NEC Registration Examination

Computer Engineering (ACtE)

PYQS(PREVIOUS YEAR QUESTION SET)

EASY EXPLANATION

EXPLANATION

Chapter 1: Basic Electrical and Electronics Engineering (10%)

In a Star (Wye) connection, what is the relationship between Line Voltage (*L*) and Phase Voltage (*VP*)?

a) *VL*=*VP* **b) *VL*=root(3)*VP*** c) *VL*=3*VP* d) *VL*=*VP*/3

Voltage Relation	$\boldsymbol{V_L = \sqrt{3}\, V_P}$	$V_L = V_P$
Current Relation	$I_L = I_P$	$I_L = \sqrt{3}\, I_P$

In a Delta connection, what is the relationship between Line Current (*IL*) and Phase Current (*Iph*)?

a) *IL*=*Iph* b**) *IL*=root(3)*Iph*** c) *IL*=3*Iph* d) *IL*=*Iph*/3

EASY EXPLANATION

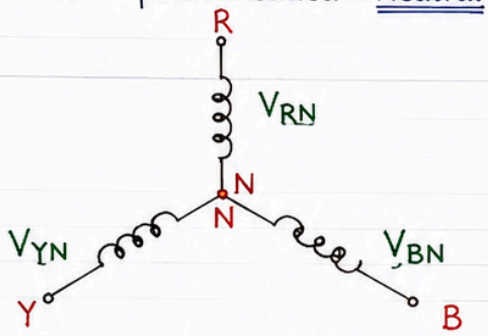
STAR OR DELTA CONNECTION

Three phase windings can be connected in two ways,

1. Star (Y) Connection
2. Delta (Δ) Connection

1. STAR (Y) CONNECTION

In star connection, one end of all the three windings are joined together to form a common point called Neutral (N).



Relations (Star)

$V_L = \sqrt{3}\ V_{ph}$

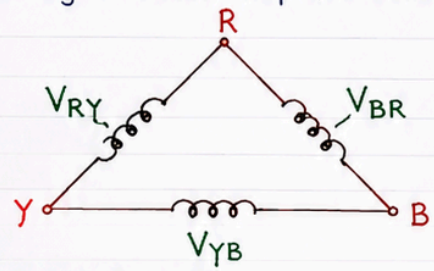
$I_L = I_{ph}$

V_L = Line Voltage
V_{ph} = Phase Voltage
I_L = Line Current
I_{ph} = Phase Current

- Neutral point is available.
- Used when neutral is required.
- Line voltage is $\sqrt{3}$ times the phase voltage.
- Commonly used in power distribution.

2. DELTA (Δ) CONNECTION

In delta connection, the end of one winding is connected to the start of the next winding forming a closed loop (no neutral point).



Relations (Delta)

$V_L = V_{ph}$

$I_L = \sqrt{3}\ I_{ph}$

V_L = Line Voltage
V_{ph} = Phase Voltage
I_L = Line Current
I_{ph} = Phase Current

- No neutral point.
- Line voltage is equal to phase voltage.
- Line current is $\sqrt{3}$ times the phase current.
- Used in heavy load and industrial applications.

COMPARISON

Parameter	Star (Y) Connection	Delta (Δ) Connection
Neutral Point	Available	Not Available
Line Voltage (V_L)	$\sqrt{3}\ V_{ph}$	V_{ph}
Line Current (I_L)	I_{ph}	$\sqrt{3}\ I_{ph}$
Use	Distribution, Domestic	Industrial, Heavy Load

★ Both connections operate at the same frequency.

