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CSCI 101
Connecting with Computer Science
Lecture 1: Introduction to IT I

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2023 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

Summary

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)

P1
History

When was the earliest Computer invented?

Guess

1. Remember, a computer is a computing machinery

NVP3D.com

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

P1
History

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

Concept

P1
History

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**

Concept

P1
History

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**)

Concept

P1
History

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 Entscheidungsproblem[1])** **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?

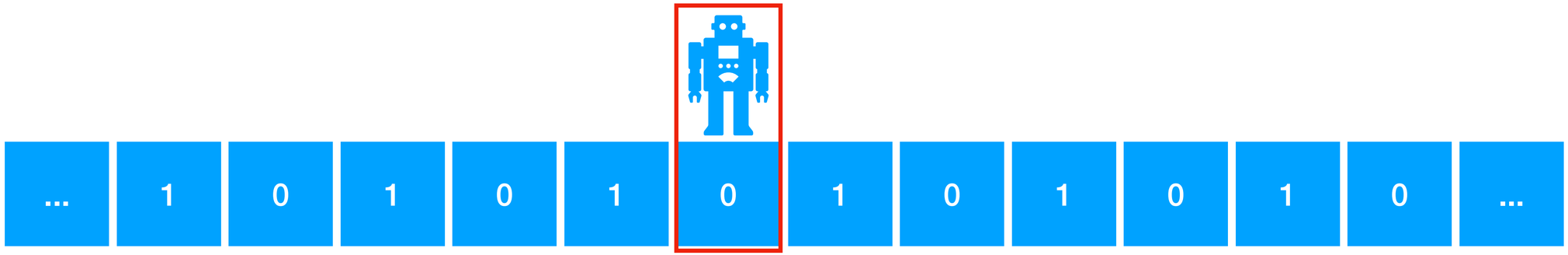
Concept

1. The decision problem

P1
History

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



Concept

1. https://plato.stanford.edu/entries/turing-machine/#TuriDefi

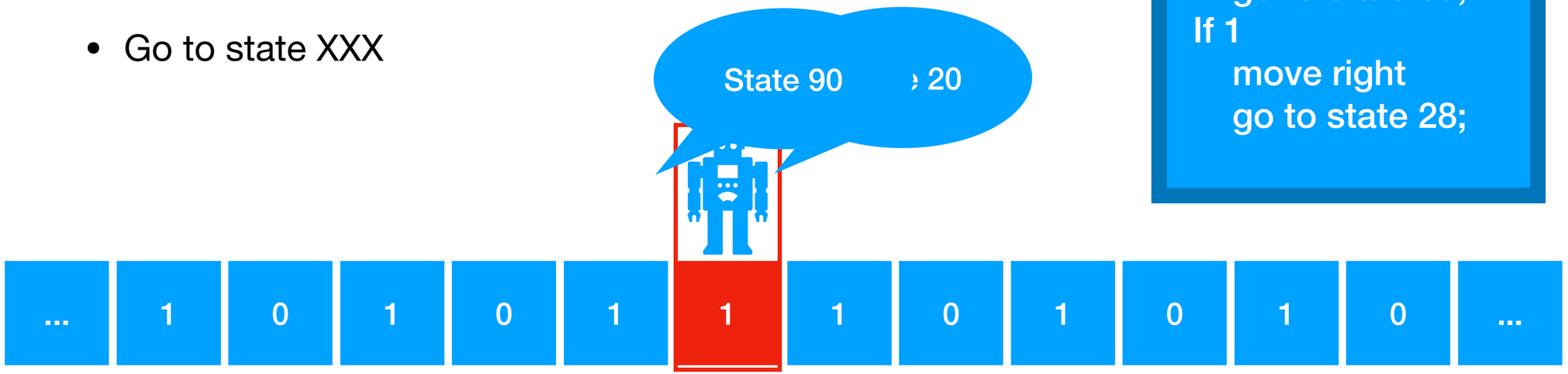
P1
History

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

State 20

If 0
  rewrite to 1
  move left
  go to state 90;
If 1
  move right
  go to state 28;



