Computer Science

1.1 Data Representation - 1.1.1 Binary systems

Candidates should be able to:

- Recognise the use of binary numbers in computer systems
- Convert positive denary integers into binary and positive binary integers into denary (a maximum of 16 bits will be used)
- Show understanding of the concept of a byte and how the byte is used to measure memory size
- Use binary in computer registers for a given application (such as in robotics, digital instruments and counting systems)

Information in computers is represented in **bits**. Computers systems use the binary number system. Binary only consist of **1s** and **0s**. Each binary digit is referred to as **1 bit**. Computers use the binary number system to manipulate and store all of their data.

A computer is made up of millions of switches which must be in the **ON** or **OFF** position.

The **ON position** can be represented by **1**.
The **OFF position** can be represented by **0**.

The binary value represents the current flowing through a circuit:
1 – Current is flowing.
0 – No current is flowing.

Denary Number System

Units increase by the power of **10**

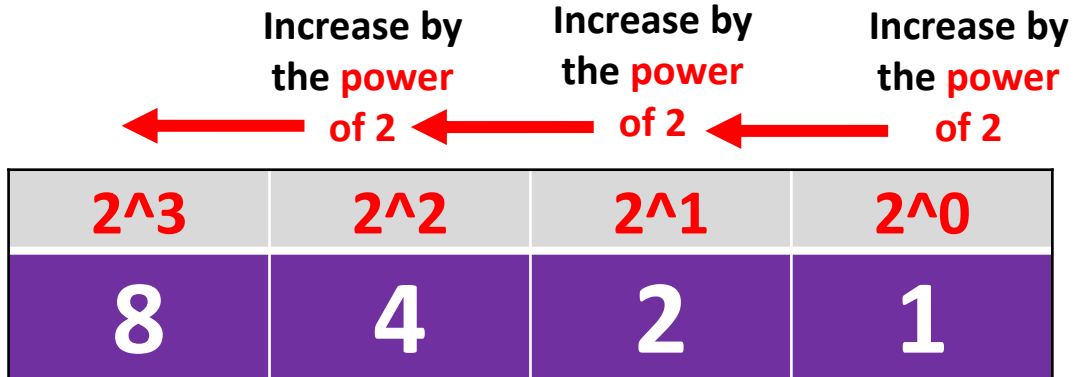| Hundreds	Tens	Units
1 Hundred	5 Tens	7 Units
1	5	7

1.1 Data Representation - 1.1.1 Binary systems

Binary – A system of numbers with a base of 2. Each unit is increased by the power of 2.

Increase by the power of 2	Increase by the power of 2	Increase by the power of 2
←	←	←

2^3	2^2	2^1	2^0
8	4	2	1

Converting Binary Numbers to Denary Numbers

8	4	2	1
1	1	1	1

8+4+2+1   Denary 15

128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1

Denary 255

128+64+32+16+8+4+2+1

128	64	32	16	8	4	2	1
0	1	1	0	0	1	0	1

Denary 101

64+32   +4   +1

2048	1024	512	256	128	64	32	16	8	4	2	1
1	0	1	0	0	1	1	0	0	1	0	1

2048+512+64+32+4+1   Denary 2661

32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1
0	1	0	0	1	0	1	0	0	1	1	0	0	1	0	1

16384+2048+512+64+32+4+1

Denary 19045

Theory of Computer Science

Computer Science

147	## Convert 147 (Denary) into Binary

Binary (Base-2) - 2^0, 2^1, 2^2, 2^3 etc.							
128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
1	0	0	1	0	0	1	1
19			**3**			**1**	

