

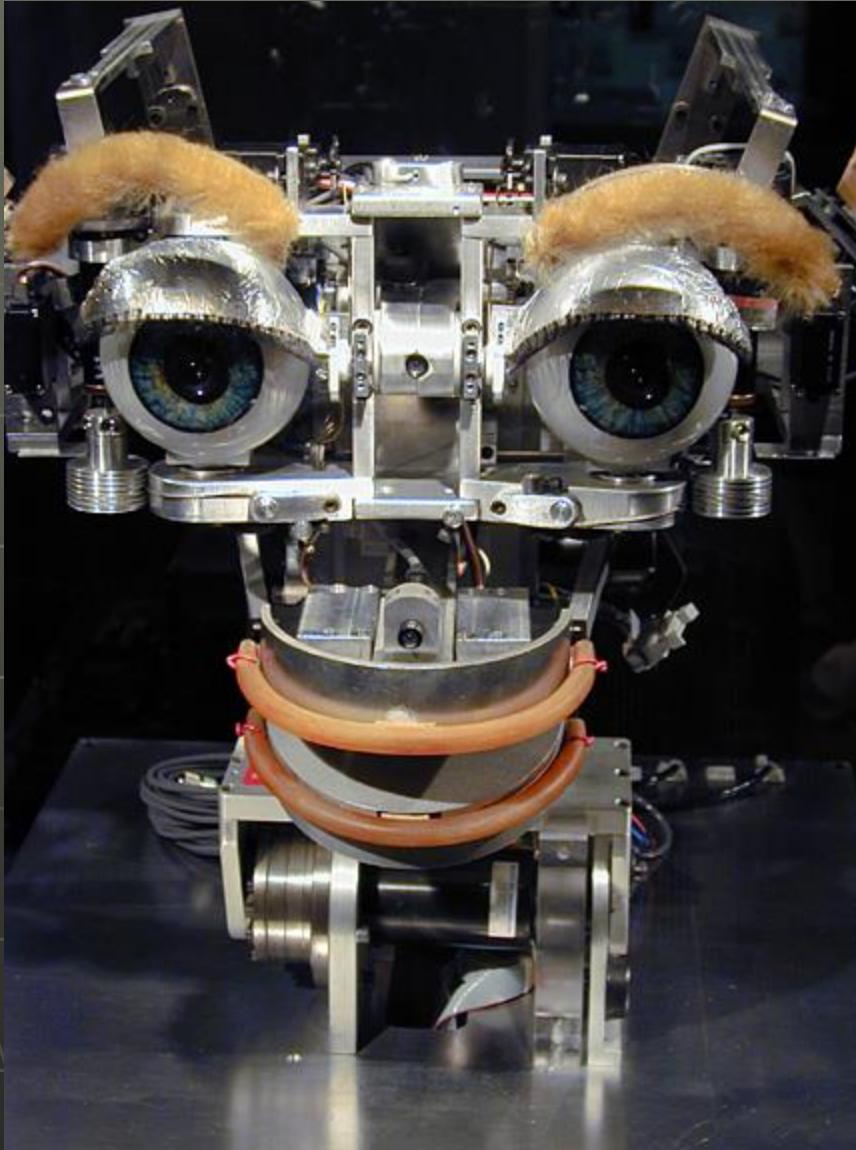
# ASIMO robot (Honda)







# Kismet, the Sociable Robot



<https://www.youtube.com/watch?v=3lFuv1AVouM>

<https://www.youtube.com/watch?v=hIHrvQ7D5OU>

<http://time.com/2917394/japan-human-robots/#2917394/japan-human-robots/>

<https://wtvox.com/robotics/top-10-humanoid-robots/>

<https://www.youtube.com/watch?v=IhVu2hxm07E>

# **From Insects to Realistic A.I. Algorithms**

# From Ants to Algorithms

- Swarm intelligence information allows us to address modeling via:
  - Problem solving
  - Algorithms
  - Real world applications

# Modeling

- Observe Phenomenon
- Create a biologically motivated model
- Explore model without constraints

# Modeling...

- **Creates a simplified picture of reality**
- **Observable relevant quantities become variables of the model**
- **Other (hidden) variables build connections**

# A Good Model has...

- Parsimony (simplicity)
- Coherence
- Refutability
- Parameter values correspond to values of their natural counterparts

# Travelling Salesperson Problem

Initialize

**Loop /\* at this level each loop is called an iteration \*/**

Each ant is positioned on a starting node

**Loop /\* at this level each loop is called a step \*/**

Each ant applies a state transition rule to incrementally build a solution and a local pheromone updating rule

**Until** all ants have built a complete solution

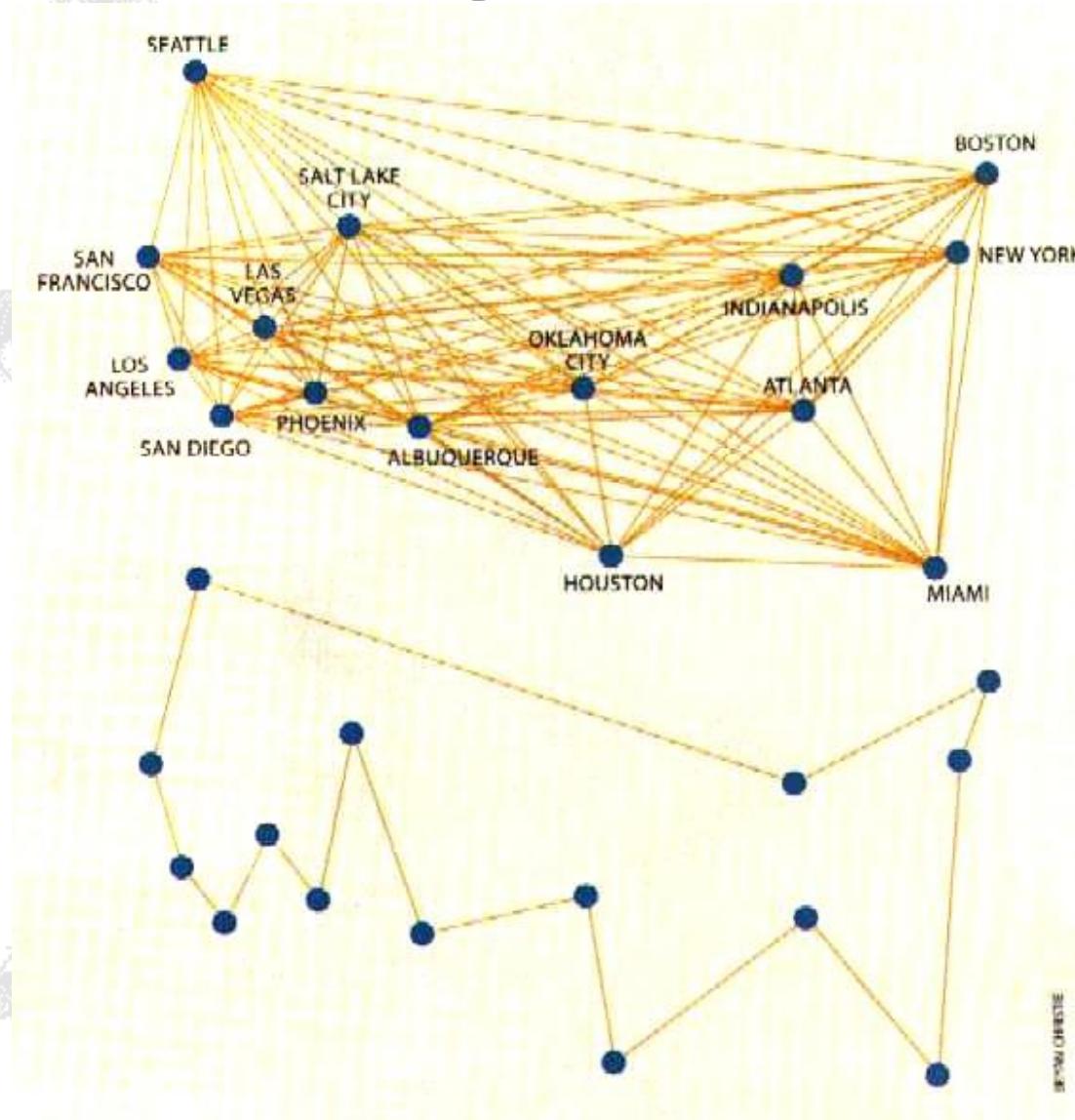
A global pheromone updating rule is applied

**Until** End\_condition

M. Dorigo, L. M. Gambardella : <ftp://iridia.ulb.ac.be/pub/mdorigo/journals/IJ.16-TEC97.US.pdf>

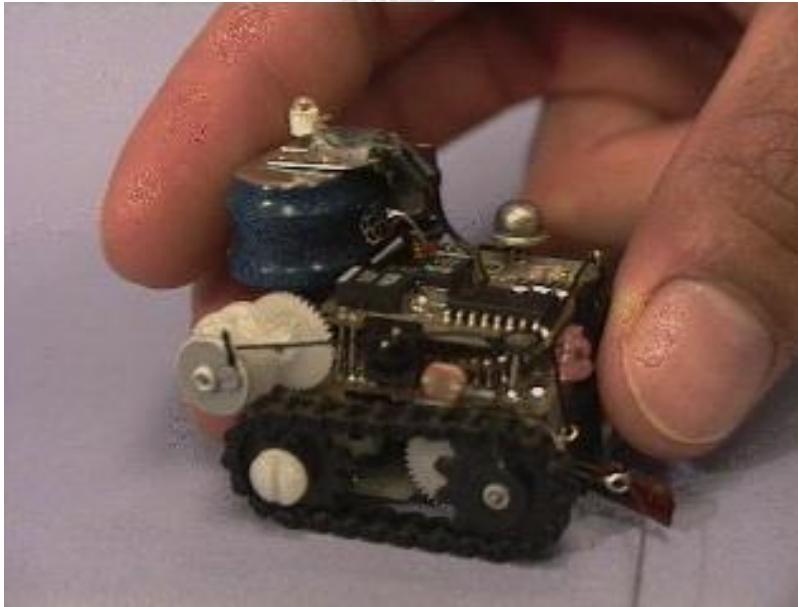
Ant Colony System: A Cooperative Learning Approach to the Traveling Salesman Problem