Concept

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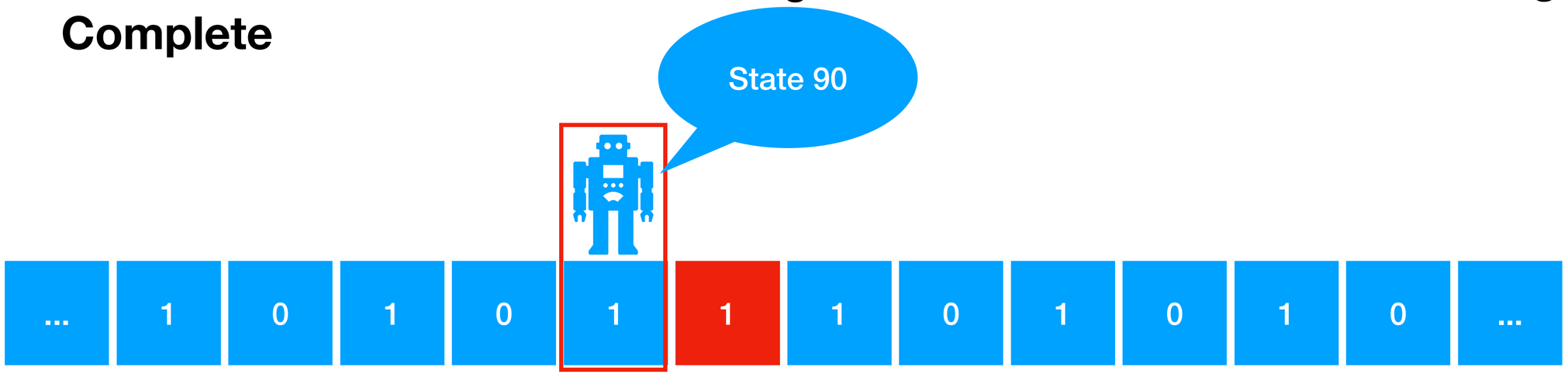
P1
History

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

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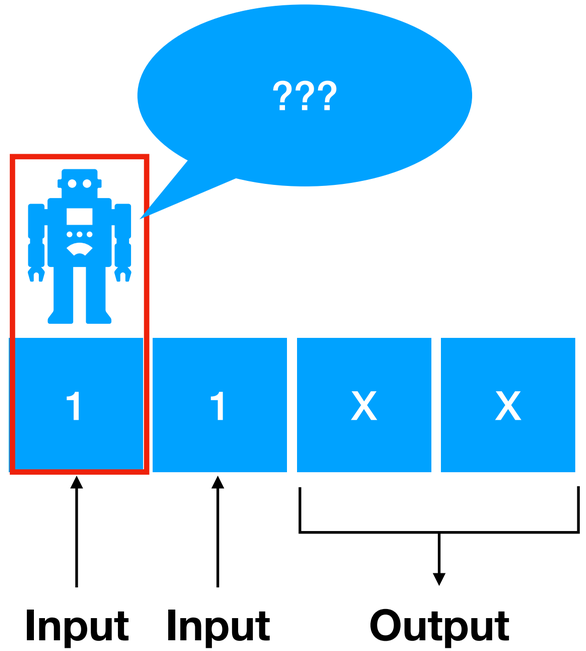
P1
History

