PDST
Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí

An Roinn Oideachais
Department of Education

National Workshop 4

DayTwo

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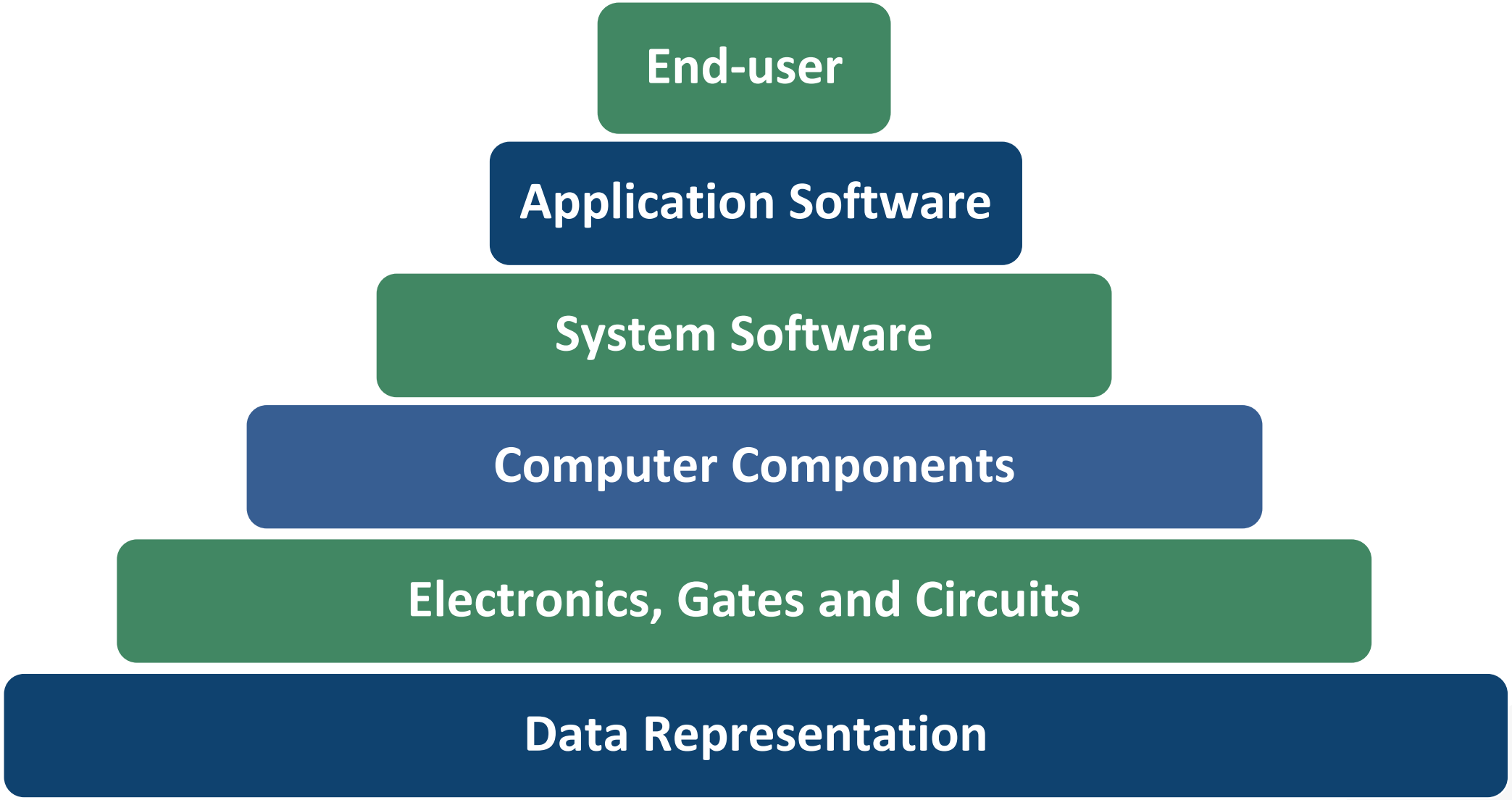
Computer Systems 2

