Introduction: Neural Information Processing

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Human brains perform sophisticated information processing tasks using the hardware and the processing tools that are quite different from the ones that the conventional computers use.

Neurons:
The neurons are the processors in the brain. They are rather noisy ones and capable to operate in parallel, usually or8ganised in dense networks, whose structures may vary from very regular to almost amorphous (without a clearly defined form).

Synapses:
Inter-neuron connections called synapses are used to communicate the signals between neurons. These synapses represent the program of a network. The program can be modified by updating the strengths of these connections and can 'learn' from experience and adapt to the changing circumstances.

Neurons are rather poor processors, they are slow and unreliable. So this issue is overcome by using always a large number of neurons in any task and operate them in parallel, with many connections. While in conventional computers operations are rule-performed in a sequential manner, so that failure in any part of the chain of operations will result in the total failure.

Neural networks can adapt to the changing circumstances while the conventional computers execute detailed specifications of orders, and operate on the data specified clearly.

Large number of neurons die each day in a human brain. But that is not the case with conventional computers.

Hence conventional computers are the tools that can perform good in well-defined and rule-based information processing task, in stable and safe environments, where all possible situations as well as how to respond in every situation are known beforehand. Like brute-force chess playing, word processing, etc.,

While the neural information systems, are useful in dealing with real world tasks, such as communication (vision, speech recognition), movement coordination (robotics) and experience based decision making, where data are often messy or inconsistent, possible situations is infinite and perfect solutions are practically not possible.

There are three types of motivation for studying the neural networks:

1. From the perspective of biologists, physiologists and psychologists:
   Aim to understand the information processing in real biological nervous tissue. To study models mathematically and through computer simulations, to understand global properties and functioning of brain regions.
2. From the perspective of Engineers and Computer Scientists:
   For designing software and artificial information processing systems, which can learn. Exploit the emerging insight into the way biological neural networks manage to process information efficiently in parallel by building artificial networks in hardware, which also operate in parallel.
3. From the perspective of theoretical physicists and mathematicians:
   Many fundamental new mathematical problems posed by neural networks has to be solved. It is easy to come up with ideas about certain information processing tasks of neural networks, but potentials and restrictions of such ideas can be found out only working out the mathematics. It also allows further systematic design of new networks and discovery of new mechanisms.