

Progress has been tremendous

# Artificial Intelligence

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# Thinking with Electricity

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  - Do calculators “think”?
  - Does performing arithmetic, which is entirely algorithmic, require thinking?
  - Once, performing arithmetic, was thought to be a divinely or magically conferred ability

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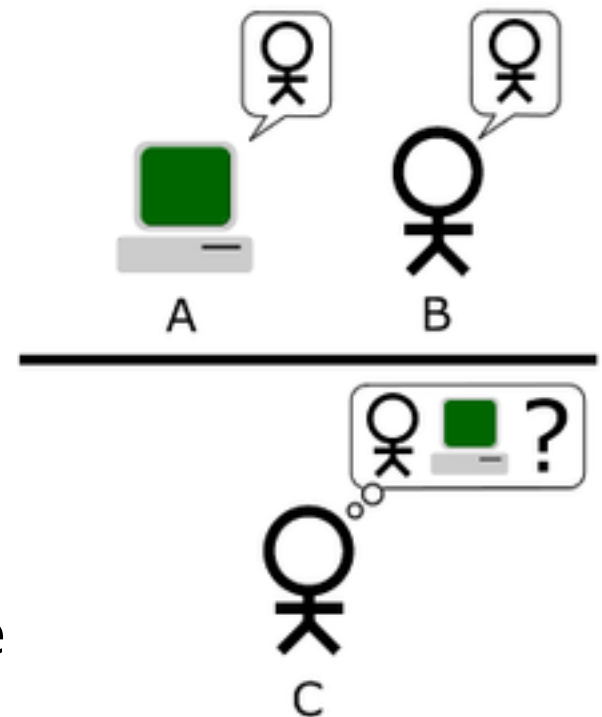
The Problem: Many human activities look like thinking until they are understood (to be algorithmic)

# Turing's Test

- A.M. Turing, computer pioneer, worried about intelligence in humans & machines; proposed a test (1950)

- Aware that it is intelligence until it's understood, Turing devised a test with this experimental setup:

A computer (A) and a person (B) are connected to an examiner, who can ask questions using text to determine which is which



# What Would You Ask?

- Formulate questions a person can answer but a computer can't

# Turing's Idea of Interrogation

**Interrogator** In the first line of your sonnet which reads 'Shall I compare thee to a summer's day', would not 'a spring day' do as well or better?

**Computer** It wouldn't scan.

**Interrogator** How about 'a winter's day'? That would scan all right.

**Computer** Yes, but nobody wants to be compared to a winter's day.

**Interrogator** Would you say Mr. Pickwick reminded you of Christmas?

**Computer** In a way.

**Interrogator** Yet Christmas is a winter's day, and I do not think Mr Pickwick would mind the comparison

**Computer** I don't think you're serious. By a winter's day one means a typical winter's day, rather than a special one like Christmas.

# Loebner Prize



# Captcha

- Completely Automated Public Turing Test To Tell Computers and Humans Apart
  - Developed at CMU by Luis Van Ahn and his team





# Seeming To Be Intelligent

- Joel Weizenbaum's "Doctor" [a.k.a "Eliza"] was a program that *appeared* intelligent

*User:* I'm depressed.

*Doctor:* Why are you depressed?

*User:* My mother is not speaking to me.

*Doctor:* Tell me about your mother.

*User:* She doesn't want me to major in CS.

*Doctor:* No?

*User:* No, she wants me to go into medicine.