# Traveling Sales Ants



**Welcome to the  
Real World**

# Robots



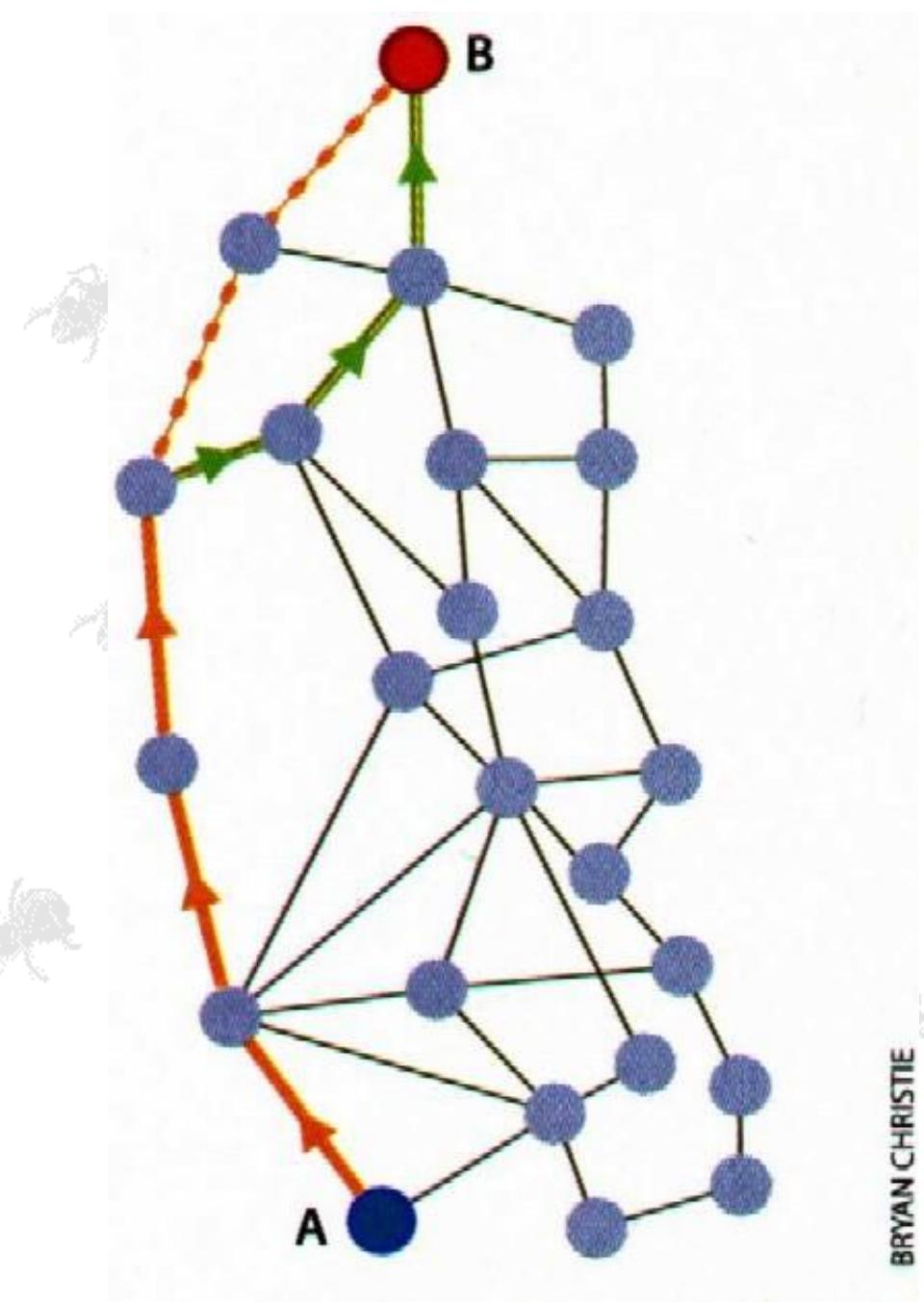
- **Collective task completion**
- **No need for overly complex algorithms**
- **Adaptable to changing environment**

# **Robot Feeding Demo**

# Communication Networks

- Routing packets to destination in shortest time
- Similar to Shortest Route
- Statistics kept from prior routing (learning from experience)

- Shortest Route
- Congestion
- Adaptability
- Flexibility



# Antifying Website Searching

- Digital-Information Pheromones (DIPs)
- Ant World Server
- Transform the web into a gigANTic neural net

# Closing Arguments

- Still very theoretical
- No clear boundaries
- Details about inner workings of insect swarms
- The future...???

*Dumb parts, properly  
connected into a swarm,  
yield smart results.*

**Kevin Kelly**

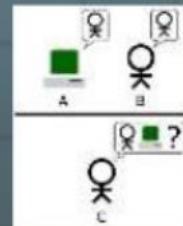
# The Future?

- Miniaturization
- Pipe Inspection
- Job Scheduling
- Interacting Chips in Mundane Objects
- Satellite Maintenance
- Pest Eradication
- Vehicle Routing
- Optimal Resource Allocation
- Data Clustering
- Cleaning Ship Hulls
- Engine Maintenance
- Telecommunications
- Medical Self-Assembling Robots
- Self-Assembling Robots
- Combinatorial Optimization
- Distributed Mail Systems

# ...but what is AI?

- John McCarthy (1955, roots in Lithuania) suggested:

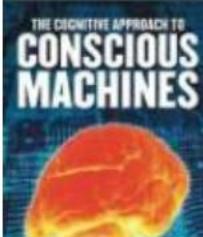
- AI is a science and engineering aimed at creating intelligent machines
  - But what is an “intelligent machine”?
  - Turing test (1950): a machine can reason if:
    - It can imitate humans so that an average person would assume he/she is dealing with another person



SM&E

- New definitions:

- Jeff Hawkins: an **intelligent system can correctly predict what's coming**. Created **hierarchical temporal memory** (**Numenta, Grok, Vicarious Systems**)
  - Dr. Kestas Kveraga, Harvard University: visual brain systems use predictive feedback loops to speed up object recognition
  - Penti Haikonen (Nokia): **intelligent systems can predict outcomes of their actions**
  - Imagination is required in order to simulate consequences of choosing alternative actions. Igor Aleksander: **computers with imagination**



# Achievements of AI

## Playing chess:

- IBM's Deep Blue computer defeated the world champion Garry Kasparov in 1997.
  - Used simple search algorithm
  - Triumph of pure AI: no inspiration from the brain



## Speech synthesis:

- Apple popularized it 25 years ago with Macintosh.
  - computer algorithms have trouble pronouncing irregular words.
- Terrence Sejnowski, Salk professor, in 1987 created a neural net Nettalk that learned to pronounce them in a way like human baby.
  - Showed advantages of brain-like algorithms.

## Face detection:

- Face detection algorithm is ubiquitous in photo cameras.  
Based on the algorithm invented by MIT professor Paul Viola.
  - Used inspiration from visual system of primate brain. Had many conversations with him



## Face recognition:

- A harder problem, but several companies solve it successfully, including Dr. Algimantas Malickas' company in Vilnius: Neurotechnology.
  - Relies on AI methods (machine learning, such as SVMs)

# Achievements of AI, cnt'd

## Voice recognition:

- Nuance Dragon used in speech transcription, e.g. medicine.
- Google Voice – suitable for transcribing 70-80% voice messages.
- Weakness: break down in presence of accent, background noise.



## Language understanding:

- IBM Watson won “Jeopardy” game (2011)
- Largest project – Stanford Research Institute’s “personal assistant” (DARPA).
- SRI system was commercialized and Apple bought it in 2011: Siri app for iPhone.



## Maintaining dialogue: No machine has passed the Turing test



## Recognition of human actions and intentions:

- Simple algorithms for human action recognition in security tapes (San Diego)
- Numenta (Vicarious ?): uses brain- inspired principles for human action detection, and other applications.
- Intentiva: recognizes human intentions



## Recognizing emotional and social states:

- San Diego company Emotient recognizes emotions from facial expressions.

# AI

# vs. Artificial Brain



- Principle of operation: logical rules created by engineers
- Works with standard digital computers
- Software is separated from hardware
- Memory is separate from CPU
- Advantage: the logic of operation is straightforward to understand
- Disadvantages:
  - Limited tolerance for errors
  - Needs a lot of energy for each computational cycle



- Principle of operation: adaptive processes, statistical learning rules
- Requires neuromorphic electronics
- Software is merged with hardware
- Each processor has its own memory
- Advantages:
  - Tolerance to errors and malfunctions, ability to compensate them
  - Asynchronous parallel operation needs little energy
- Disadvantage: unexpected emergent phenomena can arise
  - e.g.: artificial “epilepsy”

# *Need Of Artificial Brain*

We have achieved a great development of computer technologies, but the ability of machines is limited to simple tasks which require human beings have to order what to do.