Turing Machine

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

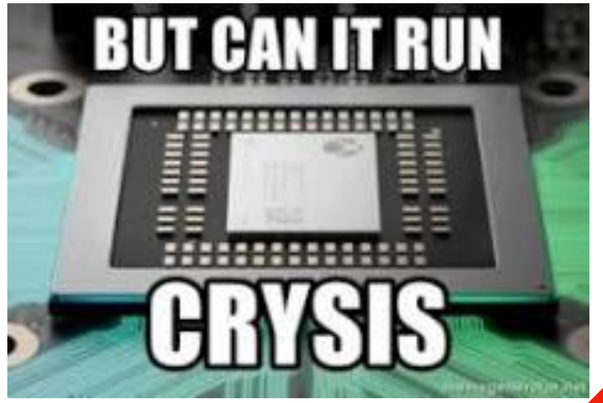


Thinking

1. https://plato.stanford.edu/entries/turing-machine/#TuriDefi

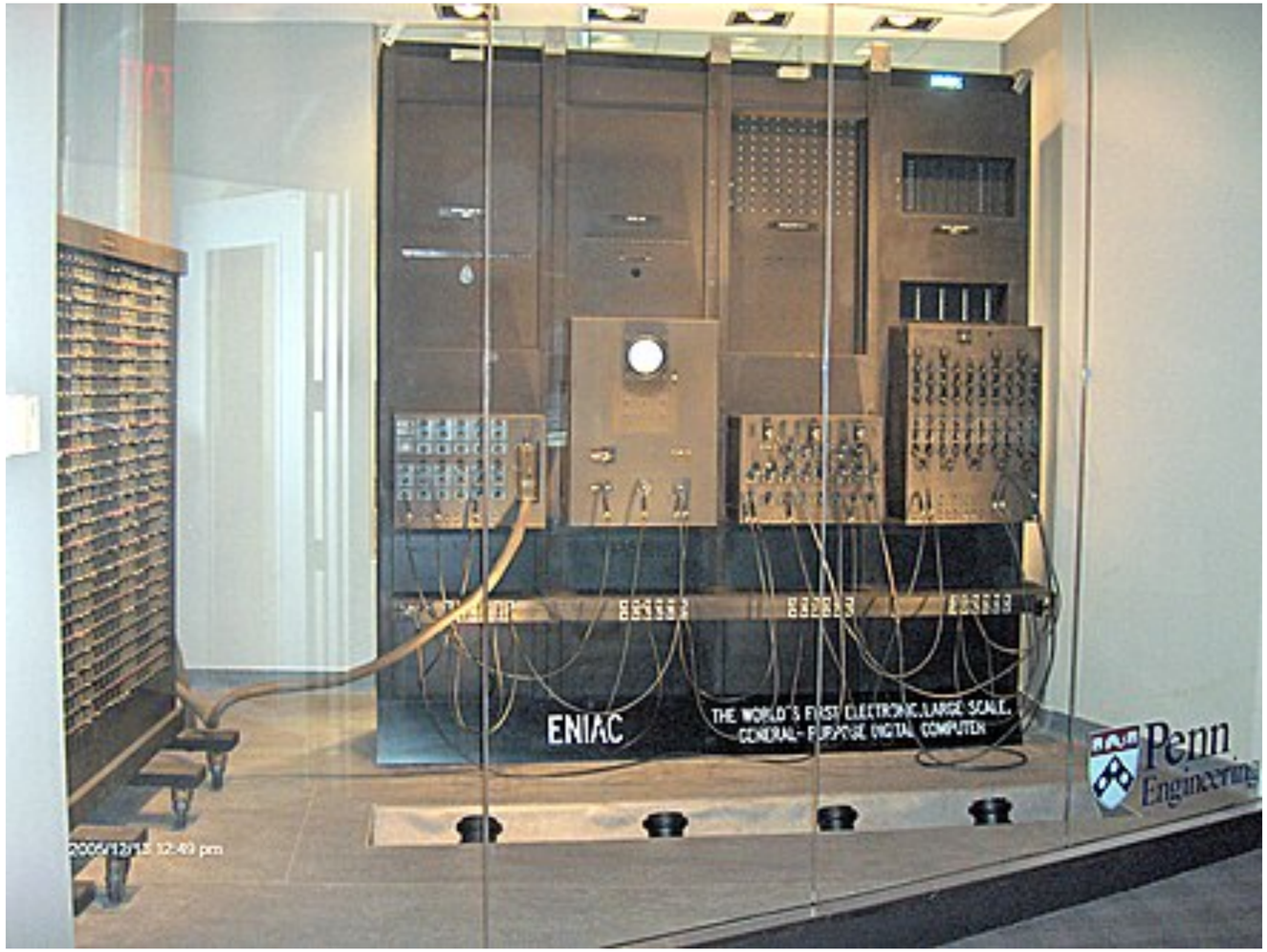
Interesting Digital Computers in History

- 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**
  - 100kHz
  - Is Turing complete! In theory, it can run Crysis!



