NPTEL

National Programme on Technology Enhanced Learning

Artificial Intelligence
Introduction
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The Syllabus

Introduction: Overview and Historical Perspective, Turing test, Physical Symbol Systems and the scope of Symbolic AI, Agents.

State Space Search: Depth First Search, Breadth First Search, DFID.

Heuristic Search: Best First Search, Hill Climbing, Beam Search, Tabu Search.

Randomized Search: Simulated Annealing, Genetic Algorithms, Ant Colony Optimization.

Finding Optimal Paths: Branch and Bound, A*, IDA*, Divide and Conquer approaches, Beam Stack Search:

Problem Decomposition: Goal Trees, AO*, Rule Based Systems, Rete Net.

Game Playing: Minimax Algorithm, AlphaBeta Algorithm, SSS*.

Planning and Constraint Satisfaction: Domains, Forward and Backward Search, Goal Stack Planning, Plan Space Planning, Constraint Propagation.

Logic and Inferences: Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward chaining.

Text Book and References

<u>Text Book</u>

Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013.

<u>Reference Books</u>

Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, Morgan Kaufmann, 2011.

John Haugeland, Artificial Intelligence: The Very Idea, A Bradford Book, The MIT Press, 1985.

Pamela McCorduck, Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence, A K Peters/CRC Press; 2 edition, 2004.

Zbigniew Michalewicz and David B. Fogel. How to Solve It: Modern Heuristics. Springer; 2nd edition, 2004.

Judea Pearl. Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison-Wesley, 1984.

Elaine Rich and Kevin Knight. Artificial Intelligence, Tata McGraw Hill, 1991.

Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009.

Patrick Henry Winston. Artificial Intelligence, Addison-Wesley, 1992.

History and Philosophy of AI

The two books mentioned below give an insightful and entertaining account of the history and philosophy of AI.

"AI: The Very Idea"
by John Haugeland
http://philosophy.uchicago.edu/faculty/haugeland.html

"Machines Who Think"
by Pamela McCorduck
http://www.pamelamc.com/html/machines_who_think.html

Some definitions

We call programs intelligent if they exhibit behaviors that would be regarded intelligent if they were exhibited by human beings.

– Herbert Simon

Physicists ask what kind of place this universe is and seek to characterize its behavior systematically. Biologists ask what it means for a physical system to be living. We in AI wonder what kind of information-processing system can ask such questions. – Avron Barr and Edward Feigenbaum

AI is the study of techniques for solving exponentially hard problems in polynomial time by exploiting knowledge about the problem domain.

– Elaine Rich

AI is the study of mental faculties through the use of computational models.

– Eugene Charniak and Drew McDermott

David Levy
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Machines with Minds of their Own

"The fundamental goal of Artificial Intelligence research is not merely to mimic intelligence or produce some clever fake.

Not at all.

"AI" wants the genuine article: machines with minds, in the full and literal sense.

This is not science fiction, but real science, based on a theoretical conception as deep as it is daring: namely, we are at root, computers ourselves.

That idea – the idea that thinking and computing are radically the same – is the idea of this book."

John Haugeland in "AI: The Very Idea"

Some fundamental questions

What is intelligence?

What is thinking?

What is a machine?

Is the computer a machine?

Here on when we say machine we will mean a programmable computer system

Can a machine think ?

If yes are we machines?!