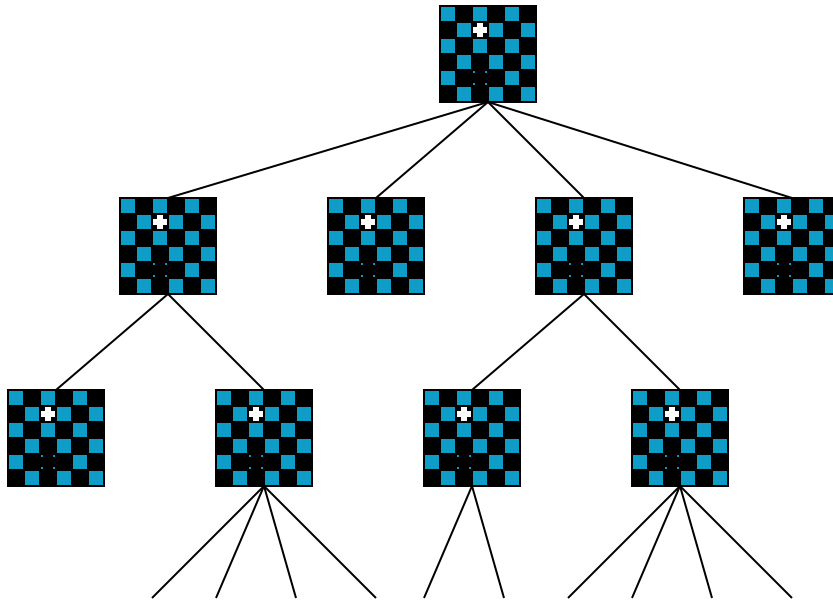
Doctor was basically scripted

# Artificial Intelligence

- The study of making computers act intelligently
  - They already act intelligent ... e.g. they can correct your spelling mistakes
  - Is this intelligent behavior? Most AI researchers would say “no” ... algorithmic
  - Playing grandmaster level chess in a tournament became an AI goal (1952)
    - Minimizes real world knowledge
    - Clear goal, formal system

# Playing Chess

- Chess is a game, so it uses a game tree
  - At each node is a ‘board’ -- easily digitized
  - Below it are all boards created in 1 move; below those, all boards needing another move



An objective function evaluates “goodness” of the position: go for highest ... opponent goes for lowest

# Deep Blue vs Kasparov

- An IBM system, Deep Blue, played world champion Gary Kasparov
  - In 1996 Kasparov won, but Deep Blue played 1 game well!!! This was a first.
  - In May 11, 1997 Deep Blue won 3.5-2.5

Deep Blue is a 32 processor parallel computer with 256 “chess processors” that can consider 200,000,000 chess positions per second + opens + ends

# Intelligent?

- Does Deep Blue's performance show that a computer can be intelligent?
  - No -- it repeats its designers intelligence (weak rebuttal)
  - Yes -- it's better than anyone in the world at something people find interesting and fun
  - Maybe -- it shows intelligence in chess, but can it apply its intelligence elsewhere?

What do you think?