What is the relationship between Star connection impedance (ZL) and Delta connection impedance (ZD)?

a) $ZL=3ZD$

b) $ZL=ZD/3$

c) $ZL=3ZD$

d) $ZL=ZD$

If the individual delta resistance in each branch is 3 ohms, what is the equivalent star connection resistance?

a) 9 ohms b) 3 ohms c) **1 ohm** d) 6 ohms

Which value is calculated by dividing the area of a half cycle of a sine wave by the length of the base?

a) RMS value b) **Average value** c) Instantaneous value d) Peak value

The relationship between Alpha (α) and Beta (β) in a Bipolar Junction Transistor (BJT) is:

a) $\alpha=\beta/(\beta+1)$ b) $\alpha=(\beta+1)/\beta$ c) $\alpha=\beta/(\beta-1)$ d) $\alpha=(\beta-1)/\beta$

A Zener diode is primarily used as a:

a) Current amplifier b) **Voltage regulator** c) Rectifier d) Oscillator

A Zener diode allows current to flow in the reverse direction only when:

a) Forward biased b) **Reverse voltage exceeds breakdown voltage** c) Current is zero d) It is in series

Which amplifier configuration is famous for providing the lowest distortion?

a) **Class A** b) Class B c) Class C d) Class AB

A crystal oscillator is based on which effect?

a) **Piezoelectric effect** b) Photoelectric effect c) Seebeck effect d) Hall effect

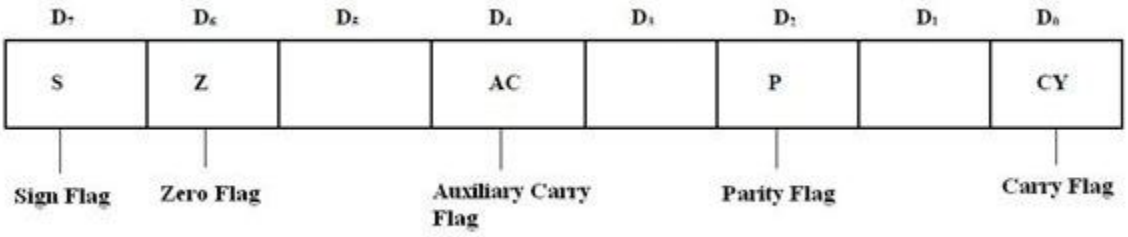
Chapter 2: Digital Logic and Microprocessor (10%)

Which logic gate is considered a Universal Gate?

a) XOR b) **NAND** c) AND d) OR

The 8085 microprocessor flag register consists of how many flip-flops?

a) 4 b) **5** c) 8 d) 16



How many hardware interrupts are available in the 8085 microprocessor?

a) 2 b) 3 c) 4 d) **5**

Hardware interrupts of 8085

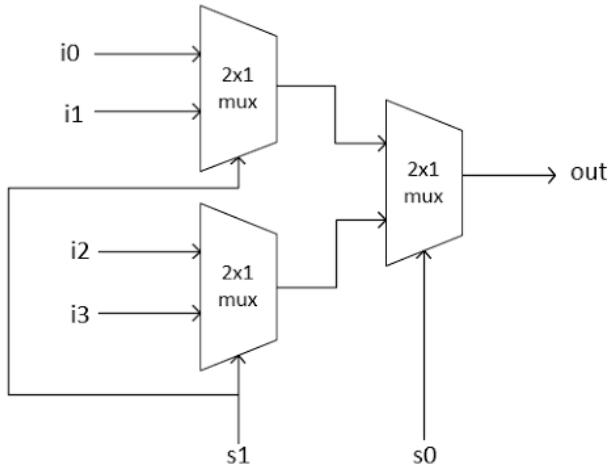
Interrupt	Interrupt vector address	Maskable or non-maskable	Edge or level triggered	priority
TRAP	0024H	Non-makable	Level	1
RST 7.5	003CH	Maskable	Rising edge	2
RST 6.5	0034H	Maskable	Level	3
RST 5.5	002CH	Maskable	Level	4
INTR	Decided by hardware	Maskable	Level	5

In the 8085, which interrupt has the highest priority and is non-maskable?

a) INTR b) RST 7.5 c) **TRAP** d) RST 5.5

How many 2x1 Multiplexers (MUX) are required to create a 4x1 MUX?

a) 2 b) **3** c) 4 d) 8



Which flip-flop does not have a "race-around" problem?

a) RS b) JK c) **D Flip-Flop** d) T

EASY EX

TYPES OF DIGITAL FLIP-FLOPS

① SR (Set-Reset) Flip-Flop

Function :
Stores one bit of data. Set input (S) sets the output and Reset (R) resets it to 0.