We lack the specific and concrete algorithms to solve practical problems in the real world.

A human brain is the best model in solving practical problems in the real world, and we came up with neural networks based on the human neural information processing.

## **Advantages:-**

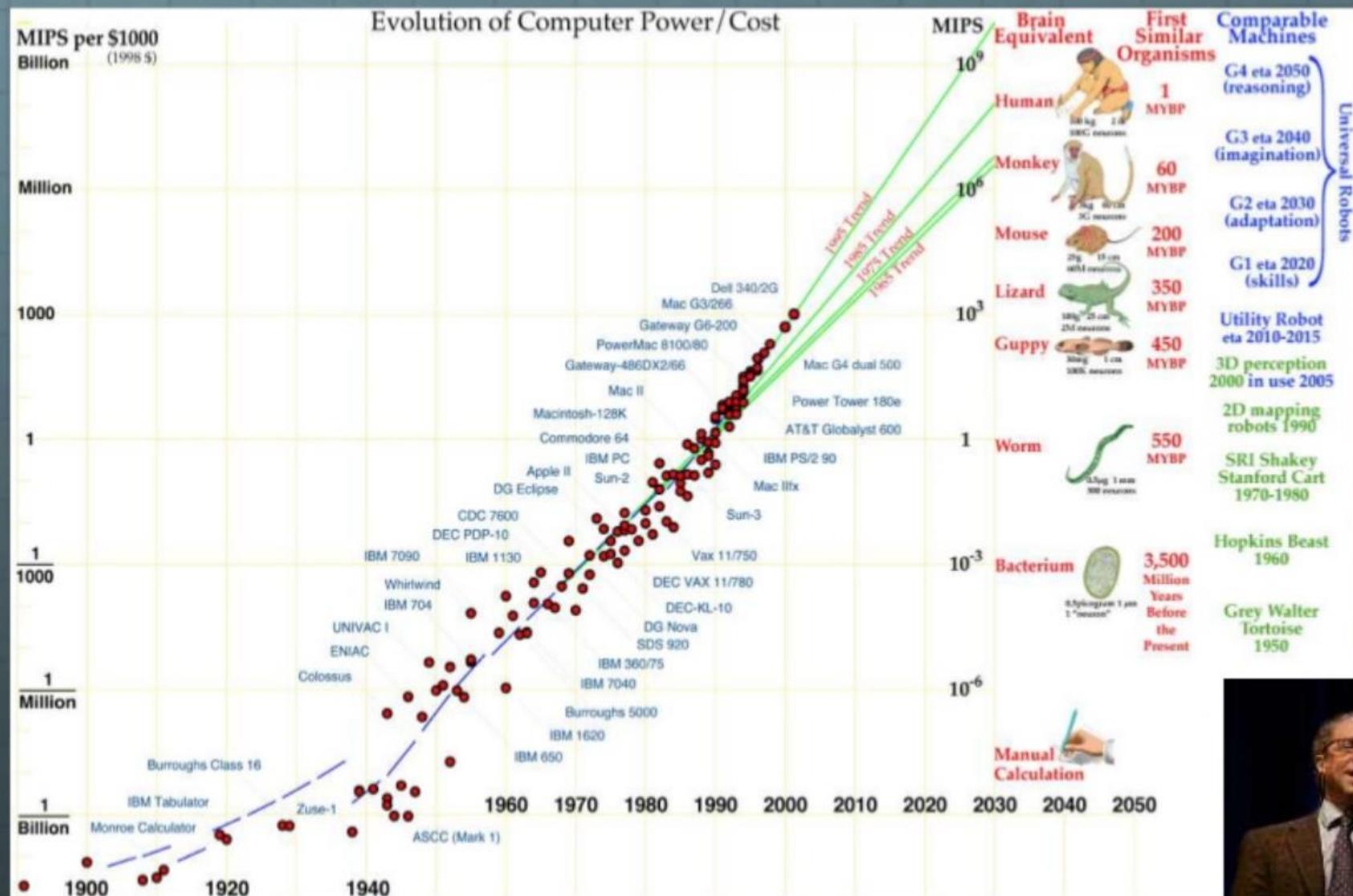
- Remembering things without any effort.
- Making decision without the presence of a person.
- Using intelligence of a person after the death .
- Understanding the activities of animals .
- Allowing the deaf to hear via direct nerve stimulation.

## **Disadvantages:**

- ❑ We become dependent upon the computer .
- ❑ Others may use technical knowledge against us.
- ❑ Another fear is found with respect to human cloning.



# When computers and AI surpass human intellect?



Ray Kurzweil

ΣΚΕΨΟΥ

THINK



\$200

Ken

\$4,000

WATSON

\$600

BRAD

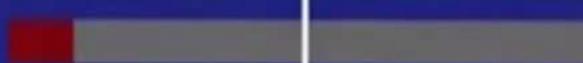
Maxwell's silver hammer

FRANK SINATRA

Brown



96%



11%



7%

IBM

# 23M

Medical researchers make decisions from a repository of over 23 million articles, updated daily.

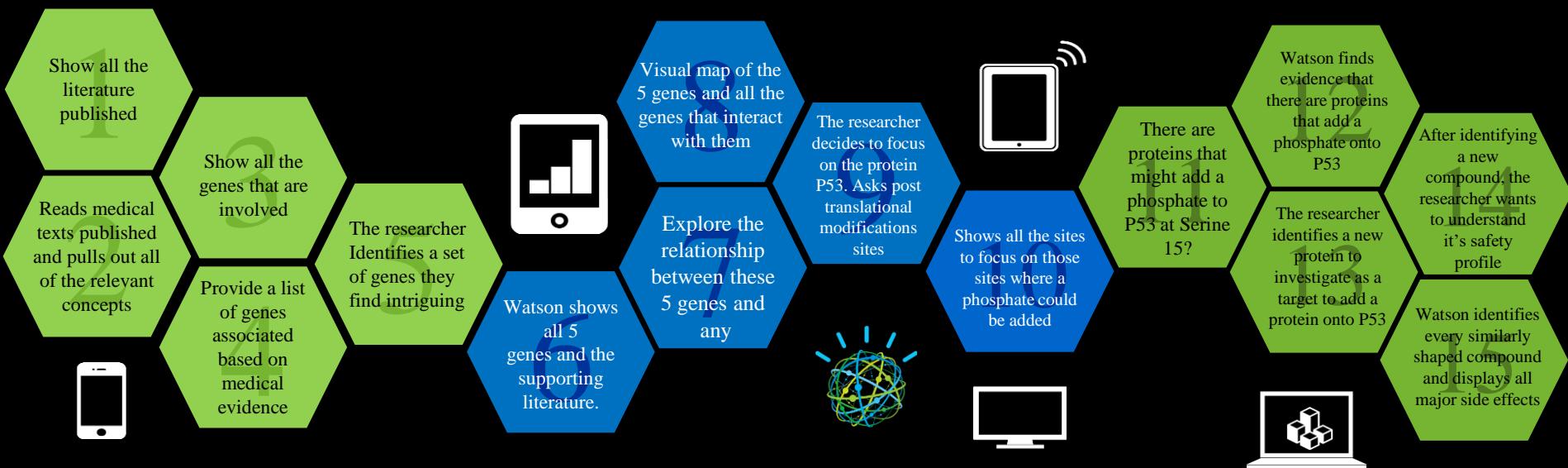
IBM

# Watson: Transforming the Discovery of Breakthrough Treatments

## Gain Awareness

## Increase Understanding

## Clarify and Validate



## Watson Enhancements

Awareness of the Scientific Landscape

Deep Exploration of Domains

Relating Domains

Exploring Relationships

Seeing New Possibilities

Forming New Hypotheses

Validating hypotheses

Assessing Safety



IBM  
Research  
Project  
(2006 – )

Jeopardy!  
Grand  
Challenge  
(Feb 2011)

Watson  
for  
Healthcare  
(Aug 2011 – )

Watson  
for Financial  
Services  
(Mar 2012 – )

Watson  
Ecosysteem  
(2014 – )

