Motivation/Rationale

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Syllabus

Unit 1 – Introduction to Neural Networks **[_ hrs.]**

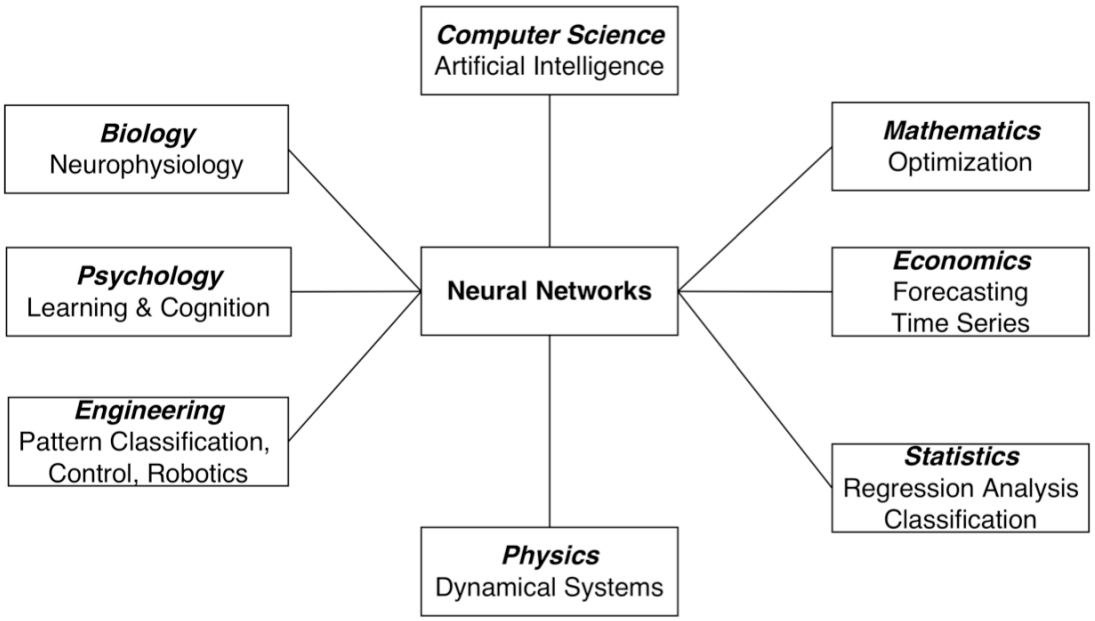
1.1. Introduction to Neural Networks
1.2. Historical background
1.3. Application of Neural Networks in Medicine
1.4. Neural networks vs. conventional computers – a comparison

INTRODUCTION

Problems and Problem Solving

- Classification (sets, decision making)
- Association (associations, storage)

