COMP110: Principles of Computing

1: Computing Foundations

Learning outcomes

By the end of today's session, you will be able to:

- **Recall** the historical context of computing and gaming technology
- **Explain** the basic architecture of a computer
- **Distinguish** the most common programming languages and paradigms in use today

Today's agenda

- COMP110 course outline
- History of computing
- Computer architecture
- Programming languages and paradigms

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Course introduction

From the module guide

This module is designed to introduce you to the basic principles of computing and programming in the context of digital games. It is designed to complement the other modules through providing a broad foundation on the different methods and techniques which will help you to be able to construct computer programs and able to use relevant scholarly sources. You will gain an understanding of software development and the various roles, pipelines, and terminology used within game development.

Topic schedule

On LearningSpace...

Timetable

`http://mytimetable.falmouth.ac.uk`

- Odd numbered weeks:
  Monday **13:30**
  P/PL/Seminar 08 (here)
- Even numbered weeks:
  Monday **09:00**
  P/PL/Games Teaching Space

Worksheet A

- SpaceChem!
- Due in class on **Monday 26th September** (next week)

Reading

C. Horsman, S. Stepney, R.C. Wagner and V. Kendon, 2014. When does a physical system compute? *Proceedings of the Royal Society A*, 470:20140182.
Available online:
`http://rspa.royalsocietypublishing.org/content/royprsa/470/2169/20140182.full.pdf`

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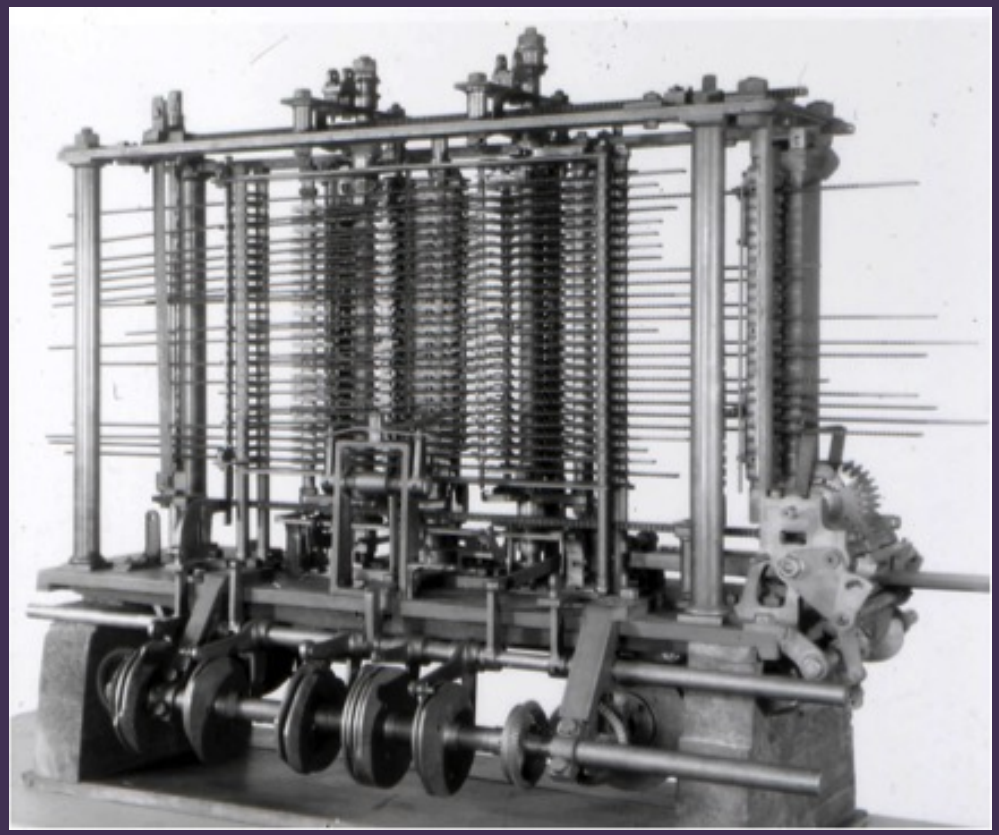
What was the first computer?

Antikythera Mechanism ($\sim$150 BC)

First mechanical computer?

