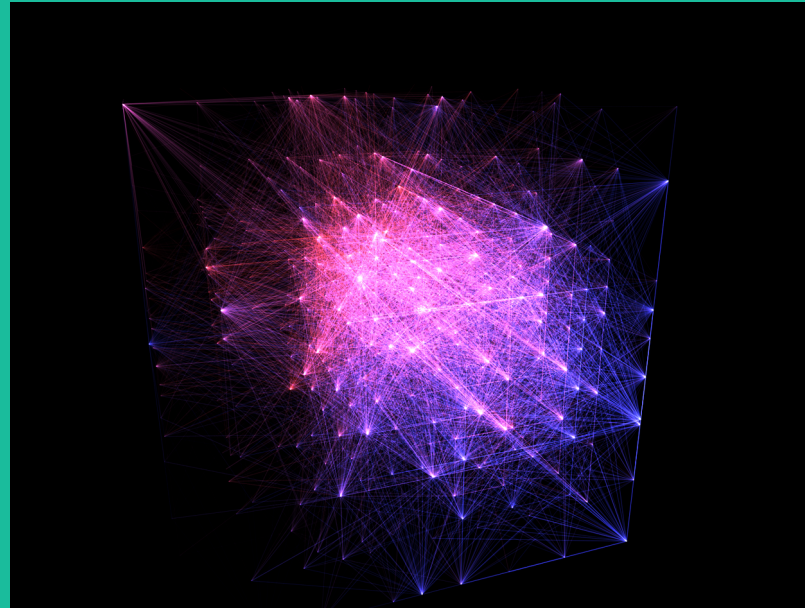# A Deep Learning Approach to Thyroid Disease Classification

A presentation by Endri Kastrati

October 19, 2017

Introduction

- Medical diagnosis is difficult and complex

- Preexisting data-sets rich in features and content

- Re-emergence of artificial neural networks

- Confidence reinforcement tool, not a replacement

Artificial Neural Networks

- A set of supervised learning algorithms

- Computational models based on biological systems

- Black-box model / encoded generalization

- Pattern classification

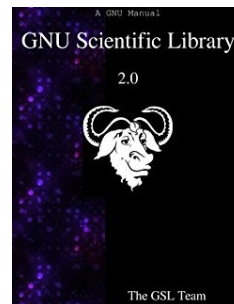- Curve approximation

- Time-variant systems
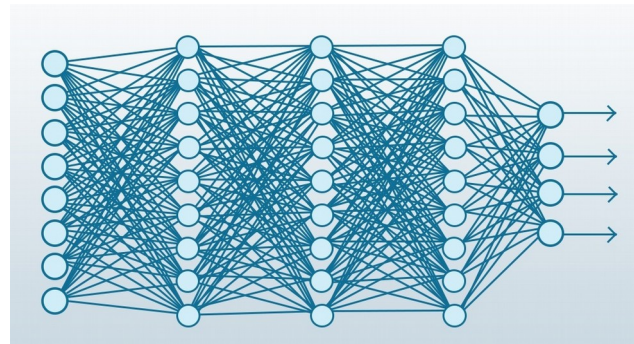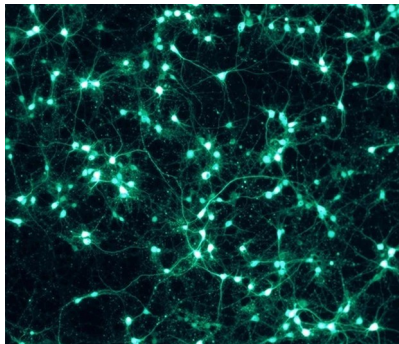
Aims and Objectives

"Deployment of artificial neural networks for the precise classification of diagnostics regarding thyroid diseases."

