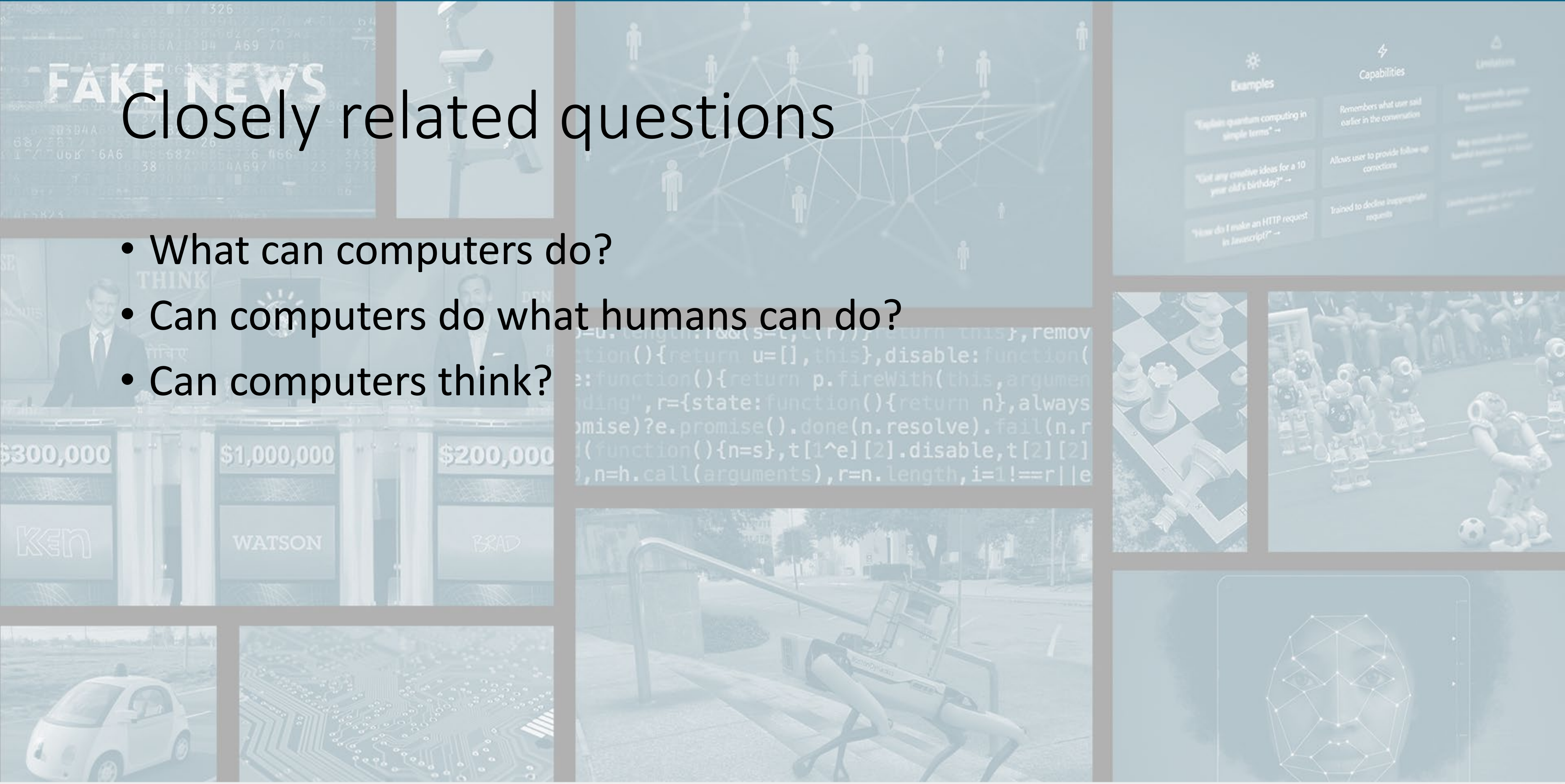
History of Artificial Intelligence

- Term coined in 1956
- Key conference at Dartmouth, McCarthy, Minsky, Rochester, Shannon
- Conference to focus on
  - Natural language processing
  - Neural networks
  - Theory of computation
  - Abstraction
  - Randomness and creativity