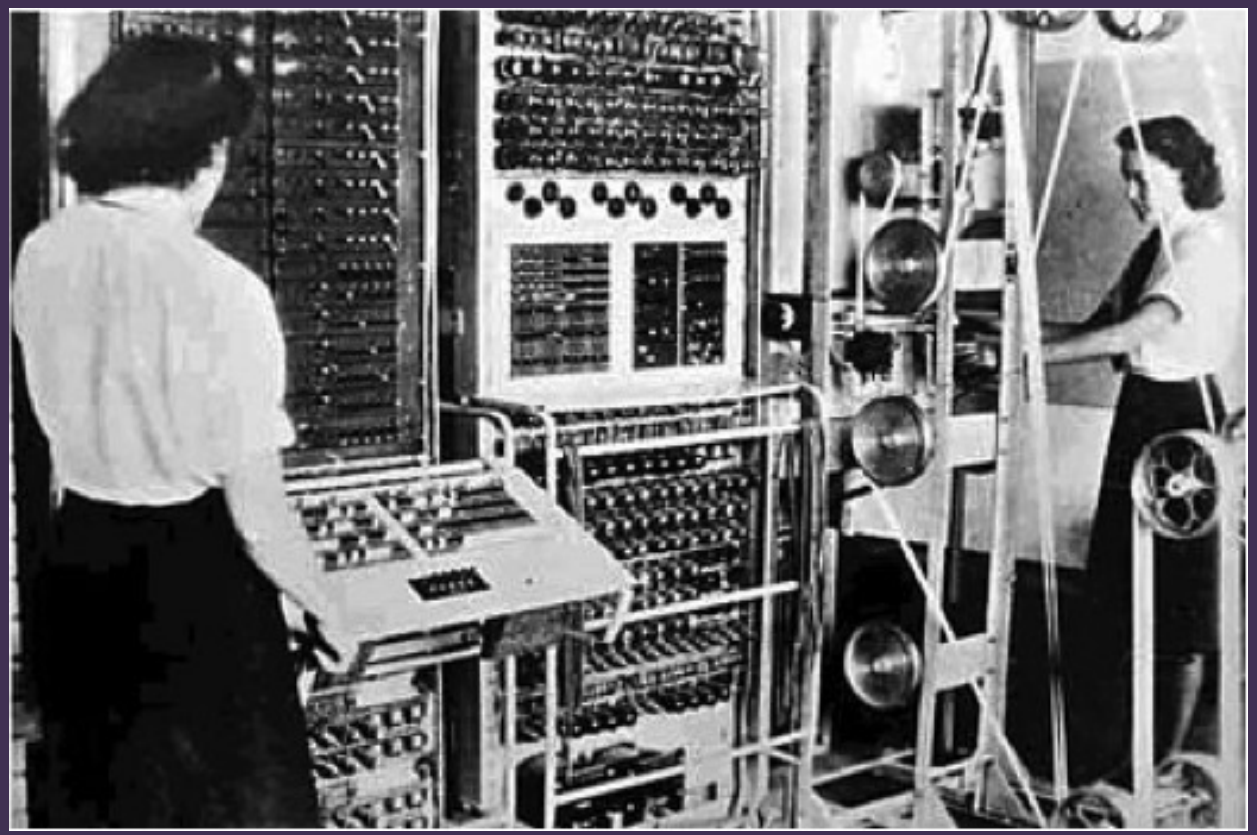
Babbage's Difference and Analytical Engines (1837)

