Artificial Intelligence …an overview

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The Dartmouth Conference and the Name Artificial Intelligence

J. McCarthy, M. L. Minsky, N. Rochester, and C.E. Shannon. August 31, 1955. "We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it."

What is AI?

- Various definitions:
  - The automation of activities that we can associate with human thinking such as decision making, problem solving, learning…
  - A field of study that seeks to explain and emulate intelligent behaviour in terms of computational processes.
  - The study of the computations that make it possible to perceive, reason and act.
  - Getting computers to do tasks which require human intelligence.

Historical Attempts - Frankenstein

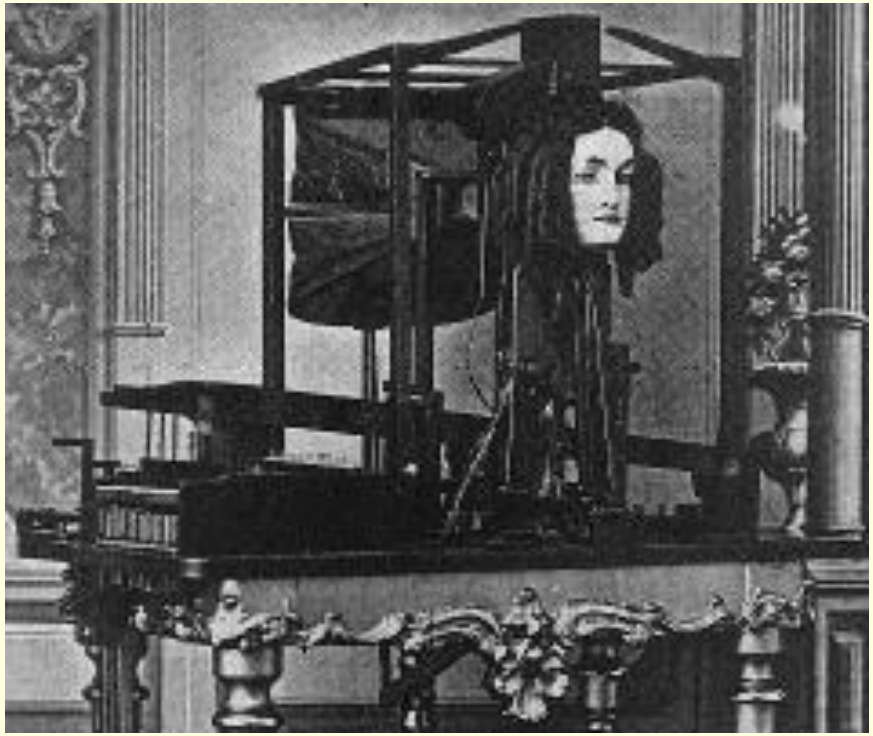
The original story, published by Mary Shelley, in 1818, describes the attempt of a true scientist, Victor Frankenstein, to create life.

Frankenstein creates the fiend - illustration by Bernie Wrightson (© 1977)

Historical Attempts - Euphonia

Joseph Faber's Amazing Talking Machine (1830-40's). The Euphonia and other early talking devices are described in detail in a paper by David Lindsay called "Talking Head", *Invention & Technology*, Summer 1997, 57-63.

About this device, Lindsay writes:
It is "... a speech synthesizer variously known as the Euphonia and the Amazing Talking Machine. By pumping air with the bellows ... and manipulating a series of plates, chambers, and other apparatus (including an artificial tongue ...), the operator could make it speak any European language. A German immigrant named Joseph Faber spent seventeen years perfecting the Euphonia, only to find when he was finished that few people cared."