National Workshop 4 – Day Two Session Two

Layers of a Computing System



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Computer Systems

Logic Gates

Computer Systems

S2: Computer systems	
CPU: ALU, Registers, Program counter, Memory	2.11 describe the different components within a computer and the function of those components
Basic electronics: voltage, current, resistors, capacitors, transistors	2.12 describe the different types of logic gates **and explain how they can be arranged into larger units to perform more complex tasks**
Operating system layers: Hardware, OS, Application, User	2.13 describe the rationale for using the binary number system in digital computing and how to convert between binary, hexadecimal and decimal
	2.14 describe the difference between digital and analogue input
Web infrastructure - Computer Network Protocols: HTTP, **TCP, IP, VOIP**	2.15 explain what is meant by the World Wide Web (WWW) and the Internet, including the client server model, hardware components **and communication protocols**

Examples of Logic Gates and their Symbols

AND

Accepts two inputs

Has one output

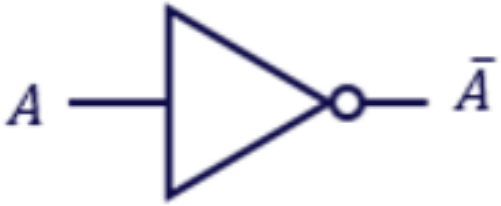
If both inputs are 1, the output is 1.

OR

Accepts two inputs

Has one output

If either input is 1, the output is 1.



NOT

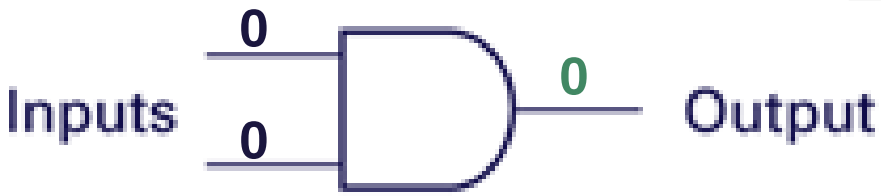
Inverts a single input

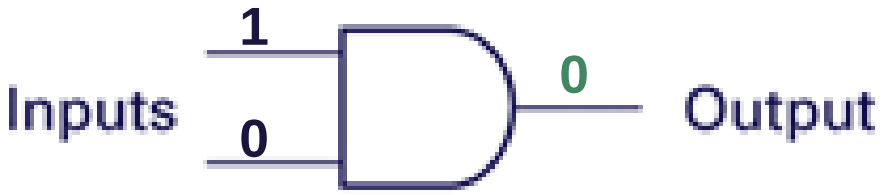
NAND

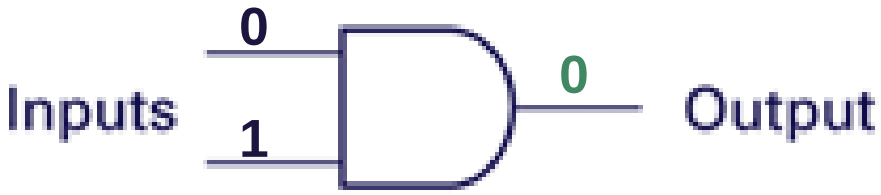
Accepts two inputs

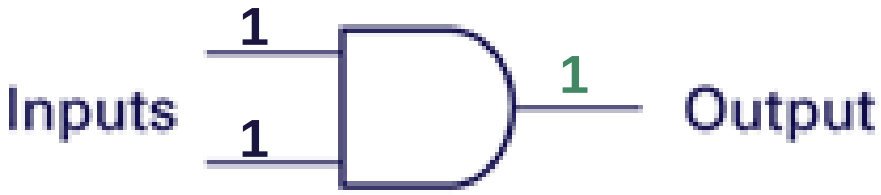
If both inputs are not 1, the output is 1.

The AND operation









0 = FALSE

1 = TRUE

Truth Tables

AND

A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

OR

A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

NOT

A	$\overline{A}$
0	1
1	0

NAND

A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

Breakout Task – Design a Half-Adder

Classroom Activity

Design your own half-adder in some language you have learned, for example Python or Scratch.

Page 23 of the *"Evolution of Computers in Society"*, NCCA booklet.

