08 – STORED PROGRAMS AND MICRO-INSTRUCTIONS

COMP256 – COMPUTING ABSTRACTIONS

DICKINSON COLLEGE

PHYSICALLY PROGRAMMED COMPUTERS

- *Physically programmed computers* were physically reconfigured into a machine that performs the desired computational task. "Programming" involved rewiring and setting knobs and switches.

Colossus – 1945
Tommy Flowers
Bletchley Park, UK

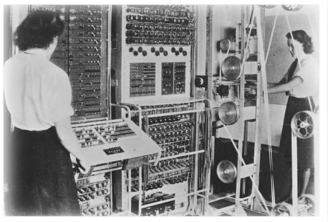


Image from: https://www.nationalarchives.gov.uk/education/worldwar2/theatres-of-war/atlantic/investigation/battle-of-the-atlantic/sources/photos/1/

ENIAC – 1945
John Mauchly, J. Presper Eckert
University of Pennsylvania

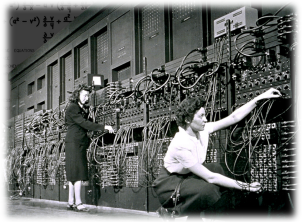


Image from: https://spectrum.ieee.org/tech-talk/tech-history/dawn-of-electronics/untold-history-of-ai-invisible-woman-programmed-americas-first-electronic-computer

STORED PROGRAM COMPUTERS

- *Stored program computers* store both the instructions for the program (the computational task) and the data on which it operates in the the computer's main memory.

EDSAC – 1949
Maurice Wilkes
Cambridge UK

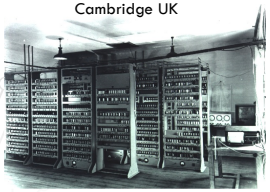


Image from: https://en.wikipedia.org/wiki/EDSAC

EDVAC – 1949
John Mauchly, J. Presper Eckert
John Von Neuman, University of PA

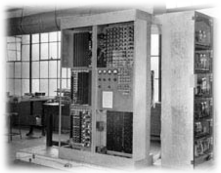


Image from: https://www.thocp.net/hardware/edvac.htm

Manchester Mark I – 1949
Frederic C. Williams, Tom Kilburn
Manchester, UK

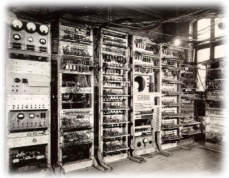
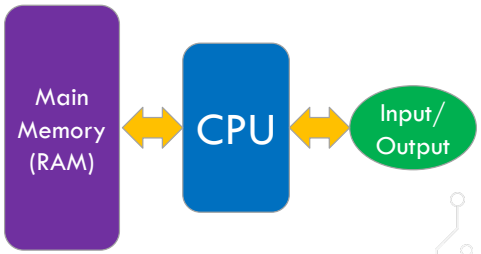


Image from: https://en.wikipedia.org/wiki/Manchester_Mark_1

THE STORED PROGRAM ARCHITECTURE

- The *stored program architecture* has three main components:
  - *The Central Processing Unit (CPU)* performs computations and controls the flow of data and instructions.
  - *The Main Memory* stores the program instructions and data of currently running programs.
  - *Input/Output Devices (I/O)* store programs and data not currently in use and allow user interaction.



STORED PROGRAM ARCHITECTURE

- All of the elements of the stored program architecture are inside the box!

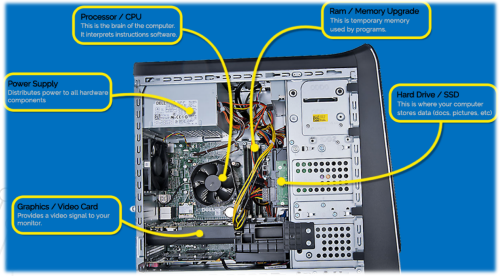


Image from: https://www.kindpng.com/imgv/iRhRJhh_old-computer-diagram-wiring-diagram-g11-computer-components/

