31268 Web Systems

UNIVERSITY OF TECHNOLOGY SYDNEY
Faculty of Information Technology

Week 07: Computer Science 1

Part 1: Computer Architecture

- And now for something different….
- The next 2 lectures cover computer science theory…

- **Recap: Theory!!**
  - This is a foundation subject

→ **You need to learn some computer science theory!!!**

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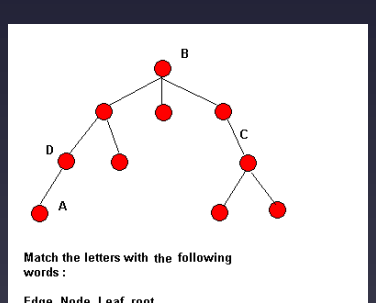

- file systems

- complexity theory
- information representation – binary, hex
- Logic - Boolean algebra, binary arithmetic
- computation theory, memory, coding

10101010 = 0xAA

not(A and B) = not(A) or not(B)

Mathematics and Computer Science

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- **Storage and processing of information**
  - History of computing
  - Computation
  - Memory
  - Coding
- **Under the bonnet**
  - Representation of information
  - Number systems
- **Logic and Mathematics**
  - Boolean Algebra
  - Binary Arithmetic

Early history of Computers

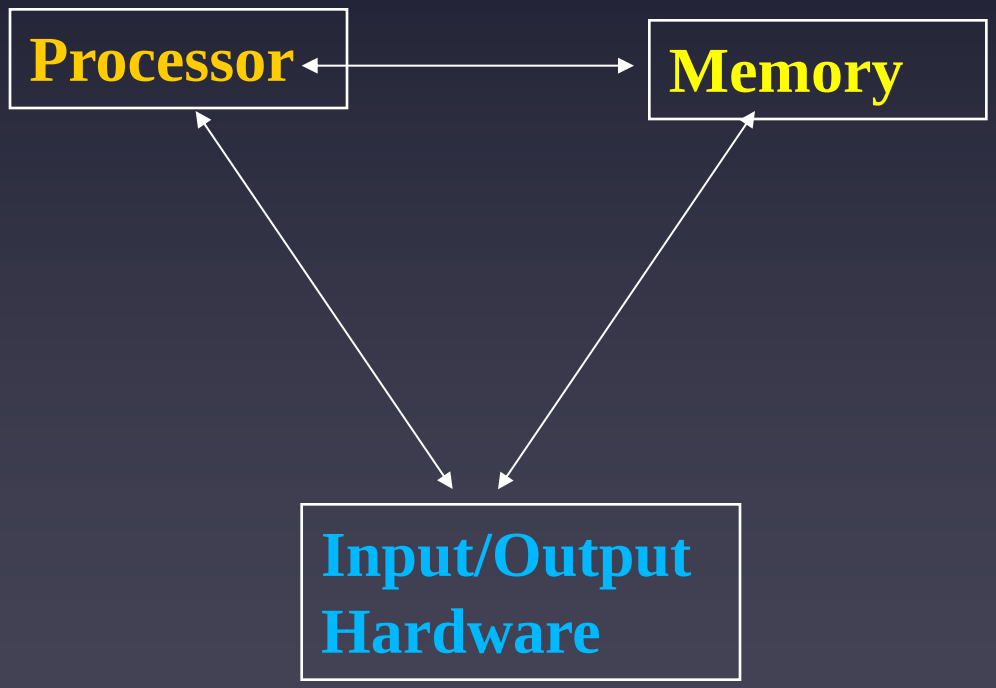
- Charles Babbage (1791-1871)
  - English mathematician, inventor and reformer
  - Designed the Analytic engine - the first modern computer (it was never built)
- Luigi Menabrea (1809-1896)
  - Italian mathematician and politician
  - Extended and published Babbage's design
- Lady Ada Lovelace (1815-1852)
  - Daughter of English poet Lord Byron
  - Translated and extended Menabrea's paper
  - Helped secure funding toward the construction of the analytic engine

Definition of Computer

From Shelly/Cashman:

- "An electronic machine operating under the control of instructions stored in its own memory, that can accept data, manipulate the data according to specified rules, produce results, and store the results for future use."