First mechanical computer in modern age



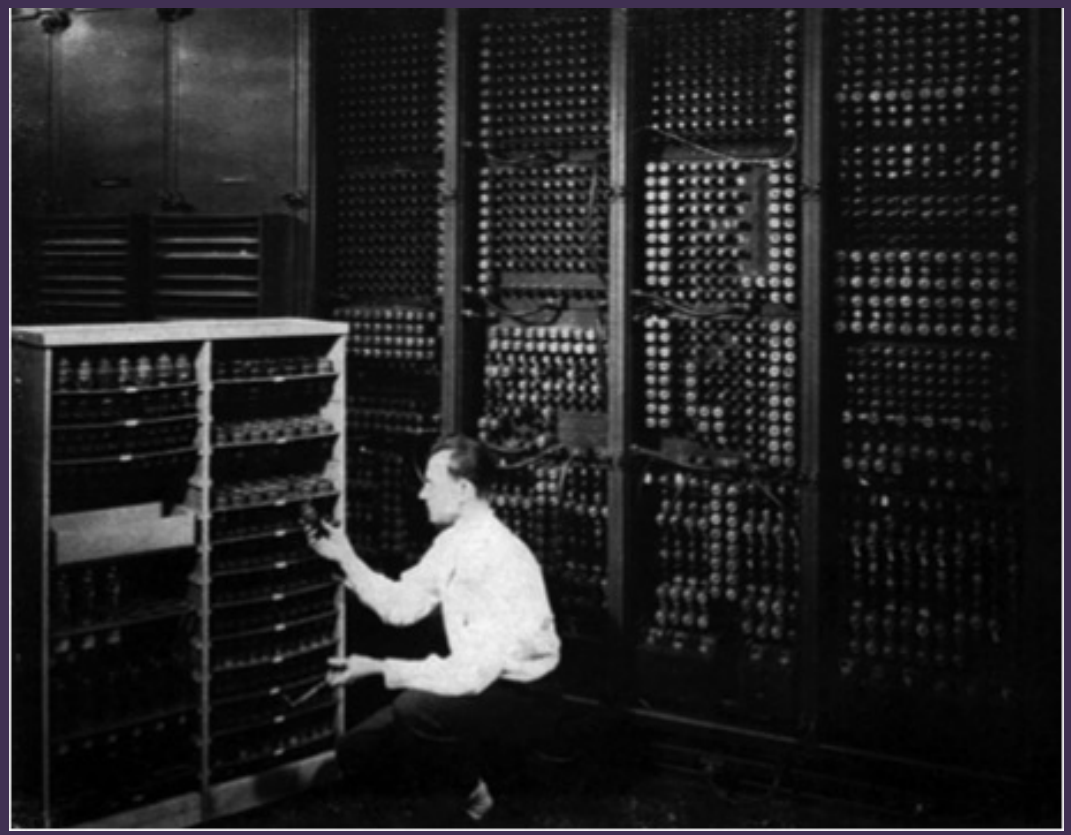
Colossus (1943)

First programmable electronic computer



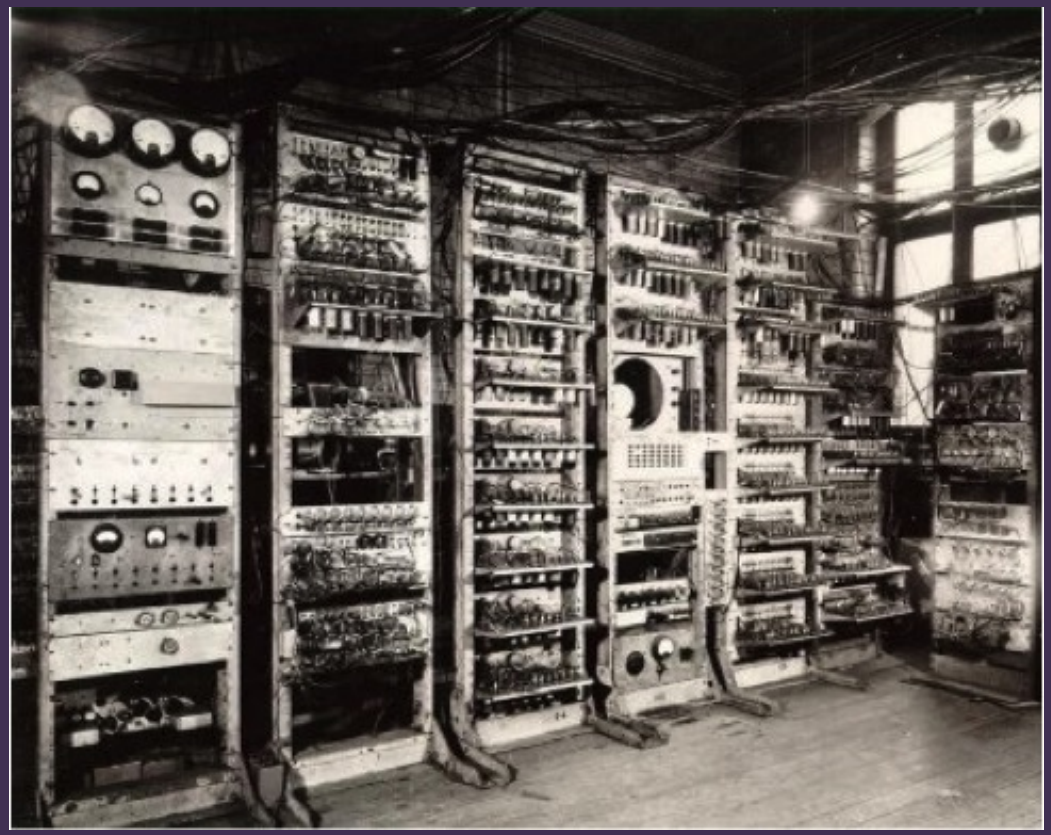
ENIAC (1946)