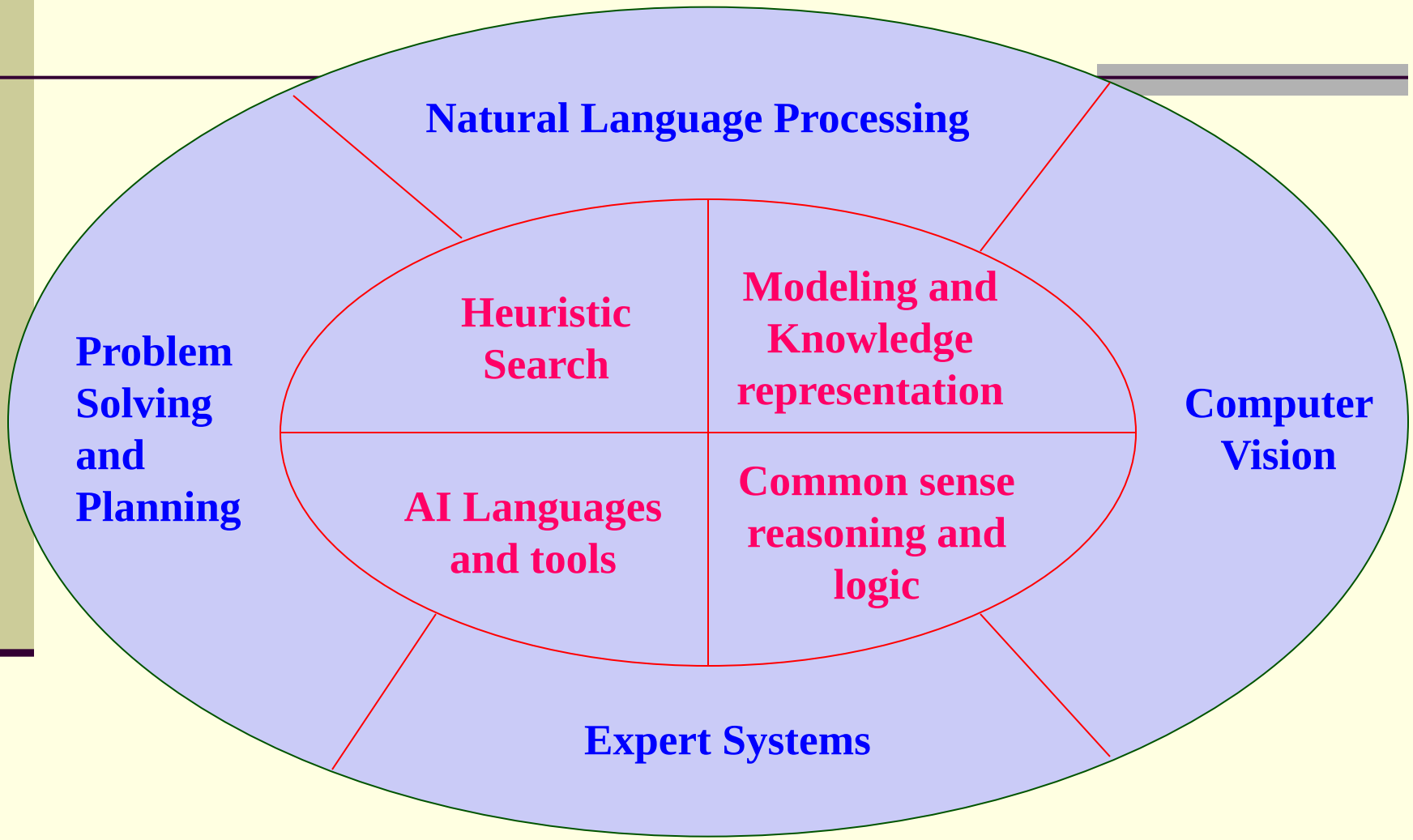
What is Intelligence?

- Simple things turn out to be the hardest to automate:
  - Recognising a face.
  - Navigating a busy street.
  - Understanding what someone says.
- All tasks require reasoning on knowledge.

Why do AI?

- Two main goals of AI:
  - To understand human intelligence better. We test theories of human intelligence by writing programs which emulate it.
  - To create useful “smart” programs able to do tasks that would normally require a human expert.