(some useful information on page 22)

INPUTS		OUTPUT	
A	B	Sum (S)	Carry (C)
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Feedback

Once you complete this task you should prepare feedback that addresses each of the following points:

1. A statement of the problem.
2. A summary of how you approached the problem.
3. What prior knowledge would it be useful for students to have before attempting a task such as this to design a half-adder?
4. Describe any challenges you encountered and how you attempted to overcome these challenges. What were the outcomes?
5. What challenges are there to implementing this lesson in your classroom?
6. What scaffolding would be needed for your students with special educational needs?
7. Did you get a working solution?
8. Discuss alternative approaches that could be taken to teaching how logic gates can be arranged into larger units to perform more complex tasks.

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Von Neumann Architecture

Von Neumann Architecture

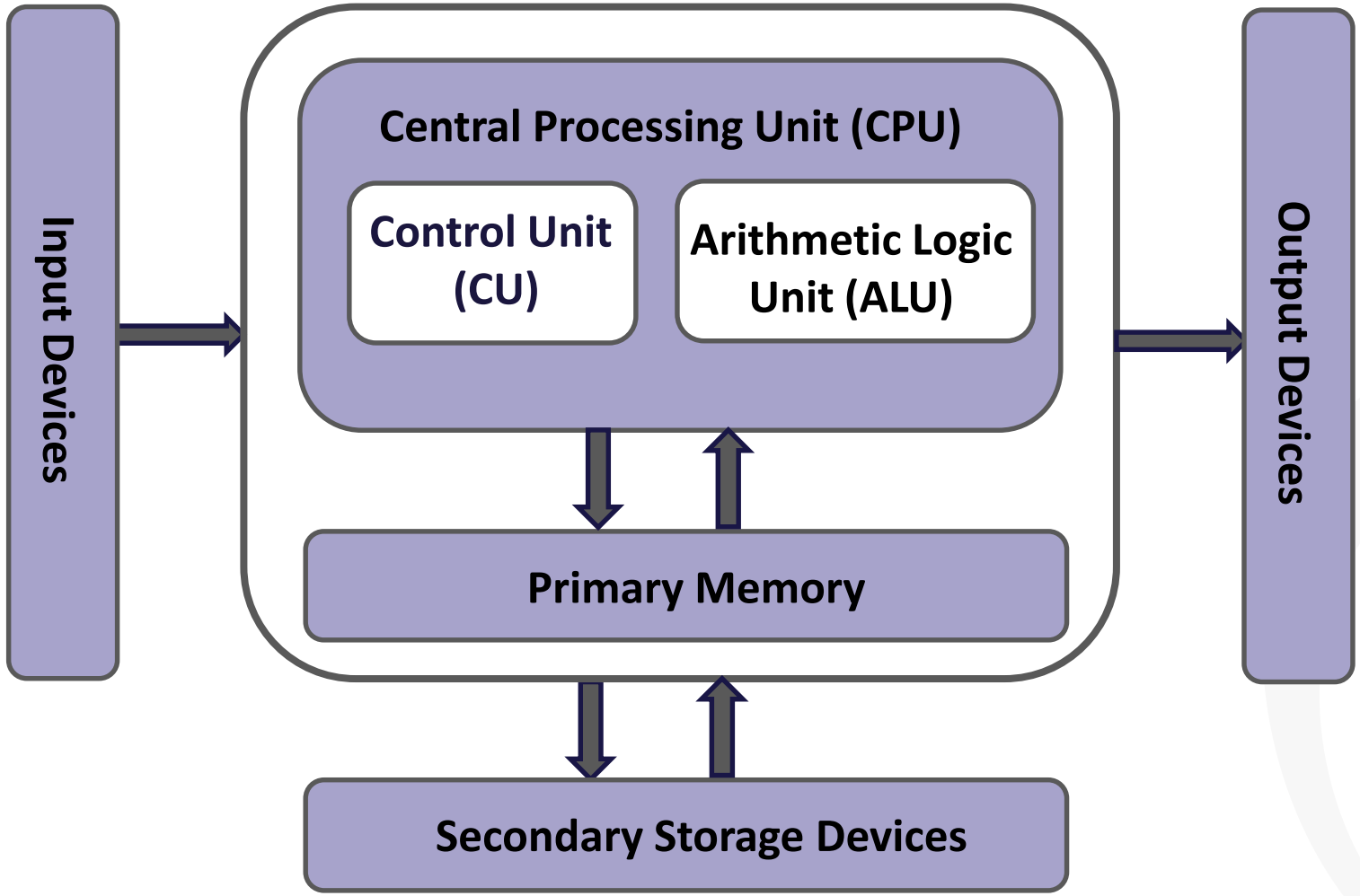
Both program and data kept in storage (previously programs had been hard coded into the machine)

