



18.09.20 00:00

CSCI 101

Connecting with Computer Science

Lecture 1: Introduction to IT I



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2020 Fall Semester (S3)

Overview

- Focus: History of Computers
- Architecture: von Neumann
- Readings: 0
- Core Ideas:
 1. The History of Computing Machinery

History of Computing Machinery

What is a computer?

- A computer is a computing machinery
- ACM: Association for Computing Machinery
- IT: Information Technology
- The technology of processing information (typically in digital format)



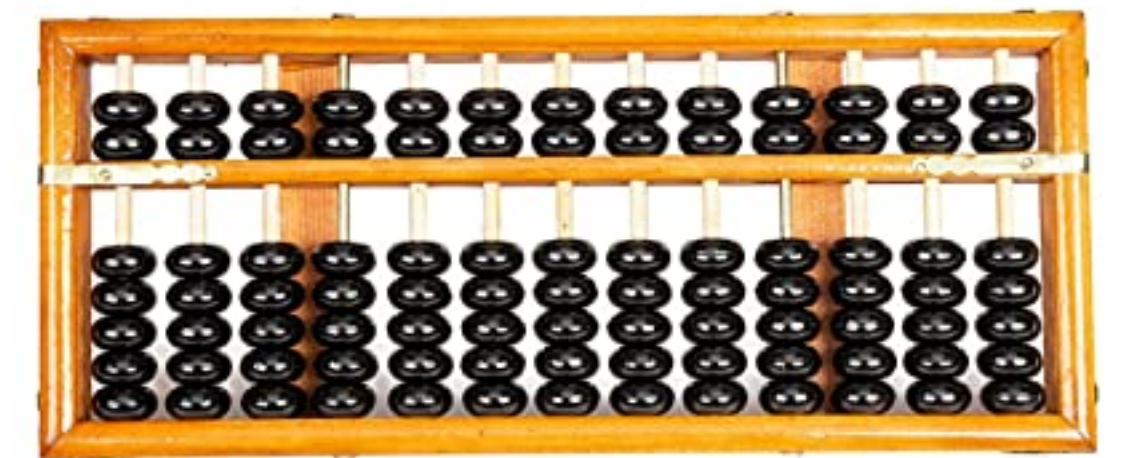
When was the earliest Computer invented?

Guess

NVP3D.com

The Antikythera Mechanism

- Mechanical devices (circa 3000BC) to aid calculation have existed even before the Antikythera Mechanism
- The Antikythera Mechanism from circa 80BC was discovered as a machine for calculating motions of planets in the sky
- It is important to know that Computers are simply tools for computation
- Computers are still until this day, designed to execute computations of mathematical models




1900-WWII

- ! There were computers before 1900
- Attempts to build electronic computer (Harvard Mark I) by Howard H. Aiken
7 Aug 1944, 3-5 seconds per multiplication
- Enigma machines: processing information for encryption (Enigma code)
1930s
- The Colossus machine: a machine designed to crack the Enigma code
1940s by **Alan Turing**

After the War

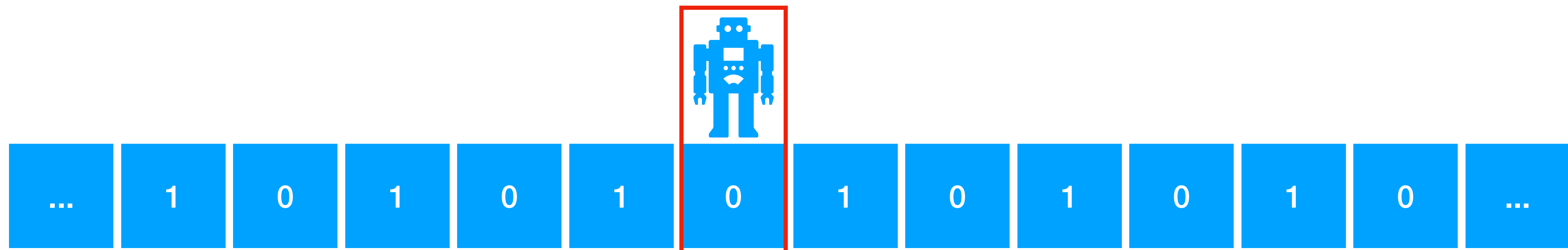
- Computing Machinery divided into two categories
 - Calculators
 - Perform designed mathematical computations ONLY
 - General-purpose computers
 - Can perform a wide-variety of tasks
 - Based on the Theory of **Alan Turing (Turing Machines)**

