

# IS2020 COMP 2540: Data Structures and Algorithms

## Lecture 00(II): A Brief History of Computer Science

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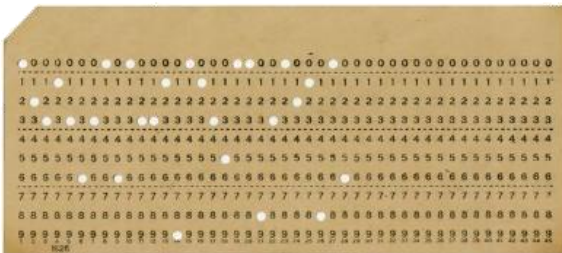
# A Brief History of Computer Science

- Watch the BBC documentary:
  - <https://www.youtube.com/watch?v=6dME3wgaQpM&list=PL1331A4548513EA81&index=1>
- Late 19th / Early 20th Century – Mechanization of Labor
  - Industrial Revolution – Began in the 1840s
  - Development of the assembly line
  - Each person on the line performed a task that was a single part of the entire process
  - By the early 20th century, machines had the capability to perform tasks at a faster rate than humans.
- The next logical step: If we can mechanize tasks of the body, can we mechanize tasks of the mind?

# A Brief History of Computer Science

- Difference Engine and Analytical Engine

- Invented by Charles Babbage in 1822 and 1834.
- It is the first mechanical computer.
- In 1840, Augusta Ada Byron suggests to Babbage that he use the binary system.



- 1890: Hollerith's Punched Card Solution

- Contained ASCII values to be processed by a machine
- Initially used to store and structure Census data
- Reduced census data computation time by 80%

- 1934: Z1 Computer

- World's first freely programmable computer
- First device to use a control unit that was independent of the punch card
- Predecessor of the CPU, such as the Pentium IV.



# A Brief History of Computer Science

- Computation in World War I

- HMS Dreadnought Class

- Long range weapons used the target's range, bearing, and speed were input into a mechanical computer to generate an aiming command
    - Lookup tables calculated the guns' elevation and azimuth at the moment of firing to acquire the target

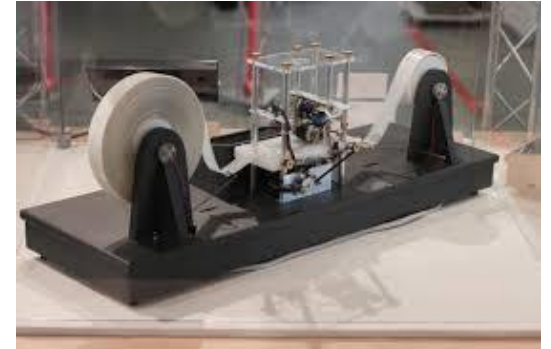
- ASDIC Sonar (SOund NAvigation Ranging)

- Sends a sound wave, and calculates the distance based on return time
    - Initial research began after the RMS Titanic sank to detect icebergs
    - Quickly developed to detect German U-boats

# A Brief History of Computer Science

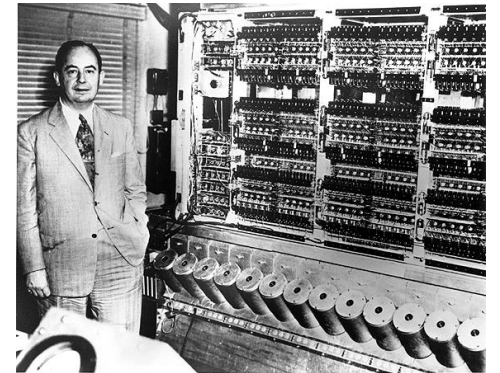
- 1936: Turing machine

- A mathematical model of computation that defines an abstract machine.
- Alan Turing provided a solution to Hilbert's Entscheidungsproblem by constructing a formal model of a computer.
- Alan Turing provided a new concept of both algorithms and the process of calculations with the invention of his Turing Machine.



- 1944: EDVAC

- John von Neumann designed a stored-program electronic computer.



# A Brief History of Computer Science

- Computation in World War II - Lorenz Cipher and Colossus
  - Lorenz Cipher
    - Used cryptography to make secure communications from Hitler to his armies
    - Used a plaintext and a cipher (adding a character to the original) to hide the transmission
  - Allies broke Lorenz, but translating by hand took weeks
    - By the time it was broken, the information was useless
  - Colossus
    - The world's first large-scale electronic computer
    - Reduced breaking Lorenz from weeks to hours
    - Gained intelligence crucial to the Allies' success in the D-Day landings and the rest of European campaign

# Data structures and Algorithms

- Main aspects of advanced code implementation within a computing device
  - **Data structure** - a collection of data values, the relationships among them, and the functions or operations that can be applied to the data
  - **Algorithm** - a process or set of rules to be followed in calculations or other problem-solving operations

# Data structures and Algorithms

- Why Do They Go Together?
  - Computing systems are concerned with the **storage and retrieval** of information.
  - For systems to be economical the data must be organized (into data structures) in such a way as to support efficient manipulation (by algorithms).
  - Choosing the wrong algorithms and data structures makes a program slow at best and unmaintainable and insecure at worst.



# Data structures and Algorithms

- The five key benefits of data structures
  - In general, the more sophisticated the data structure, the simpler the algorithm.
  - Simple algorithms are less expensive to develop.
  - There is less code to read and comprehend.
  - The logic is simpler, and modifications are less likely to introduce errors.
  - It's usually much easier to repair defects, make modifications, or add enhancements.

# So, what exactly is Computer Science?

- Do not think of the computer as the solver of problems.
  - The coder solves the problem, and then tells the computer how to do it.
- Computer science is better defined as the study of the use of machines to efficiently implement human computation.
  - “The hardest concept to grasp when one first tries to use a computer . . . These machines have no common sense; they do exactly as they are told, no more and no less” – Donald Knuth, The Art of Computer Programming
- “*Efficiently* implement human computation”
  - To do so efficiently, you must learn the best approaches to *structuring data*