TRUTH TABLE

S	R	Q (next)
0	0	Q (no change)
0	1	0 (reset)
1	0	1 (set)
1	1	Invalid

ADVANTAGES
- Simple design
- Easy to understand
- Can be used for basic storage applications

DISADVANTAGES
- Invalid state when S = R = 1
- Not suitable for many practical high-speed systems

② JK Flip-Flop

Function :
An improved version of SR FF. It eliminates the invalid state when J = K = 1.

TRUTH TABLE

J	K	Q (next)
0	0	Q (no change)
0	1	0 (reset)
1	0	1 (set)
1	1	$\overline{Q}$ (toggle)

ADVANTAGES
- No invalid state
- More versatile
- Can perform Set, Reset and Toggle operations

DISADVANTAGES
- More complex circuit design
- May exhibit race around condition in
- level-triggered circuits

③ D (Data or Delay) Flip-Flop

Function :
Stores the value present at D into Q when the clock is active.

TRUTH TABLE

D	Q (next)
0	0
1	1

ADVANTAGES
- Simple operation
- No invalid states
- Widely used in registers and data storage

DISADVANTAGES
- Cannot toggle
- Less flexible compared to
- JK Flip-Flop

④ T (Toggle) Flip-Flop

Function :
Output toggles whenever T = 1 and remains unchanged when T = 0.

TRUTH TABLE

T	Q (next)
0	Q (no change)
1	$\overline{Q}$ (toggle)

ADVANTAGES
- Simple design
- Useful in counters
- Can be derived
- from JK Flip-Flop
- (with J = K = T)

DISADVANTAGES
- Less commonly used
- Not as flexible as JK or D Flip-Flop

⑤ Master-Slave JK Flip-Flop

Function :
Uses two JK Flip-Flops in cascade to avoid race around condition and improve stability.

TRUTH TABLE

J	K	Q (next)
0	0	Q (no change)
0	1	0 (reset)
1	0	1 (set)
1	1	$\overline{Q}$ (toggle)

ADVANTAGES
- Eliminates race around condition
- More stable operation
- Suitable for
- high-speed circuits

DISADVANTAGES
- Requires more hardware
- More power consumption
- Slightly more complex design

SUMMARY TABLE

Flip-Flop	Inputs	Main Function
SR	S, R	Set and Reset
JK	J, K	Set, Reset, Toggle
D	D	Data Storage
T	T	Toggle Output
Master-Slave JK	J, K	Stable JK with race elimination

APPLICATIONS OF FLIP-FLOPS

- Digital Registers
- Counters
- Frequency dividers
- Data storage
- Sequence generators
- Shift registers
- State machines
- Microprocessor systems

Flip-Flops are the basic building blocks of DIGITAL SYSTEMS

What does a Master-Slave flip-flop prevent?

a) **Race condition** b) Power loss c) Voltage spikes d) Signal noise

The number of address lines in the 8086 microprocessor is:
a) 16 b) **20** c) 24 d) 32

What does UART stand for?
a) **Universal Asynchronous Receiver/Transmitter** b) Uniform Address Reset Tool

Binary representation of -7 in 8-bit 2's complement is:
a) **11111001** b) 00000111 c) 10000111 d) 11110001

Chapter 3: Programming Language and Its Applications (10%)

In C programming, structure members are accessed using which operator?
a) **. (dot)** b) -> (arrow) c) * (asterisk) d) & (ampersand)

The operator used for dereferencing or indirection in C/C++ is:
a) & b) ***** c) -> d) .

Can a friend function access the private data members of a class in C++?
a) No b) **Yes, it has full access** c) Only if it is static

In C, the function malloc() **returns a:**
a) **void pointer** b) int pointer c) null pointer d) char pointer

The default return type of the main() **function in C is:**
a) void b) **int** c) float d) char

Which access specifier is used to make a private member inheritable but not public?
a) private b) **protected** c) public d) static

Using the same operator for different meanings in OOP is called:
a) Overriding b) **Overloading** c) Inheriting d) Encapsulating

In C, which function is used to change the location of the file pointer?

a) ftell() b) **fseek()** c) fclose() d) locate()

Which STL container in C++ stores key-value pairs?
a) vector b) **map** c) stack d) queue