First general-purpose computer



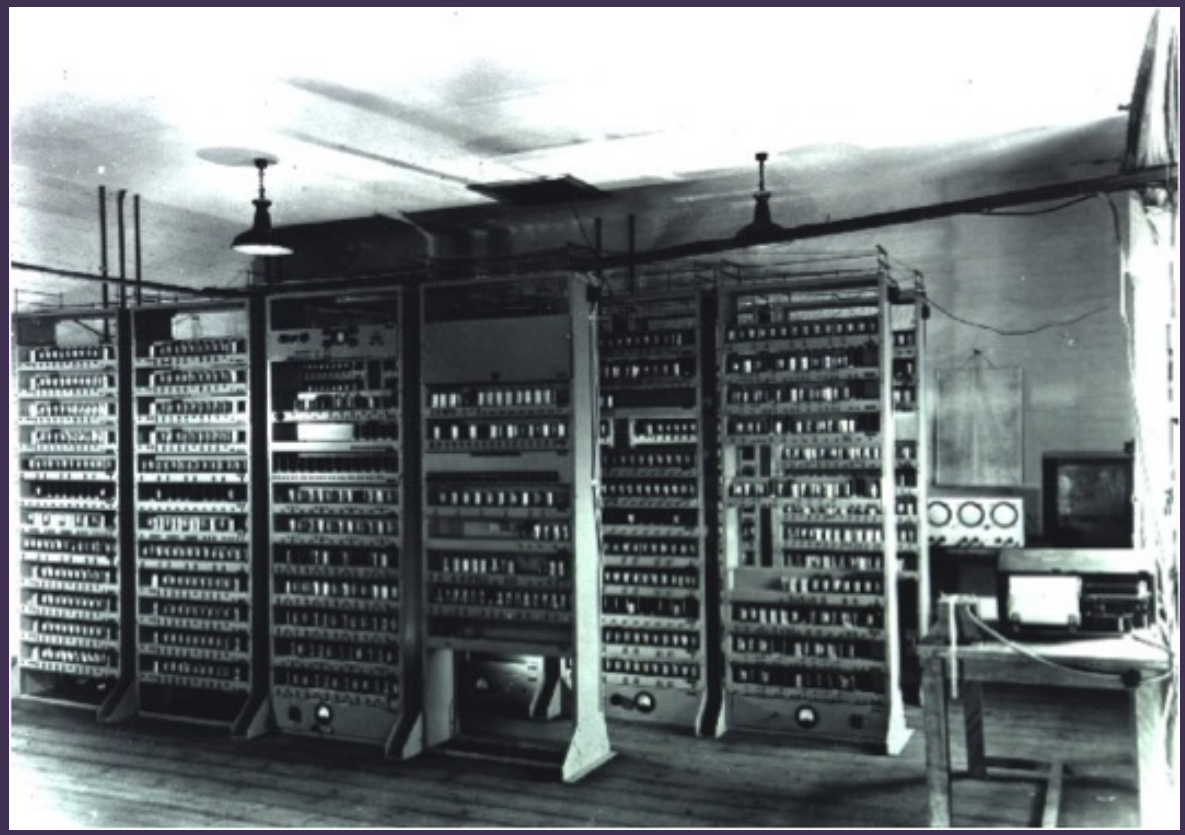
Manchester Small-Scale Experimental Machine (1948)

