Thinking, Algorithmic and Otherwise

When algorithmic thinking was introduced, it was observed that everything a computer does was planned out for it by a programmer … does that mean a computer cannot think? Or could a programmer plan out a way to think?

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Can A Computer Think?

“Asking if a computer can think is like asking if a submarine can swim”

- Intelligence could be defined as a property of people
- But computers can do interesting things that people do that seem to take intelligence:
  - Balance a check book and approximate pi
  - Check for spelling errors
  - Type-set documents aesthetically
  - Make medical diagnoses
  - Recognize spoken English over the phone
  - Play and win at games
  - ...
In 1950 A.M. Turing proposed a way for answering the question of whether computers are intelligent.

Strategy: If a person cannot determine through a dialog with a computer and a person which one is the person, then the computer must have some level of intelligence.

What questions would you ask?
Revealing Questions

- Are you a person?
- What day is it?
- Who was the first president of the US?
- What is $441093387 \times 77327$?
- Can white win in 1 move from this chess position ...?
- How does Hamlet’s most famous soliloquy start?
- What’s odd about “We all scream for ice cream”?
- What was your father like?
- What is your opinion about impeaching someone for private, personal behavior?

Which of these might a computer answer?
The Challenge of Chess

- Chess is a deterministic game in the sense that it does not involve randomization, such as dice.
- There are a finite number of chess positions, that is, legal arrangements of chess pieces on a board.
- Computers are fast, so enumerate all positions...

Initial board

White moves

Black moves
A Computer Can Solve Chess, Not

- Exhaustive searching of the chess game tree is impractical
  - 20 possible initial moves
  - On average there are about 35 moves possible from a given position
  - Typical games are about 100 moves long
- Estimate $35^{100}$ boards in the tree … there are fewer protons in the entire universe
  For a computer to play good chess it needs smarts!
- In the 1960s the pioneers of artificial intelligence -- researchers who study making computers “intelligent” thought that “the day is near when a computer will be the reigning world chess champion"
Game Trees

- How could a computer play chess, if not exhaustively
- A game tree ...

Heuristics are "rules of thumb"
Heuristics

- Heuristic programming is simply encoding the guidelines of a heuristic into an otherwise deterministic program.
- Heuristic techniques are can be used in “algorithmic” programming.
  - Think of finding whether a grid point is covered by a drop by looking through the array of drops … where to begin
    - At the end
    - With the last drop
The Day Came

- Deep Blue, IBM’s chess playing supercomputer was the first computer to win a tournament against the world champion, Gary Kasparov
- Kasparov resigned (in a huff) after 19 moves into the sixth and final game of the match (losing 2.5 to 3.5)

“I tried to play through the rest of the game as best I could, but I lost because [Deep Blue] played great. It played like God.”

Did Deep Blue Exhibit Intelligence?
Summary

- Are computers intelligent? The question is still open.
- As time has passed programs have solved problems in a more intelligent way.
- Many characteristics that make people appear to be intelligent can be programmed … whether they all will be is unknown.