Lecture 01: Course Overview

NEURAL NETWORKS

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INTRODUCTION TO THE COURSE

1. **Course Title: Neural Networks**
2. **Course Code: CSE-5504**
3. **Course Contents:**
   - Classifier: Linear discriminate function, activation function;
   - Network Architecture: Feedforward network, single-layer, multi-layer network, radial function, Hopfield network;
   - Algorithms and methods: supervise and unsupervised learning, issues in learning: data, training, test, bias, variance and stop training, stopping criteria, complexity, first order methods of learning, classical supervised learning algorithm, back propagation learning algorithm: cascade correlation, RBF network, alternative learning: simulated annealing, genetic algorithms, error correction learning, ensemble based classifier.

COURSE OVERVIEW

1. Artificial Neural Network is a branch of Artificial Intelligence concerned with simulating neurons (cells in the brain responsible for learning) and applying them to perform learning tasks and representing knowledge.
   - Neurons are **information messengers**. They use electrical impulses and chemical signals to transmit information between different areas of the brain, and between the brain and the rest of the nervous system. The average that we have so far is a total of 86 billion neurons.
2. Through learning, machines are able to perform complex tasks not achievable (or too complex to be implemented) using conventional techniques.

LEARNING OBJECTIVE

The objective of this course is to provide students with a sound and comprehensive understanding of artificial neural networks and machine learning, including subjects of -

1. McCulloch-Pitts model, Hopfield network, Feed-forward and feed-back network structures, Activation functions;
2. Supervised and unsupervised machine learning algorithms, Perceptron learning algorithms, Recurrent neural networks, Weighted networks;
3. Pattern recognition and classification;
4. Dynamic Programming, and deep-learning techniques.

LEARNING OBJECTIVE

Course Objectives include-

Objective 1: To provide an introduction to the field of artificial neural networks and machine learning;

Objective 2: To teach students how to solve practical problems via implementation of these techniques;

Objective 3: To promote further independent learning on the topics of artificial neural networks and machine learning;

HOW NEURAL NETWORKS USED IN REAL LIFE?

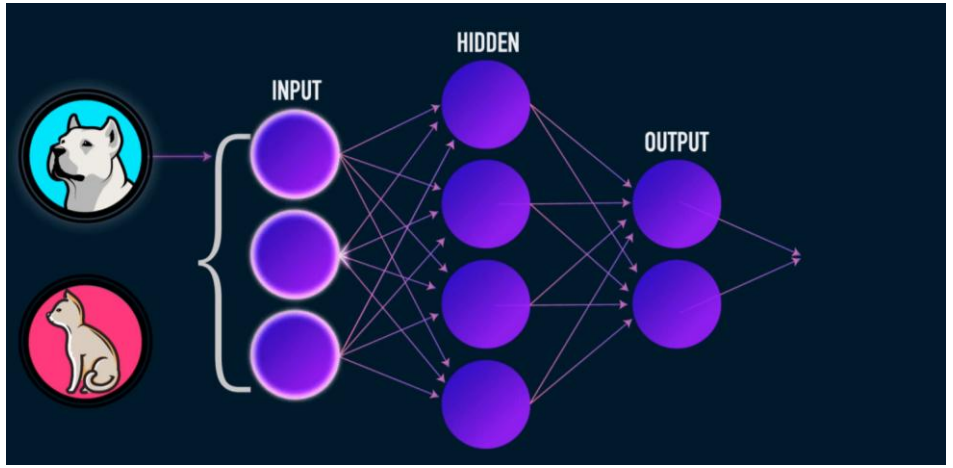
As modern computer become ever more powerful, scientists continue to be challenged to use machines effectively for tasks that are relatively simple for humans.

Neural networks are a series of algorithms that mimic the operations of an animal brain to recognize relationships between vast amounts of data.

Based on examples:

- We learn easily to recognize the letter A or distinguish a cat from a dog.
- Another common human activity is trying to achieve a goal that involves maximizing a resource while satisfying certain constraints.

They are good for **Pattern Recognition, Classification and Optimization**. This includes handwriting recognition, face recognition, speech recognition, text translation, credit card fraud detection, medical diagnosis and solutions for huge amounts of data.



WHY NEURAL NETWORKS?

The development of artificial neural networks began approximately 50 years ago, motivated by a desire to try both to understand the brain and to emulate some of it's strengths.

Interests in neural networks can be attributed to several factors:

- Training techniques have been developed for the more sophisticated network architectures that arc able to overcome the shortcomings of the early, simple neural nets.
- High-speed digital computers make the simulation of neural processes more feasible.
- Technology is now available to produce specialized hardware for neural networks.
- Fresh approaches to parallel computing may benefit from the study of biological neural systems. which are highly parallel.