Turing Machine

- 1928: 3 questions by David Hilbert (German Mathematician)
 1. Completeness **Kurt Gödel (1931): No**
Can every mathematical statement be either proved or disproved?
 2. Consistency **Kurt Gödel (1931): No**
Is it true that statements such as " $0 = 1$ " cannot be proved by valid methods?
 3. **Decidable (Das Entscheidungsproblem¹)** **Alan Turing (1938):**  **The Turing Machine**
Is there a mechanical method that can be applied to any mathematical assertion and (at least in principle) will eventually tell whether that assertion is true or not?

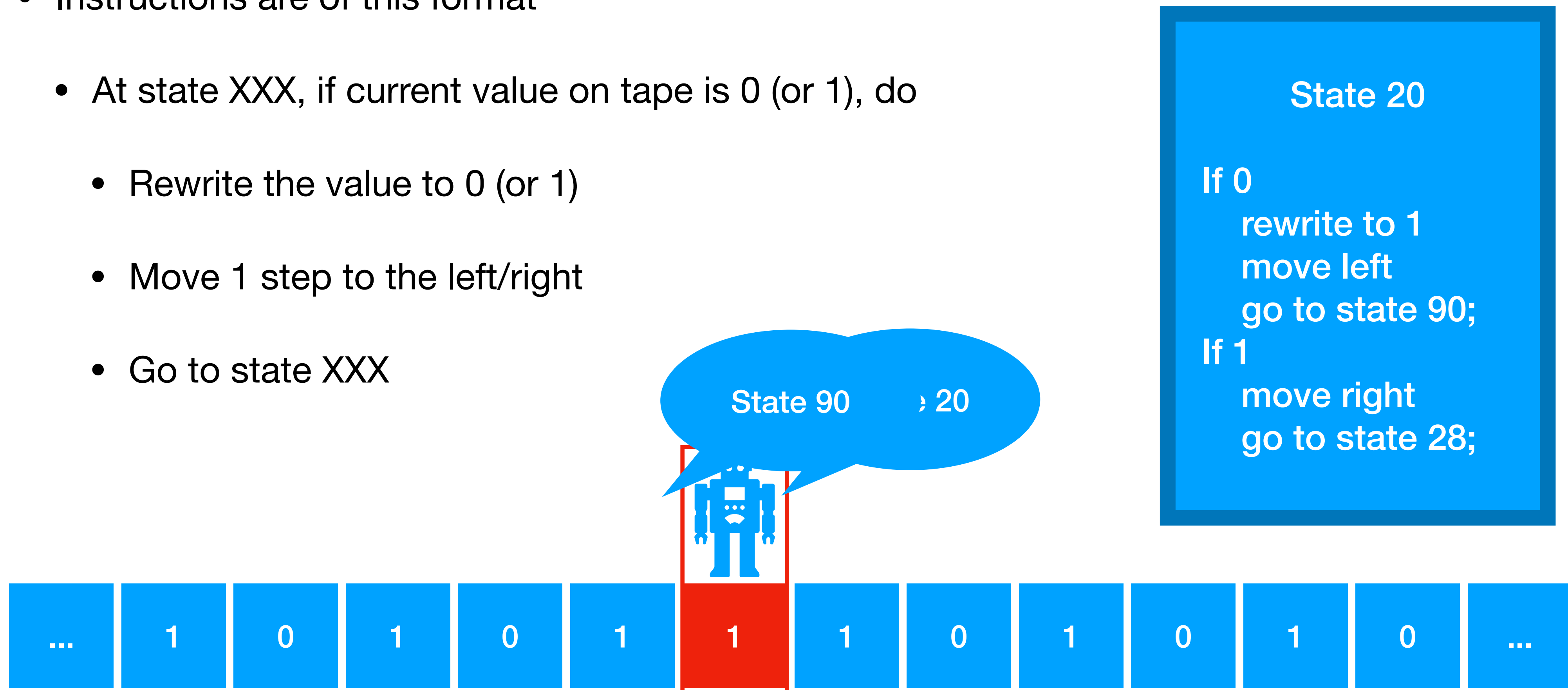
Turing Machine

- Mathematical model for computing machines
- Very simple instructions
 - A tape of 0/1s, and various number of states
 - At any time step, the machine has access to a single digit on the tape



