



FALMOUTH
UNIVERSITY

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

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](http://rspa.royalsocietypublishing.org/content/royprsa/470/2169/20140182.full.pdf)

What was the first computer?



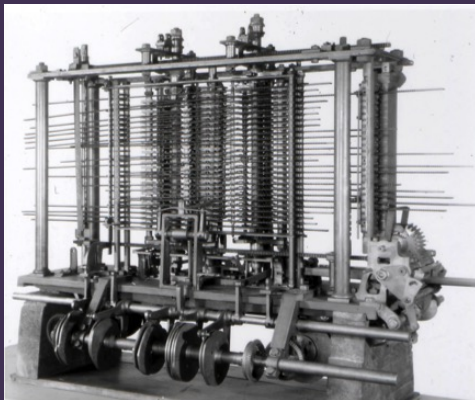
Antikythera Mechanism (~150 BC)

First mechanical computer?



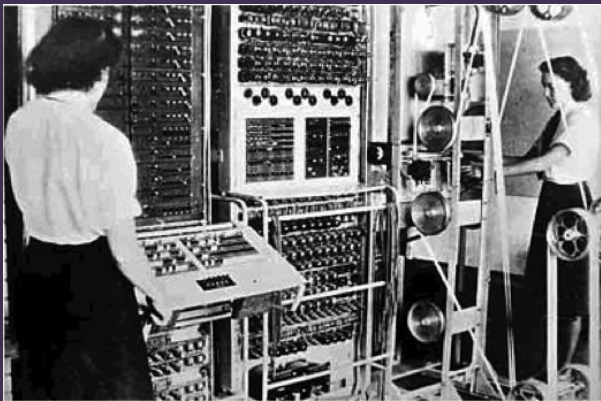
Babbage's Difference and Analytical Engines (1837)

First mechanical computer in modern age



Colossus (1943)

First programmable electronic computer



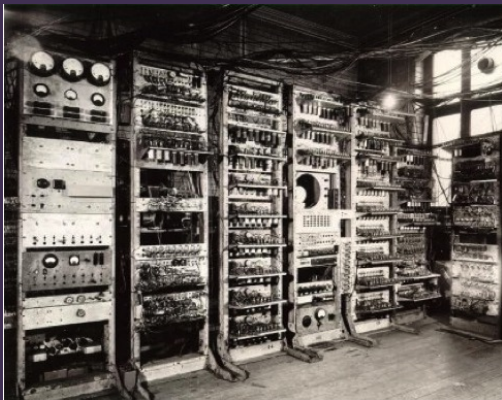
ENIAC (1946)

First general-purpose computer



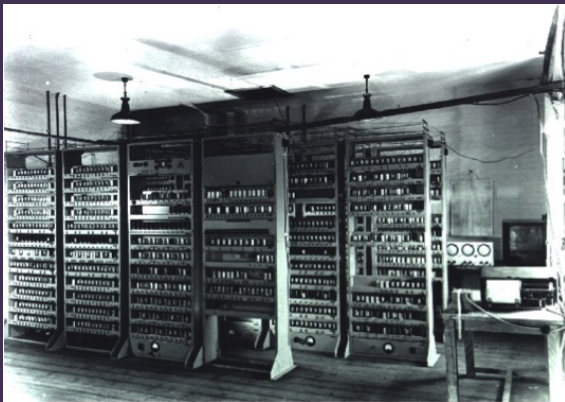
Manchester Small-Scale Experimental Machine (1948)

First stored program computer



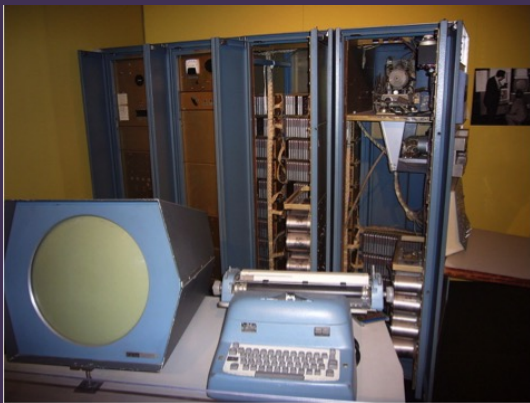
EDSAC (1949)

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



The image shows a classic IBM Model 5150 personal computer setup. The monitor is positioned at the top, displaying a list of system specifications in German. Below the monitor is the system unit, which features two 5.25-inch floppy disk drives. In front of the system unit is a standard IBM Model 5151 keyboard. The entire setup is presented against a plain white background.