Deliverables

- Design of an artificial neural network library

- Unix application programming interface

- A minimalist web application for the medical expert

ANN library

- Written in the C programming language

- Extensive use of the GNU scientific library

- Highly portable / minimalist design (5 modules + main)

- Computational properties

  - Time complexity: $O(n^3)$ per training epoch
  - Space complexity: $O(n^2)$ per training process

Correctness of ANN library

"Multi-layer feed-forward neural networks are universal function approximators"

M. Stinchcombe, H. White and K. Hornik
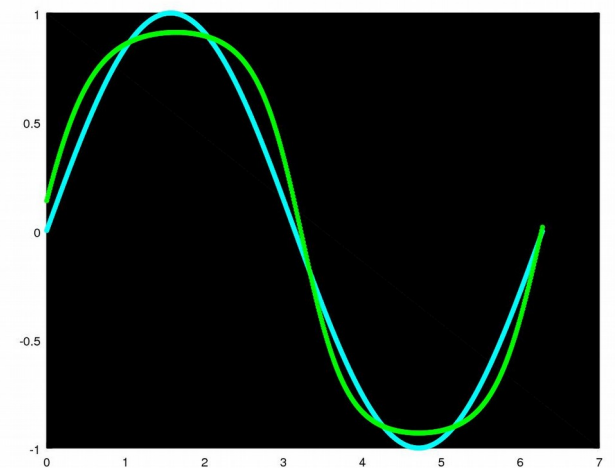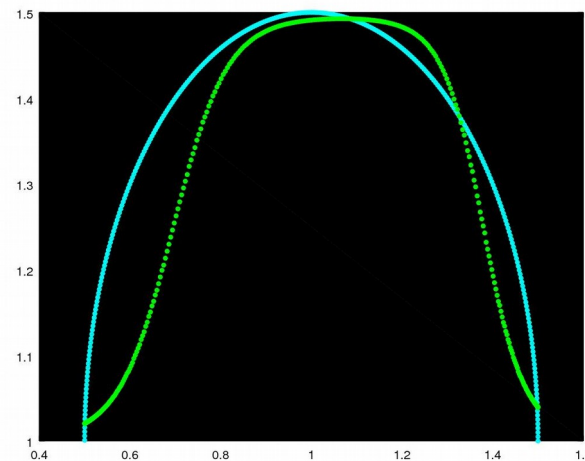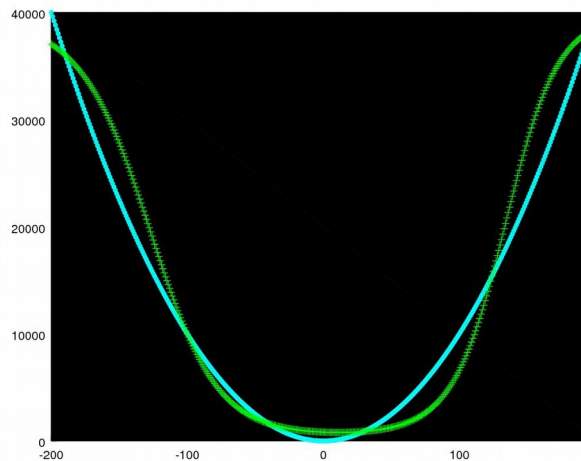
Thyroid disease dataset

- Established by the department of mathematics and statistics at James Cook University, Australia

- Used for the comparison of multivariate discriminant techniques and medical decision making applications.

- Dataset contains 5 features and 3 target classes, euthyroidism, hyperthyroidism and hypothyroidism.