A pure virtual function is defined using which syntax?
a) **virtual void func() = 0;** b) virtual void func();

Chapter 4: Computer Organization and Embedded System (10%)

In the memory hierarchy, which is the fastest but most limited memory?
a) **Register** b) Cache c) RAM d) Hard Disk

What is the full form of the AAU in computer architecture?
a) **Auxiliary Arithmetic Unit** b) Address Arithmetic Unit

The Finite State Automata (FSA) is primarily used for designing which type of processor?
a) General Purpose b) **Custom Single Purpose Processor**

The main objective of an embedded system is:
a) High complexity b) **Low cost and low power**

Which type of RTOS does not enforce strict timing requirements?
a) **Soft RTOS** b) Hard RTOS

CISC architecture uses what to store complex instructions?
a) CMOS b) **Register/Control Memory**

Memory mapping where a virtual address is translated to a physical address is done by:
a) Cache b) **Page table** c) Segment table d) TLB

"Memory Write Ability" and "Storage Permanence" are elements of:
a) Cache size b) **Memory Hierarchy/Composing Memory**

Instruction formats and addressing modes are functions of the:
a) RAM b) **Central Processing Unit (CPU)**

VHDL is a language primarily used for:
a) Web design b) **Hardware description and IC technology**

Chapter 5: Computer Network and Network Security (10%)

The purpose of the Address Resolution Protocol (ARP) is to:
a) **Translate IP to MAC** b) Resolve DNS

TCP is best described as:
a) Connectionless b) **Connection-oriented with a three-way handshake**

Which protocol is responsible for transferring email between mail servers?
a) HTTP b) **SMTP** c) FTP d) SNMP

The Point-to-Point Protocol (PPP) is primarily used for:
a) LAN management b) **Transmitting data over serial links**

Which OSI layer handles end-to-end connection and flow control?
a) Network b) **Transport Layer**

The loopback address in IPv4 is:
a) **127.0.0.1** b) 192.168.1.1

Link-state routing is the basis for which protocol?
a) RIP b) **OSPF** c) BGP d) EIGRP

Which model is based on participants having equal responsibility?
a) Client-Server b) **P2P (Peer-to-Peer)**

A digital signature is created using which key?
a) Public Key b) **Private Key**

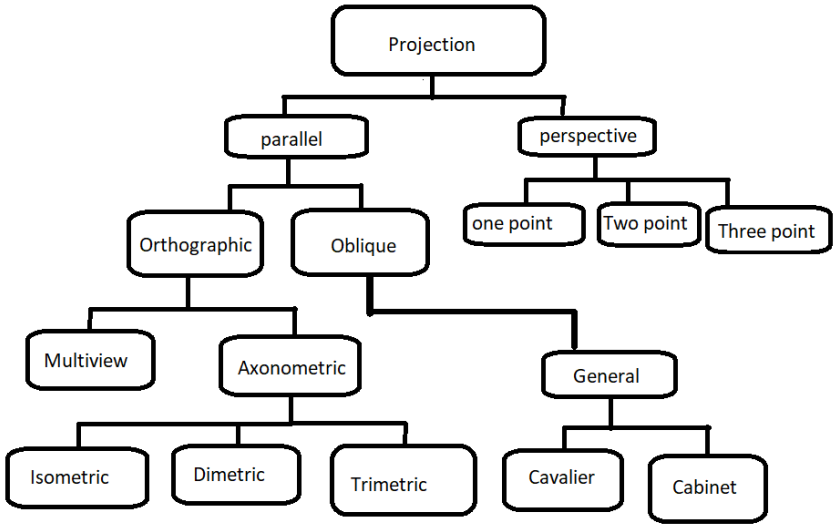
Which wireless LAN protocol handles collision avoidance?

a) CSMA/CD b) **CSMA/CA**

Chapter 6: Theory of Computation and Computer Graphics (10%)

How many primary types of projections are there in computer graphics?