IBM
5150

IBM System Information: Microsoft Edition, 100 Base 100, 10MB, 8086, 80286, 80386, 80486, 80586, 80686, 80786, 80886, 80986, 81086, 81186, 81286, 81386, 81486, 81586, 81686, 81786, 81886, 81986, 82086, 82186, 82286, 82386, 82486, 82586, 82686, 82786, 82886, 82986, 83086, 83186, 83286, 83386, 83486, 83586, 83686, 83786, 83886, 83986, 84086, 84186, 84286, 84386, 84486, 84586, 84686, 84786, 84886, 84986, 85086, 85186, 85286, 85386, 85486, 85586, 85686, 85786, 85886, 85986, 86086, 86186, 86286, 86386, 86486, 86586, 86686, 86786, 86886, 86986, 87086, 87186, 87286, 87386, 87486, 87586, 87686, 87786, 87886, 87986, 88086, 88186, 88286, 88386, 88486, 88586, 88686, 88786, 88886, 88986, 89086, 89186, 89286, 89386, 89486, 89586, 89686, 89786, 89886, 89986, 90086, 90186, 90286, 90386, 90486, 90586, 90686, 90786, 90886, 90986, 91086, 91186, 91286, 91386, 91486, 91586, 91686, 91786, 91886, 91986, 92086, 92186, 92286, 92386, 92486, 92586, 92686, 92786, 92886, 92986, 93086, 93186, 93286, 93386, 93486, 93586, 93686, 93786, 93886, 93986, 94086, 94186, 94286, 94386, 94486, 94586, 94686, 94786, 94886, 94986, 95086, 95186, 95286, 95386, 95486, 95586, 95686, 95786, 95886, 95986, 96086, 96186, 96286, 96386, 96486, 96586, 96686, 96786, 96886, 96986, 97086, 97186, 97286, 97386, 97486, 97586, 97686, 97786, 97886, 97986, 98086, 98186, 98286, 98386, 98486, 98586, 98686, 98786, 98886, 98986, 99086, 99186, 99286, 99386, 99486, 99586, 99686, 99786, 99886, 99986, 100086, 100186, 100286, 100386, 100486, 100586, 100686, 100786, 100886, 100986, 101086, 101186, 101286, 101386, 101486, 101586, 101686, 101786, 101886, 101986, 102086, 102186, 102286, 102386, 102486, 102586, 102686, 102786, 102886, 102986, 103086, 103186, 103286, 103386, 103486, 103586, 103686, 103786, 103886, 103986, 104086, 104186, 104286, 104386, 104486, 104586, 104686, 104786, 104886, 104986, 105086, 105186, 105286, 105386, 105486, 105586, 105686, 105786, 105886, 105986, 106086, 106186, 106286, 106386, 106486, 106586, 106686, 106786, 106886, 106986, 107086, 107186, 107286, 107386, 107486, 107586, 107686, 107786, 107886, 107986, 108086, 108186, 108286, 108386, 108486, 108586, 108686, 108786, 108886, 108986, 109086, 109186, 109286, 109386, 109486, 109586, 109686, 109786, 109886, 109986, 110086, 110186, 110286, 110386, 110486, 110586, 110686, 110786, 110886, 110986, 111086, 111186, 111286, 111386, 111486, 111586, 111686, 111786, 111886, 111986, 112086, 112186, 112286, 112386, 112486, 112586, 112686, 112786, 112886, 112986, 113086, 113186, 113286, 113386, 113486, 113586, 113686, 113786, 113886, 113986, 114086, 114186, 114286, 114386, 114486, 114586, 114686, 114786, 114886, 114986, 115086, 115186, 115286, 115386, 115486, 115586, 115686, 115786, 115886, 115986, 116086, 116186, 116286, 116386, 116486, 116586, 116686, 116786, 116886, 116986, 117086, 117186, 117286, 117386, 117486, 117586, 117686, 117786, 117886, 117986, 118086, 118186, 118286, 118386, 118486, 118586, 118686, 118786, 118886, 118986, 119086, 119186, 119286, 119386, 119486, 119586, 119686, 119786, 119886, 119986, 120086, 120186, 120286, 120386, 120486, 120586, 120686, 120786, 120886, 120986, 121086, 121186, 121286, 121386, 121486, 121586, 121686, 121786, 121886, 121986, 122086, 122186, 122286, 122386, 122486, 122586, 122686, 122786, 122886, 122986, 123086, 123186, 123286, 123386, 123486, 123586, 123686, 123786, 123886, 123986, 124086, 124186, 124286, 124386, 124486, 124586, 124686, 124786, 124886, 124986, 125086, 125186, 125286, 125386, 125486, 125586, 125686, 125786, 125886, 125986, 126086, 126186, 126286, 126386, 126486, 126586, 126686, 126786, 126886, 126986, 127086, 127186, 127286, 127386, 127486, 127586, 127686, 127786, 127886, 127986, 128086, 128186, 128286, 128386, 128486, 128586, 128686, 128786, 128886, 128986, 129086, 129186, 129286, 129386, 129486, 129586, 129686, 129786, 129886, 129986, 130086, 130186, 130286, 130386, 130486, 130586, 130686, 130786, 130886, 130986, 131086, 131186, 131286, 131386, 131486, 131586, 131686,