Simple structure

Basis upon which all modern computers are constructed

Von Neumann Architecture

2.11 describe the different components within a computer and the function of those components



The components are connected to one another by a collection of wires called a **bus**

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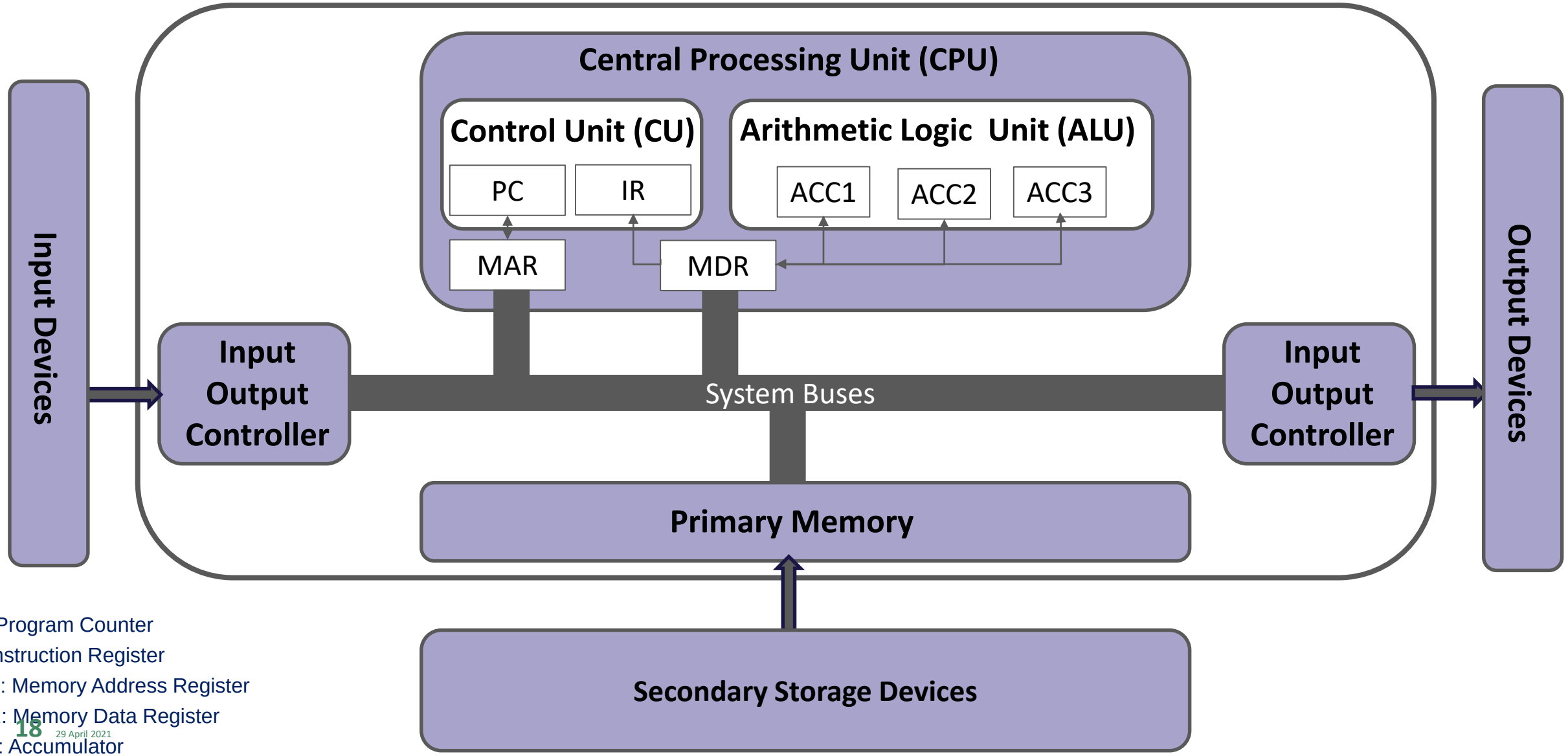
Registers