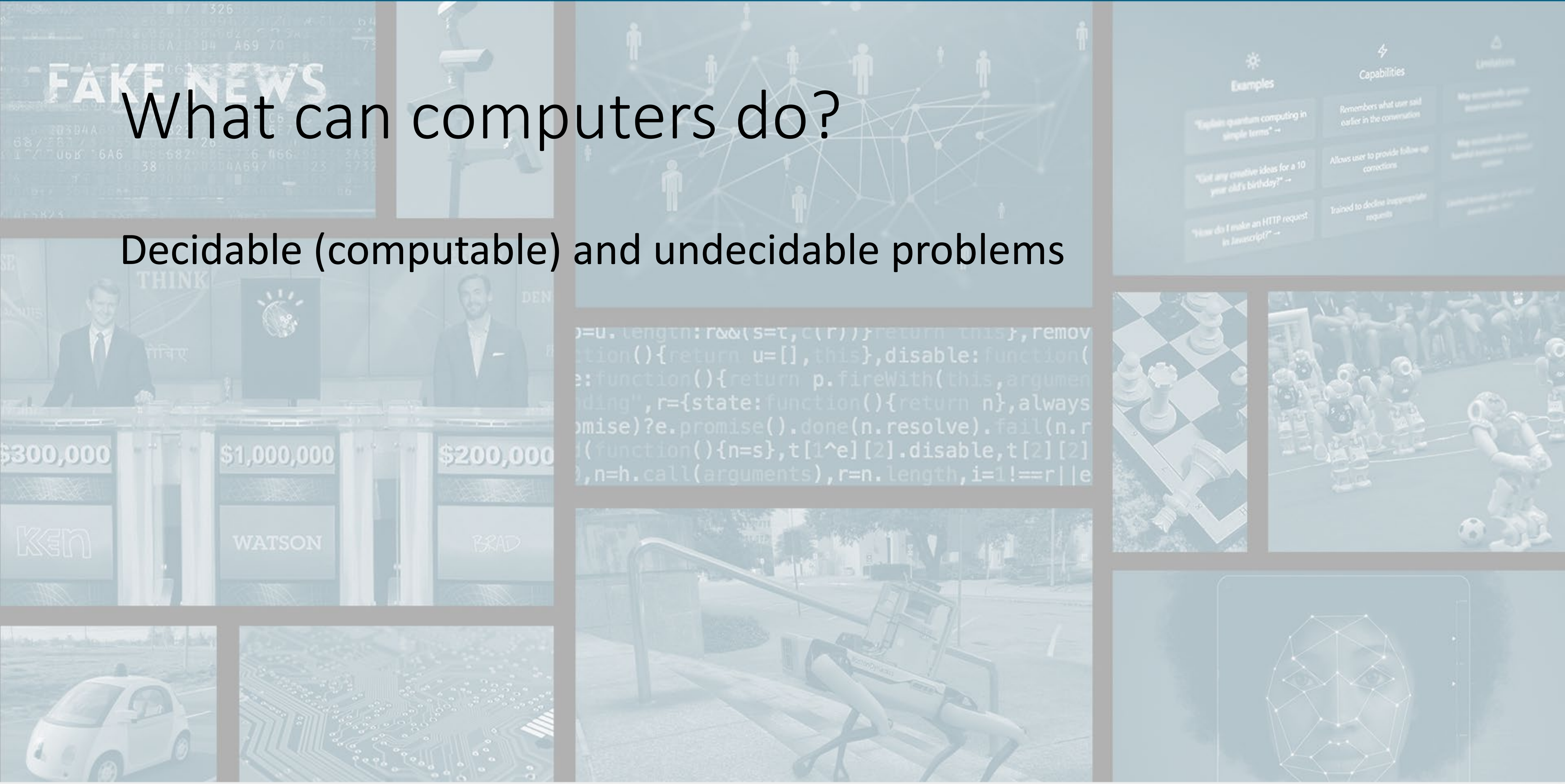
History of Artificial Intelligence

- Since that time
- Focus on hard problems that come naturally to humans
  - Perception (Image recognition, audio recognition, etc.)
  - Natural language processing (computer languages are much better understood and easier to deal with)
  - Games (checkers, chess, go, …)
  - Reasoning, theorem proving, etc.
  - Neural networks
  - Robotics



Closely related questions

- What can computers do?
- Can computers do what humans can do?
- Can computers think?