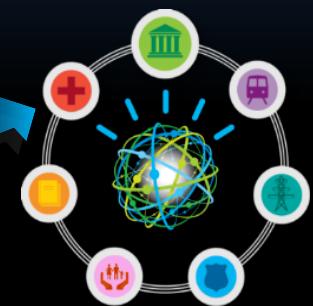


Demonstration

Commercialization



Expansion



Cross-industry  
Applications

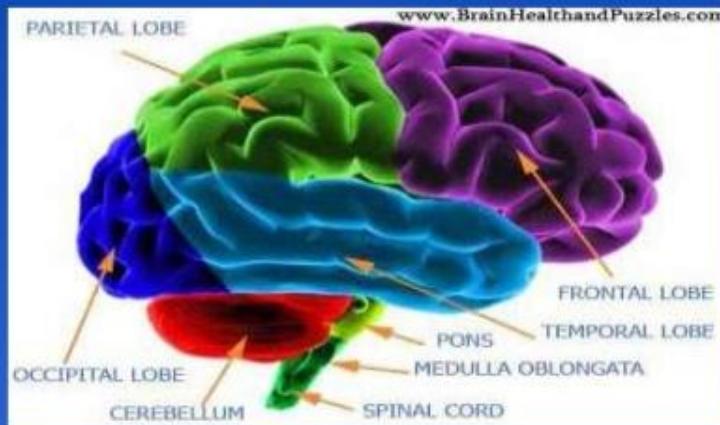
R&D

IBM

# BRAIN SIMULATION

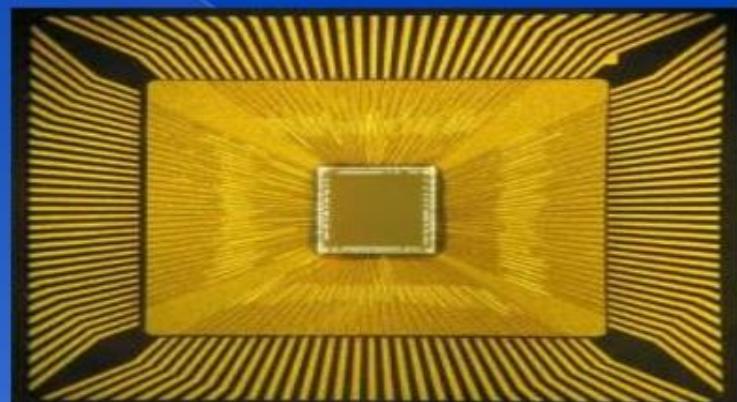
## Natural Brain

- Input
  - By neurons
  - By sensory cells
- Interpretation
- Memory

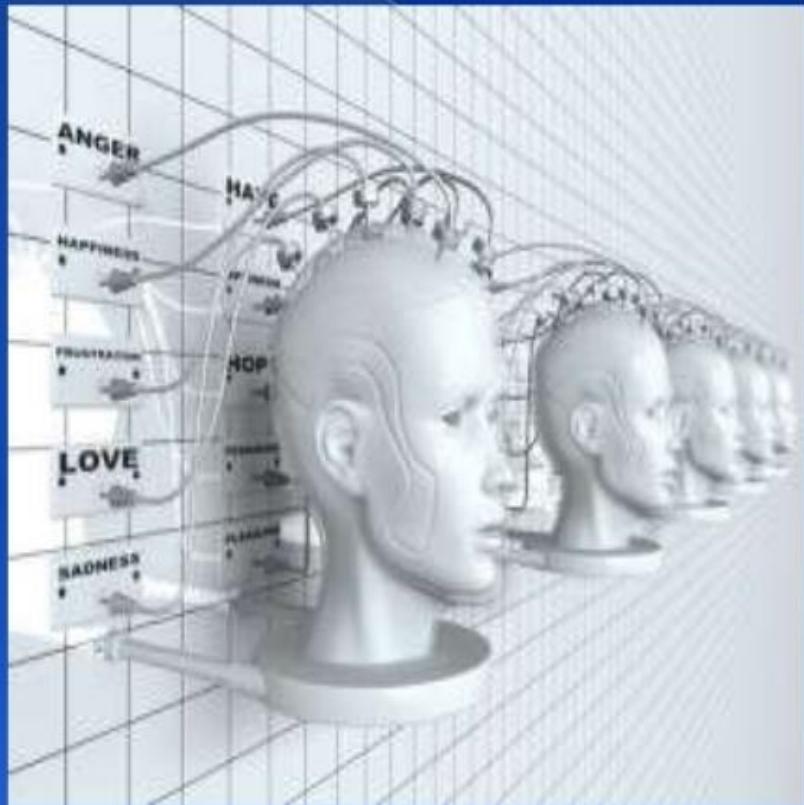


## Virtual Brain

- Input
  - ANN with silicon chip.
  - Electric impulses
- Interpretation
- Memory



# BRAIN SIMULATION



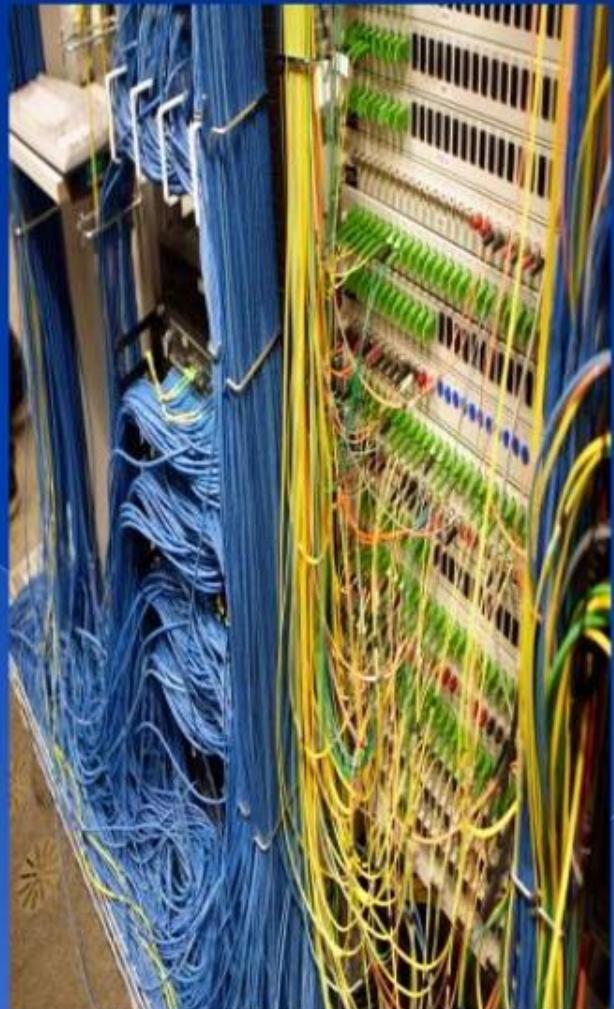
➤ Simulating human brain by reverse engineering & combining biological studies to digital technology using concept of Artificial Neural Network (ANN)

# REQUIREMENTS

The hardware & software required to build a Blue Brain...

- 8,096 CPUs at 700 MHz each of which can map one or two simulated brain neurons
- 256MB to 512MB memory per processor.
- 100 kilowatts power consumption.
- Processor with a very high processing power.
- 22.8 TFLOPS peak processing speed.
- Linux and C++ software.

# REQUIREMENTS



# What is Artificial Brain ?



**Artificial brain** (or **artificial mind**) is a term commonly used in the media to describe research that aims to develop software and hardware with cognitive abilities similar to those of the animal or human brain.

# BLUE BRAIN



# WHAT IS VIRTUAL BRAIN

- A machine that can function as brain .
- It can take decision.
- It can think.
- It can respond.
- It can keep things in memory.



# WHY WE NEED VIRTUAL BRAIN

- To upload contents of the natural brain into it .
- To keep the intelligence , knowledge and skill of any person for ever .
- To remember things without any effort .



# FUNCTIONING OF BRAIN

- Sensory Input :-

Receiving input such as sound ,image, etc through sensory cell .

- Interpretation.

Interpretation of the received input by the brain by defining states of neurons in the brain.

- Motor Output.

Receiving of electric responses from the brain to perform any action .



# BRAIN SIMULATION

NATURAL BRAIN

VS

SIMULATED BRAIN

- INPUT
- Through the natural neurons.
- INTERPRETATION
- By a set of bits in the set of register .
- INPUT
- Through the silicon chip or artificial neurons.
- INTERPRETATION
- By different states of the neurons in the brain.



# BRAIN SIMULATION

## NATURAL BRAIN

- OUTPUT

- Through the natural neurons.

- PROCESSING

- Through arithmetic and logical calculations.

## SIMULATED BRAIN

- OUTPUT

- Through the silicon chip .

- PROCESSING

- Through arithmetic and logical calculation and artificial intelligence .



# BRAIN SIMULATION

## NATURAL BRAIN VS SIMULATED BRAIN

- **MEMORY**
- Through permanent states of neurons .
- **MEMORY**
- Through Secondary memory
- Now there is no question how the virtual brain will work. But the question is how the human brain will be up loaded into it. This is also possible due to the fast growing technology.



# UPLOADING HUMAN BRAIN

- The uploading is possible by the use of small robots known as the **nanobots**.
- These robots are small enough to travel throughout our circulatory system.
- Traveling into the spine and brain, they will be able to monitor the activity and structure of our central nervous system.
- They will be able to provide an interface with computer that is as close as our mind can be while we still reside in our biological form .



# UPLOADING HUMAN BRAIN

- The uploading is possible by the use of small robots known as the **NANOBOTS**.
- These robots are small enough to travel throughout our circulatory system.
- Will monitor activity of brain by traveling into the spine and brain
- They will provide an interface with computer .



# UPLOADING HUMAN BRAIN(CONT....)

- Nanobots could also carefully scan the structure of our brain, providing a complete readout of the connection.
- This information, when entered into a computer, could then continue to function as us.
- Thus the data stored in the entire brain will be uploaded into the computer.



# EXAMPLE OF BLUE BRAIN

- A very good example of utilisation of blue brain is the case "short term memory".
- In some movies we might have noticed that a person might be having short term memories.
- Another situation is that when a person gets older, then he starts forgetting or takes a bit more time to recognise a person.
- For the above reason we need a blue brain. It is a simple chip that can be installed into the human brain for which the short term memory and volatile memory at the old age can be avoided.



# HARDWARE AND SOFTWARE REQUIREMENT

- A Super computer.
- Memory with a very large storing capacity.
- Processor with a very high processing power.
- A very wide network.
- A program to convert the electric impulses from the brain to input signal, which is to be received by the computer and vice versa.
- Very powerful Nanobots to act as the interface between the natural brain and the computer.
- The Blue Brain has some 8,000 processors which map one or two simulated brain neurons to each processor, making the computer a replica of 10,000 neurons.