Scope of AI


Natural Language Processing
Problem Solving and Planning
Heuristic Search
Modeling and Knowledge representation
AI Languages and tools
Common sense reasoning and logic
Computer Vision
Expert Systems

Topics in AI

- Knowledge representation:
  - How do we represent knowledge about the world in a formal manner that can be manipulated in a sound and efficient manner?
- Search:
  - How can an AI system go through all the possibilities in a systematic manner when looking for solutions to complex problems.

Topics in AI

- Natural Language:
  - How can a system communicate in a natural language such as English.
- Machine learning and neural networks:
  - How can a system learn from experience, or from past case data.
- Agents:
  - How can we develop and use practical “intelligent agents”.
- Knowledge Engineering:
  - How do we elicit the human expertise required to build intelligent applications.

Disciplines involved in AI…

- Many disciplines contribute to goal of creating/modelling intelligent entities:
  - Computer Science
  - Psychology (human reasoning)
  - Philosophy (nature of belief, rationality, etc)
  - Linguistics (structure and meaning of language)
  - Human Biology (how brain works)
- Subject draws on ideas from each discipline.

Typical AI Problems

- Intelligent entities (or “agents”) need to be able to do both “mundane” and “expert” tasks:
- Mundane tasks - consider going shopping:
  - *Planning* a route, and sequence of shops to visit!
  - *Recognising* (through *vision*) buses, people.
  - Communicating (through *natural language*).
  - *Navigating* round obstacles on the street, and *manipulating* objects for purchase.
- Expert tasks are things like:
  - medical diagnosis.
  - equipment repair.
- Often “mundane” tasks are the hardest.

Philosophical Issues

- What is intelligence?
- Can a machine be truly “intelligent”? Is there more to human intelligence than rules, data and calculations?

Tests:

- Turing Test: Can someone tell which is the machine, when communicating to human and to a machine in another room? If not, can we call the machine intelligent?
- Chinese room argument : Searle describes a thought experiment where communication is in Chinese by looking up what to say from huge rule book.

How Will We Recognize AI?

1950 Alan Turing's paper, *Computing Machinery and Intelligence*, described what is now called "The Turing Test". *http://www.abelard.org/turpap/turpap.htm*

1990 Loebner Prize established. Grand Prize of $100,000 and a Gold Medal for the first computer whose responses are indistinguishable from a human.

The Origins of AI Hype

1950 Turing predicted that in about fifty years "an average interrogator will not have more than a 70 percent chance of making the right identification after five minutes of questioning".

1957 Newell and Simon predicted that "Within ten years a computer will be the world's chess champion, unless the rules bar it from competition."

Was Turing Right?

A conversation with Jabberwacky, 2003

Jabberwacky: Have you been to the Moon?
User: No. Few have. Have you?
Jabberwacky: Many a time my dear chap!
User: What was the most interesting thing you saw?
Jabberwacky: Fred.
User: Why did you find him interesting?
Jabberwacky: It just came into my head.
User: What sorts of things do you generally find interesting?
Jabberwacky: Nothing but smelly socks.

Were Newell and Simon Right?

- 1950 — Claude Shannon published a paper describing how a computer could play chess.
- 1957 — Newell and Simon predicted that a computer will beat a human at chess within 10 years.
- 1967 — MacHack was good enough to achieve a class-C rating in tournament chess.

Why Did They Get it Wrong?