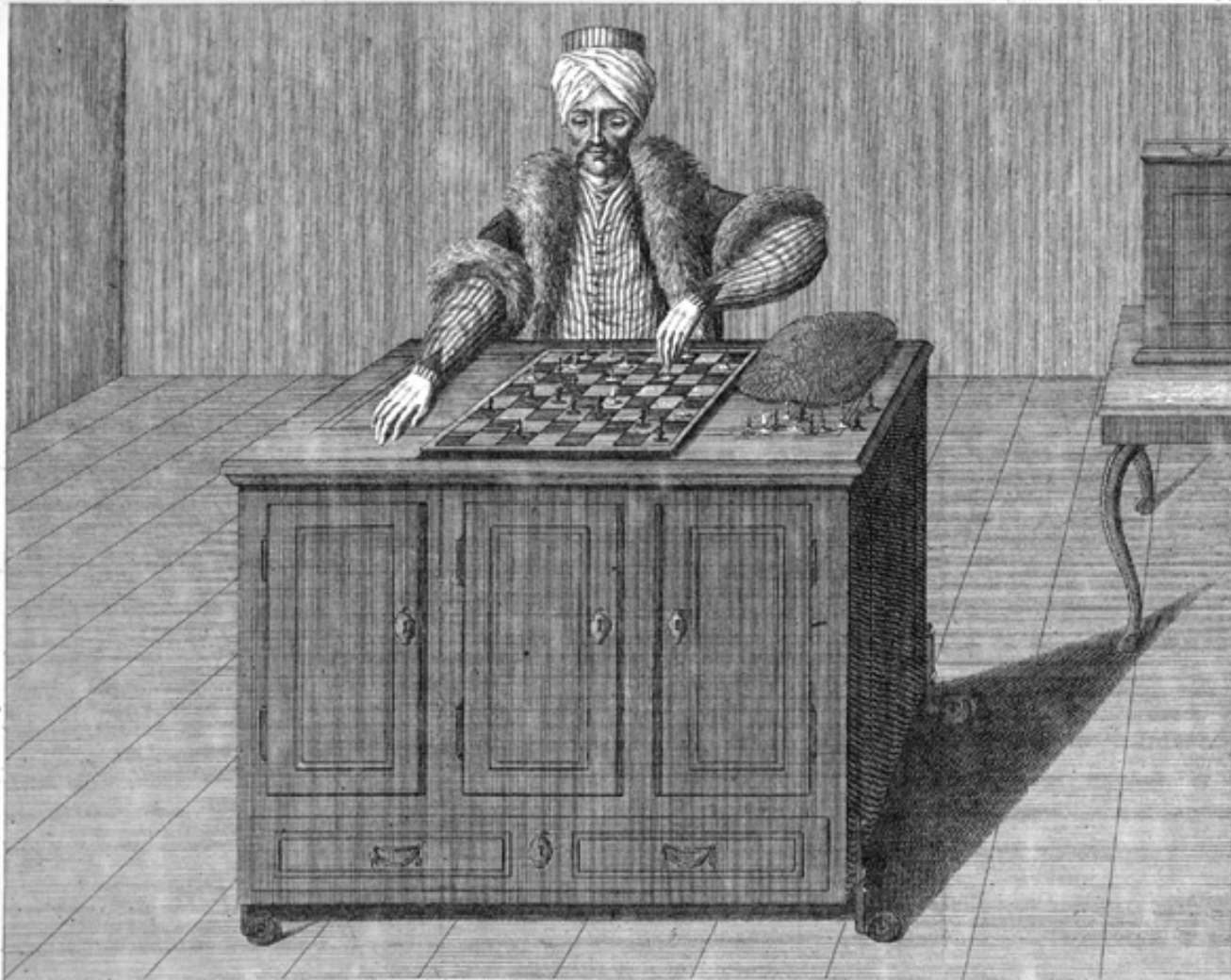
# Chess vs Poker

- True(A) or false(B), a computer program to play poker would be similar to a computer program to play chess. You would create a tree, but the nodes would be hands instead of chess board positions. The program would evaluate the nodes in the tree to decide what to do.

# Chinese Room – John Searle



# The Turk



W. de Kempelen del.

Chr. à Meckel excud. Basilea.

P. G. Pintz. sc.

Der Schachspieler im Spiele begriffen. Le Joueur d'Échecs tel qu'on le voit pendant le jeu.



# And Now Watson plays Jeopardy!



# Watson: More Sophisticated

- Compared to Deep Blue, Watson is much more sophisticated in design, organization
  - runs on ~2,500 parallel CPUs, each capable of up to 33 billion operations a second; size of small RV
  - crawled and organized 200 million pages of data
  - “expert” analyzers — more than 100 different techniques running concurrently to analyze natural language, appraise sources, propose hypotheses, merge results and rank top guesses.

# Watson: In Winter 2011 it won at Jeopardy!

- <http://www.nytimes.com/interactive/2010/06/16/magazine/watson-trivia-game.html?ref=magazine>
- Let's try it.

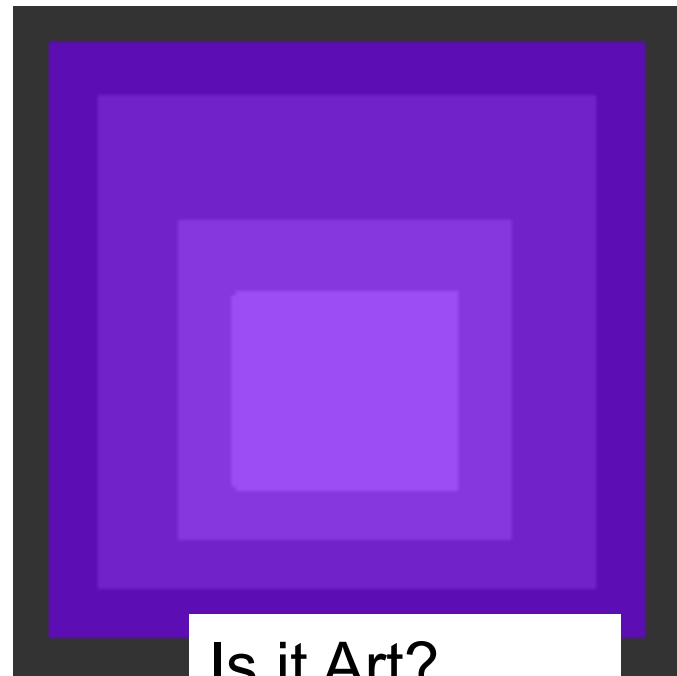
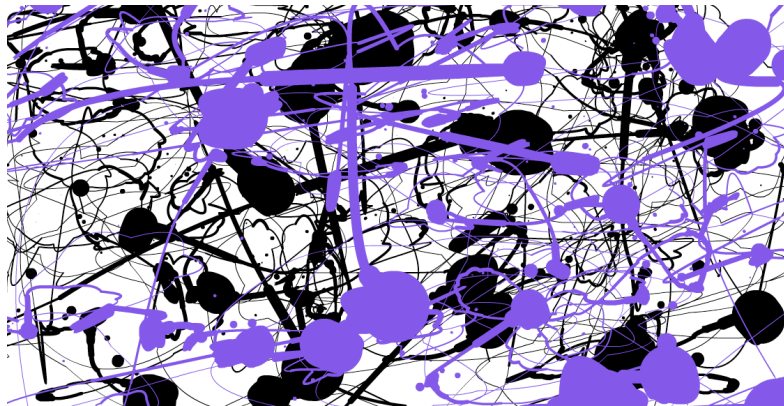
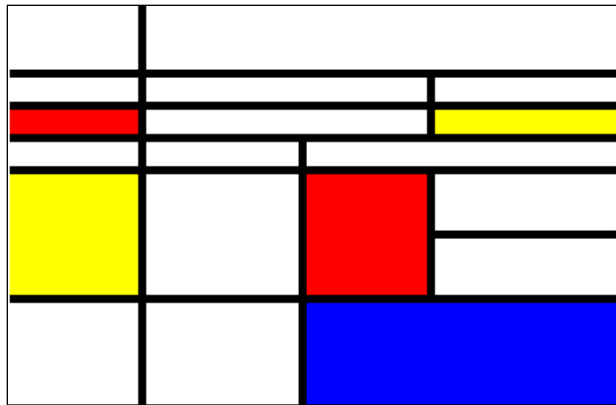