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



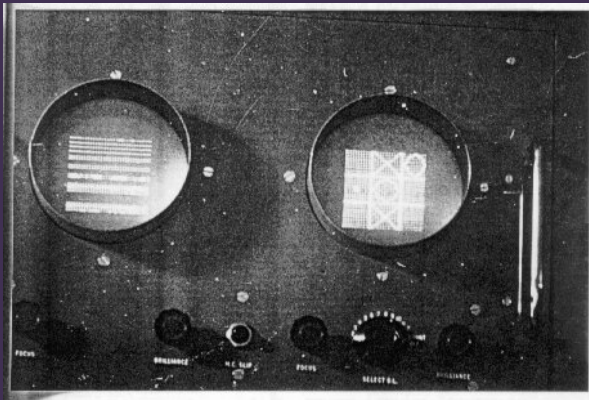
Bertie the Brain (1950)

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



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](http://www.onlineeducation.net/videogame_timeline/video-game-timeline.jpg)
(A little out of date!)

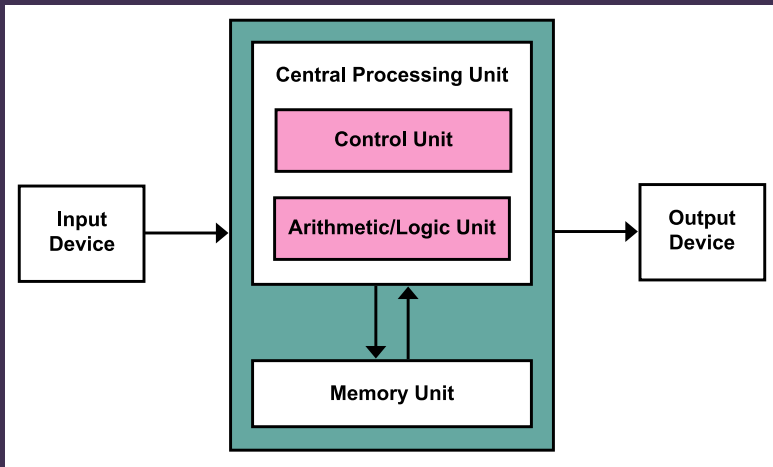
Basic computer architecture



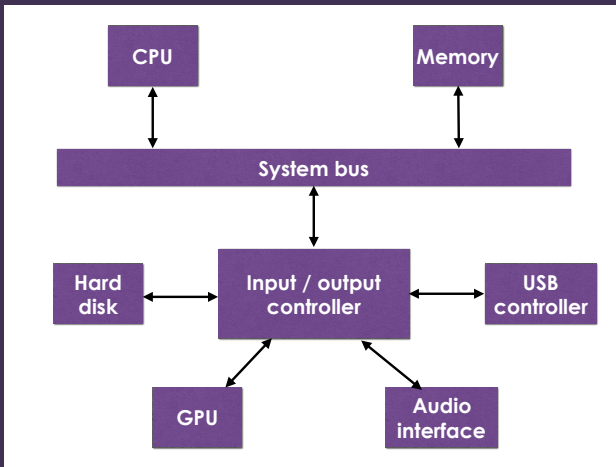
What is a computer?

- ▶ 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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- ▶ Arithmetic operations

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- ▶ Logic operations

Central processing unit (CPU)

Carries out

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- ▶ Logic operations
- ▶ Control operations

Storage

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- ▶ Primary storage

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 - ▶ Directly accessible by the CPU

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 - ▶ Random access memory (RAM)

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- ▶ Nowadays, essentially a highly specialised CPU with its own primary storage

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The stored program architecture

- ▶ A **computer program** is a sequence of instructions for the CPU
 - ▶ (Note: it's spelled "program", not "programme")
- ▶ 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

Programming languages and paradigms



What is a programming language?

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- ▶ 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

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- ▶ 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

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

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- ▶ Most commonly used languages today are a mixture of **procedural** and **object-oriented** paradigms, with many also incorporating ideas from **functional** programming
- ▶ 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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- ▶ 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

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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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- ▶ ActionScript (Flash games)
- ▶ Objective-C, Swift (iOS games)

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- ▶ Java (Minecraft, Android games)

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- ▶ 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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Many games use scripting languages in addition to their main development language

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- ▶ Lua (many AAA games)

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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)

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- ▶ 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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- ▶ 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://github.info`

“Family tree” of programming languages

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

Debrief

Debrief

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- ▶ **Explain** the basic architecture of a computer
- ▶ **Distinguish** the most common programming languages and paradigms in use today

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Remember: Worksheet A is due at **9am next Monday!**