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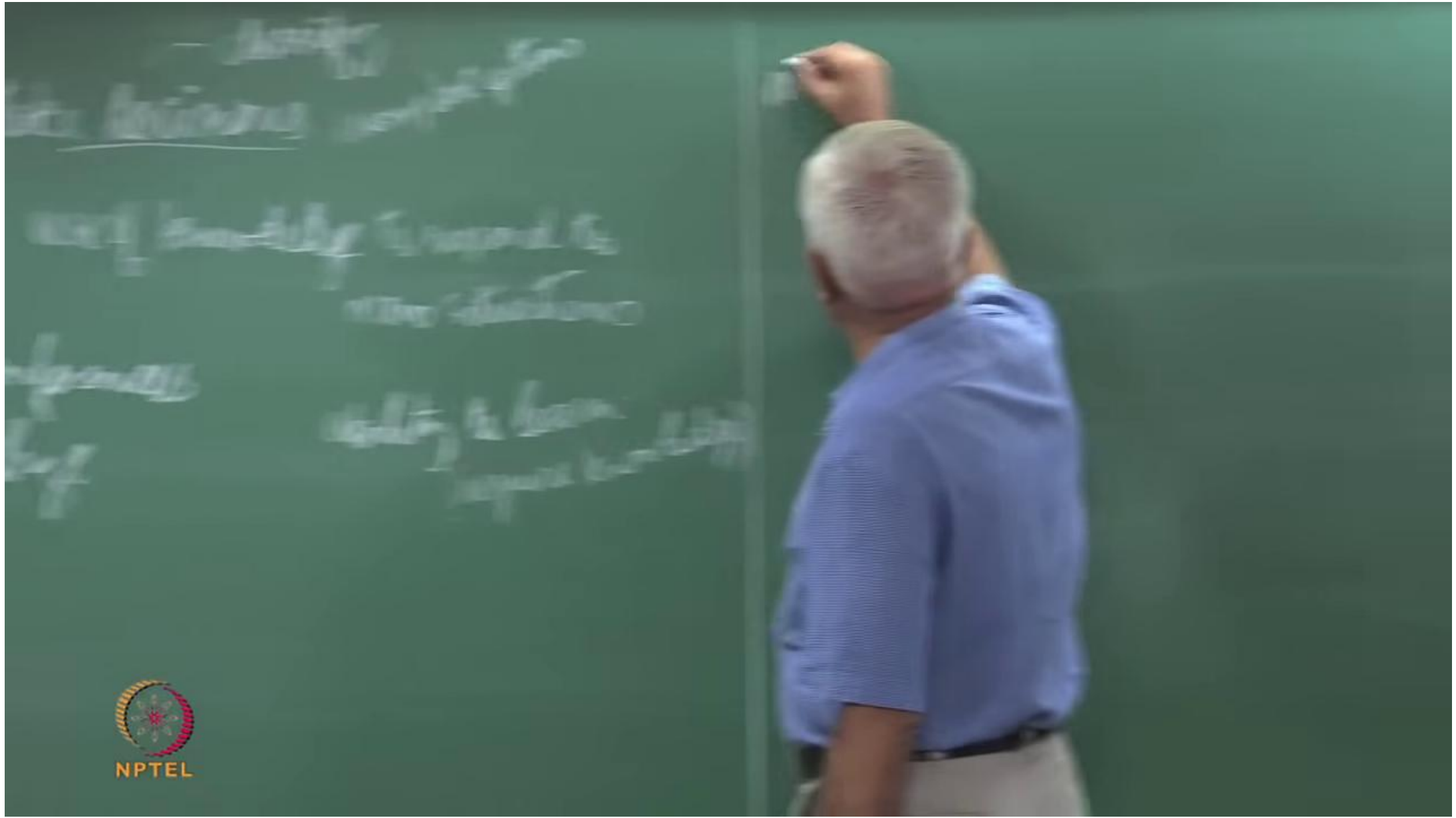
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David Levy
~ 1968

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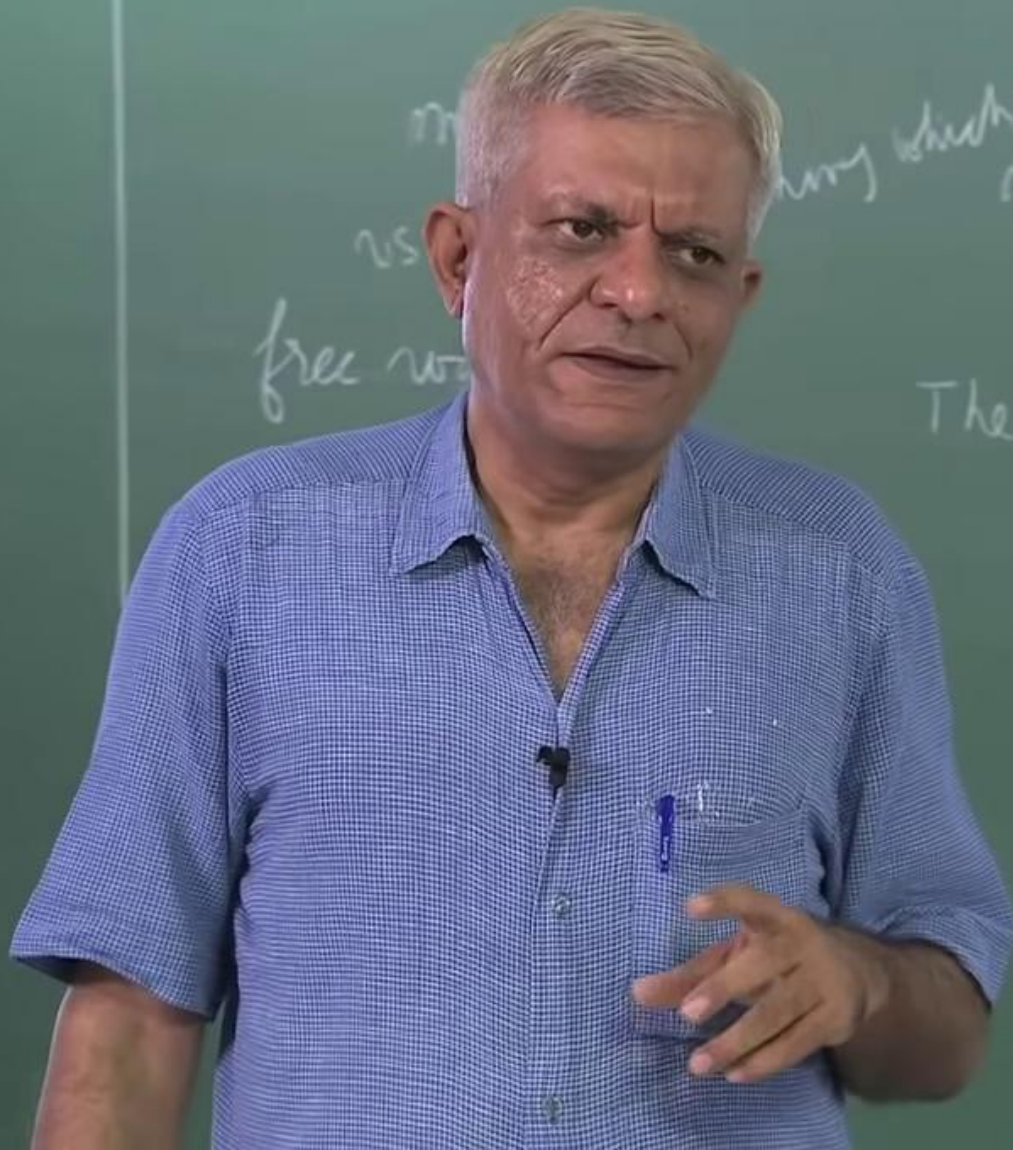
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The Emotion Machine
— Marvin Minsky