Computer Architecture



John von Neumann

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- **Hardware**
  - CPU – central processing unit
    - e.g. Intel Core 2 Duo
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  - Storage
    - e.g. flash, hard drive, DVD

Memory

Memory stores programs and data, encoded as binary numbers, to be accessed by the processor.

Memory types :

- ROM: Read Only Memory
  - Permanent information
- RAM: Random Access Memory
  - Computer forgets it when it's off
  - Programs change the contents

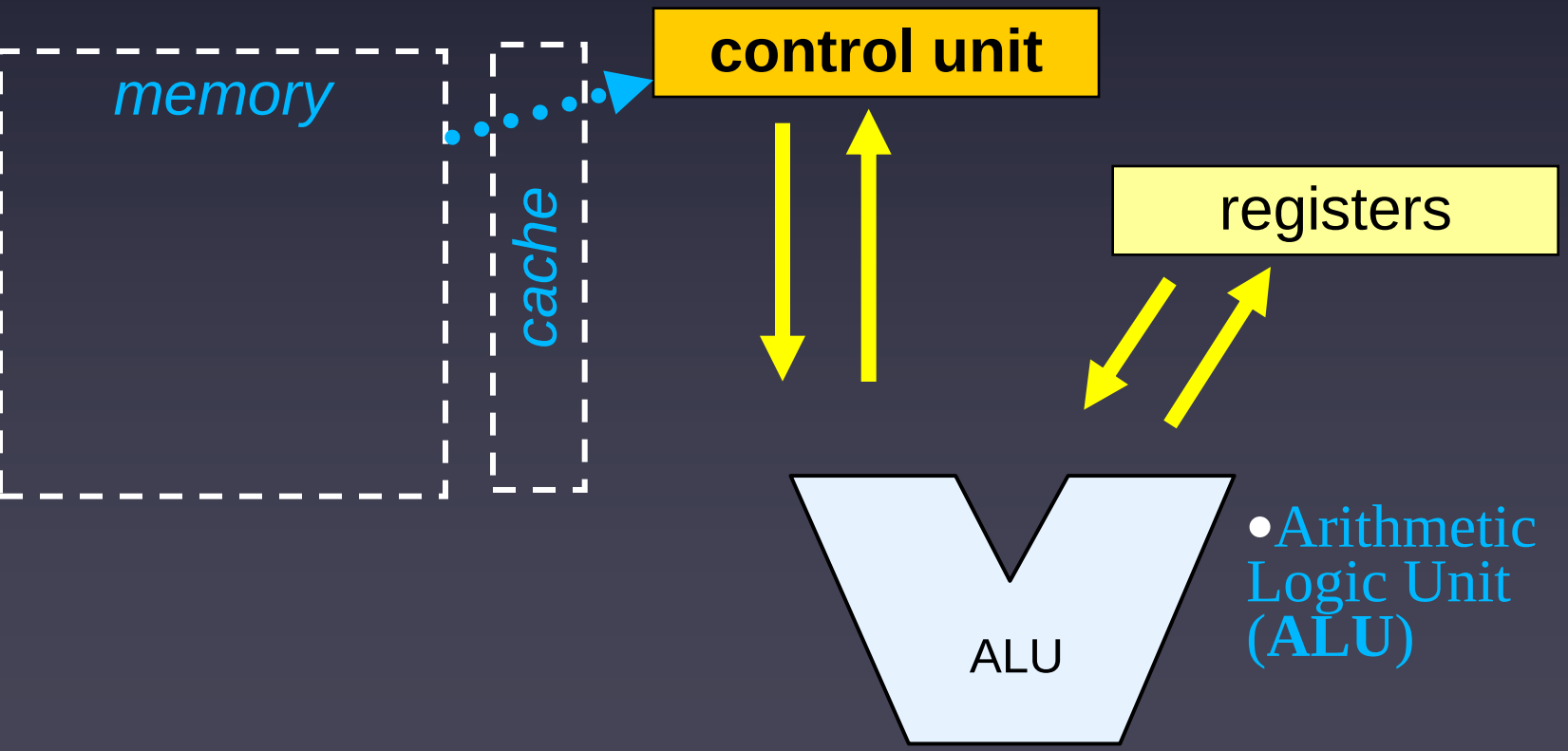
I/O Hardware

- Input Devices:
  Keyboard, Mouse, Microphone, Scanner…
- Output Devices:
  Monitor, Printer, Projector…
- Network devices: ethernet, wifi..
- Storage:
  Disks, Tapes, flash …

