Why Can't A Computer Be More Like A Brain?

Outline

- Introduction
- Turning Test
- HTM
  - A. Theory
  - B. Applications & Limits
- Conclusion

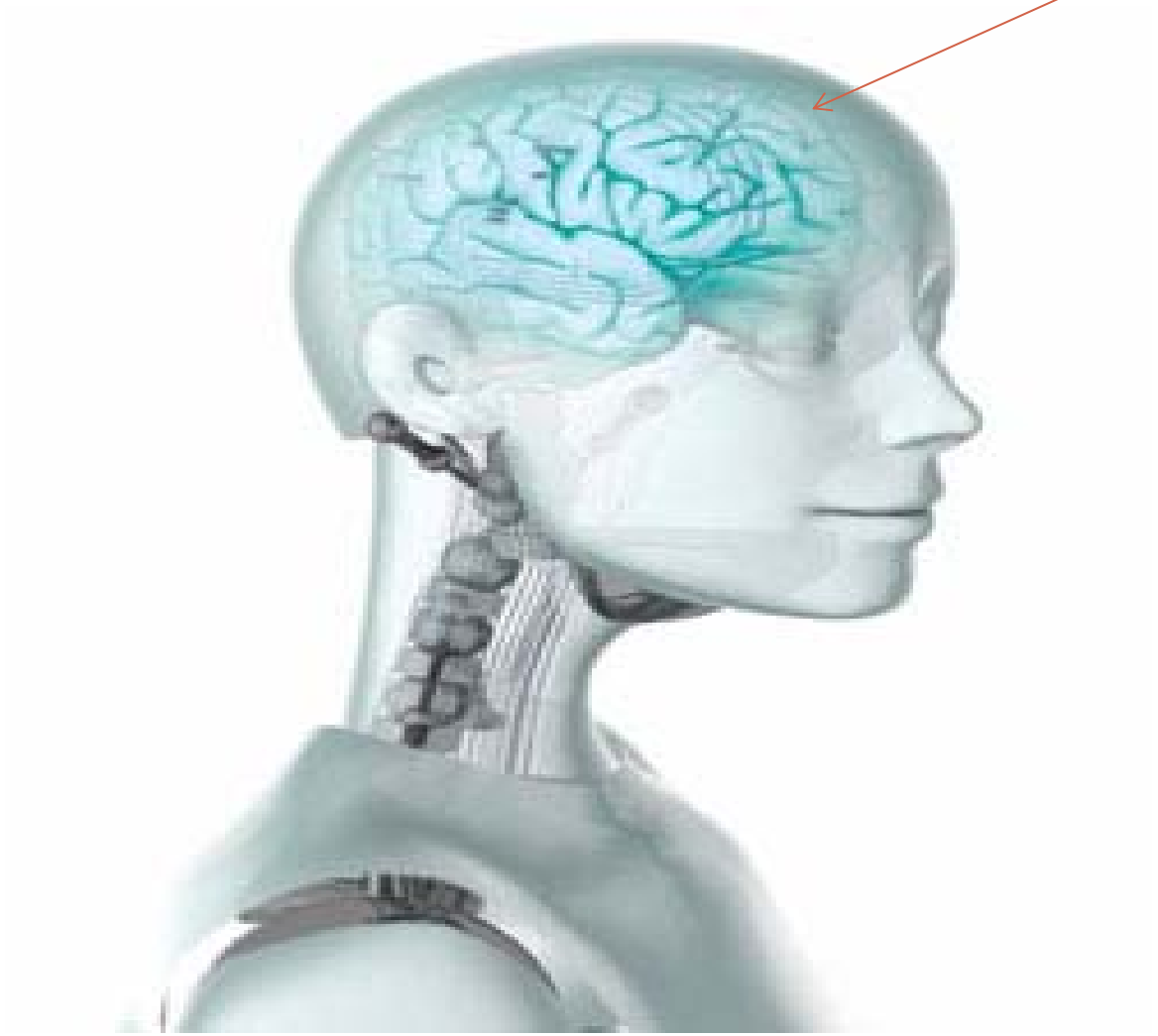
Introduction

- Brain allows: conversation, cat or dog, play catch
- Robots & Computers: NONE
- Wrong start despite 50 years of research?
- Neglect of human brain in research
- Neural network programming techniques

Turning Test

- It asked if a computer hidden away, could converse and be indistinguishable from a human
- Today, the answer is NO, Behavioral frame?
- Understand then replicate
- Jeff Hawkins: Palm Computing, Hand Spring, Numenta
- HTM (Hierarchical Temporal Memory) theory