# BLUE BRAIN PROJECT OBJECTIVES

- The project will search for insights into how human beings think and remember.
- Scientists think that blue brain could also help to cure the Parkinson's disease.
- The brain circuitry is in a complex state of flux, the brain rewiring itself every moment of its existence. If the scientists can crack open the secret of how and why the brain does it, the knowledge could lead to new breed of supercomputers.



# HOW THE BLUE BRAIN PROJECT WILL WORK

- The neocortex is the largest and most complex part of the human brain, and constitutes about 85 per cent of the brain's total mass.
- The neocortex is thought to be responsible for the cognitive functions of language, learning, memory and complex thought.
- The simulated neurons will be interconnected with rules the team has worked out about how the brain functions.
- This result would develop a simulated model known as “Bluebrain”.



# THE "BLUE BRAIN" & HUMAN CONSCIOUSNESS

- "Blue Brain" offer a better understanding of human consciousness.
- It's an actual 'computer brain' that may eventually have the ability to think for itself.
- When it was first fed electrical impulses, strange patterns began to appear with lightning-like flashes produced by 'cells' that the scientists recognized from living human and animal processes. "It happened entirely on its own,"

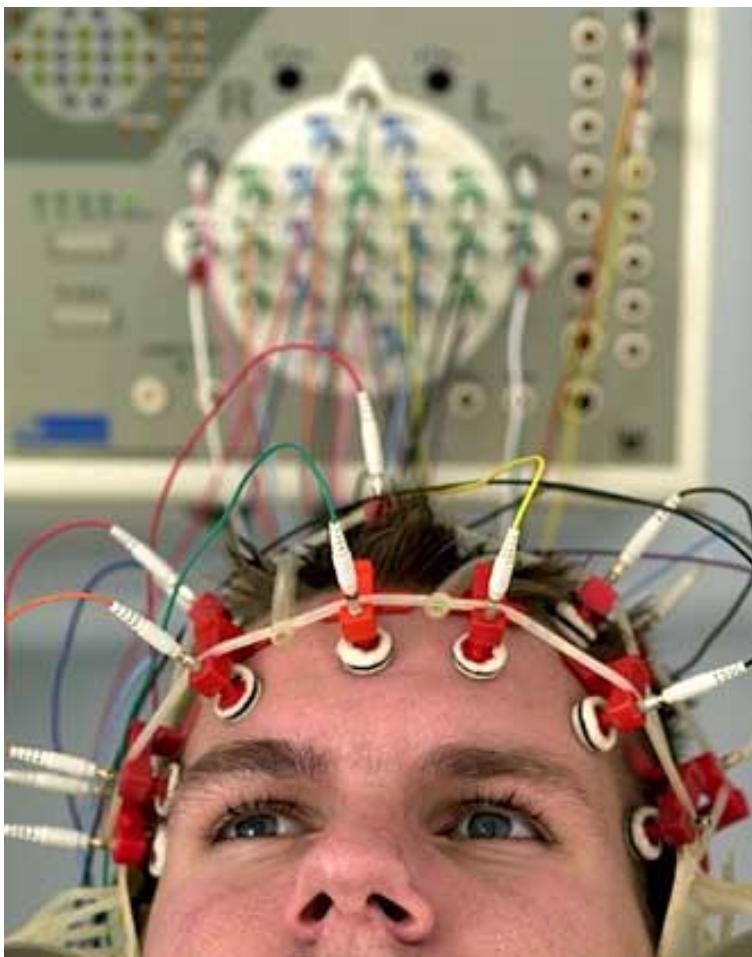


# THE "BLUE BRAIN" & HUMAN CONSCIOUSNESS(CONT..)

- This helped the scientists to understand the actual processing of the brain which arised the concept of “Blue brain”.
- Blue brain acts as a computer that would operate at inconceivable speeds – something fast enough to simulate the human brain.
- A Blue brain aims to unlock the secrets of brain by using the brute power of a supercomputer.



# FLASHES OF ACTIVITY

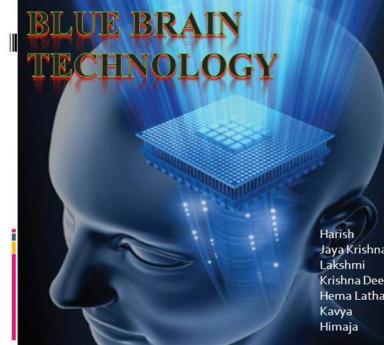


- Blue Brain started producing flashes of activity that scientists recognized from measurements of natural brain behavior -- on its very first day. "It happened entirely on its own".

# **BLUE BRAIN TECHNOLOGY**



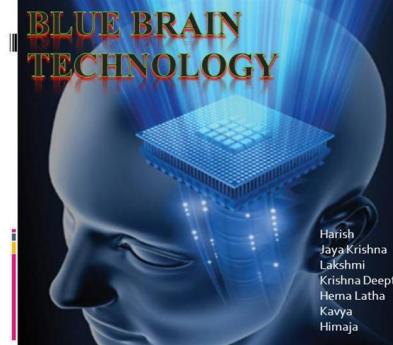
Harish  
Jaya Krishna  
Lakshmi  
Krishna Deepthi  
Hema Latha  
Kavya  
Himaja



Harish  
Jaya Krishna  
Lakshmi  
Krishna Deepthi  
Hema Latha  
Kavya  
Himaja

# BLUE BRAIN POWER

- The human brain has 100 billions,nerve cells that enable us to adapt quickly to an immense array of stimuli.
- Blue brain is a technology that uses “Blue Gene” a supercomputer capable of processing 228 TFLOPS.
- The main aim of blue brain is to build an software replica or template which could reveal many existing aspects of the brain circuits, memory capacity, and how memories are lost.



Harish  
Jaya Krishna  
Lakshmi  
Krishna Deepthi  
Hema Latha  
Kavya  
Himaja

# BLUE BRAIN POWER(CONT...)

- The modeling is also able to work out best way to compensate and repair error circuits .
  
- The blue brain model can be used to detect and test treatment statergies for neurological diseases.



## **ABSTRACT**

- The Blue Brain Project was started and successfully carrying over by IBM (International Business Machines) and the main objective of this project is to create a virtual brain.
- “BLUE BRAIN”- world’s first virtual brain which means a machine that can function as human brain.
- The research involved in the study of slices of living brain tissue using microscopes.
- A full human brain simulation (86 billion neurons) should be possible by 2023 provided sufficient funding is received.
- It is estimated to be completed around 2025A.C.
- It has been used for many applications and mainly to gain better development in the field of medical science.

# INTRODUCTION

- Blue Brain Technology was first framed out in the year of 2002 by Henry Markham. He founded the Brain Mind Institute at EPFL that stands for École polytechnique fédérale de Lausanne and after that in 2005 June,EPFL and IBM agree to launch Blue Brain Project.
- IBM installs Blue Gene-The 8<sup>th</sup> super computer in the world and the project named after this super computer.
- The project is headed by the founding director Henry Markram and co-directed by Felix schurmann and Sean Hill. Using Blue gene supercomputer running Michael Hines's NEURON software, the simulation does not consist simply of an artificial neural network, but involves a biologically realistic model of neuron.
- It is hoped that it will eventually shed light on the nature of consciousness.

# EXPERIMENTS ON BLUE BRAIN

- Scientists rely on computer models to understand the toughest concepts in science.
- A computer model is being designed to take on the human brain.
- A generic template is build which allows us to reconstruct a brain according to any specifications.



# 'BLUE BRAIN': AN ARTIFICIAL BRAIN COMES TO LIFE IN SWITZERLAND

- The machine is beautiful as it wakes up – it means it works in a fine way when started.Nerve cells flicker on the screen , along with that electrical charges are produced.
- This piece of hardware consists of about 10,000 computer chips that act like real nerve cells.
- The simulation was created at the Technical University in Lausanne, Switzerland, where 35 researchers participate in maintaining this artificial brain.



# 'BLUE BRAIN': AN ARTIFICIAL BRAIN COMES TO LIFE IN SWITZERLAND

- It runs on one of the world's most powerful supercomputers.
- The goal is to build a much bigger electronic thinking machine -- one that would ultimately replicate the human brain .
- "Blue Brain," is the most radical attempt so far to investigate the mystery of consciousness.