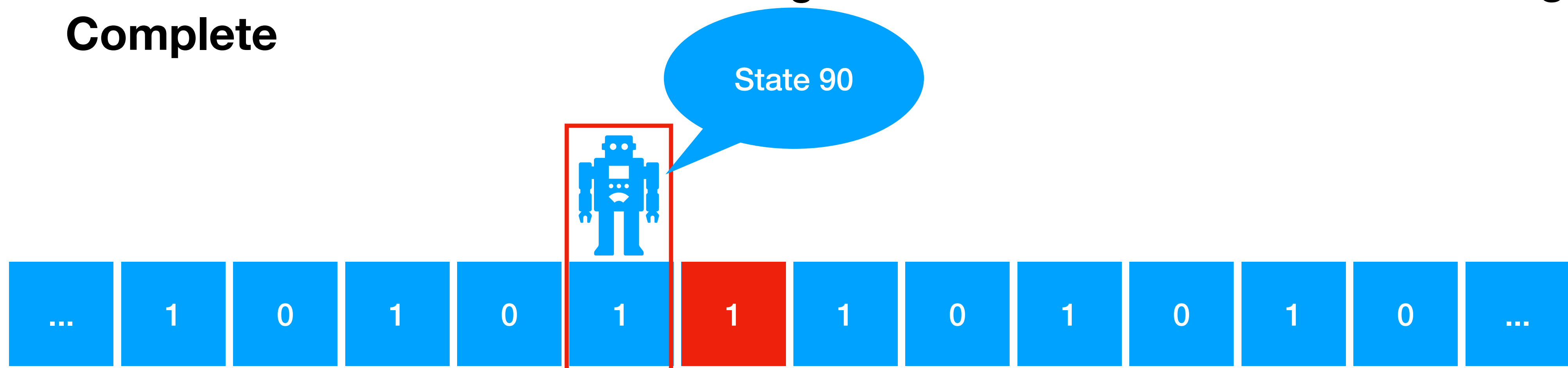
Turing Machine

- Instructions are of this format
 - At state XXX, if current value on tape is 0 (or 1), do
 - Rewrite the value to 0 (or 1)
 - Move 1 step to the left/right
 - Go to state XXX