The Emotion Machine

- Marvin Minsky

The raging debates over Thinking Machines

- Herbert Dreyfus: "..intelligence depends upon unconscious instincts that can never be captured in formal rules"
  - http://en.wikipedia.org/wiki/Dreyfus%27_critique_of_artificial_intelligence
  - Made a career opposing the possibility of machine intelligence
- John Searle: The Chinese Room argument – can an agent locked in a room processing questions in Chinese based on a set of syntactic rules be said to *understand* Chinese?
  - How many rules will the agent need to have for the thought experiment to be convincing?
- Roger Penrose: "..there is something (quantum mechanical) going on in our brains that current day physics cannot explain"
- Other arguments based on Emotion, Intuition, Consciousness, Ethics etcetera.

R Penrose

The Emperor's New Mind

— Mar

# Alan Turing's Imitation Game

Alan Turing (1912 – 1954)

- The question whether machines can think itself "too meaningless"

- Prescribed a test which he called the *Imitation Game* which is now known as *The Turing Test*

- *"I believe that in about fifty years' time it will be possible to programme computers, with a storage capacity of about 10^9, to make them play the imitation game so well that an average interrogator will not have more than 70 percent chance of making the right identification after five minutes of questioning. … I believe that at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted"*
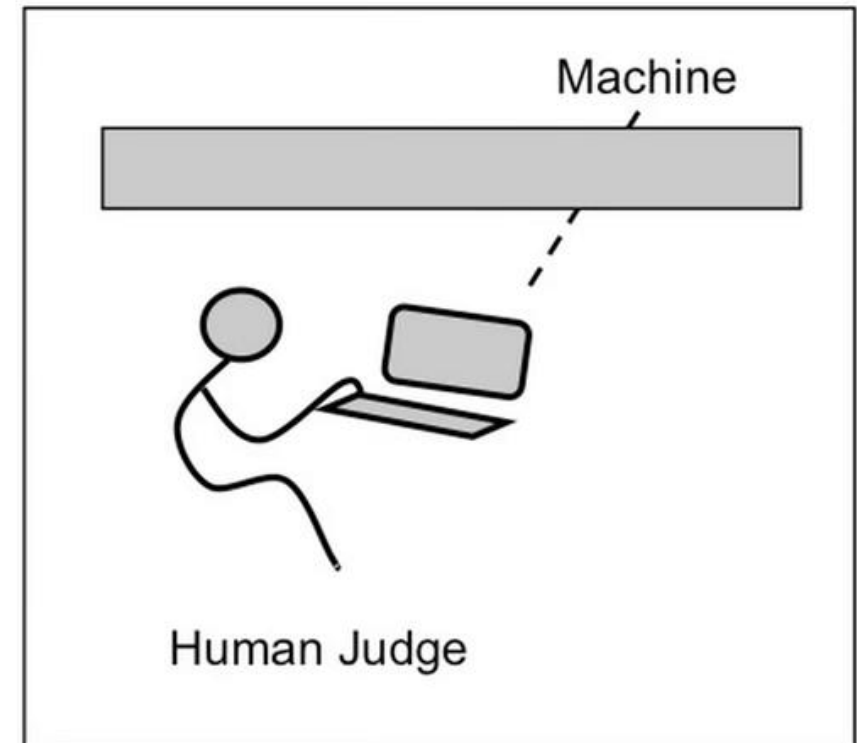
  — Turing, A.M. (1950). Computing machinery and intelligence. Mind, 59, 433-460. http://www.loebner.net/Prizef/TuringArticle.html

