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ASSIGNMENT-1

A

1. The cummulative addition of the four binary bits (1+1+1+1) gives

$$\begin{array}{r} 1 \\ +1 \\ \hline 10 \end{array} \Rightarrow \begin{array}{r} 10 \\ +1 \\ \hline 11 \end{array} \Rightarrow \begin{array}{r} 11 \\ +1 \\ \hline 100 \end{array} \Rightarrow 100$$

2. The digital system usually operates on ______ system

Binary

3. The two digits hexadecimal numbers which has largest value is ______. Which corresponds to: ______ ?

FF , 255 Decimal

4. If the decimal number is a fraction then its binary equivalent is obtained by ______ the number continuously by 2.

Multiplying

5. What is computer organization ?

Structure and behaviour of a computer system as observed by the developer.

6. Which of the following is a type of architecture used in the computers nowadays ?

Von-Neumann Architecture

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7 MAR stands for ?
Memory Address Register

8. _______ and _______ Gates are universal logic gates.
NAND and NOR

9. 2's complement is obtained by adding 1 to 1's complement of a number.
True

10. What is the 1's complement of 11010 ?
00101

B

1. What is computer organization ?
Computer organization is the structural components and their functional behaviour of a computer system as observed by the developer.
It is the study of the structure, design and operation of computer systems, including the hardware, software and firmware components.

2. Convert the following binary numbers to decimal:

2A. 101110

$= 1\times2^5 + 0 + 1\times2^3 + 1\times2^2 + 1\times2^1 + 2^0\times0$

$= 32 + 8 + 4 + 2 = 46$

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2B. 1110101

$= 1\times2^6 + 1\times2^5 + 1\times2^4 + 0\times2^3 + 1\times2^2 + 0\times2^1 + 1\times2^0$

$= 64 + 32 + 16 + 4 + 1$

$= 117$

2C. 110110100

$= 1\times2^8 + 1\times2^7 + 0\times2^6 + 1\times2^5 + 1\times2^4 + 0\times2^3 + 1\times2^2 + 0\times2^1 + 0\times2^0$

$= 256 + 128 + 32 + 16 + 4$

$= 436$

3. Find the fixed point representation (signed magnitude, signed 1's complement, signed 2's complement) of (−37)

Use leftmost bit as 0 for positive, 1 for negative

We have negative number so we'll use 1 as leftmost bit

We will consider 8-bit signed integer in three different fixed point formats

3.A Signed magnitude representation

for +37 : $32 + 4 + 1 = 00100101_2$

−37 : 10100101_2

set leftmost bit ~~is~~ to 1, since the number is negative.

For −37 :

Signed magnitude : 10100101_2

Signed 1's complement : 11011010_2 (bits are flipped)

Signed 2's complement : 11011011_2 (bits are flipped and 1 is added.)

4. Define logic gates with example.

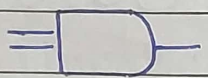
Logic gates are fundamental building blocks of digital circuits that perform logical operations on one or more binary inputs and produce a binary output based on those inputs.

There are many types of logic gates like, AND, OR, NOT, NAND, NOR, XOR and XNOR gates

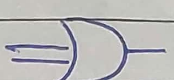
Input		Output					
		AND (x)	OR (+)	NAND	NOR	XOR	X-NOR
A	B	$y = A \cdot B$	$y = A + B$	$y = \overline{A \cdot B}$	$y = \overline{A+B}$	$y = A \oplus B$	$y = A \odot B$
0	0	0	0	1	1	0	1
0	1	0	1	1	0	1	0
1	0	0	1	1	0	1	0
1	1	1	1	0	0	0	1

Basic Gates

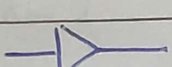
AND


$A \cdot B$

OR

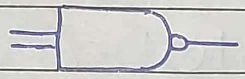

$A + B$

NOT

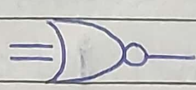


Universal Gates

NAND

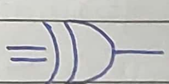

$\overline{A \cdot B}$

NOR

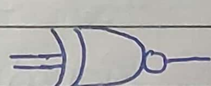

$\overline{A+B}$

Arithmetic Gates

XOR


$A \cdot \bar{B} + \bar{A} \cdot B$

X NOR


$A \cdot B + \bar{A} \cdot \bar{B}$

C

1. Convert the following numbers with the indicated bases to decimal

1.A $(12121)_3 - (?)_{10}$

$1 \times 3^4 + 2 \times 3^3 + 1 \times 3^2 + 2 \times 3^1 + 1 \times 3^0$
$= 81 + 54 + 9 + 6 + 1$
$= (151)_{10}$

1B. $(4310)_5 - (?)_{10}$

$4 \times 5^3 + 3 \times 5^2 + 1 \times 5^1 + 0 \times 5^0$
$= 500 + 75 + 5 + 0$
$= (580)_{10}$

1C. $(50)_7 - (?)_{10}$

$5 \times 7^1 + 0 \times 7^0$
$= \cancel{35} \cancel{+0}\ 35 + 0$
$= (35)_{10}$

2. Explain basic organization of Computer.
The basic organization of a computer refers to the way its various components are organized and interconnected to perform computing tasks. The main components of a computer include the central processing unit (CPU), memory, input/output (I/O) devices, and storage.