Turing Machine

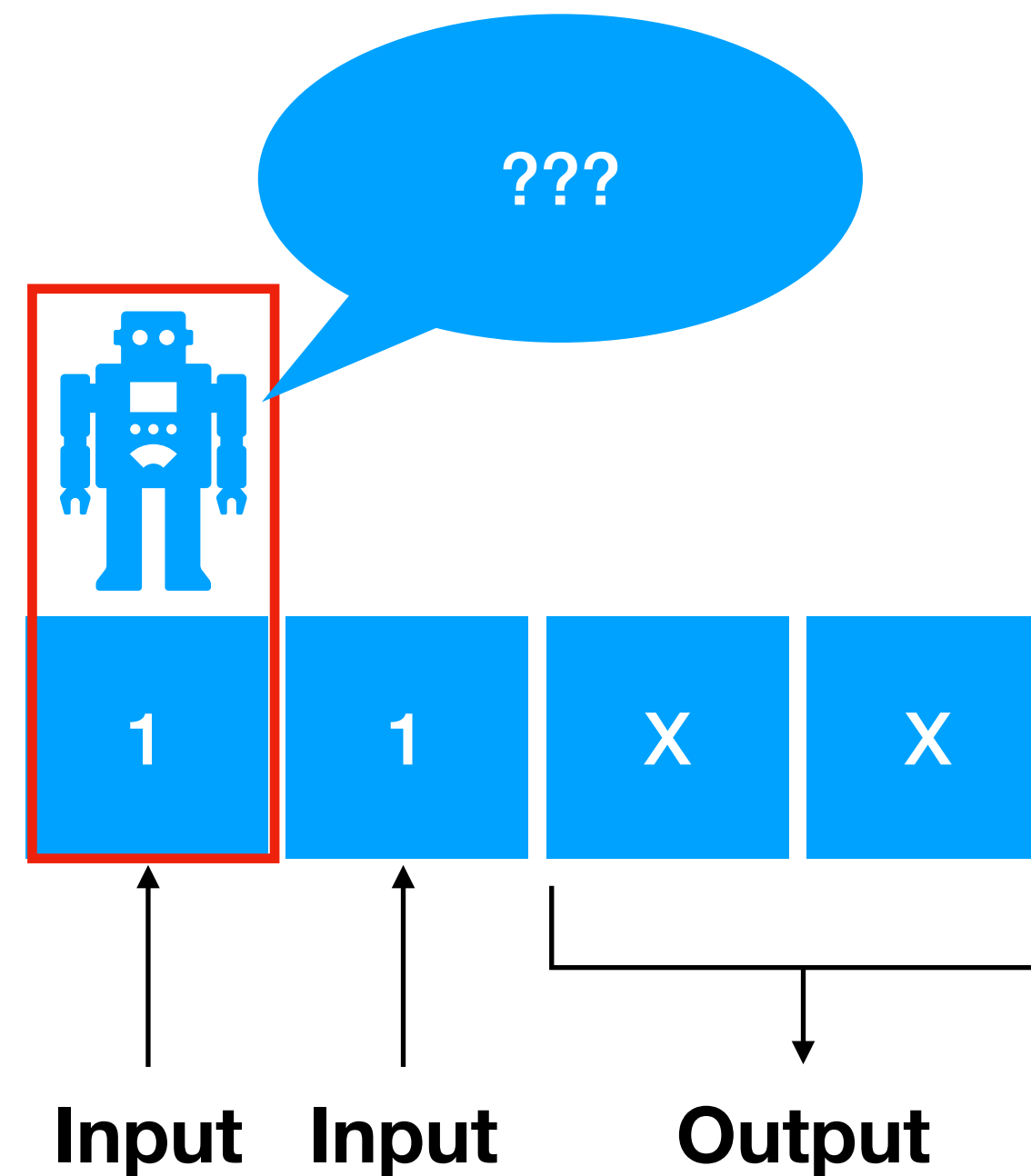
- This machine will allow you to change any value to any other value
- The Turing machine in theory can do what any modern computer (even a quantum computer) can!
- A machine that can do what a Turing machine can do is said to be **Turing Complete**



Concept

Turing Machine

- Can you design a set of Turing machine instructions to compute $1+1$?