  etc etc

Central Processing Unit (CPU)

- The Central Processing Unit (CPU) consists of three main parts:



Processor

The Central Processing Unit (CPU) consists of three main parts:

- Arithmetic Logic Unit (**ALU**)
  - performs arithmetic and logical operations
- **Control Unit**
  - Sets up ALU with instructions and data from memory
  - Often use cache for faster memory access
- Registers
  - Small, fast memory in the CPU
  - loaded by the control unit
  - accessible by the ALU

Processor Function

The processor executes instructions on data using a **Fetch-Execute** cycle:

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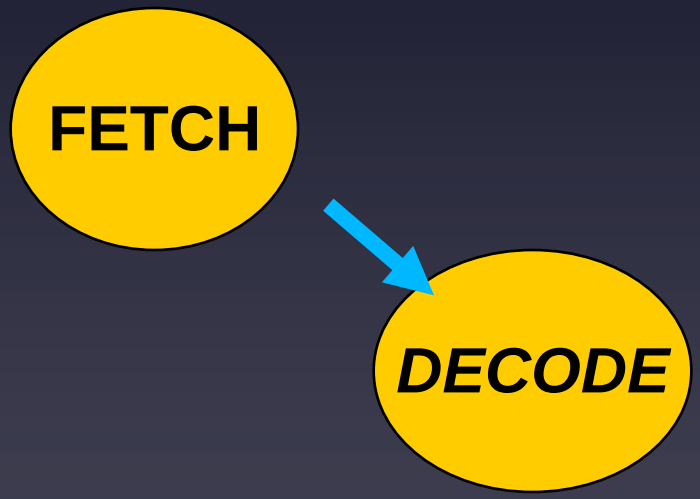

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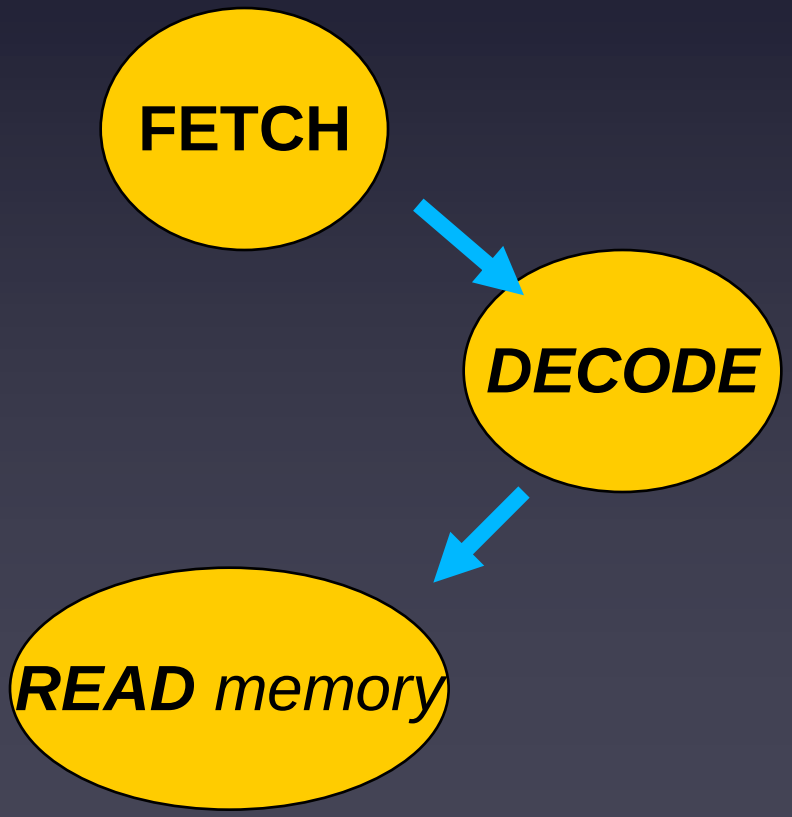