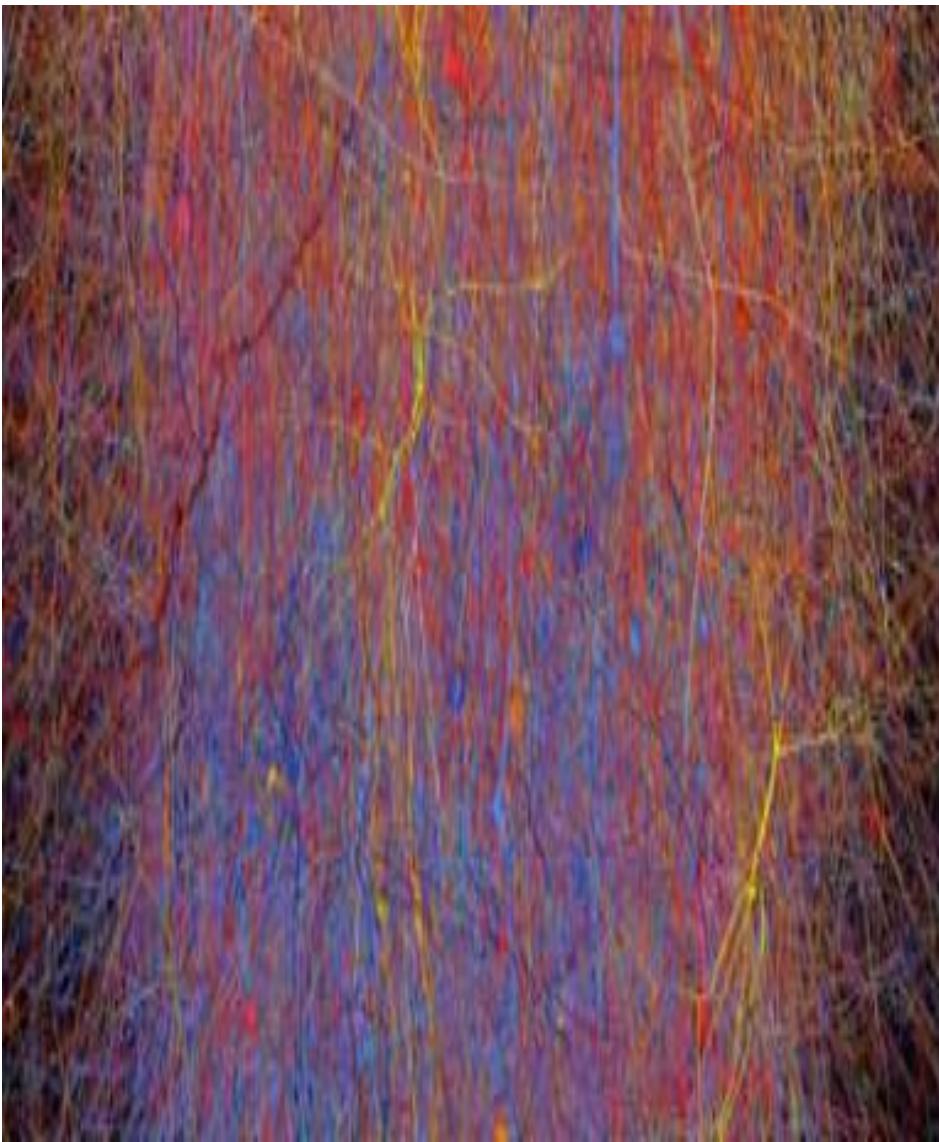


# BLUE BRAIN IN LAUSANNA,SWITZERLAND



- The "Blue Brain" supercomputer in Lausanne, Switzerland.

# BLUE BRAIN MODEL VISUALISATION

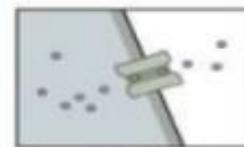


- A visual representation of a mammalian neocortical column.
- The basic building block of the cortex.
- The representation shows the part of the brain which has been modeled using a supercomputer.
- The visualization is part of an ambitious project to create a biologically accurate, functional model of the brain using IBM's Blue Gene supercomputer.

## BUILDING A BRAIN

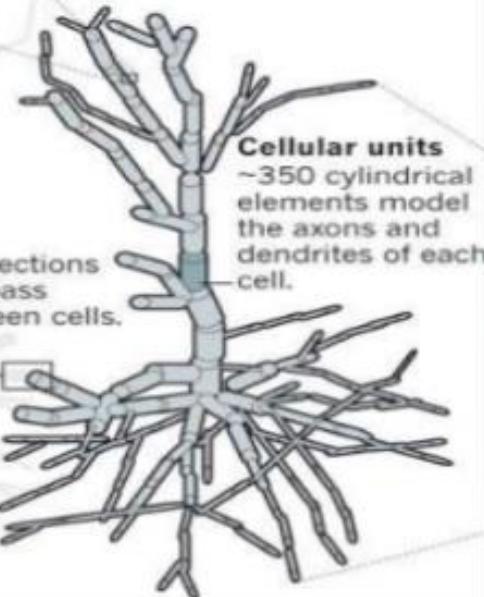
The Blue Brain simulation — a prototype for the Human Brain Project — constructs simulated sections of cortex from the bottom up, starting from detailed models of individual neurons.

### SIMULATED NEURON

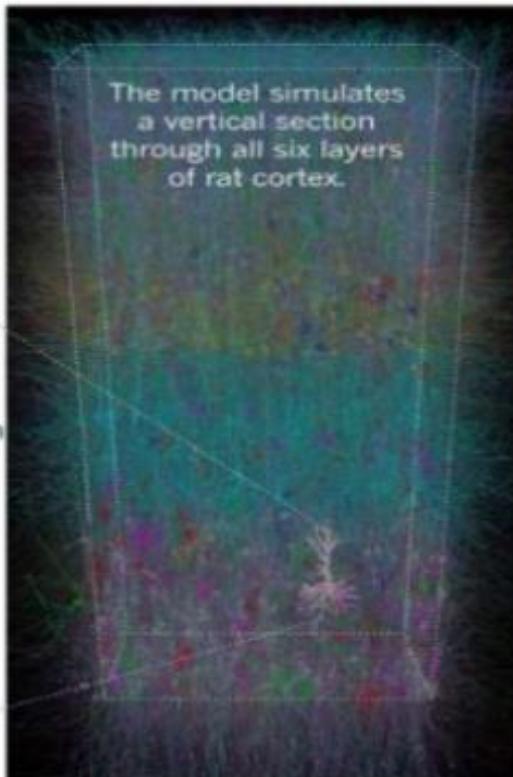


#### Ion channels

In each model neuron, ~7,000 ion channels control membrane traffic.



### NEOCORTICAL COLUMN (10,000 neurons)



# RIDDLE OF CONSCIOUSNESS



- A human brain consists of 100 billion nerve cells. A supercomputer simulating an organ using current technology - would produce a virtual human brain.



# BLUE BRAIN SIMULATION USING MICROPROCESSOR



- The Blue Brain simulation uses one microprocessor for each of the 10,000 neurons in the cortical column of a rat's cerebral cortex.  
It helps to build a brain microcircuit, in order to scale it in human brain.



# BENEFITS OF BLUE BRAIN

- It acts as a supercomputer.
- Improvements in processing, speed and memory could make entire human brain simulated.
- Things could be remembered without any effort.
- Use the intelligence of the person after death.
- It can make decisions entirely of its own.
- Allowing the deaf to hear via direct nerve simulation.



# ADVENTAGES OF BLUE BRAIN

- Blue brain is an approach to store and utilize human intelligence and information present in the mind even after human demise.
- It is an important move towards self -decision making by the computer or machine that holds a Blue brain.
- Business analysis, attending conferences, reporting, etc. are very significant functions that an intelligent machine can do consistently.
- It can be used as an interface between human and animal minds. The BBP has become successful in rat and some other animals which is a sign of success.
- It a good remedy towards human disability like a deaf can get the information via direct nerve stimulation.



# DISADVANTAGES OF BLUE BRAIN

- We become dependent upon the computers.
- Another fear is found with respect to human cloning.
- A very costly procedure of regaining the memory back.



# CONCLUSION

- Will be able to transfer ourselves into the computer at some point.
- Eventually aim of applying terrific computer power to the simulation of an entire brain.
- Very soon this technology will be highly accepted whole over the world.

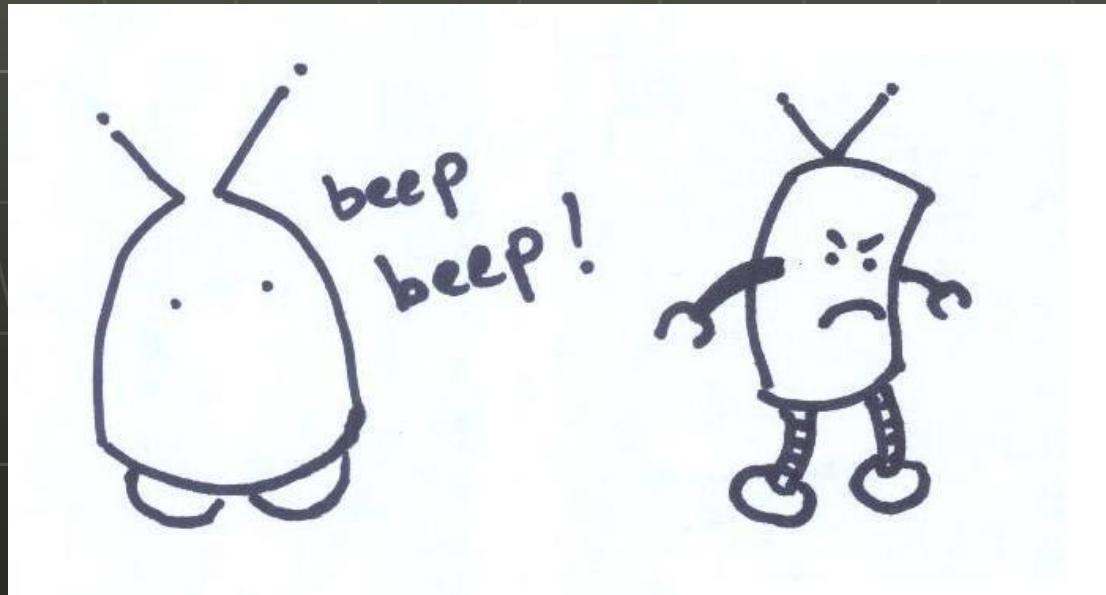


# REFERENCE

- [www.google.com](http://www.google.com)
- [www.wikipedia.com](http://www.wikipedia.com)
- [www.studymafia.org](http://www.studymafia.org)