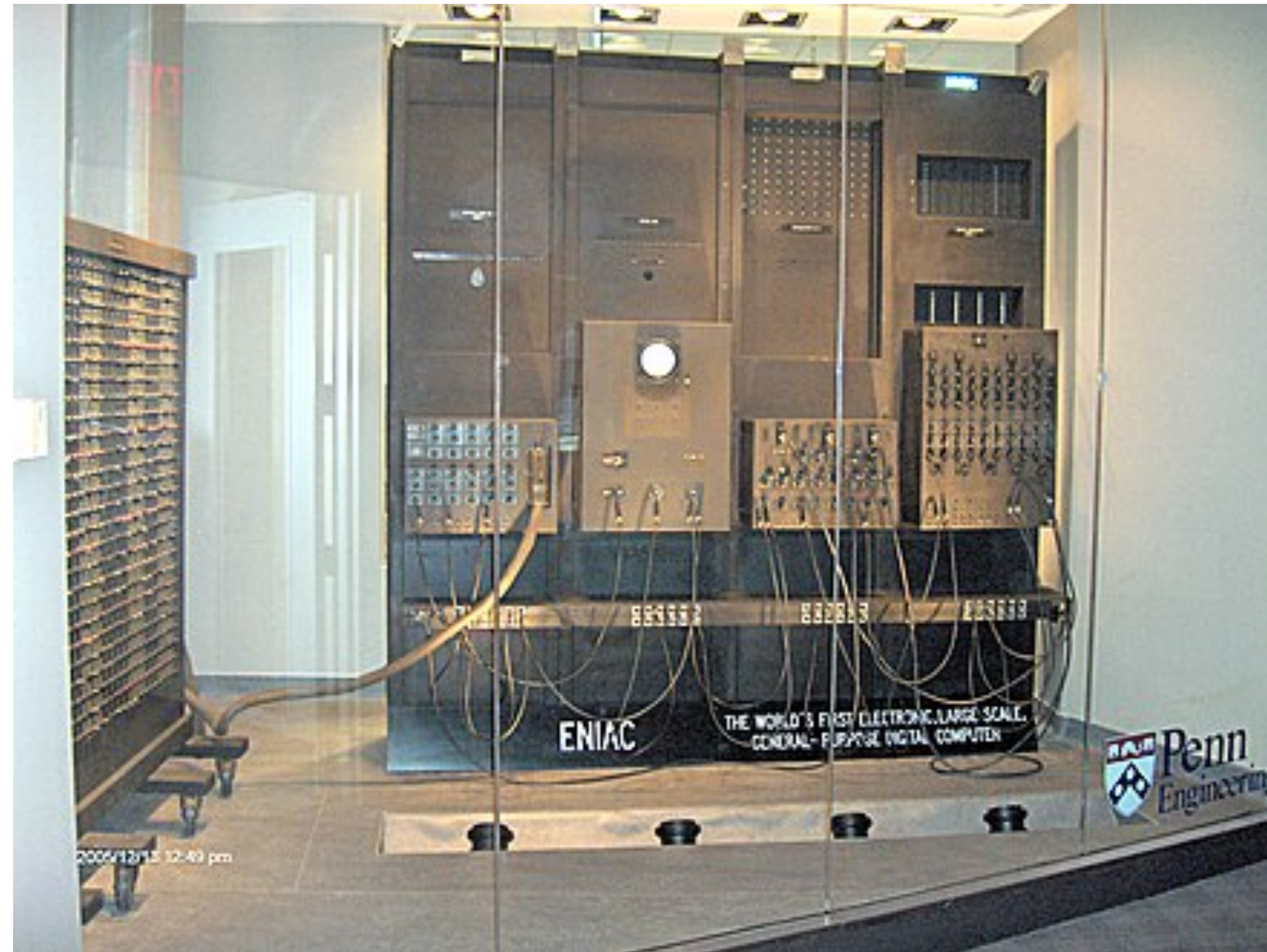
Thinking

Interesting Digital Computers in History

- 1945-1956: ENIAC (Electronic Numerical Integrator and Computer)
 - Designed to calculate artillery firing tables for the US army calculated a trajectory in 30 seconds that took a human 20 hours
- Nicknamed **Giant Brain**
- Is Turing complete! In theory, it can run Crysis!



Interesting Digital Computers in History



Concept

1. https://www.youtube.com/watch?v=k4oGI_dNaPc

Interesting Digital Computers in History

- Potential presentation topics:

- The Women behind ENIAC



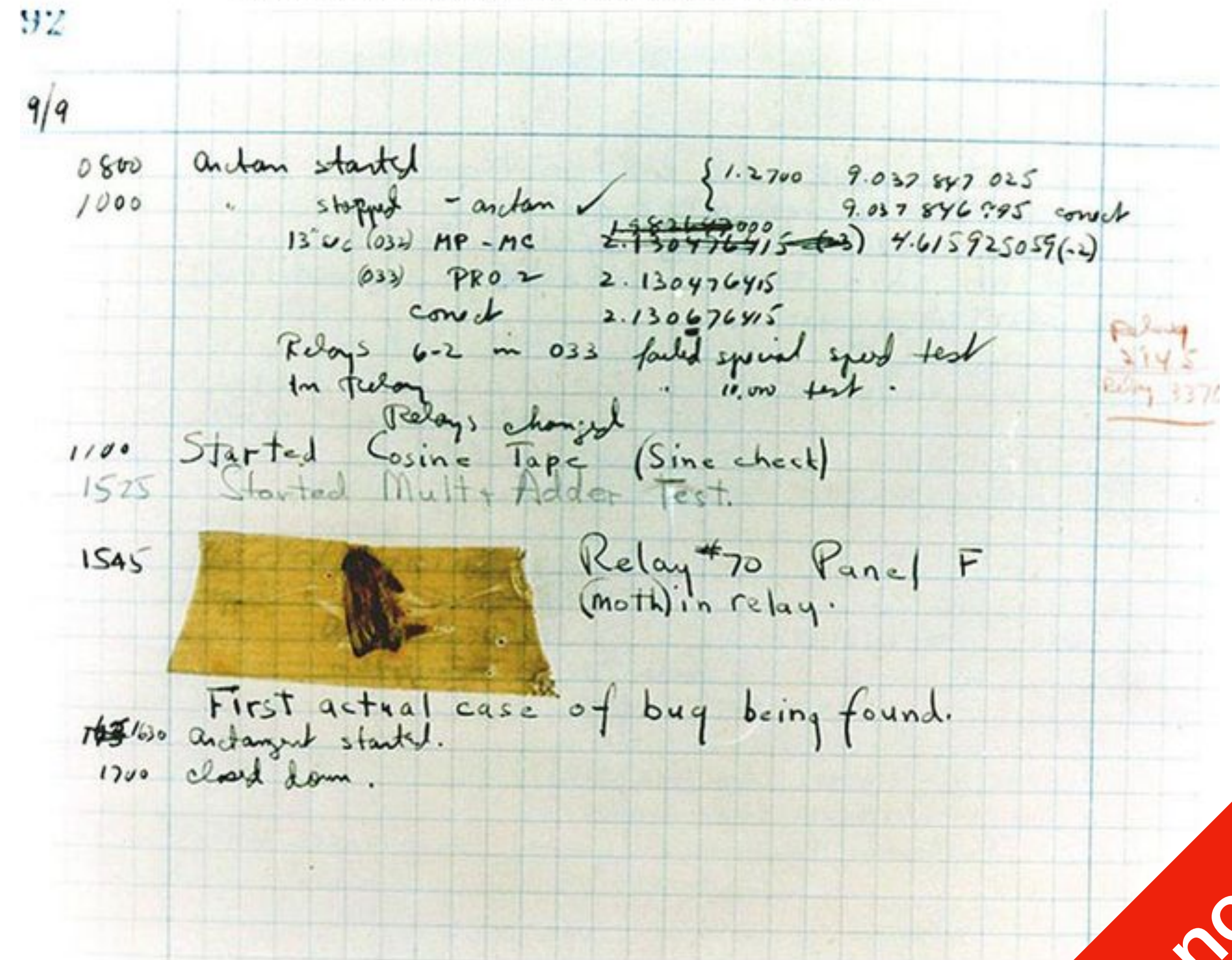
- How is ENIAC Turing Complete?



Interesting Digital Computers in History

- 9 Sept 1947: Harvard Mark II
- Grace Murray Hopper found the first "bug" in this computer
- It was a moth trapped in their computer