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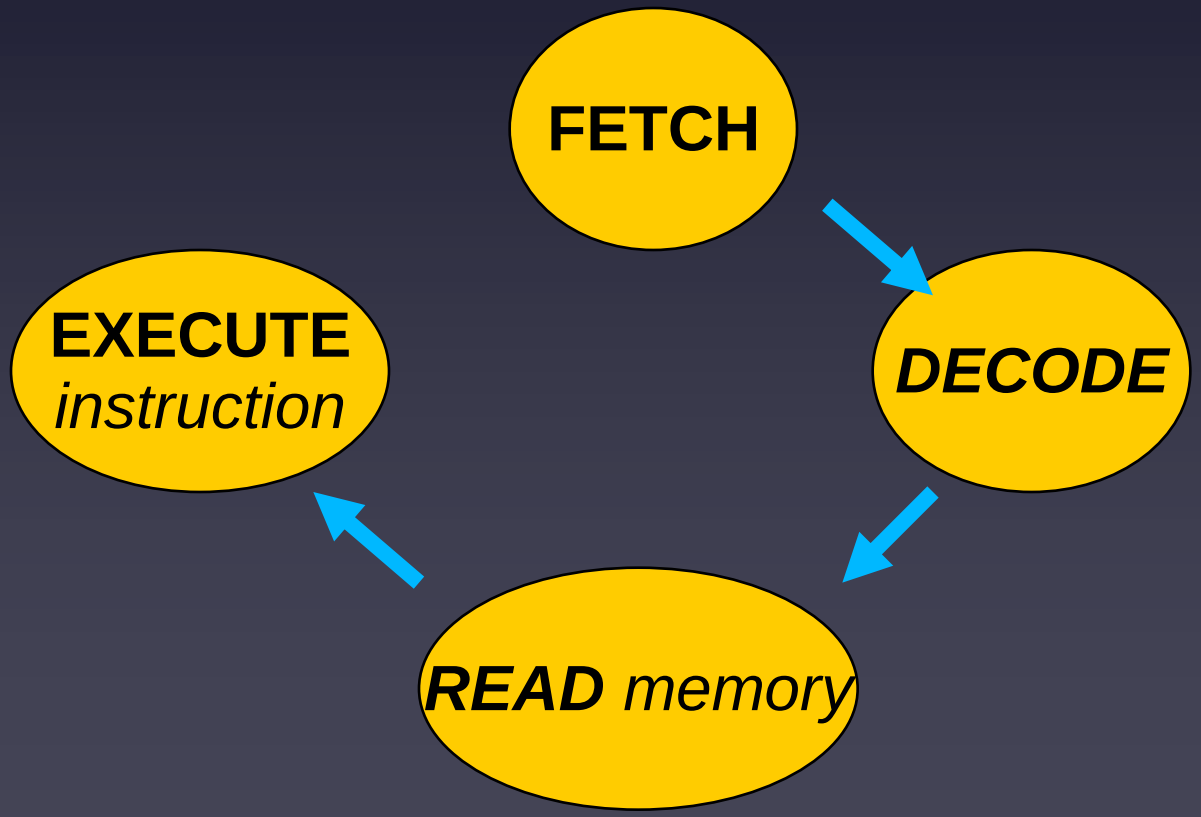