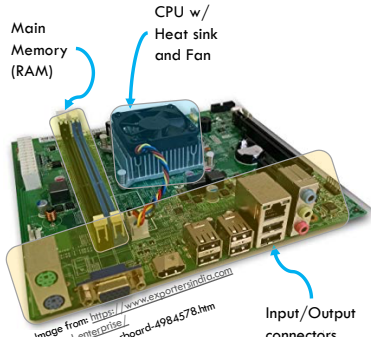
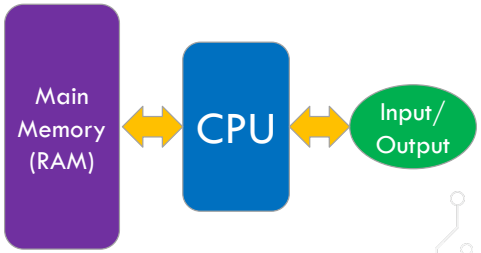


Image from: https://www.exportersindia.com/national-enterprise/computer-motherboard-4984578.htm

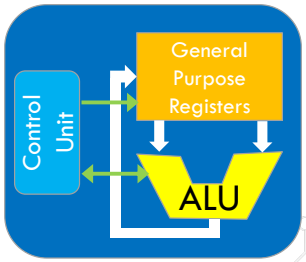
INSTRUCTION CYCLE

- Stored program machines run a continuous *instruction cycle* with three phases that are repeated:
  - In the *fetch phase* the next instruction to be executed is moved from main memory to the CPU.
  - In the *decode phase* the CPU examines the instruction and figures out what must be done.
  - In the *execute phase* the CPU controls the computer and causes it to carry out the instruction.

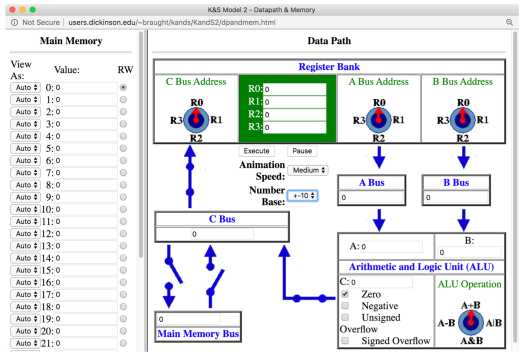


THE CPU

- The CPU is made up of three interconnected components that control the machine and perform computations:
  - The *Arithmetic and Logic Unit (ALU)* performs computations on data (add, subtract, and, or, etc.)
  - The *General Purpose Registers* provide the input data to the ALU and stores its results.
  - The *Control Unit (CU)* coordinates the other components of the computer (internal and external to CPU) so that that the instruction is carried out.

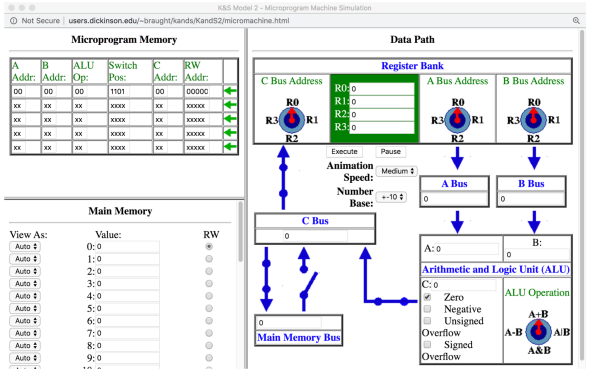


A SIMPLE "MANUAL" CPU



http://users.dickinson.edu/~braught/kands/KandS2/dpandmem.html

A CPU WITH MICRO-PROGRAMMING



http://users.dickinson.edu/~braught/kands/KandS2/micromachine.html

ACTIVITIES:

- Write micro-programs that compute:
  - MM[2] = MM[1] + MM[2]
    - Hand enter values in to MM[1] and MM[2] to start.
  - MM[3] = MM[2]
    - Hand enter a value into MM[2]
    - Do not assume 0 or any other specific value in a register or other MM locations.