WHY NEURAL NETWORKS?

Neural nets are of interest to researchers in many areas for different reasons:

- Electrical engineers find numerous applications in signal processing and control theory.
- Computer engineers are intrigued by the potential for hardware to implement neural nets efficiently and by applications of neural nets to robotics.
- Computer scientists find that neural nets show promise for difficult problems in areas such as artificial intelligence and pattern recognition.
- For applied mathematicians, neural nets are a powerful tool for modeling problems for which the explicit form of the relationships among certain variables is not known.

WHY NEURAL NETWORKS?

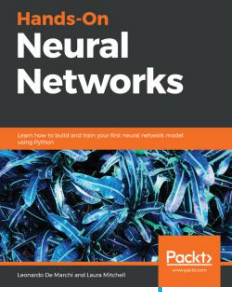
There are various points of view as to the nature of a neural net:

- For example, is it a specialized piece of computer hardware (say, a VLSI chip) or a computer program?
- The view that neural nets are basically mathematical models of information processing. They provide a method of representing relationships that is quite different from Turing machines or computers with stored programs.
- As with other numerical methods, the availability of computer re-sources, either software or hardware, greatly enhances the usefulness of the approach, especially for large problems.

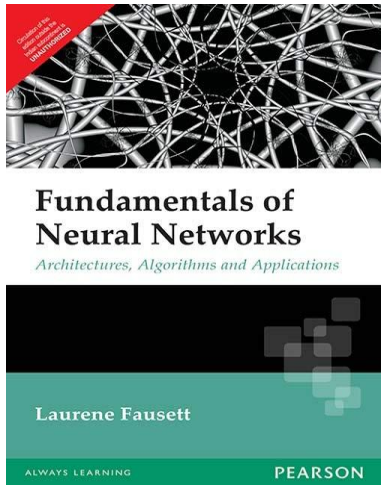
The characteristics of biological neural networks that serve as the inspiration for artificial neural networks, known as *neurocomputing*.

WHY NEURAL NETWORKS?

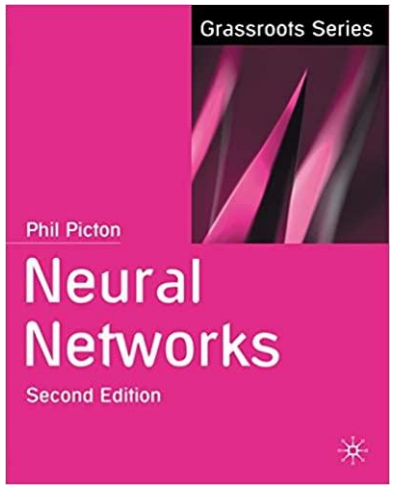
1. They are extremely powerful computational devices
2. Massive parallelism makes them very efficient
3. They can learn and generalize from training data – so there is no need for enormous feats of programming
4. They are particularly fault tolerant
5. They are very noise tolerant – so they can cope with situations where normal symbolic systems would have difficulty
6. In principle, they can do anything a symbolic/logic system can do, and more



REFERENCE BOOKS

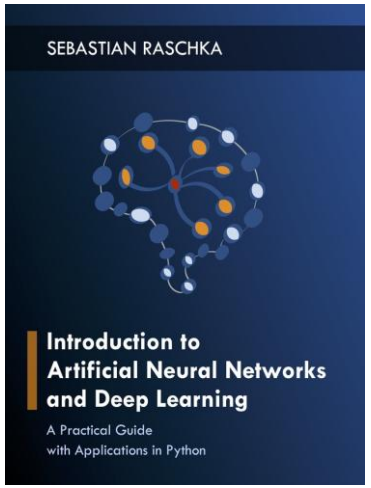


Fundamentals of Neural Networks: Architectures, Algorithms and Applications
By Laurene Fausett

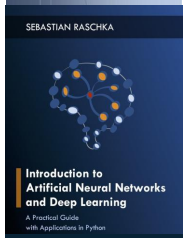


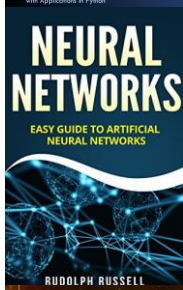
Neural Networks,
By Phil Picton

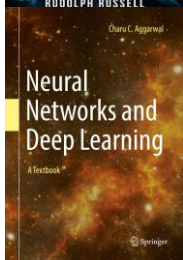
A Brief Introduction to Neural Networks
By David Kriesel



Introduction to Neural Networks and Deep Learning
By S Raschka







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LECTURE 01

COURSE OVERVIEW

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