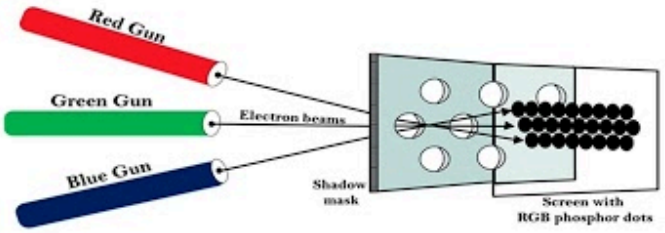
a) **2 (Parallel and Perspective)** b) 3 c) 4



A shadow mask CRT has how many phosphor color dots at each pixel position?

a) 2 b) **3** c) 4 d) 1

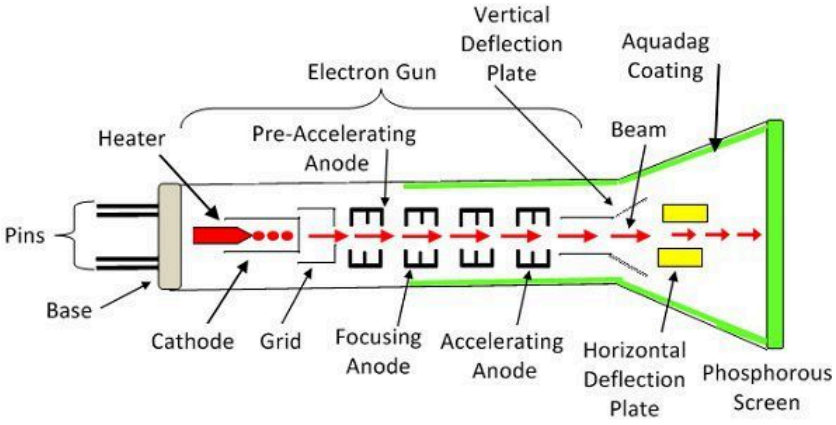
A Shadow mask CRT has 3 phosphor color dots at each pixel position. One is of red color, second is of blue color and third is of green color. This type of CRT has three electron guns, one for each color dots. The 3 electron beams are focused as a group on to the shadow mask which contains a series of holes in window.



When the three beams pass through a hole in the shadow mask, they activate a dot

What is the coating used inside a cathode ray tube?

a) Silver b) **Phosphorus** c) Gold



Cathode Ray Tube

Circuit Globe

Which method can locate pixels fastest for line generation?

a) DDA b) **Bresenham line algorithm**

Digital Differential Analyzer (DDA): Calculates pixel coordinates step-by-step using line slope equations (y = mx + b). It relies heavily on floating-point arithmetic, which requires rounding and slows down rendering performance.

Bresenham's Line Algorithm: Selects the optimal pixel path by calculating a "decision parameter" that tracks deviations from the true line path. It uses fast, efficient pure integer arithmetic instead of slow floating-point operations.

Liang-Barsky is an algorithm used for:

a) Surface removal b) **Line clipping** c) Polygon filling

If the scaling factor is 0.5, the size of the object:

a) Increases b) **Decreases** c) Stays the same

Scale factors less than 1 (but greater than 0) reduce the size of an object.

A scaling factor of 0.5 cuts the dimensions of the object **exactly in half**.

Scale factors greater than 1 increase the size.

A **scale factor of 1** keeps the size the same.

Which plane is used for 2D transformations?

a) 3D plane b) **x-y plane (Cartesian)** c) z-plane

A deterministic Turing machine is described as being:

a) Ambiguous b) **Unambiguous** c) Stochastic

Pumping lemma for context-free languages is used to prove a language is:

a) Context-free b) **Not context-free**

An intractable problem is one that is:

a) Solvable in P-time b) **Computationally expensive (NP-hard/Non-polynomial)**

Chapter 7: DSA, Database System, and Operating System (10%)

Which data structure is best suited for implementing recursion?

