledgement

TODO

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1. Introduction

Handwriting recognition is the problem of finding a proper textual representation given a handwritten symbol or sequence of symbols.

In off-line handwriting recognition, all algorithms have to work on pixel image information of the handwriting. On-line handwriting recognition on the other hand can use the information how symbols were written.

2. Baseline system

A system for symbol recognition was already written and is described in [Kir10].

2.1. Section 1

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2.2. Section 2

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3. Artificial Neural Nets

Artificial neural networks (ANNs) are models for classification that were inspired by the brain. They consist of artificial neurons and have a lot of different subtypes like Feed Forward Neural Nets.

3.1. Artificial neurons

Artificial neurons are inspired by biological neurons.

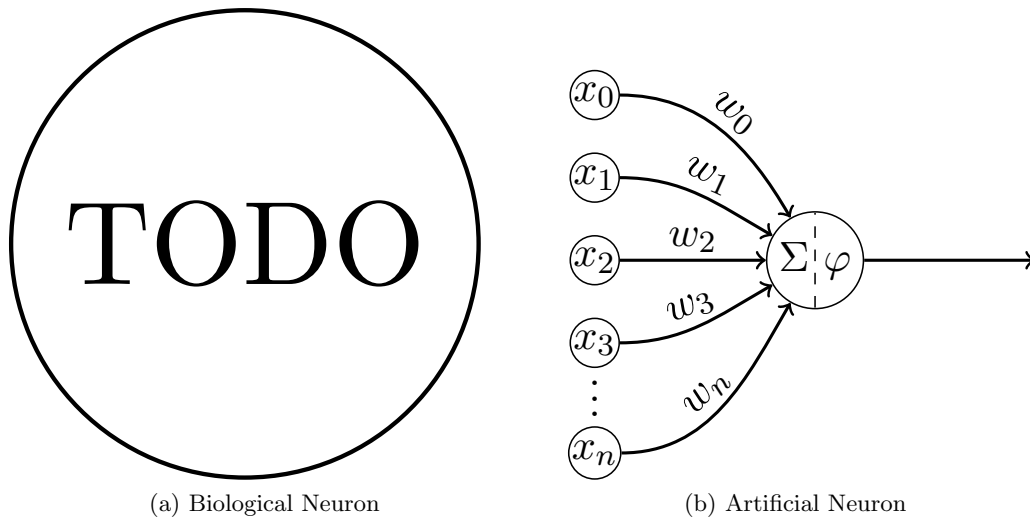


Figure 3.1.: Both neurons receive weighted input, apply a function to that and give output

They receive at least one input and at least one output. Those inputs might get weighted as well as the output.

The neurons apply a function to the sum of all weighted inputs. This function is called *activation function*.

An artificial neuron using the unit step function (see section 3.3.1) is called a *perceptron*.

The artificial neuron sums all weighted inputs $x_i \cdot w_i$ up and applies its activation function f to it.

3.2. Feedforward Neural Nets

Feedforward neural nets don't have loops.

3.3. Activation functions

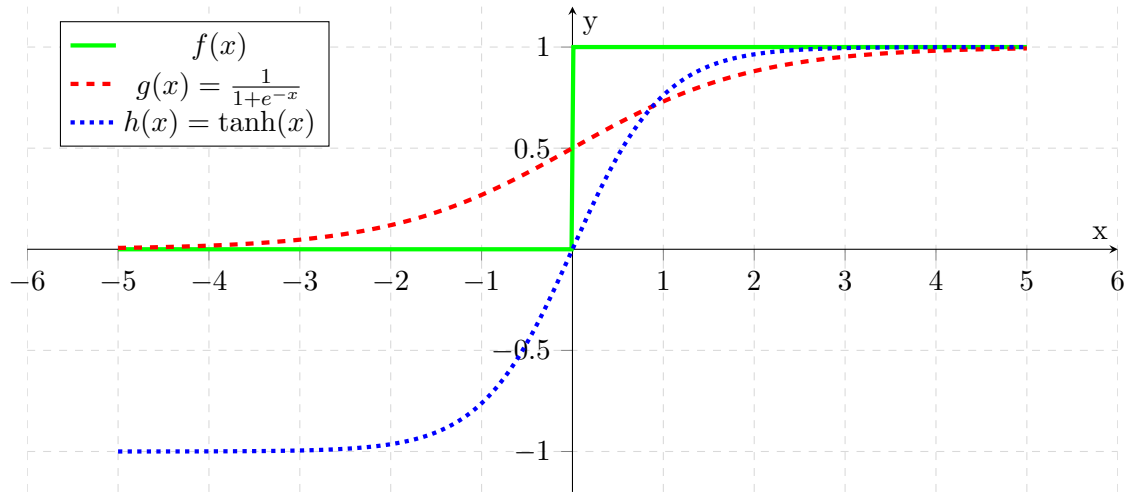


Figure 3.2.: The unit step function f , the sigmoid function g and the hyperbolic tangent h .

3.3.1. Unit step function

3.3.2. Sigmoid function

3.3.3. Hyperbolic tangent

4. Evaluation

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4.1. Section 1

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4.2. Section 2

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4.3. Section 3

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5. Conclusion

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Bibliography

- [Kir10] D. Kirsch, “Detexify: Erkennung handgemalter latex-symbole,” Diploma thesis, Westfälische Wilhelms-Universität Münster, 10 2010. [Online]. Available: <http://danielkirs.ch/thesis.pdf>

Glossary

ANN artificial neural network. 5

Appendix

A. First Appendix Section

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Figure A.1.: A figure

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