# Can a machine think?

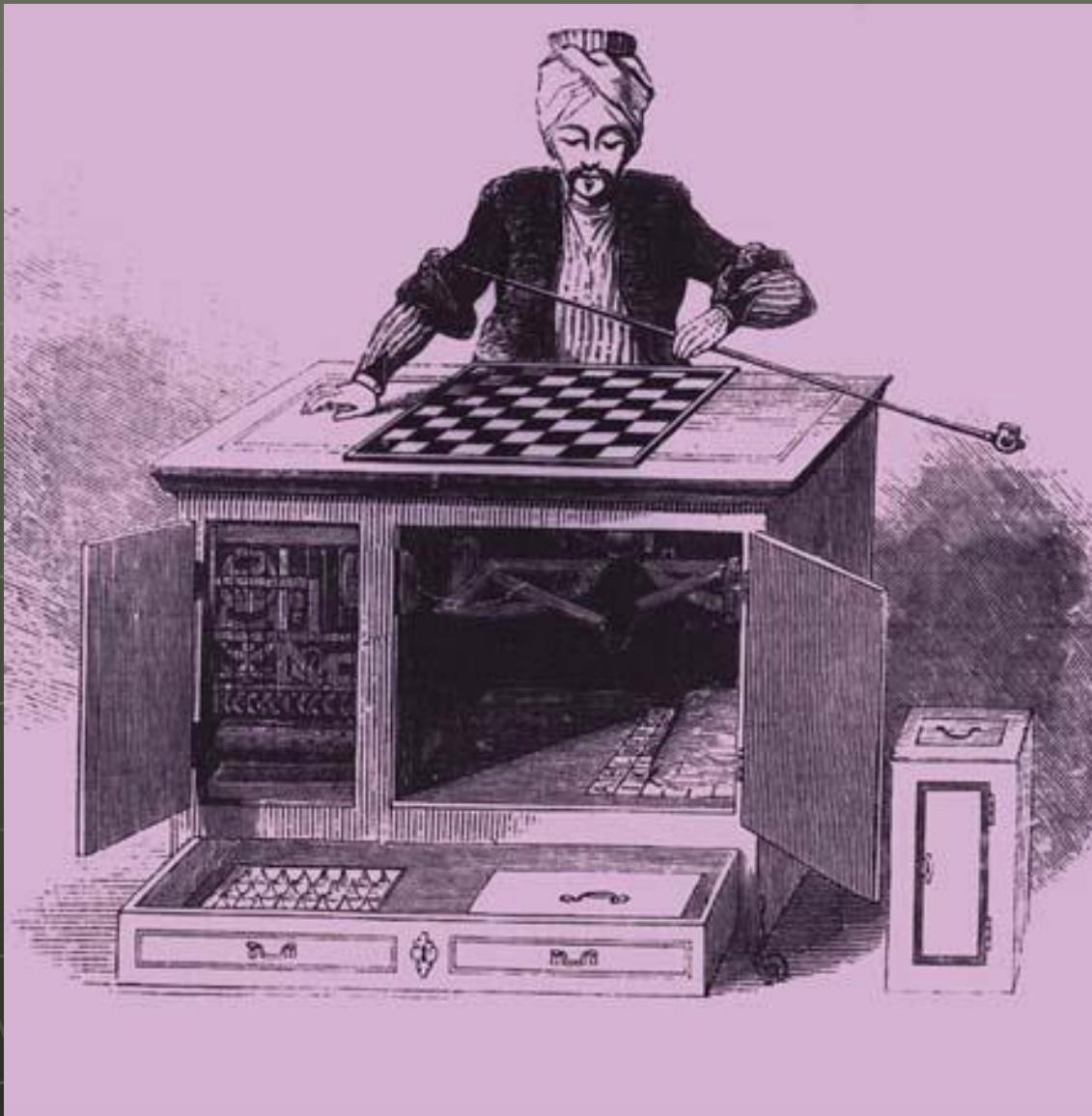


# Descartes

- Argued that human body was a mechanism
- However, no mechanism alone was capable of speech and rational thought
- *Res Cogitans* (thinking stuff) was needed for these uniquely human abilities

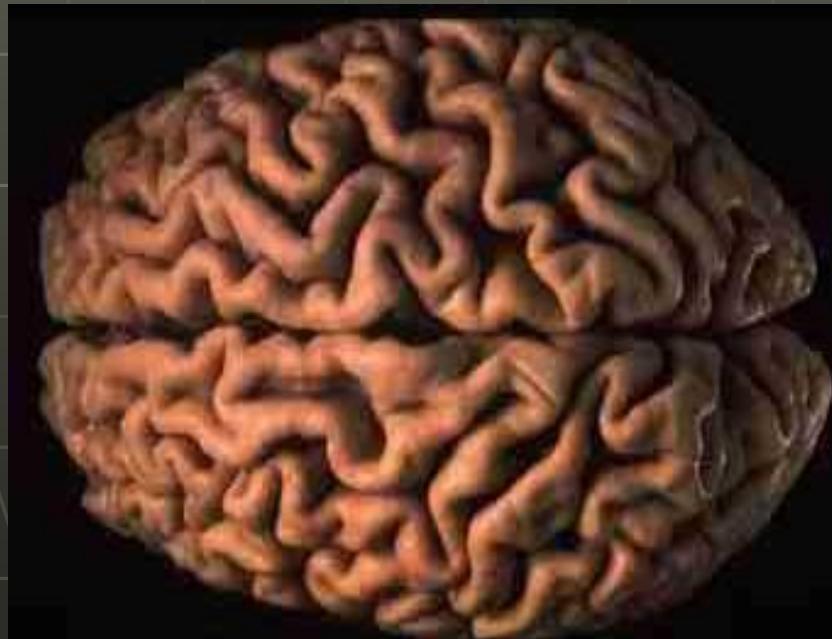


# Chess Playing Machine



# Leibniz

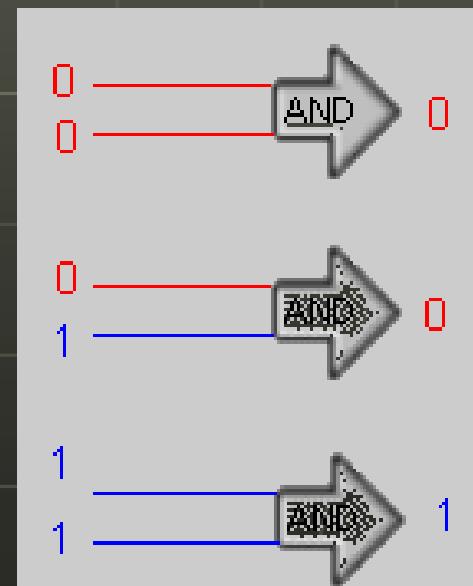
Suppose there was a thinking, perceiving machine, and that we could conceive of it getting larger and large so we could go inside it. Inside we would only find pieces working upon one another and never anything to explain the perception. Wouldn't this apply equally well to the human brain?



# George Boole

- Mathematic could explain function of cogs in a machine
- So, mathematics could possibly explain “laws of thought”
- Therefore, mathematics might explain human mind

Boolean algebra: logical problems can be solved by mechanical manipulation of symbols according to formal rules using only the two values of 0 (false) and 1 (true)

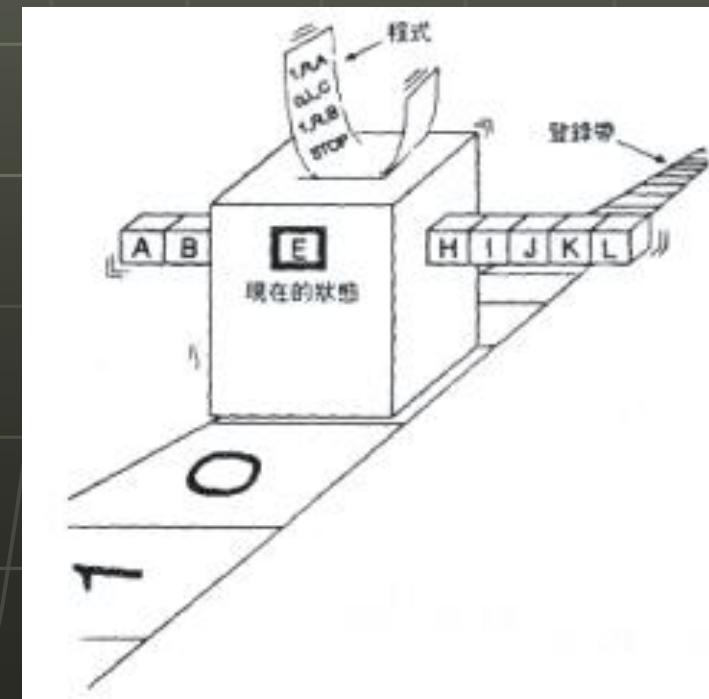


# Turing Machine

A simple machine that could move an indefinitely long tape backward and forward one square and print or erase numbers on it

This could specify the steps needed to solve **any** computable problem.