a) Queue b) **Stack** c) Linked List d) Tree

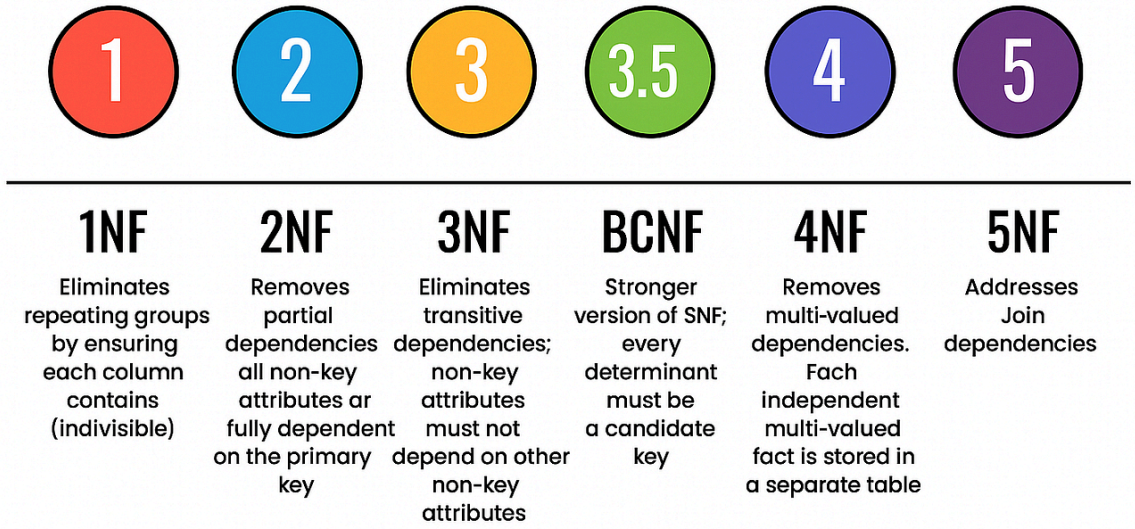
The time complexity of binary search in a sorted array is:

a) O(n) b) **O(log n)** c) O(1)

Algorithm	Best Time Complexity	Average Time Complexity	Worst Time Complexity	Worst Space Complexity
Linear Search	O(1)	O(n)	O(n)	O(1)
Binary Search	O(1)	O(log n)	O(log n)	O(1)
Bubble Sort	O(1)	O(n^2)	O(n^2)	O(1)
Selection Sort	O(n^2)	O(n^2)	O(n^2)	O(1)
Insertion Sort	O(n)	O(n^2)	O(n^2)	O(1)
Merge Sort	O(nlogn)	O(nlogn)	O(nlogn)	O(n)
Quick Sort	O(nlogn)	O(nlogn)	O(n^2)	O(log n)
Heap Sort	O(n+k)	O(nlogn)	O(nlogn)	O(n)
Bucket Sort	O(n+k)	O(n+k)	O(n^2)	O(n)
Radix Sort	O(nk)	O(nk)	O(nk)	O(n+k)
Tim Sort	O(n)	O(n)	O(nlogn)	O(n)
Shell Sort	O(n)	O(n)	O(nlog(n)^2)	O(1)

Which normal form eliminates transitive dependency?

a) 1NF b) 2NF c) **3NF** d) BCNF



SQL command used to remove a table/relation entirely from a database:

a) DELETE b) REMOVE c) **DROP** d) TRUNCATE

The ACID property of a DBMS ensures:

a) **Atomicity, Consistency, Isolation, Durability**

In the dining philosophers problem, the main issues are:

a) **Deadlock and starvation** b) Race conditions

THE DINING PHILOSOPHERS

Scenario: 5 philosophers, 5 forks.
A philosopher needs both fork on his left and right hand to eat, else, he can't.

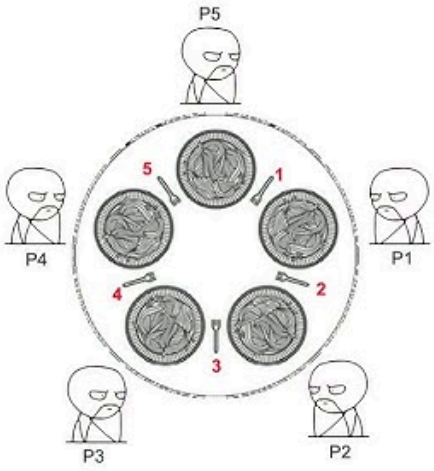
PROBLEMS:

Deadlock - each of the philosophers pick up a fork, no one can eat, hence, a deadlock.