First stored program computer



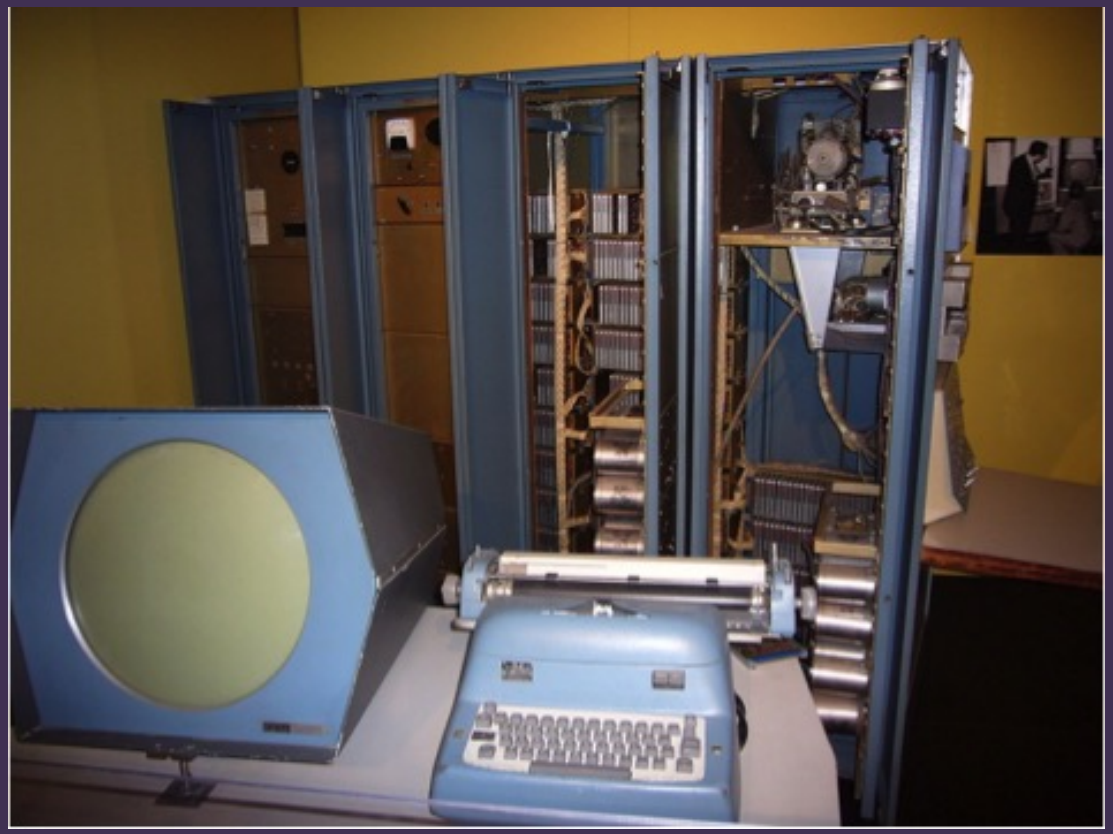
EDSAC (1949)

Many firsts in mathematics and science



PDP-1 (1959)

Influenced “hacker culture”



Datapoint 2200 (1970)

First microcomputer

Commodore VIC 20 (1980)

First computer to sell 1 million units

IBM Personal Computer Model 5150 (1981)

Precursor to the modern PC

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What was the first computer game?

Cathode Ray Tube Amusement Device (1948)

First interactive electronic game

Chess AI on the Ferranti Mark I (1951)