They failed to understand at least three key things:

- The need for knowledge (lots of it)
- Scalability and the problem of complexity and exponential growth
- The need to perceive the world

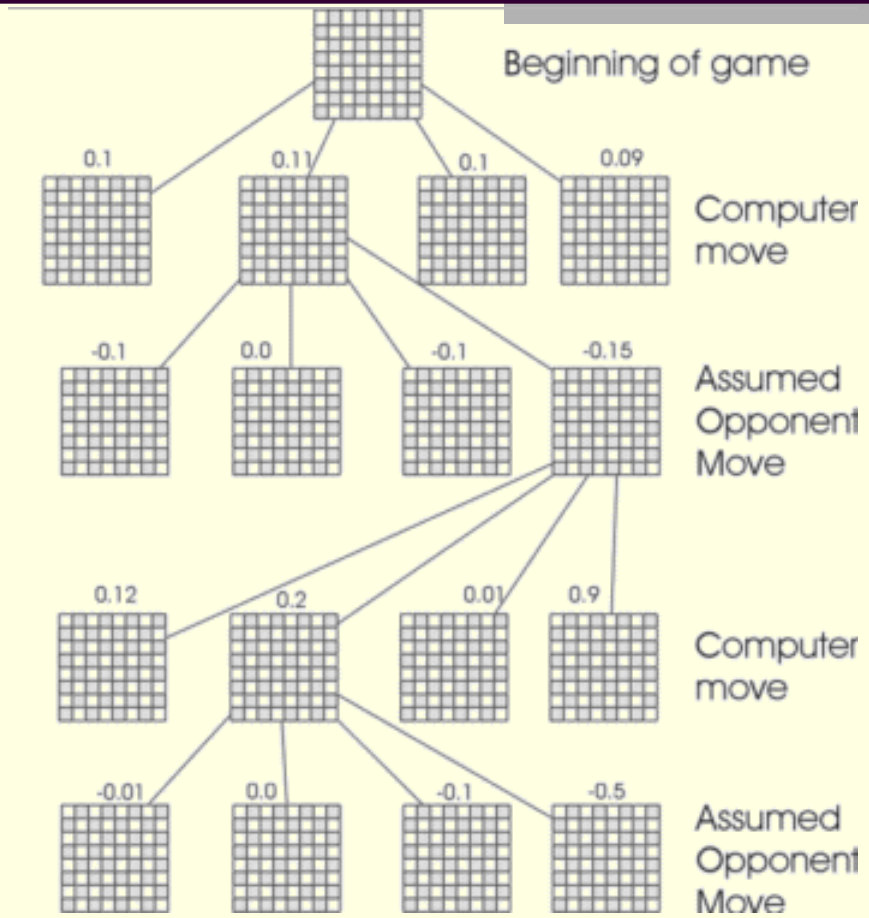
But Chess is Easy

- The rules are simple enough to fit on one page
- The branching factor is only 35.