P1
History

Interesting Digital Computers in History



Concept

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

P1
History

Interesting Digital Computers in History

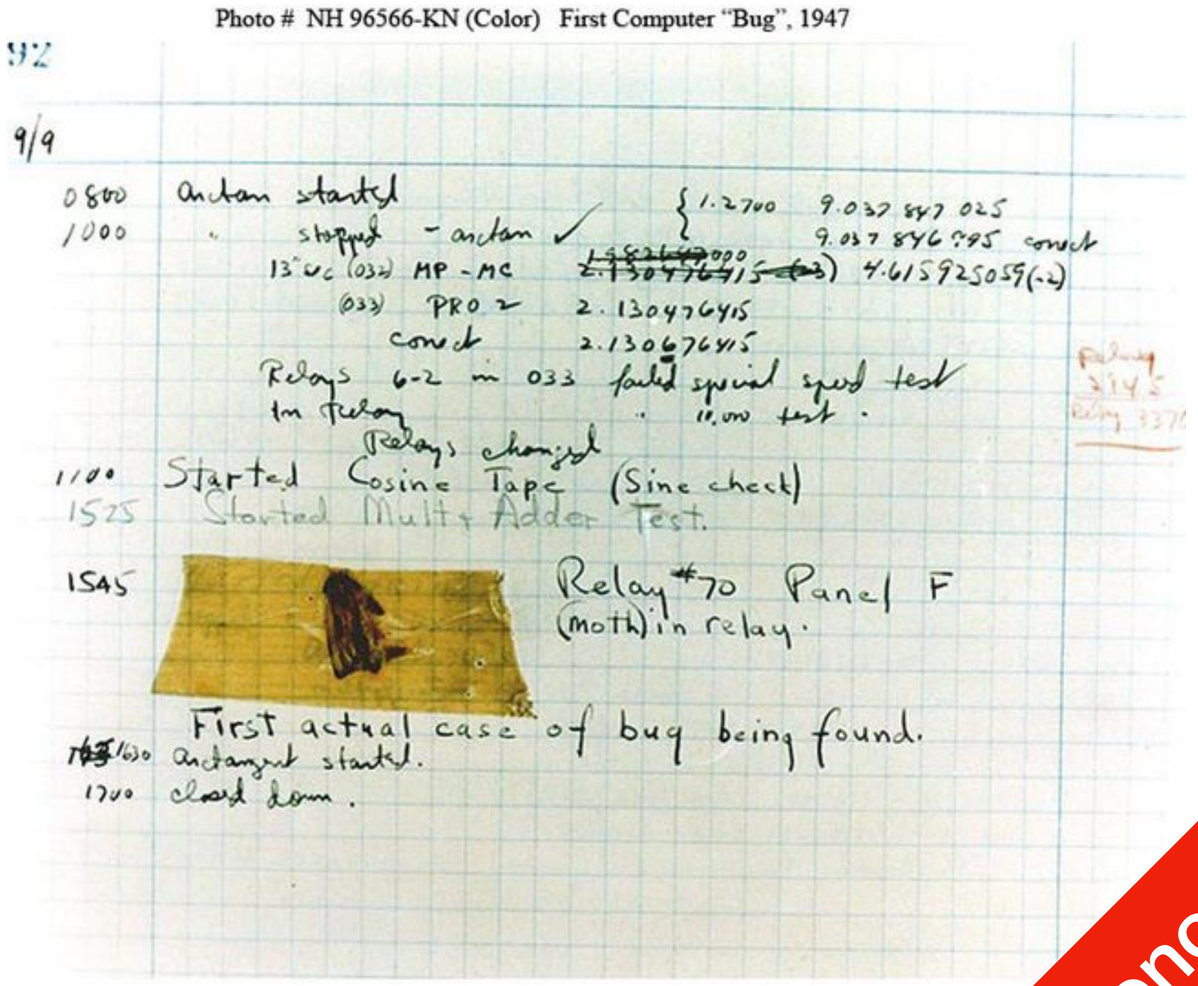
- Potential presentation topics:
  - Generations of MicroComputers 
  - How is ENIAC Turing Complete? 