1. CPU: The CPU is the central processing unit of the computer and it is responsible for executing instruction and performing calculations. The CPU consists of an arithmetic logic unit (ALU) that performs arithmetic and logical operations and a control unit (CU) that fetches instructions from memory and coordinates the activities of the other components.

2. Memory: Memory refers to the storage space that the computer uses to store data and instructions that the CPU can access quickly. There are two main types of memory in a computer: primary memory and secondary memory. Primary memory, also known as RAM (Random Access Memory), is volatile and temporary, and it is used to store data and instructions that the CPU is currently processing. Secondary memory, such as hard drives, solid-state drives, and optical disks, is non-volatile and is used for long term storage.

3. Input/Output (I/O) devices: I/O devices are used to interact with the computer and provide input and output from the computer. Examples of input devices include keyboards, mice, scanners and microphones, while examples of output devices include displays, printers and speakers.

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4. Storage: Storage refers to the devices that are used to store data and programs that are not currently in use. The most common types of storage devices include hard disk drives (HDDs), solid-state drives (SSDs) and flash drives.

These components are interconnected through a system bus, which allows them to communicate with each other and transfer data and instructions. The organization of a computer also includes the software, which consists of the programs and applications that the computer runs. Overall, the basic organization of a computer is designed to efficiently process data and instructions, store and retrieve information, and interact with users.

D

1. Explain Von-Neumann and Harvard architecture of computer and differentiate both of them.

1.A Von-Neumann : The Von-Neumann architecture is named after the mathematician and computer scientist John von Neumann, who designed the first stored-program computer. In this architecture the same memory space is used to store both data and instructions. The CPU reads an instruction from memory, executes it, and then moves on to the next instructions. This process continues until the program is complete.

The Von Neumann architecture is characterized by the following features:

- Data and instructions are stored in the same memory space.
- There is a single bus that is used for data transfer between memory, CPU and I/O devices.
- The CPU and memory are interconnected by a bus and the CPU can access any memory location directly.
- It supports sequential execution of instructions.

1.B. Harvard Architecture: The Harvard architecture is named after the Harvard Mark I computer, which was one of the earliest stored-program computers. In this architecture, the memory space is divided into separate areas for instructions and data. This means that the CPU has separate for instructions and data. This means that the CPU has separate buses for instructions and data access, and can fetch both simultaneously.

The Harvard architecture is characterised by the following features:

- Data and instructions are stored in separate memory spaces.
- It has separate buses for data transfer b/w memory, CPU and I/O devices.

- The CPU and memory are interconnected by separate buses, one for instructions and one for data.
- It supports parallel execution of instructions.

Differences between Von-Neumann and Harvard Architecture :

Von-Neumann	Harvard Architecture
In Von-Neumann architecture, data and instructions are stored in the same energy space.	While in Harvard Architecture, data and instructions are stored in separate memory spaces.
The CPU can access only one memory location at a time.	The CPU can access both instruction and data memory simultaneously.
Instructions are executed sequentially	Instruction can be executed in parallel.
There is single bus for data transfer b/w memory, CPU and I/o devices.	There are separate buses for instruction and data transfer.

2. Write the single precision and double precision floating point representation of the following numbers -

2A. $(-17.5)_{10}$

First convert the number in binary form:

$(17)_{10} = (10001)_2$

$(0.5) = (0.1)_2$

$17.5 = (10001.1)_2$

sign	exponent	mantissa
1bit	8bits	23 bits

Single Precision Floating Point representation:
The number is represented in 32 bits in this format which is divided into three parts sign bit, exponent bits and mantissa bits.
0 for +ve no. i.e., sign bit and 1 for -ve.

Single Precision Floating point representation

Sign bit : 1 (no. is -ve)
Exponent bit : 10000011
Mantissa bit : 00011000000000000000000

→ single precision floating point representation of $(-17.5)_{10}$ is

→ 1 10000011 00011000000000000000000

sign	exponent	mantissa
1bit	11bit	52 bits

Double precision floating point representation :
In this format, the number is represented using 64 bits. it is also divided into three parts : ~~are~~ sign bit, exponent bits and mantissa bits.

for $(-17.5)_{10}$, Double precision floating point representation is :

sign bit : 1
exponent bit : 10000000010
mantissa bit : 00011000000000000000000000000000000000
00000000000000

Double precision floating point representation of $(-17.5)_{10}$

→ 1 10000000010 000110000000000000000000000000000000000
000000000000000000

2B. $(0.375)_{10}$

single precision floating point representation
sign bit : 0
Exponent bits : The unbaised exponent is $\log_2 0.375 = -1.415$, which means the biased exponent is $-1+127=126$
The binary representation of 126 is $(01111110)_2$
mantissa bits : 01100000000000000000000

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Single precision floating point representation of $(0.375)_{10}$ is

→ 0 01111110 01100000000000000000000

Double Precision floating point representation $(0.375)_{10}$

sign bit : 0

exponent bits : The unbaised exponent is -1, which means the baised exponent is $-1 + 1023 = 1022$
binary representation of 1022 is
01111111110

mantissa bits : 0110000000000000000000000000
000000000000000000000000

→ Double Precision floating point representation $(0.375)_{10}$

→ 0 01111111110 01100000000000000000000000000
00000000000000000000000

* The mantissa bits represent the fractional part of the number in binary, plus an implicit leading 1 (which is not actually stored in the bits)
* The exponent bits are used to represent the power of 2 that the mantissa is multiplied by. The exponent is biased by 127, meaning that the actual exponent represented is the exponent bits interpreted as an unsigned integer minus 127.