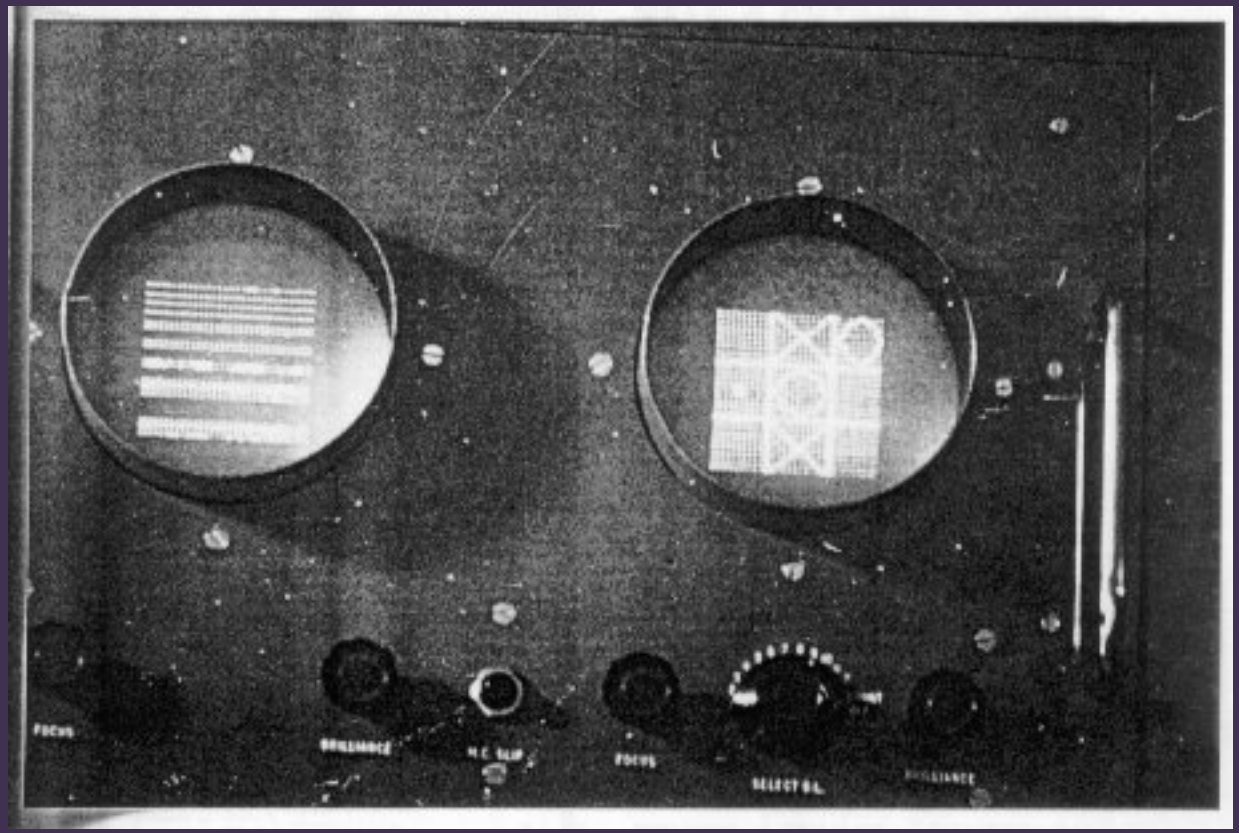
First chess program

Bertie the Brain (1950)

First computer game with a visual display

OXO (1951)

First game with visuals on a general-purpose computer



Tennis for Two (1959)

First to be created purely for entertainment

SpaceWar! (1962)

First widely available game, inspired first arcade games

Pong (1972)

First commercially successful game

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What was the first games console?

The Brown Box (1967)

First prototype console

Magnavox Odyssey (1972)

First commercial console

Game console timeline

http://www.onlineeducation.net/videogame_timeline/video-game-timeline.jpg

(A little out of date!)

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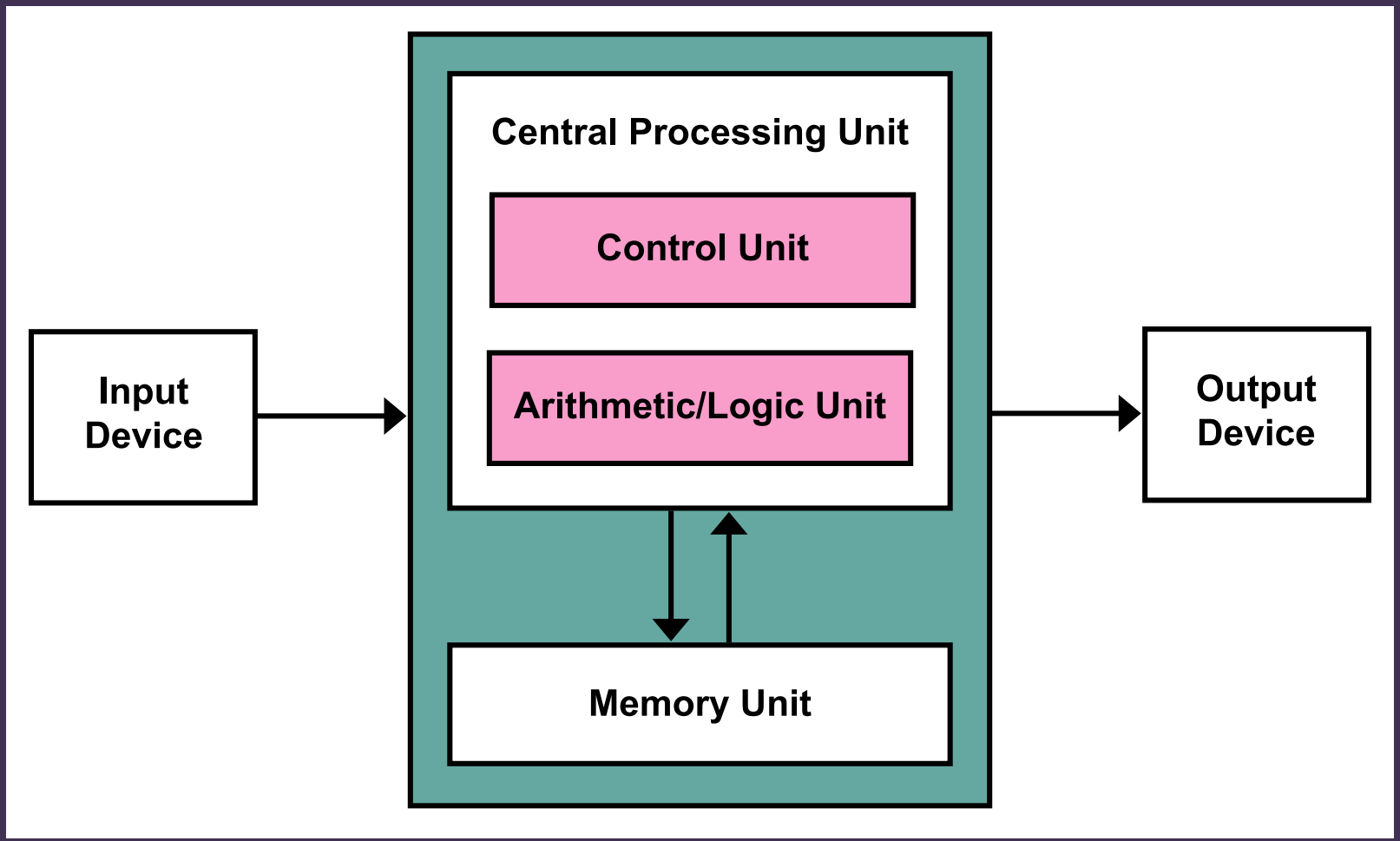
Basic computer architecture