Dataset class distributions

Percentage distribution

Euthyroidism
Hyperthyroidism
Hypothyroidism
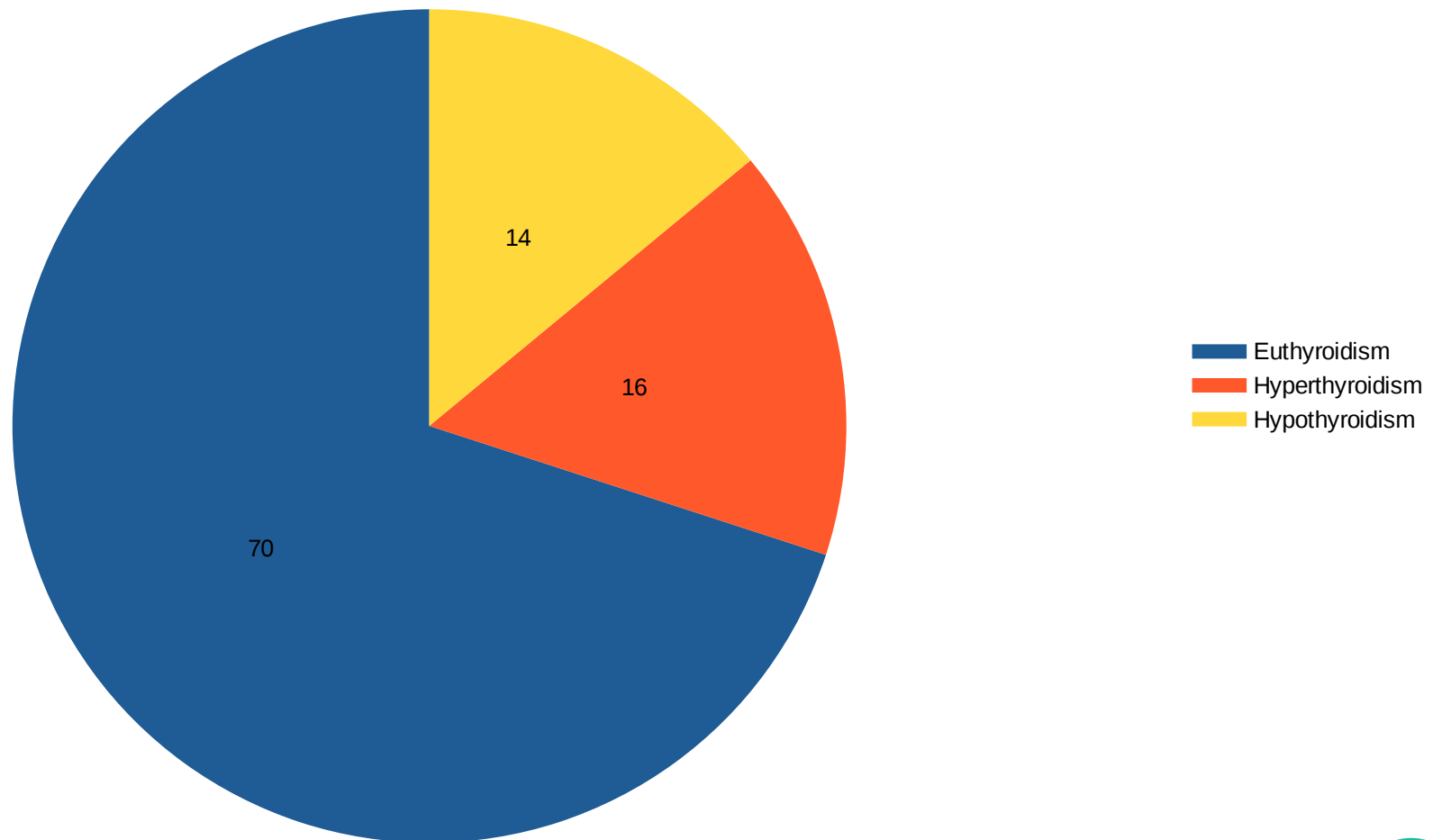
Obtaining a classifier

Through repetitive experimentation the following configurations give an optimal thyroid disease classifier.

Neural layers:	2
Neurons per layer:	20,3
Activation function:	Logistic function
Convergence rate:	1e-12
Learning rate:	0.5
Momentum rate:	0.009
Epochs:	700

Web application

- A simplified interface for interacting with the classifier

- Nodejs environment and express framework

- Using processes and web sockets for real-time interaction

Demonstration

- Iris flower classifier, training and deployment

- Curve approximation and visualization via octave

- Thyroid disease classifier, training and deployment

- Web application interface demo

Future

- Expand the capabilities to support time-variant systems

- Higher levels of abstractions to support all kinds of ANN

- Genetic algorithms to find optimal ANN configurations

- Implementation of cross-validation techniques

- Improve design of web interface

Conclusion

- ANNs are excellent models for pattern classification

- ANNs can reduce the degree of uncertainty

- Depend on the quality and size of the data-sets

- Difficult to figure optimal configuration

The End, Thank you!