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Neural Networks

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Анотація:*нейронні мережі є новітніми технологіями, що лише починають розвиватись, їхні можливості значно перевищують сьогоднішні електронні засоби в більшості аспектів. Головним завданням даної доповіді є ознайомлення аудиторії з багатофункціональними нейронними мережами, показати їхні переваги та майбутній розвиток даної галузі науки.*

Ключові слова: нейронна мережа, порівняльна характеристика НМ з комп'ютером, додатки НМ, біологічний нейрон, ключові елементи НМ, характеристика НМ, НМ-проекти, НМ в реальних задачах, операційна частина проти функціональної; НМ, в системах фон Неймана, майбутнє НМ, нейрокомп'ютер.

Abstract: *neural networks are new technology, that are just beginning to grow, their opportunities far exceed our electronics devices in many aspects. Main task of this presentation are briefing the audience with multi-functionally neural networks, show their advantages and features of neural networks, as a part of neuroscience.*

Keywords: Neural Network Techniques, NNs vs Computers, Applications off NNs, What can you do with an NN and what not?, Who is concerned with NNs?, The Biological Neuron, The Key Elements of Neural Networks, Characteristics of NNs, Neural Networks Projects, NNs in real problems, Hardware vs Software, Applications of Hardware NNWs, NNets in VLSI, NNW Features, NeuroComputers.

Introduction To Neural Networks

- Development of Neural Networks date back to the early 1940s. It experienced an upsurge in popularity in the late 1980s. This was a result of the discovery of new techniques and developments and general advances in computer hardware technology.
- Some NNs are models of biological neural networks and some are not, but historically, much of the inspiration for the field of NNs came from the desire to produce artificial systems capable of sophisticated, perhaps intelligent, computations similar to those that the human brain routinely performs, and there by possibly to enhance our understanding of the human brain.

Neural Network Techniques

- ◦ The neural computer adapts itself during a training period, based on examples of similar problems even without a desired solution to each problem. After sufficient training the neural computer is able to relate the problem data to the solutions, inputs to outputs, and it is then able to offer a viable solution to a brand new problem.

What can you do with an NN and what not?

- In principle, NNs can compute any computable function, i.e., they can do everything a normal digital computer can do. Almost any mapping between vector spaces can be approximated to arbitrary precision by feed forward NNs
- In practice, NNs are especially useful for classification and function approximation problems usually when rules such as those that might be used in an expert system cannot easily be applied.

- NNs are, at least today, difficult to apply successfully to problems that concern manipulation of symbols and memory. And there are no methods for training NNs that can magically create information that is not contained in the training data.

NNs vs Computers

Digital Computers

- Deductive Reasoning. We apply known rules to input data to produce output.
- Computation is centralized, synchronous, and serial.
- Memory is packetted, literally stored, and location addressable.
- Not fault tolerant. One transistor goes and it no longer works.
- Exact.

Neural Networks

- Inductive Reasoning. Given input and output data (training examples), we construct the rules.
- Computation is collective, asynchronous, and parallel.
- Memory is distributed, internalized, short term and content addressable.
- Fault tolerant, redundancy, and sharing of responsibilities.
- Inexact.

Applications off NNs

in marketing: consumer spending pattern classification

In defence: radar and sonar image classification

In agriculture & fishing: fruit and catch grading

In medicine: ultrasound and electrocardiogram image classification, EEGs, medical diagnosis

Characteristics of NNs

- Learning from experience: Complex difficult to solve problems, but with plenty of data that describe the problem
- Generalizing from examples: Can interpolate from previous learning and give the correct response to unseen data
- Rapid applications development: NNs are generic machines and quite independent from domain knowledge
- Adaptability: Adapts to a changing environment, if is properly designed
- Computational efficiency: Although the training off a neural network demands a lot of computer power, a trained network demands almost nothing in recall mode
- Non-linearity: Not based on linear assumptions about the real word

NNW Features

- Neural Network architecture(s)
- Programmable or hardwired network(s)

- On-chip learning or chip-in-the-loop training
- Low, medium or high number of parallel processing elements (PE's)
- Maximum network size.
- Can chips be chained together to increase network size.
- Bits of precision (estimate for analog)
- Transfer function on-chip or off-chip, e.g. in lookup table (LUT).
- Accumulator size in bits.
- Expensive or cheap

NeuroComputers

- Neurocomputers are defined here as standalone systems with elaborate hardware and software.
- Examples:
  - Siemens Synapse 1 Neurocomputer:
    - Uses 8 of the MA-16 systolic array chips.
    - It resides in its own cabinet and communicates via ethernet to a host workstation.
    - Peak performance of 3.2 billion multiplications (16-bit x 16-bit) and additions (48-bit) per sec. at 25MHz clock rate.
  - Adaptive Solutions - CNAPServer VME System
    - VME boards in a custom cabinet run from a UNIX host via an ethernet link.
    - Boards come with 1 to 4 chips and up to two boards to give a total of 512 PE's.
    - Software includes a C-language library, assembler, compiler, and a package of NN algorithms.

References:

http://wiki.tntu.edu.ua/Нейронні_мережі

http://www.quickanddirtytips.com/education/science/what-is-a-neural-network?WT_mc_id=11041

http://www.scientificamerican.com/article/experts-neural-networks-like-brain/

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