The Turing Test
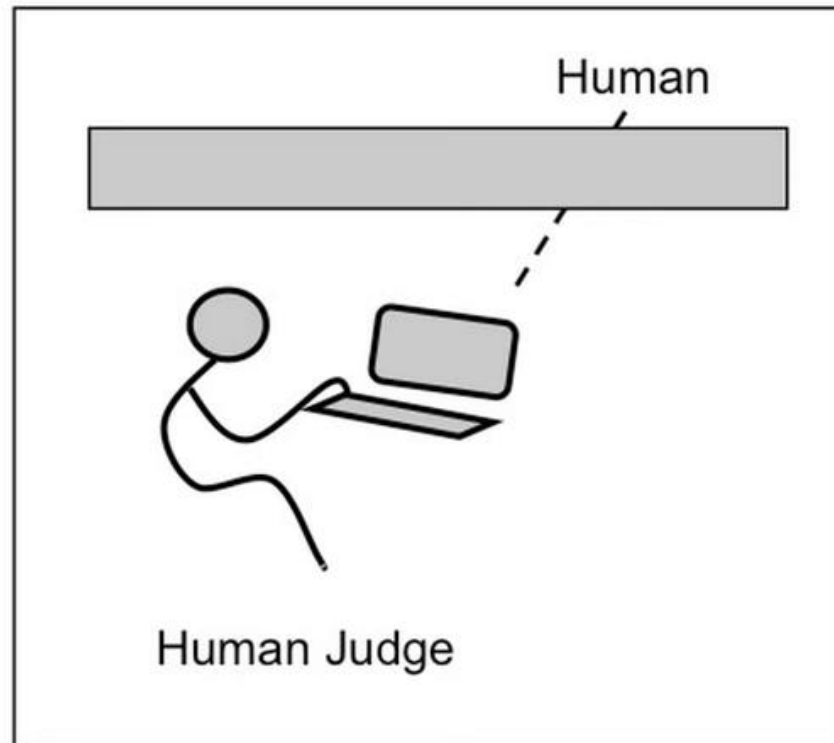
or?

The Loebner Prize – an annual competition where chatbots are judged for human like response. The grand prize of USD 100,000 is still open.

The Loebner Prize 2013

Four finalists to compete on Sept 14, 2013

Excerpts from the leader *Izar*

IZAR TRANSCRIPT

JUDGE: Hello I'm Ronan. What is your name?

IZAR: Ronan! It's about time you contacted me! I was waiting for you! My name is Izar pronounced I zar, but you can call me Izzy if you want. Doing anything fun? Too much recursion in AIML

. . .

JUDGE: I like bananas. Which is your favorite fruit?

IZAR: Tell me more about your unknown. You are not the only one. I don't have a problem with bananas. Is that your favorite fruit? The obvious one. Does that remind you of unknown??

JUDGE: What music do you like?

IZAR: I like many kinds of human music, but recently, I've been getting into Hoomii, a type of Mongolian throat singing. Why? What kind of music do you like?

ELIZA

….named after Eliza Doolittle, a working-class character in George Bernard Shaw's play *Pygmalion*,

ELIZA was a simple natural language processing program written at MIT by Joseph Weizenbaum around 1966.

It had **simple rules** to manipulate language and would essentially modify the users input to generate its response. A popular version called Doctor was running a script designed to make respond like a Rogerian psychotherapist.

A Russian scientist chatting with Doctor at Stanford

Doctor: What brought you here to see me today?

Visitor: Oh, nothing much. I'm feeling a bit tired, that's all.

Doctor: Why do you think you're feeling a bit tired.

Visitor: Well I've been traveling a lot, and away from home.

Doctor: Tell me about your family.

Weizenbaum found people's responses to the program disturbing and wrote a book highlighting the limitations of a computer!

Computer Power and Human Reason: From Judgment to Calculation