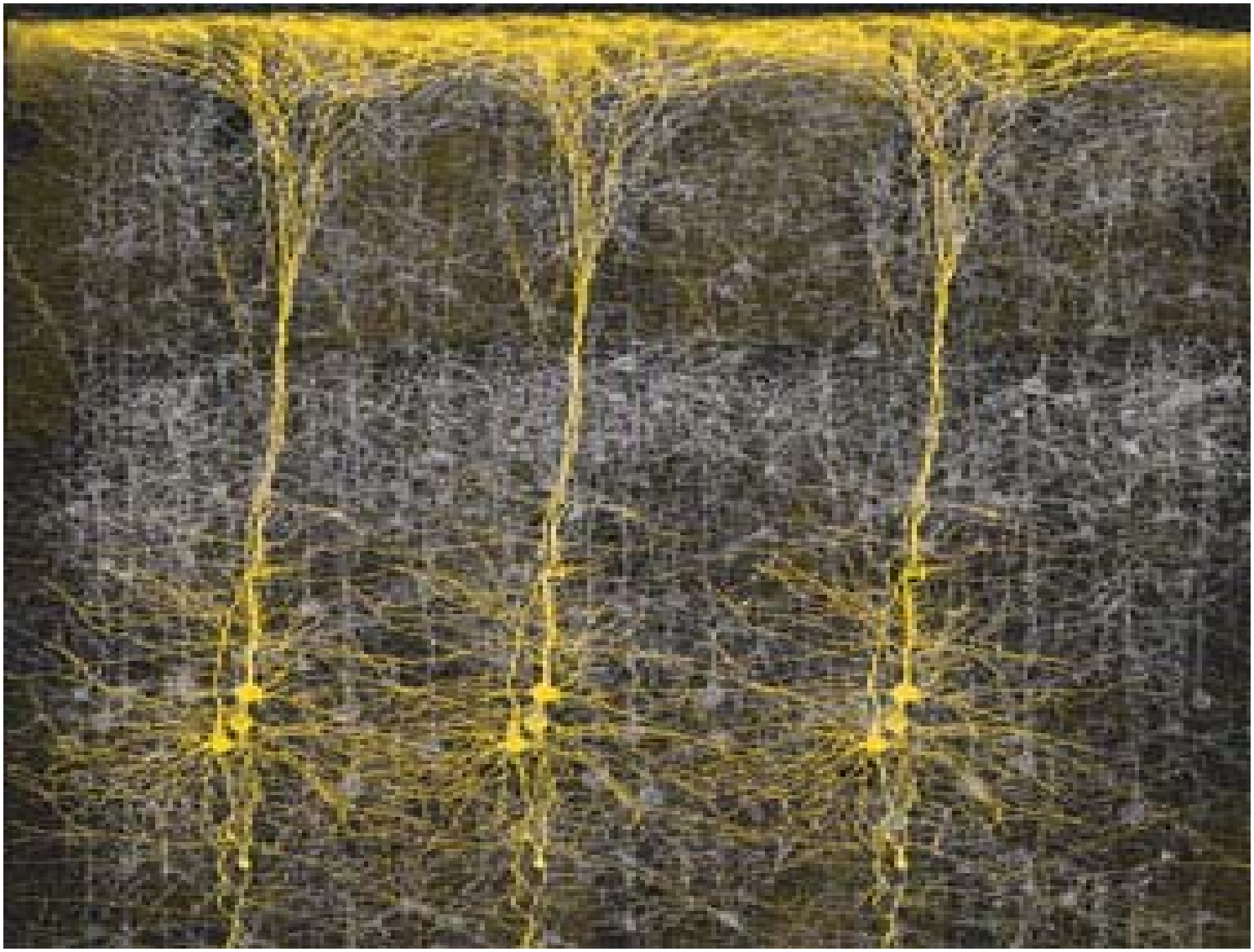
HTM: Theory



HTM: Theory

- Neocortex & How it works
- Motor control, language, music, vision, different jobs
- Uniform structure, suggest common algorithm code
- General purpose learning machine
- 6 sheets, 30 billion neurons
- Learning depends on size, senses, experiences

HTM: Theory



HTM: Theory

- Different sheets connected by bundles of nerve fibers
- A map reveals a hierarchical design
- Input directly to regions, feed others
- Info also flows down the hierarchy
- Low level nodes, simple input, high more complex
- HTM similarly built on hierarchy of nodes

HTM: Theory

- Memory not stored in a single location
- Example: Cat
- Ears, fur, eyes: low level nodes
- Head, torso: high level nodes
- Takes time, but can learn dog with less memory
- Reuse knowledge, unlike AI and neural networks

HTM: Theory

- Time is the teacher
- Patterns that occur together in generally have common cause
- Hear sequence of notes, recognize melody
- Memory: hierarchical, dynamic, memory systems
- Not computer memory or single instance
- Train HTM: Sensory input through time

HTM: Theory

- Machine learning difference?
- Hybrid with a twist
- Hierarchy: HHMM (Hierarchical Hidden Markov Models)
- Spatial variation problem
- Similarity means same conclusion

HTM: Theory

- Biological model: Accurate, neuroanatomy and physiology for direction
- HTMs work: Can identify dogs in various forms
- Bayesian network
- Numenta: Three components
- 1) Run-time engine: C++ routines, create, train, run
- From small laptops to multi-core PC
- Runs on Linux, can use Mac

HTM: Theory

- Automatically handles the message processing back and forth in nodes
- 2) Tools: Python scripting language, train and test
- Sufficient, but could modify/enhance: visualization
- 3) Plug-in API and associated source code
- Create new kinds of nodes
- Two kinds: Basic learning (appears anywhere in net)
- Interface node (out of the net to sensors input or effectors that output).

HTM: Applications & Limits

- What can you do with Numenta?
- Car manufacturers: Spatial inference, data from camera/laser
- Social networks, machine net, oil exploration
- Work best when hierarchical structure in data (e.g.?)
- What sensory data to train with?
- Present them in time-varying form

HTM: Applications & Limits

- Applications that cannot be solved today:
- Long memory sequences or specific timing
- Example: Spoken Language, music, robotics require precise timing
- Limitation because of tools & algorithms, not platform
- Takes time to learn, never learned to program
- Not humanlike, not brain, not to pass test

Conclusion

- Difference between brain and computer
- Wrong approach, Turning test, Neocortex
- HTM: Hierarchy, nodes, reuse data, learns on its own
- Numenta platform: Run-time engine, Tools, Plug-in API
- Applications: Spatial inference, networks
- Limits: Long sequence, specific timing

Question Time