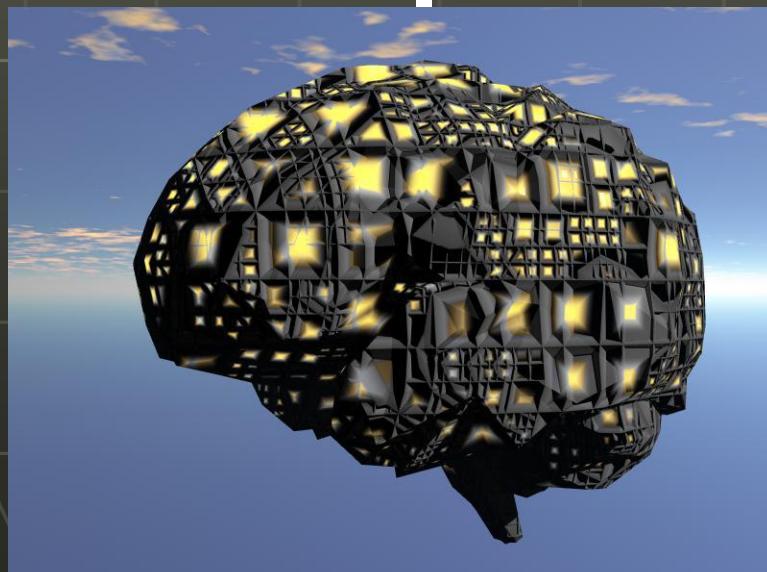
This is the foundation of modern computing.



# Strong AI vs. Weak AI

- A computer running the right program would be intelligent and have a mind just as we do
- Nothing more to having a mind than running the right program
- REAL intelligence

- Computers can simulate mind
- May usefully simulate many mental processes of thinking, deciding, etc.
- Can never create real intelligence; AS-IF intelligence



# Brains vs. Computers

- Both digital and analog
  - Digital – neuron fires or not
  - Analog – rate of firing continuous variable
- Parallel machine simulating serial machine (Dennett's Joycean Machine)
  - No central processing unit; many different units working
  - Outputs (speaking, writing) are serial
- Non-computable
  - Consciousness can not be described explicitly
- Deterministic and non-deterministic
  - Do not always produce same output to same input
  - Underlying molecular processes deterministic

- Digital
  - Works in discrete states
- Serial
  - Single central processing unit
- Computable
  - Procedure that is described explicitly
- Deterministic
  - Produces same output for same input
  - Same internal state

# Emergent Minds

- Basically a useful and apparently intelligent behavior has emerged from an extremely simple system.
  - Ex: Wall Following Robot
- Could consciousness be an emergent property as Humphrey (1987) and Searle (1997) claimed it was?

# Garry Kasparov vs. Deep Blue



# **Chapter 14**

**Could a machine be  
conscious?**

**[Artificial Consciousness]**

**Consciousness is hard to  
define,  
and there's no real objective  
test for it  
because consciousness is  
subjective.**

# What is the difference between pretending to be conscious and actually being conscious?



Art by Ed STASTNY - edesito.org

"If a robot told you its life story, looked hurt when you offended it and laughed at your funny stories, would you think it was conscious? How could you tell?"

# Souls, Spirits, and Separate Minds

- Religious: Consciousness is the unique capacity of the human soul that is given by God to us alone. God would not give a soul to a human-made machine, so machines can never be conscious.
- Non-religious: Consciousness is the property of the non-physical mind, which is separate from the physical brain. No machine could be conscious unless it were given a separate non-physical mind and this is impossible so machines can never be conscious.

Objections:

- If one day you conversed with a truly remarkable machine, we conclude:
1. The machine is a zombie (with all the familiar problems that entails)
  2. God saw fit to give this wonderful machine a soul or, the machine had attracted or created a separate mind
  3. We were wrong, and a machine can be conscious.

# The Importance of Biology

- Only living, biological creatures can be conscious; therefore a machine, which is manufactured and non-biological, cannot be

## Objections:

- Possibly, we can create robots with the same protein structures/neurons
- We can give robots a long learning period in a real environment, like humans, in order to give them the best learning



# Machines will Never do X

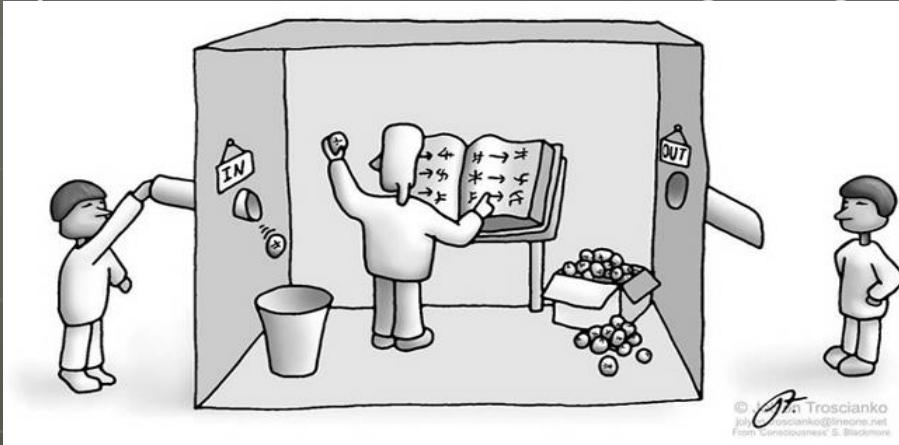
- There are some things that no machine can possibly do because those things require the power of consciousness.

## Objections:

- Evolutionary algorithm
  1. Take a segment of computer code or program
  2. Copy it with variations
  3. Select from the variants according to specified outcome
  4. Take selected variant and repeat process
- Biological creativity, human creativity, and machine creativity would all be examples of the same evolutionary process in operation and none would be more real than others

# The Chinese Room

Most powerful advocate for Turing's argument.



- Searle says that whatever purely formal principles you put into a computer, they will not be sufficient for real understanding just like whatever rules he uses to translate Chinese will not be sufficient for him to understand Chinese.
- He concludes that you cannot get **semantics** (meaning) from **syntax** (rules for symbol manipulation).
- Any meaning or reference that the computer program has is in the eye of the user, not in the computer or its program. SO STRONG AI IS FALSE.
- Objection: this would be that Searle is asking us to imagine something that is not possible.
- There is no final consensus on what, if anything the Chinese Room experiment shows.

# Non-Computability to Quantum Consciousness

There are some things that machines cannot do, so if we humans can do even one of these things then that proves we cannot be mere machines, and we must have something extra  
→ consciousness

**It seems none of these  
arguments proves once and  
for all the impossibility of a  
conscious machine.**

# Chapter 15

## How to Build a Conscious Machine

Humans seem to adopt intentional stance toward others on the flimsiest of pretexts



Tactic of attributing mental states to other systems best way to understand and interact with them



Recently, people have been upset by Sony taking away support for their robot dogs.

# McGinn and his Mysterian Theory

The human intellect is incapable of understanding how organic brains become conscious, so there is no hope of us ever finding consciousness or knowing whether a machine has it or not.

## Chalmers and Global Workspace Theories (GWTs)

“not just that implementing the right computation suffices for consciousness, but that implementing the right computation suffices for rich conscious experience like our own”

~Chalmers

The GW is a large network of interconnected neurons, and its contents are conscious by virtue of the fact that they are made globally available to the rest of the system, which is unconscious. X is global availability.

# Could machines become “deluded” that they are conscious?

- Luc Steels has built robots that can make sounds, detect each other's sounds, and imitate them. They can also track each other's gaze while looking at different things.
- Through imitating each other, robots come to agree on sounds that refer to things they see. Spontaneous emergence of vowel sounds, syntactic structures, and grammar have been observed
- Could robots invent self-referential words (ie. I, me, mine)? If so, could machines delude themselves into thinking they, themselves, are conscious?
- If machines are capable of language, their ability to imitate could spawn a new machine “culture”. Could they possibly evolve a separate culture from us humans? Could they then actually be conscious?

# Brain Scanning

- Someday, possibly, we can increase the speed and accuracy of the scanning processes already available, copy the relevant aspects of a brain's organization into a computer, and live on in brain copies of ourselves.
- Will resultant creature be conscious? Will it be the same consciousness as before? Could this make someone immortal?
- "...initial downloads will be somewhat imprecise...As our understanding of the mechanisms of the brain improves and our ability to accurately and noninvasively scan these features improves, reinstating (reinstalling) a person's brain should alter a person's mind no more than it changes from day to day"

~Kurzweil



# Morphed into Machines

- Imagine permanent, fast access to the Internet as a part of you with implanted electrodes. Would there be a global consciousness if we were all connected? Today we are already almost permanently hooked to the Internet with multiple mobile devices
- Imagine replacing parts of our bodies with organic tissue grown especially outside the body. Today, people have hip replacements, artificial skin, heart pacemakers, and cochlear implants regularly.
- Imagine, controlling machines and doing work merely with your mind. Today, severely disabled people (and monkeys) can already control external devices merely by thinking
- Imagine a memory chip to improve memory, and implanted mobile phone for instant quick communication. Today, many people already are dependent on their hard drive of a computer and would utterly distraught if it was destroyed.

# Could the World Wide Web be a form of Consciousness?

- Chatrooms on the webs have bots (ie. Smarterchild)
- Virtual warriors on games such as World of Warcraft acquire personalities
- Web crawlers go around the web collecting information for Google

They are all autonomous and go where they like. All depend on physical substrates for existence, but none has a permanent physical home.

# Are only humans conscious?



Are animals?

Can even non-living things be conscious?

**Someday,  
when machines  
claim they are conscious,  
Will we believe them?**





## CES 2019: AI robot Sophia goes deep at Q&A

<https://www.youtube.com/watch?v=T4q0WS0gxRY>