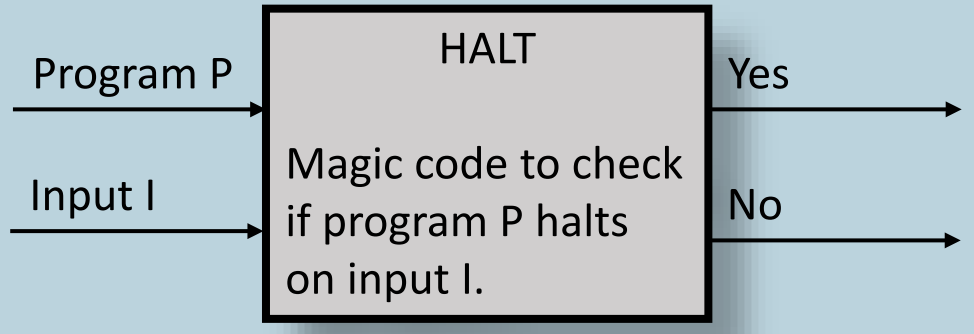
What can computers do?

Decidable (computable) and undecidable problems

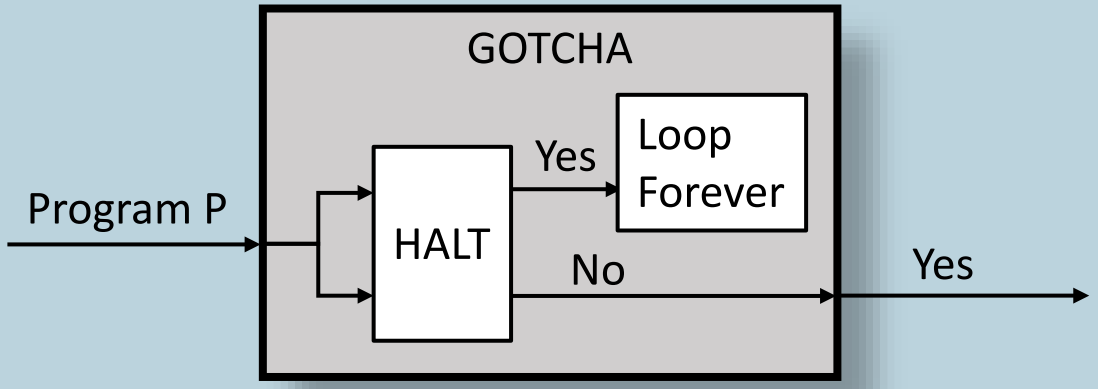
Decidability (Computability)

- The Halting Problem
  - Suppose you have some program P and you'd like to know if it will halt and produce an answer given an input I.
  - You could try just running P with input I to see, but then if it doesn't halt for some time, when do you determine that you know the answer?
  - Instead you'd like to create a program HALT that can take the source code to P and the input I and tell you whether or not P will halt and produce an answer given I as input. In fact, you'd like to make H be able to tell you this for any program and input that you might give it.
  - It can be proven that HALT cannot exist, i.e. that you cannot write a program that takes any program and its input and tells you whether it will halt and give an answer.

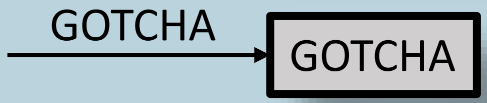
- Suppose you had such a program, call it HALT:



- You could create from it another program, GOTCHA:



- Then run GOTCHA on itself:



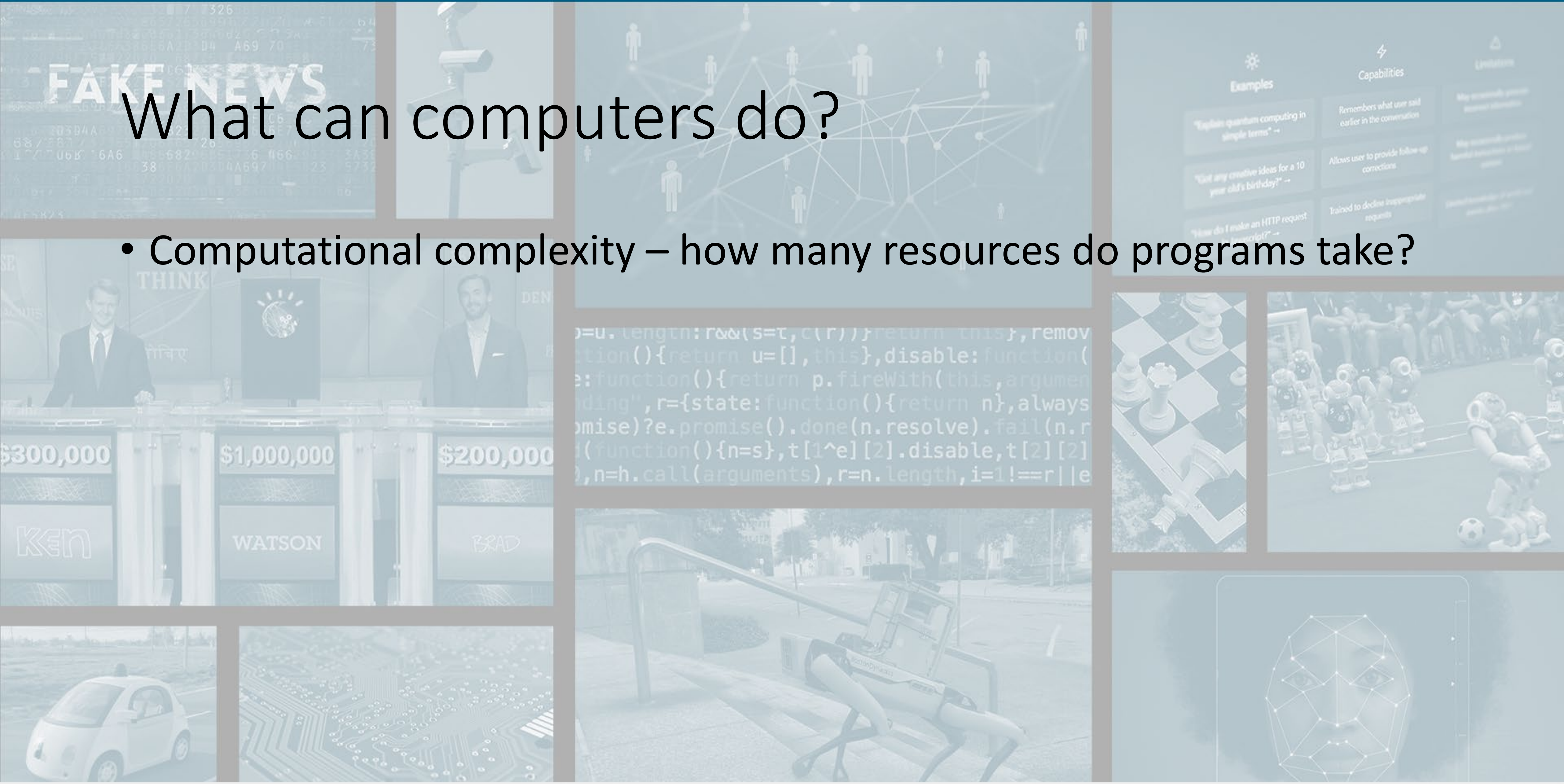
If GOTCHA halts, then it doesn't halt, and if it doesn't halt, then it halts

Decidability

- This is not just a toy problem.
- Program analysis tools
    - Automatically check your program for ”correctness”
    - Check to see if a particular part of your code will ever be executed
- But there are programs that do these things
    - We know these can work on some interesting set of programs, but not on every program

Decidability

- Given a mathematical conjecture, it is possible to create a program that will tell whether it is provable (and thus a theorem)?
- No, this is the problem Turing proved undecidable in the paper that defined Turing Machines (also Godel and Church)
- Yet one of the first significant AI programs was Newell and Simon’s “Logic Theorist”, which proved theorems from Russell and Whitehead
- We still build “Automated Theorem Provers”, in fact UTCS has been one of the leaders in this area, and we use this technology to verify correctness of systems



What can computers do?

- Computational complexity – how many resources do programs take?