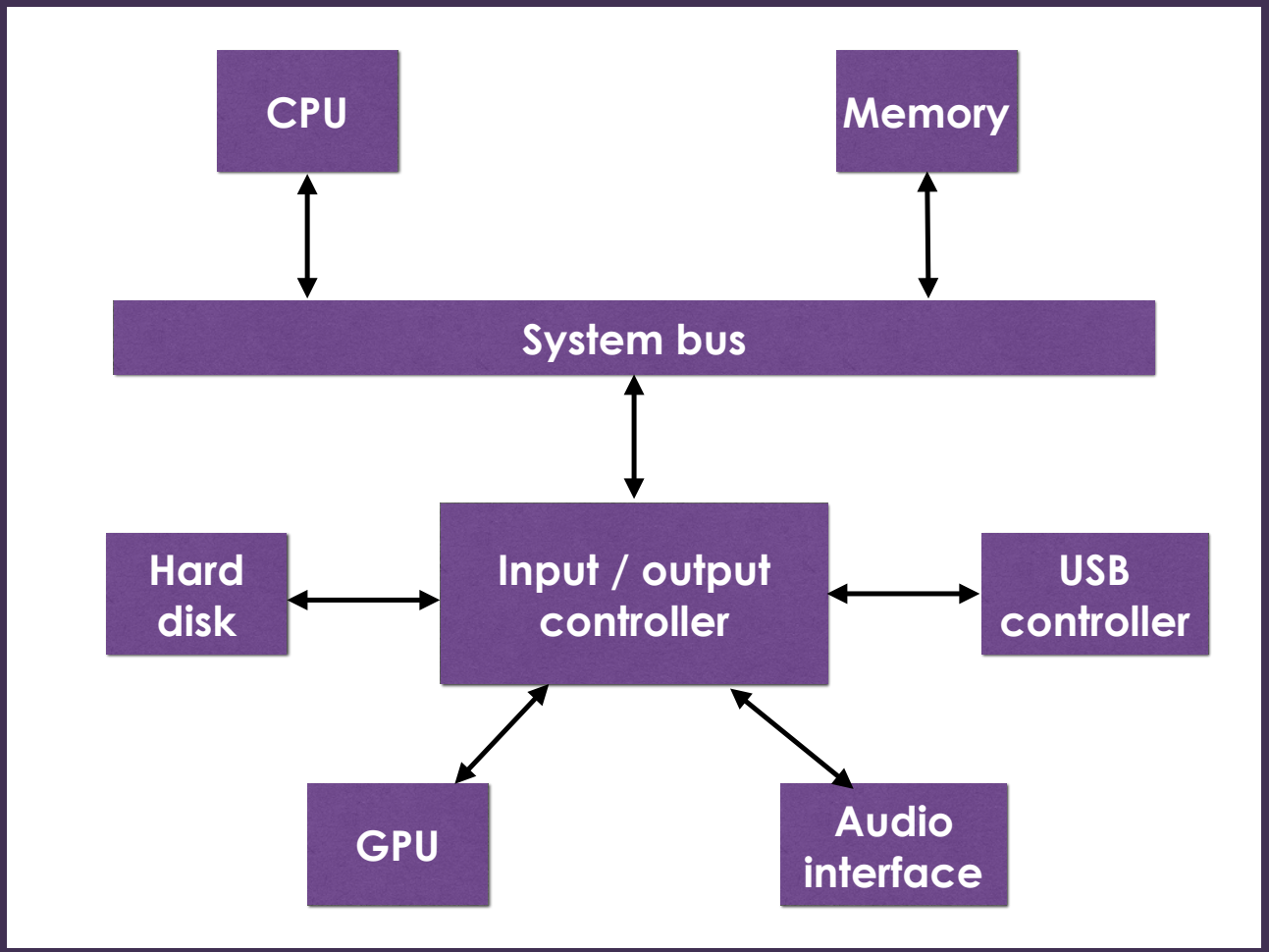
What is a computer?