Photo # NH 96566-KN (Color) First Computer "Bug", 1947



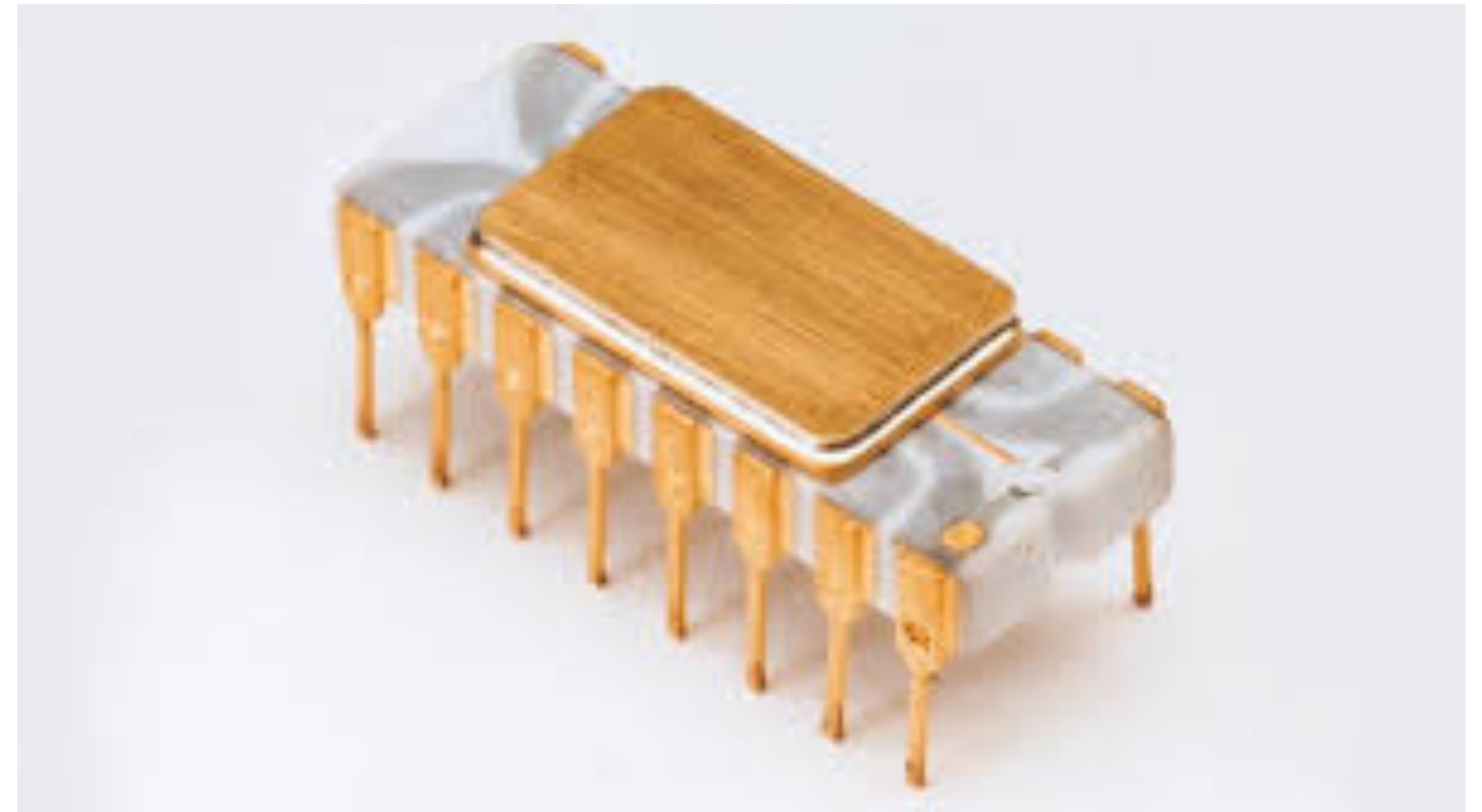
Interesting Digital Computers in History

- 1966: Apollo Guidance Computer
- First integrated circuit processor (CPU)
- Originally designed for a printer
- Same computing power as ENIAC
- 2,300 transistors
a 2010 Intel CPU have 560 million



Interesting Digital Computers in History

- 1971: Intel 4004
 - First microprocessor (CPU) computer on a chip (12 years after the invention of chips)
 - Originally designed for a printer
 - Same computing power as ENIAC
 - 2,300 transistors
a 2010 Intel CPU have 560 million



Interesting Digital Computers in History

- 1977: first Personal Computer, the Apple II
- Steve Jobs and Wozniak
- Fun fact!
- Apple II is also the first computer with Colour display, hence the colourful Apple Logo



Interesting Digital Computers in History

- 1999: GeForce 256, the first GPU
- GPUs are designed to process computer graphics
- More computational units than CPU, and all in parallel (so that colours for each pixel can be calculated simultaneously)
- 2001: people started using GPUs to calculate matrix operations



Moore's Law

- By Gordon Moore in 1965
 - number of transistors on a microchip doubles every two years
 - cost of computers halves every two years
- Ended circa 2019¹
 - Why?
 - People started to look elsewhere: parallel, quantum, etc.

Significant Events

- Shakey, 1966: first AI controlled robot
- ARPANET, 1969: predecessor of the Internet
- IBM 7535, 1982: first manufacturing robot
- The Road to Point Reyes, 1983: first CG image by Lucasfilm
- C++, 1985: We are still using it!
- Deep Thought, 1989: first Computer to defeat human in Chess
- Navlab 2, 1990: first autonomous vehicle



Aspects of CS

- Computation, Scientific Computation, Physical Simulations
- Internet, Social Media, Distributed Systems
- Entertainment, Digital Art, Digital Media, CG
- Artificial Intelligence, Vision, Language, Signal, Reasoning
- Encryption, Cryptocurrency, Privacy and Security
- Brain-Computer Interface and Bioinformatics