# Compare Watson, Deep Blue

- Chess seems harder, but it's not
  - Chess has fixed rules, little real world data needed
  - Jeopardy, more free form using only real data
- Other differences
  - In chess the “problem” is known beforehand, but in Jeopardy, someone else sets up the problem
  - In chess, decisions are based on a formula, but in Jeopardy many forms of evaluation are needed (a problem solved by probabilities)
  - In chess there is very little pre-planning, but in Jeopardy, organizing the data is the key

# Being Creative

- Computers do things deemed creative in past
  - Create designs in the style of Piet Mondrian, Jackson Pollack or Josef Albers ...



Is it Art?  
Is it Creative?

# Definition of Creativity

- Creativity has two forms: “flash out of the blue” and “incremental revision”
  - “Flash,” i.e. inspiration, is rare; is it just luck?
  - “Revision”, i.e. hard work, is common and to a large degree algorithmic

Advertising agencies are famous for creativity, but in a recent study, 89% of all *award-winning* ads were an application of one of six templates -- design algorithm

# Composing Music

- An experiment at the U. of Oregon ... compose music in the style of Bach
- Three participants: Bach, U of O Professor, EMI program
- And the winner is ...

Audience Thought:	Bach's	Professor's	EMI's
	work was	work was	work was
	Professor	EMI program	Bach

# EMI

# DAVID COPE

Biography Bibliography Music Scores Software Experiments in Musical Intelligence

## Experiments in Musical Intelligence

For downloading Experiments in Musical Intelligence music as MP3 files, click [here](#).

I began Experiments in Musical Intelligence in 1981 as the result of a composer's block. My initial idea involved creating a computer program which would have a sense of my overall musical style and the ability to track the ideas of a current work such that at any given point I could request a next note, next measure, next ten measures, and so on. My hope was that this new music would not just be interesting but relevant to my style and to my current work. Having very little information about my style, however, I began creating computer programs which composed complete works in the styles of various classical composers, about which I felt I knew something more concrete.

My first exploration with Experiments in Musical Intelligence involved coding the rules of basic part-writing as I understood them, since part writing constitutes one of the primary superstructures of traditional tonal music. After much trial and error, my program produced a kind of vanilla music which basically adhered to these rules. While basically correct in terms of how the voices move one to another and still conform to classical triadic



# Other AI/Machine Learning Questions

- Robotics
- Facial recognition
- Route planning
- Displaying emotions
- Natural Language Processing
- Pattern recognition/prediction – medicine, weather, economics, spam
- Recommender systems
- Image browsers

# Summary

- Watson looks to be a major advance in AI and a big step towards answering Turing's Test

THE CAPACITY OF  
A COMPUTER TO  
PERFORM OPERATIONS  
ANALOGOUS TO  
LEARNING AND  
DECISION MAKING  
IN HUMANS

What is AI?