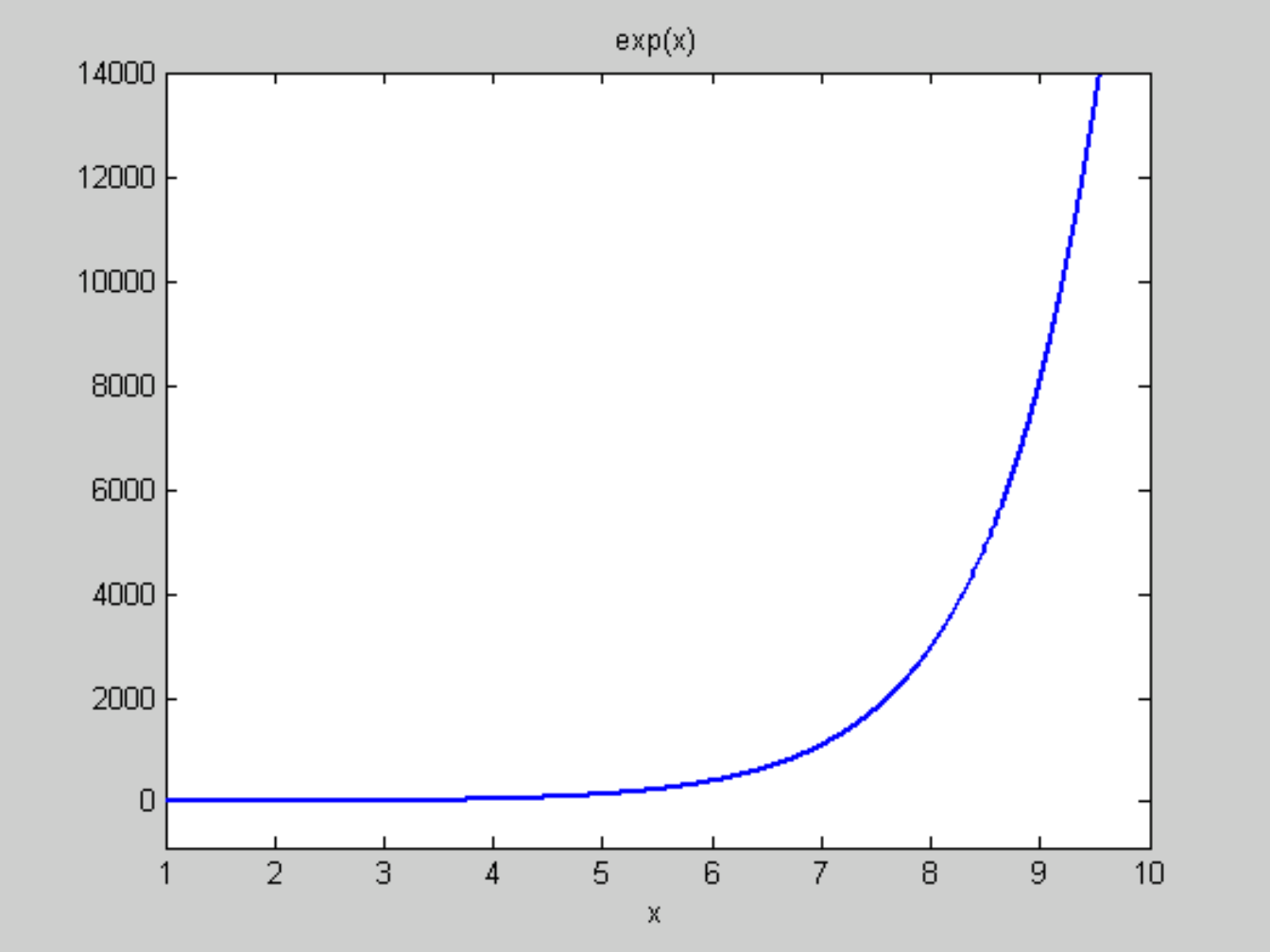
Scalability

Solving hard problems requires search in a large space.

To play master-level chess requires searching about 8 ply deep. So about 35^8 or $2 \cdot 10^{12}$ nodes must be examined.



Exponential Growth



Game begins from an initial state and ends in a position that, using a simple criterion, can be declared as a WIN/LOSS for one player or a DRAW.

Game Tree –

An explicit representation of all possible ways of the game from a given board position

Game Playing

-an intellectual activity

Our attempt

- to increase intellectual ability of computers

Game Playing

Two Person Perfect Information Games

- **Chess**
- **Checkers**
- **Tic-tac-toe**

etc….

No chance factor – dice throwing games.

1977 : Levy defeated chess 4.5
of North-Western University(NWU)

1977 : Levy beat KAISA
(A Russian program)

1978 : Six match game proposed between
Levy and chess 4.7(NWU)

1st game	:	Drawn
2nd & 3rd game	:	Levy Won
4th game	:	Computer won
5th game	:	Levy Won

1985 : Levy defeated CRAY BLITZ in four …….straight games

1985 : Levy's secret – He used to play unorthodox moves that confused the program