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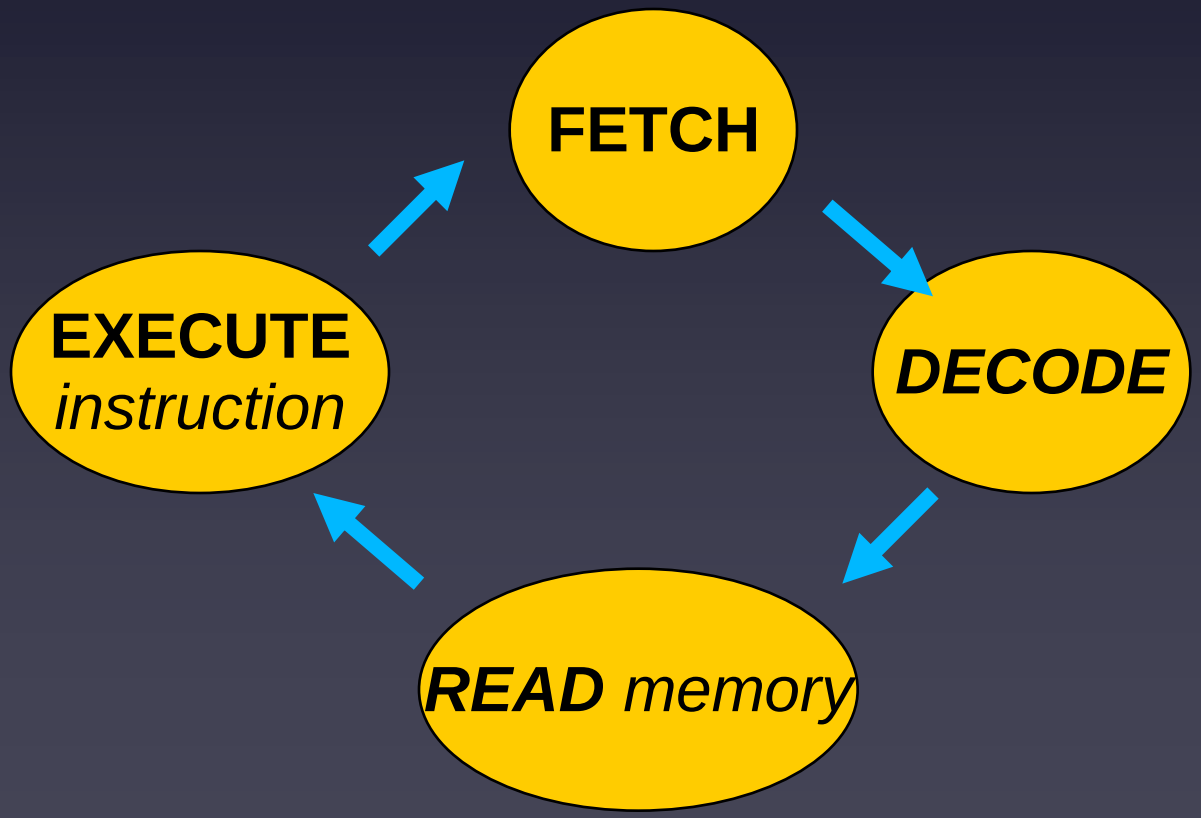