- In **groups of 2-3**
- Discuss for **10 minutes**
- Go to `www.socrative.com` (or open the Socrative app) and enter room code `FALCOMPED`
- **Individually**, suggest a **one sentence** definition for a computer

The Von Neumann model



Modern PC architecture



Central processing unit (CPU)

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Carries out

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Carries out

- Arithmetic operations

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- Logic operations

Central processing unit (CPU)

Carries out

- Arithmetic operations
- Logic operations
- Control operations

Storage

Storage

- Primary storage

Storage

- Primary storage
  - Directly accessible by the CPU

Storage

- Primary storage
  - Directly accessible by the CPU
  - Random access memory (RAM)

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- Primary storage
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  - Random access memory (RAM)
  - Volatile — loses its contents when switched off

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  - Non-volatile — keeps its contents when switched off

Graphics processing unit (GPU)

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- Traditionally, one of many input/output devices
- Nowadays, essentially a highly specialised CPU with its own primary storage

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- The **programmable computer** — can carry out different tasks depending on what program it is given
- Most modern computers use the **same** memory to store the program and the data it uses

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Programming languages and paradigms

What is a programming language?

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What is a programming language?

- A **program** is a sequence of instructions for a computer to perform a specific task
- A **programming language** is a formal language for communicating these sequences of instructions

Which is the best programming language?

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- There are hundreds of programming languages, each better suited to some tasks than others
- Sometimes your choice is dictated by your choice of platform, framework, game engine etc.
- To become a better programmer (and maximise your employability) you should learn several languages (but one at a time!)

Low vs high level

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- **High level languages** give the programmer **abstraction**, hiding the details of the hardware
- High level languages trade efficiency for ease of programming
- Lower level languages were once the choice of game programmers, but advances in hardware mean that higher level languages are often a better choice

Programming paradigms

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- **Declarative**: does not define the control flow of a program, but rather defines logical relations

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- Purely **functional** languages are mainly used in academia, but favoured by some programmers
- Purely **declarative** languages have uses in academia and some special-purpose languages

Machine code

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- More on this later in the module

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- Nobody has actually written programs in machine code since the 1960s...

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- ... but difficult to use as there is no **abstraction**
- Each CPU architecture has its own assembly language, e.g. an assembly language program for Intel-compatible processors cannot be used on ARM processors

C++

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- Low level (though higher level than assembly)
- Used by developers of game engines, and games using many popular "AAA" engines (Unreal, Source, CryEngine, ...)
- Also used by developers of operating systems and embedded systems, but falling out of favour with other software developers

High level languages

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- Objective-C, Swift (iOS games)

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- Python (EVE Online, Pygame, Ren'py)
- JavaScript (HTML5 browser games)
- ActionScript (Flash games)
- Objective-C, Swift (iOS games)
- Java (Minecraft, Android games)

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- Python (EVE Online, Pygame, Ren'py)
- JavaScript (HTML5 browser games)
- ActionScript (Flash games)
- Objective-C, Swift (iOS games)
- Java (Minecraft, Android games)

There are many others, but these are the most commonly used in game development

Scripting languages

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- UnrealScript, Blueprint (Unreal Engine)
- GML (GameMaker)

Visual programming languages

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Note: despite the name, Microsoft Visual Studio is **not** a visual programming environment!

Special purpose languages

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- SQL (database queries)

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- GLSL, HLSL (GPU shader programs)

Special purpose languages

- SQL (database queries)
- GLSL, HLSL (GPU shader programs)
- LEX, YACC (script interpreters)

Markup languages

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Not to be confused with programming languages...

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- HTML, CSS (web pages)

Markup languages

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- HTML, CSS (web pages)
- LaTeX, Markdown (documentation)

Markup languages

Not to be confused with programming languages...

- HTML, CSS (web pages)
- LaTeX, Markdown (documentation)
- XML, JSON (data storage)

Which programming language is most popular?

http://githut.info

“Family tree” of programming languages

https://www.levenez.com/lang/lang.pdf

Debrief

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