IGCSE COMPUTER SCIENCE (0478) BY AWAB AQIB

CHAPTER 1.1: DATA REPRESENTATION

1.1.1 Binary Systems

DIFFERENT UNITS OF STORAGE

-Different units of data can be used to represent the size of a file, as it changes in size
-Bit is the smallest unit of storage
-1 Byte is equal to 8 bits

The units of data increase in size from smallest to largest as:

Storage Unit	Size in decimal	Number of Bits
Bit	-	
Byte	8 bits	
Nibble	4 Bits	
Kilobyte	1024 bytes	2^{10}
Megabyte	1024 Kilobytes	2^{20}
Gigabyte	1024 Megabyte	2^{30}
Terabyte	1024 Gigabyte	2^{40}
Petabyte	1024 Terabyte	2^{50}

WHAT IS BINARY SYSTEM

-Binary system works in base of 2
-The only possible values are 0 or 1
-A typical binary value is a string of 0s and 1s e.g. 0101010000
-Computer has to translate every single instruction into Binary
-Translation of 'Call of Duty' in Binary would be:
01000011 01100001 01101100 01101100 00100000 01101111 01100110 00100000 01000100 01110101 01110100 01111001

WHY DOES COMPUTER STORE DATA IN BINARY

-Computer uses logic circuit / switches
-They work in only two states / On or Off / True or False / 1 or 0

USE OF BINARY NUMBERS IN COMPUTER SYSTEMS / REGISTERS

-Data
-ASCII value / Unicode value / character
-Number
-Part of image / small image
-A sound / sound sample / small sound track
-Instruction

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EXPLAIN THE DIFFERENCES BETWEEN BINARY AND DENARY SYSTEM

-A binary number system is a base-2 system /denary number system is a base-10 system
-A binary number system uses 0 and 1 values/ denary number system uses 0 to 9 values
-A binary number system has units / that increase by the power of 2
-A denary number system has units that increase by the power of 10
-Binary has more digit for the same value / Denary has less digits for the same value

CONVERSION FROM BINARY TO DECIMAL/DENARY (BASE 10)

-Start from the right most bit
-Multiply first bit by 2^0 , second bit by 2^1, third bit by 2^2 and n^{th} bit by 2^{n-1}
-Find the sum of products and it would give us the Decimal/Denary value

1. $010_2 = 2_{10}$

0	**1**	**0**
2^2	2^1	2^0

Sum= $(2^0 \times 0) + (2^1 \times 0) + (2^2 \times 1) = 2$

2. $1001_2 = 9_{10}$

1	**0**	**0**	**1**
2^3	2^2	2^1	2^0

Sum= $(2^0 \times 1) + (2^1 \times 0) + (2^2 \times 0) + (2^3 \times 1) = 9$

3. $100011_2 = 35_{10}$

1	**0**	**0**	**0**	**1**	**1**
2^5	2^4	2^3	2^2	2^1	2^0

Sum= $(2^0 \times 1) + (2^1 \times 1) + (2^2 \times 0) + (2^3 \times 0) + (2^4 \times 0) + (2^5 \times 1) = 35$

4. $1001001_2 = 73_{10}$

1	**0**	**0**	**1**	**0**	**0**	**1**
2^6	2^5	2^4	2^3	2^2	2^1	2^0

Sum= $(2^0 \times 1) + (2^1 \times 0) + (2^2 \times 0) + (2^3 \times 1) + (2^4 \times 0) + (2^5 \times 0) + (2^6 \times 1) = 73$

CONVERSION FROM DECIMAL/DENARY (BASE 10) TO BINARY

-Divide the decimal number by 2 repeatedly. Note the remainder which will be 0 or 1.
-You can append 0s on the left side to fill the registers since they don't make a difference
-The answer is read from last reminder till the top

1. $2_{10} = 10_2$

Division	Result	Remainder
2/2	1	0
1/2	0	1

2. $9_{10} = 1001_2$

Division	Result	Remainder
9/2	4	1
4/2	2	0
2/2	1	0
1/2	0	1

3. $35_{10} = 100011_2$

Division	Result	Remainder
35/2	17	1
17/2	8	1
8/2	4	0
4/2	2	0
2/2	1	0
½	0	1

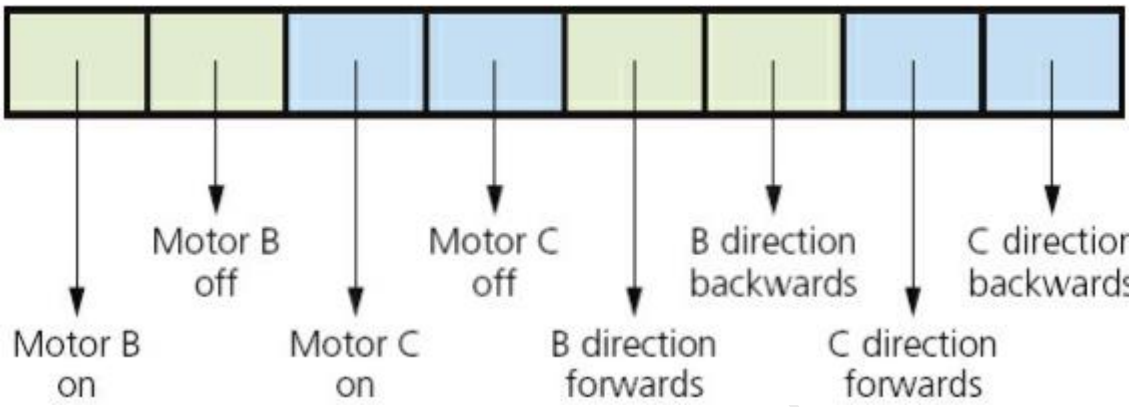
3. $73_{10} = 1001001_2$

Division	Result	Remainder
73/2	36	1
36/2	18	0
18/2	9	0
9/2	4	1
4/2	2	0
2/2	1	0
1/2	0	1

USE OF BINARY SYSTEM IN APPLICATIONS

-Binary system is used to store everything inside computer
-One of the most common use is to store information in registers of control systems
-Also used for error detection through parity bit

An 8 bit register is being used to control the movements of a vacuum cleaner



If the register is filled with values: 1010 1010 then reading from left to right, this means:
-Motor B is On, Motor C is On, B is moving forward, C is moving forward
-overall the vacuum cleaner is moving forward

If the register is filled with values 0101 0101 then reading from left to right, this means:
-Motor B is Off, Motor C is Off, Motor B and C to move in backward directions
-since the motors are off so there won't be any movement overall