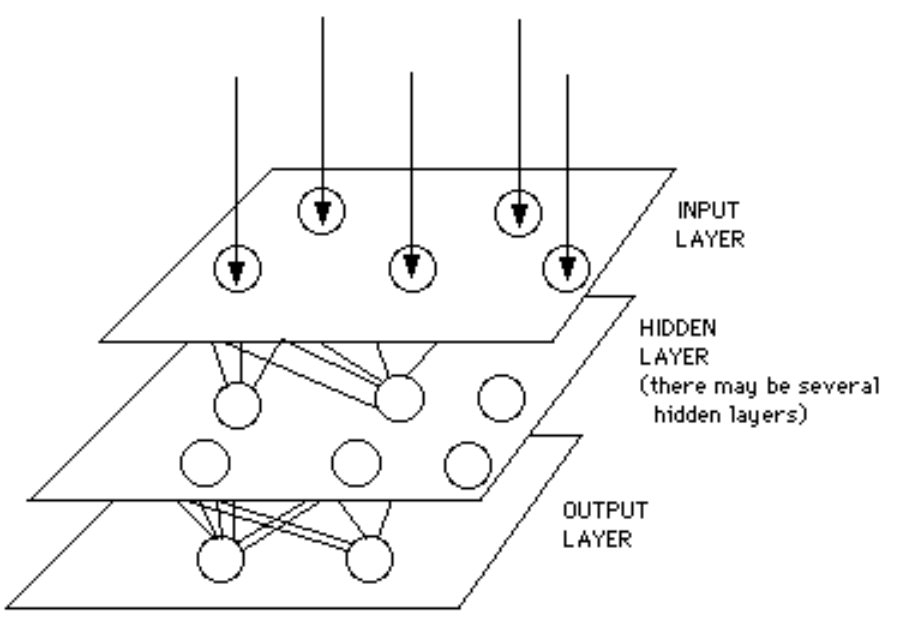
1989 : Levy was defeated by DEEP THOUGHT of CMU, but Kasparov beat the program

Chess Today

In 1997, Deep Blue beat Gary Kasparov.

Symbolic vs. Subsymbolic AI

Subsymbolic AI: Model intelligence at a level similar to the neuron. Let such things as knowledge and planning emerge.



Symbolic AI: Model such things as knowledge and planning in data structures that make sense to the programmers that build them.

```
(blueberry (isa fruit)
           (shape round)
           (color purple)
           (size .4 inch))
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Expert Systems

Late 70's realization

"To make a program Intelligent,

provide it with lots of

High Quality Specific Knowledge

about some problem area."

Expert Systems

- An Expert System is a software that manipulates encoded knowledge to solve problems in a specialized domain that usually require human expertise.
- An Expert System's knowledge is obtained from expert sources and is coded in a form suitable for the system to use in its inference or reasoning processes.

The Rise of Expert Systems

1967 Dendral – a rule-based system that inferred molecular structure from mass spectral and NMR data

1975 Mycin – a rule-based system to recommend antibiotic therapy

1975 Meta-Dendral learned new rules of mass spectrometry, the first discoveries by a computer to appear in a refereed scientific journal

1979 EMycin – the first expert system shell

1980's The Age of Expert Systems

An obvious question :-

Why develop Expert Systems

rather than rely on

Human Expertise ?

Advantages:

Human Expertise	Artificial Expertise
1. Perishable	1. Permanent
2. Difficult to transfer	2. Easy to transfer
3. Difficult to document	3. Easy to document
4. Unpredictable	4. Consistent
5. Expensive	5. Affordable

Next obvious question :-

If artificial expertise is so much better than Human Expertise, why not eliminate Human Experts, replacing them with Artificial Experts?

Disadvantages:

Human Expertise	Artificial Expertise
1. Creative	1. Uninspired
2. Adaptive	2. Needs to be told
3. Sensory experience	3. Symbolic input
4. Broad focus	4. Narrow focus
5. Common sense knowledge	5. Technical knowledge

Presently AI has turned its focus towards Soft Computing tools such as

- Artificial Neural Networks
- Fuzzy Logic
- Genetic Algorithms
- Ant-Colony Optimization

etc….

Thank You