Concept

P1
History

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



Concept

P1
History

Interesting Digital Computers in History

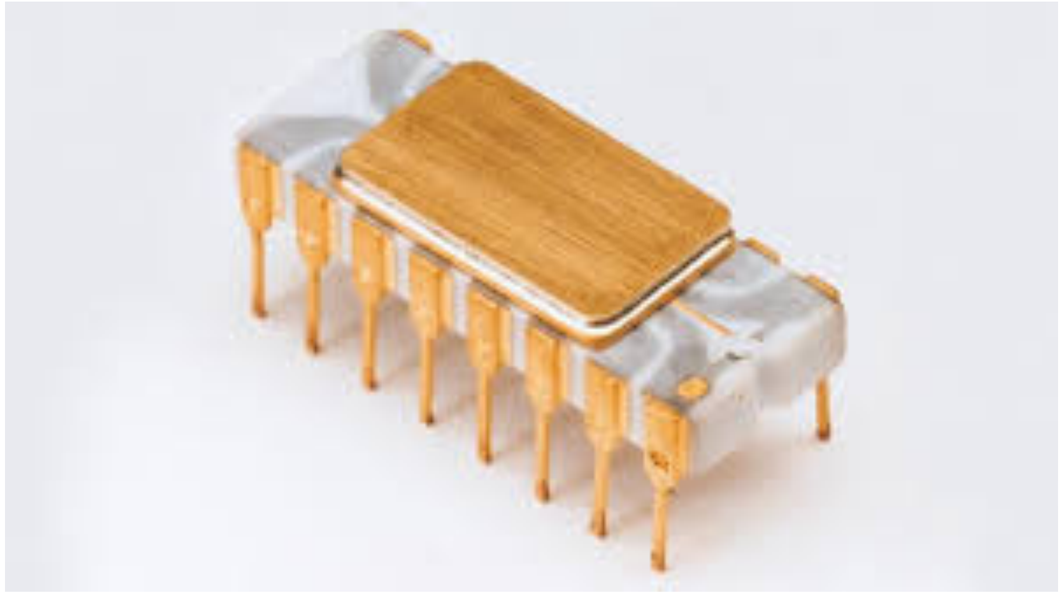
- 1966: Apollo Guidance Computer
  - First silicon-based integrated circuit processor (CPU)
  - 2MHz speed
  - 2,800 transistors
    a 2010 Intel CPU have 560 million

Concept

P1
History

Interesting Digital Computers in History

- 1971: Intel 4004
  - 740 kHz, first consumer LSI CPU
    4bit CISC Architecture
  - Originally designed for a printer
  - 2,300 transistors
    a 2010 Intel CPU have 560 million



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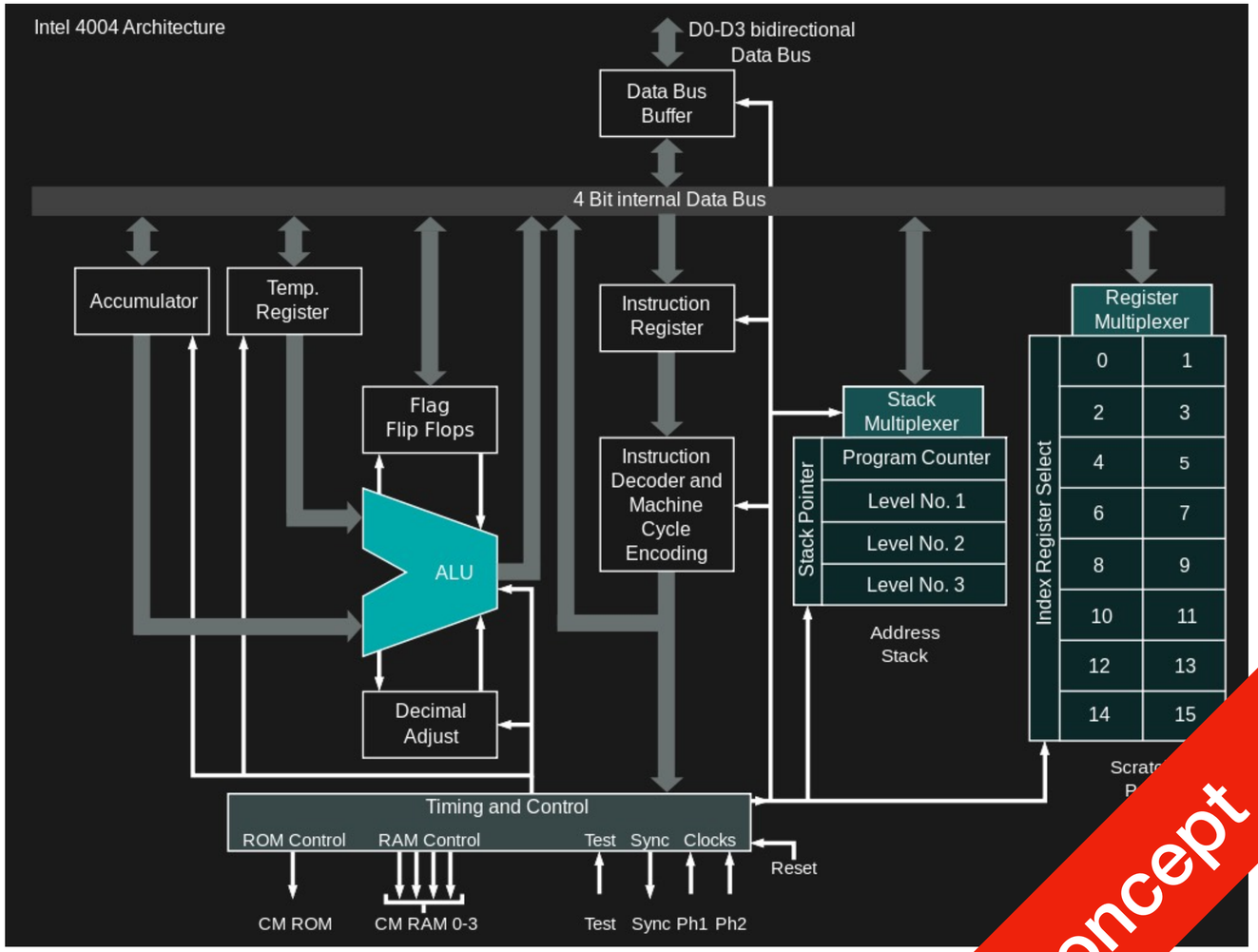