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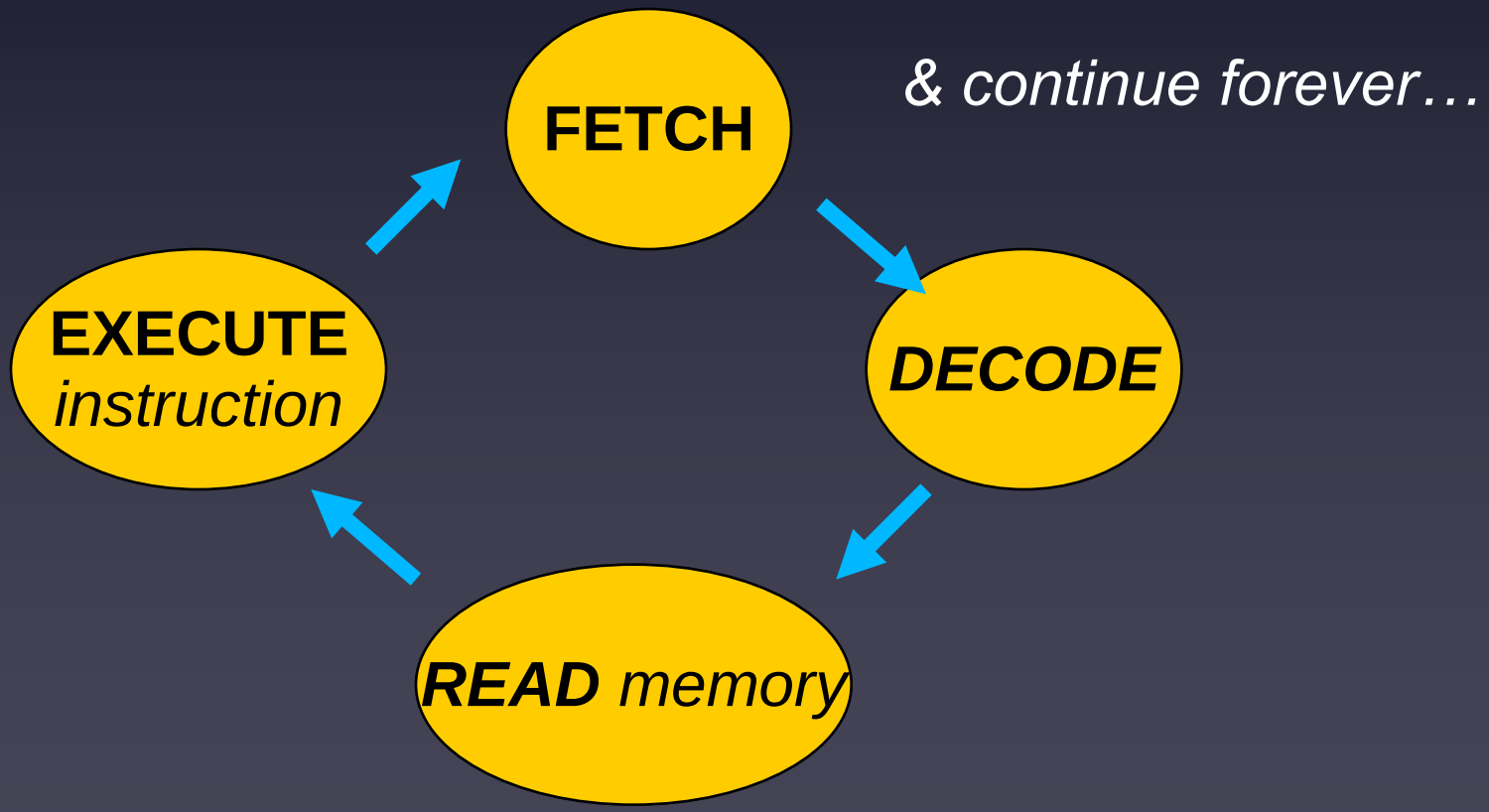

Last words on CPU etc

- All CPU's do this fetch-execute cycle
- There are improvements (like hyperthreading, multiple CPU's,etc) but this is the basics.
- Instructions tell the CPU what to do, and depending on the architecture and instruction
  → load data from memory as needed

Questions?

- ???

- Are there other computing architectures out there?

- *https://en.wikipedia.org/wiki/Von_Neumann_architecture*

Hint: Modified Harvard architecture ?