Neural Network, an electic discipline



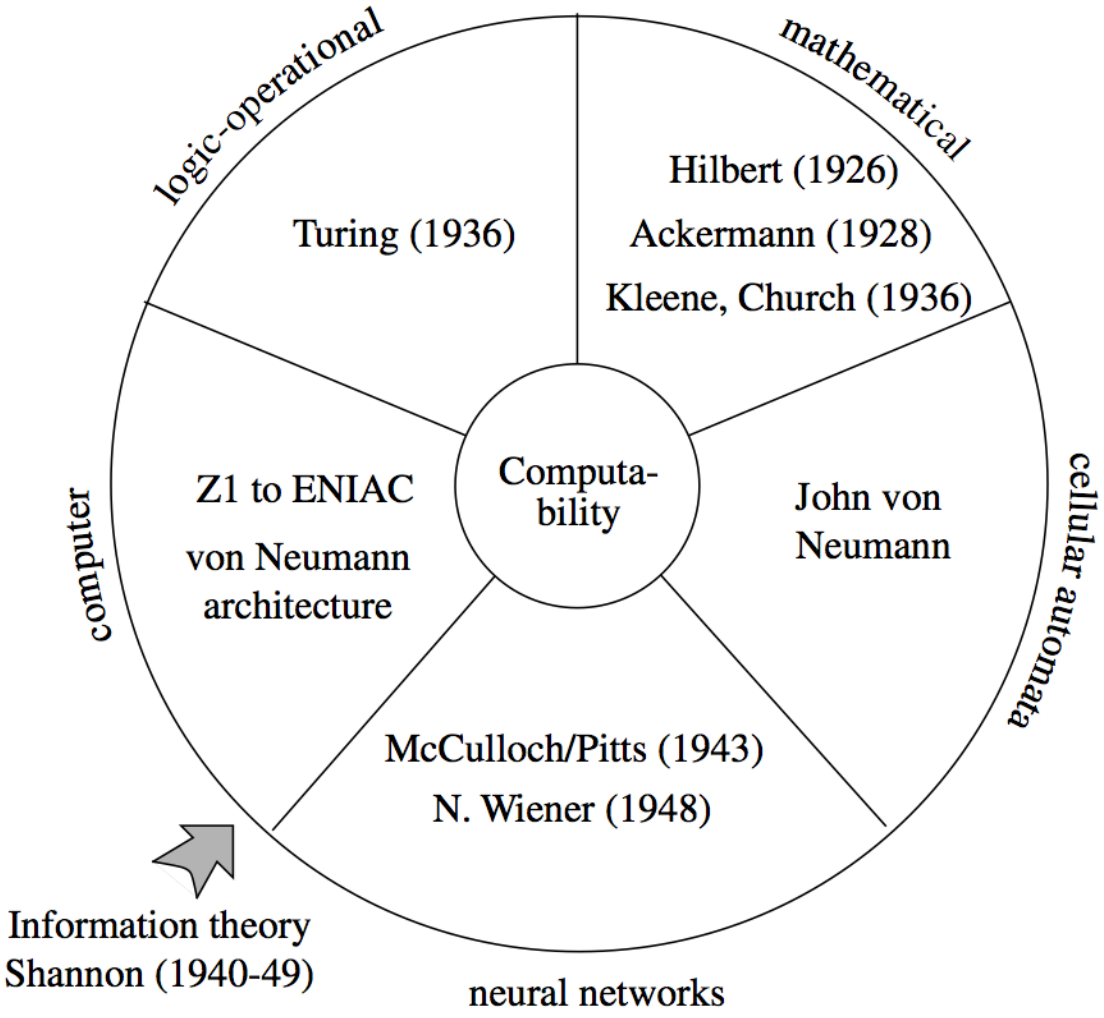
Biological Intelligence

- Intelligence, the ability to make decisions based upon input from the environment
- Intelligence is realized by a network of neurons, for example the brain and the attendant sensory and motor neurons

Not only our intelligence, but all aspects of our behavior, are the result of neural activity:

- Emotions
- Memory
- Reflexes
- Likes and dislikes
- Habits
- Addictions

5 Models of computation (historical background)



The mathematical model

- Computability
- Recursive functions

The logic-operational model (Turing machines)

- Functions are made up of basic building blocks
- Taylor and Maclourine Series

$$f(a) + \frac{f'(a)}{1!}(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \frac{f^{(3)}(a)}{3!}(x-a)^3 + \cdots$$

$$\sin(x) \approx x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!}.$$

The computer model

- Loops
- Conditional branching and self modifying programs

Cellular automata

- Computing space
- Architecture of universal computers (use of base 10 and 2)
- Parallel computing

The biological model (neural networks)

- No Turing computation
- Adaptation
- Parallel computing

Approaches to Artificial Intelligence

Reverse Engineering of Biology

- Understand real neurons well enough to model
- **Simulate** neural behavior, including learning aspects

Artificial Neural Networks

- Develop a parameterized model for a class of problems
- **Learn** the parameters

Simulated Evolution

- Provide basic evolutionary mechanism for neurons
- **Evolve** the parameters

Elements of a computing model

Computation = storage + transmission + processing

Fundamental Problems for a Given Neural Model

- How to **represent** information?
- How to characterize the **computational capability** of the model?
- How to achieve **learning** in the model?

Applications of Neural Networks in Medicine

- Cancer cell classification
- Human machine interfacing (HMI)
- Direct disease classification
- Prediction
- Optimization
- Gesture recognition
- Decision support system
- Bio-chemical analysis

References

- Rojas, R., *Neural Networks – A Systematic Introduction*
- Haykin, S., *Neural Networks – A Comprehensive Foundation*
- Keller, B., *Neural Networks, CS-152*

PRACTICAL # 1

Objectives

To implement error-corrective learning of a perceptron.

Description

Implement a perceptron and train it for adaptation using error-correction. The precision of the calculations play very important role. Choose high precision data structures (primitive/composite).

Platform

Any platform with any language of choice.

Model

Output, $$F(x) = \sum_{i=0}^{n-1} x_i . w_i$$

Goal, G

Error, $e = G - F$

Training $$\Delta w_i = x_i . w_i . \alpha$$
$$w_{i+1} = w_i + \Delta w_i$$