147		R - 19		R - 3		1

128	64	32	16	8	4	2	1
1	0	0	1	0	0	1	1

R - 19		R - 3		R - 1	
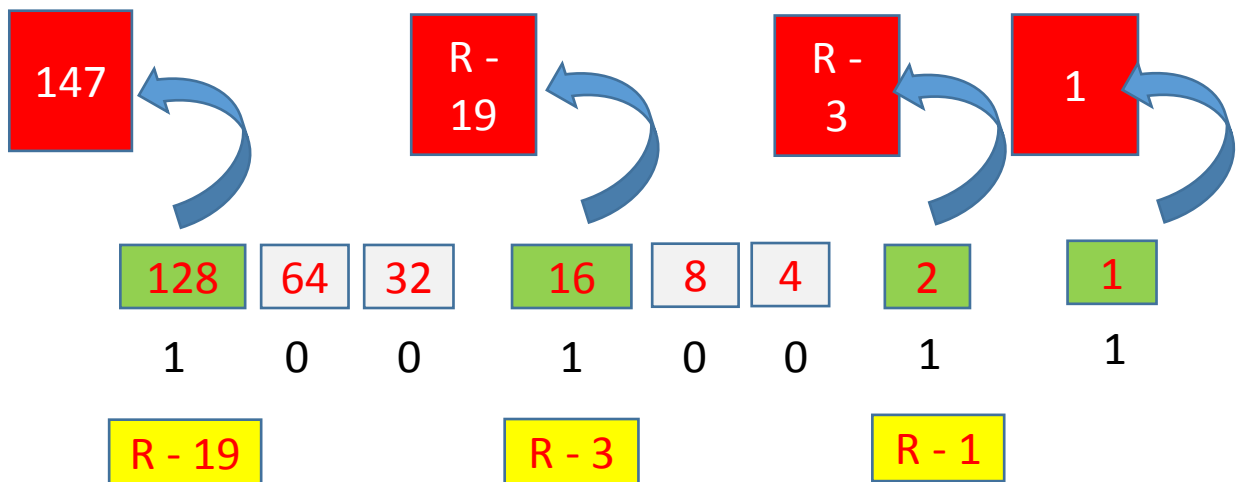
Convert 147 into Binary

1) Start with the first value which goes in to 147 (128)
2) The **remainder** is 19.
3) The next value that goes into 19 is 16.
4) **Remainder** is now 1.
5) The next value that goes into 3 is 2.
6) **Remainder** is now 1.
7) 1 goes into 1

Theory of Computer Science

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File Sizes

A **Binary digit** is referred to as a **BIT**

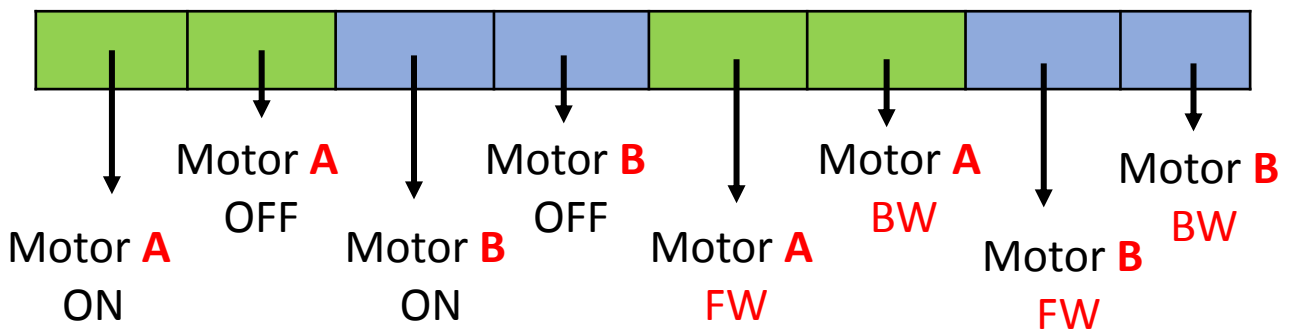| 128	64	32	16	8	4	2	1
1	0	0	1	1	0	0	1
1	0	0	1	1	0	0	1
1	0	0	1	1	0	0	1

Nibble: 4 Binary units: Example Hexadecimal

8 Bits are referred to as a **BYTE**

A register may hold an instruction, a storage address, or any kind of data

An 8 Bit Register is used to control the movement of the Robot Vacuum cleaner:

Motor **A** ON

Motor **A** OFF

Motor **B** ON

Motor **B** OFF

Motor **A** FW

Motor **A** BW

Motor **B** FW

Motor **B** BW

Example Question: Enter the values into the register to move the robot forwards and backwards

Forwards	1	0	1	0	1	0	1	0
Backwards	1	0	1	0	0	1	0	1