Storage locations internal to the CPU

Used as a scratchpad by the CPU to store data, addresses or instructions as it executes each program instruction

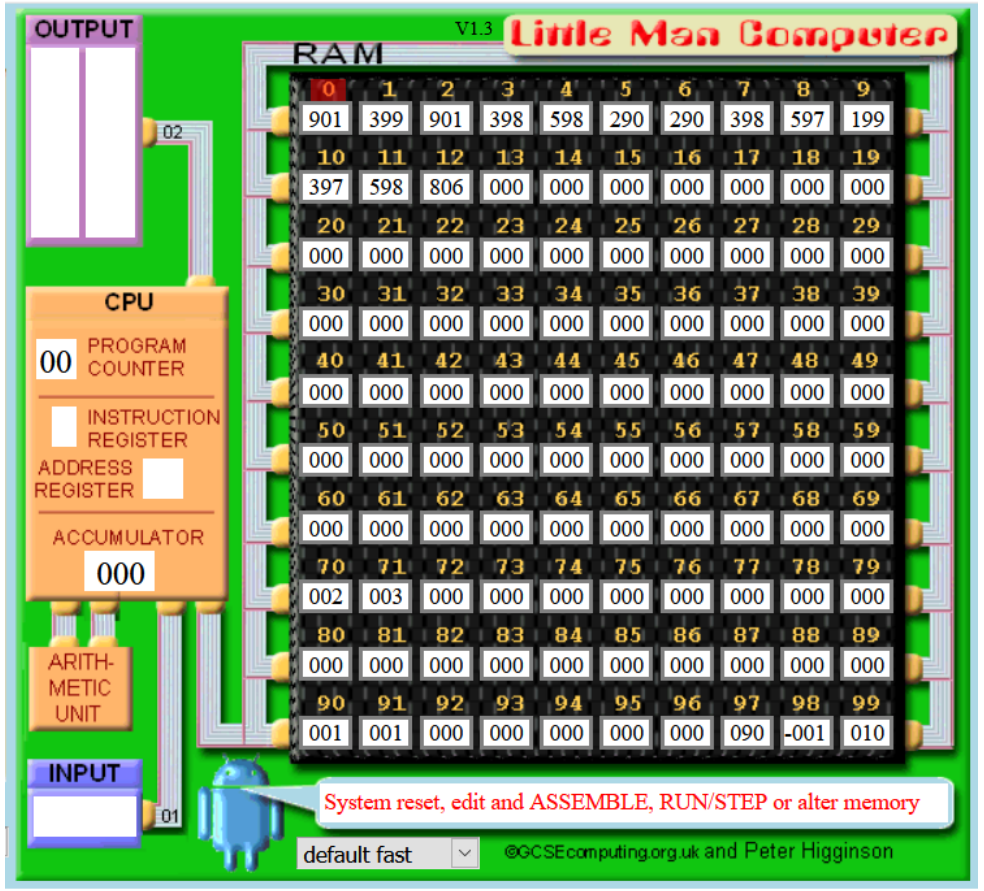
Data can be moved into and out of registers faster than from memory – dedicated pathways and hardware

The von Neumann Architecture of a Computer



PC: Program Counter
IR: Instruction Register
MAR: Memory Address Register
MDR: Memory Data Register
ACC: Accumulator

Little Man Computer



Little Man Computer Demo:
https://www.futurelearn.com/info/courses/how-computers-work/0/steps/49285

Little Man Computer Simulator:
https://peterhigginson.co.uk/LMC/

Little Man Computer Help:
https://peterhigginson.co.uk/LMC/help.html

Fetch Execute Decode Cycle:
https://www.futurelearn.com/info/courses/how-computers-work/0/steps/49284

(Another) Little Man Computer Simulator:
https://www.101computing.net/lmc-simulator/