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History

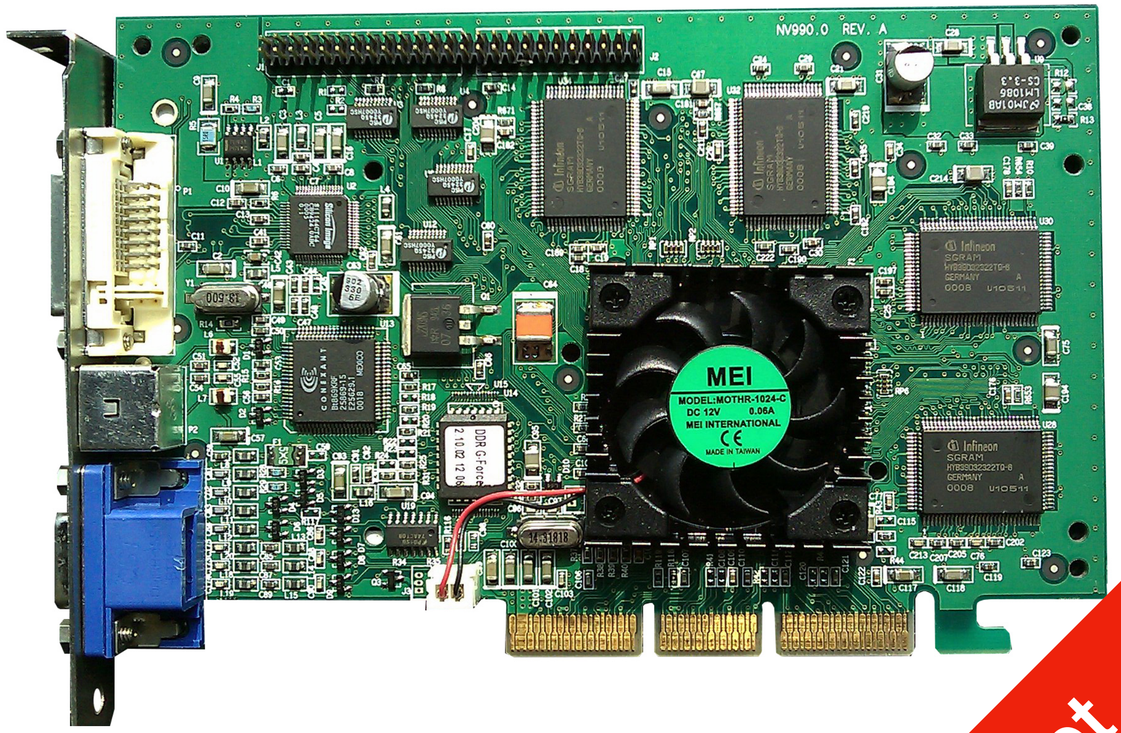
Interesting Digital Computers in History

- 1976/7: first Personal Computer, the Apple I and II
  - Steve Jobs and Wozniak
    - Apple I was only avail as kit computer
    - Apple II is also the first computer that could output Colour, hence the colourful Apple Logo

Concept

Interesting Digital Computers in History

- 1999: GeForce 256, the first swappable GPU (integrated video processors existed)
  - 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



Concept

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History

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 2019[1]
  - Why?
  - People started to look elsewhere: parallel, quantum, etc.

Concept

1. https://www.technologyreview.com/2020/02/24/905789/were-not-prepared-for-the-end-of-moores-law/

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

1. Advanced Research Projects Agency Network

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