Starvation - if a philosopher is not able to eat for a long period of time, the said philosopher may die of starvation.

POSSIBLE SOLUTIONS:

1. Resource Hierarchy Solution
2. Arbitrator Solution
3. Chandy/Misra Solution



Mutual exclusion is implemented to:

a) **Prevent simultaneous access to a shared resource**

Which algorithm is used to find the transitive closure of a graph?

a) Prim's b) **Warshall's algorithm**

Shell sort is an example of which type of sorting?

a) External b) **Internal Sorting**

In a circular queue of size N, the "full" condition is typically:

a) front == rear b) **front == (rear + 1) mod N**

Chapter 8: Software Engineering and OOAD (10%)

Which SDLC model focuses heavily on risk factors?

a) Waterfall b) **Spiral** c) Prototype

What is the testing of individual components or modules called?

a) **Unit testing** b) Integration testing c) System testing

Integration testing is primarily done to test:

a) Loops b) **Interfaces between modules**

Which UML diagram shows a snapshot of classes at a specific instance?

a) Class diagram b) **Object diagram**

Which UML diagram represents messages between objects?

a) **Collaboration diagram** b) Activity diagram c) State diagram

When preparing classes from use cases, which UML diagrams are often used?

a) **Activity and sequence diagram** b) Object diagram

Communication between objects in a sequence diagram is represented by:

a) Vertical lines b) **Horizontal message arrows**

Which of these is NOT an architectural design decision?

a) System distribution b) **Testing the system** c) Type of application

Requirements validation ensures that:

a) Code is efficient b) **Requirements meet user needs**

CASE tools are used for:

a) Database storage b) **Computer-aided software engineering**

Chapter 9: Artificial Intelligence and Neural Networks (10%)

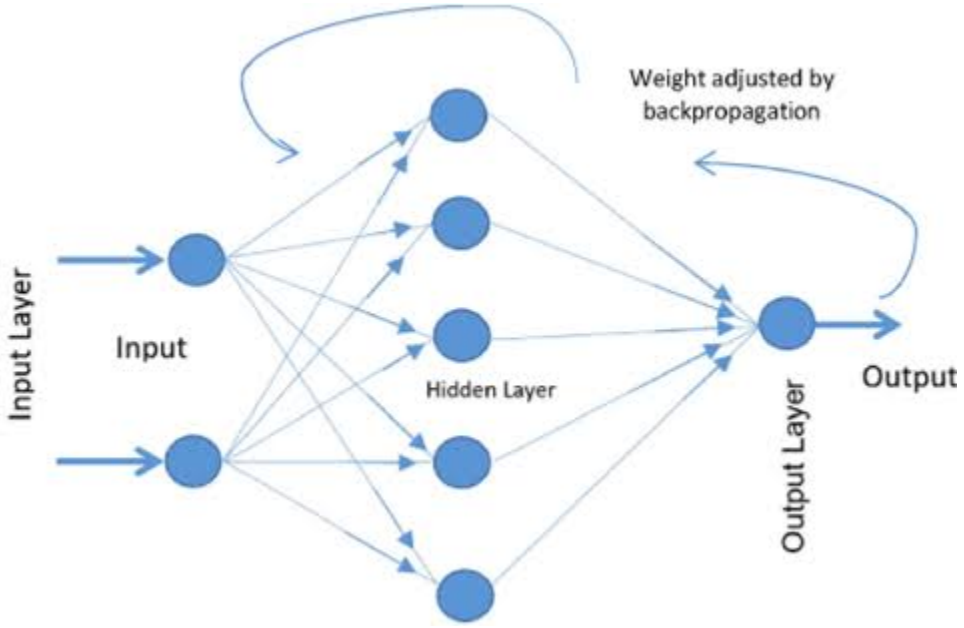
An Intelligent Agent consists of which two elements?

a) Sensors/Actuators b) **Architecture and Program**

- **Architecture:** The physical or software machinery (such as a computer, a robot body, or an operating system) that houses the sensors and actuators.
- **Agent Program:** The implementation of the decision-making logic (the "brain") that runs on top of the architecture to map inputs to outputs.

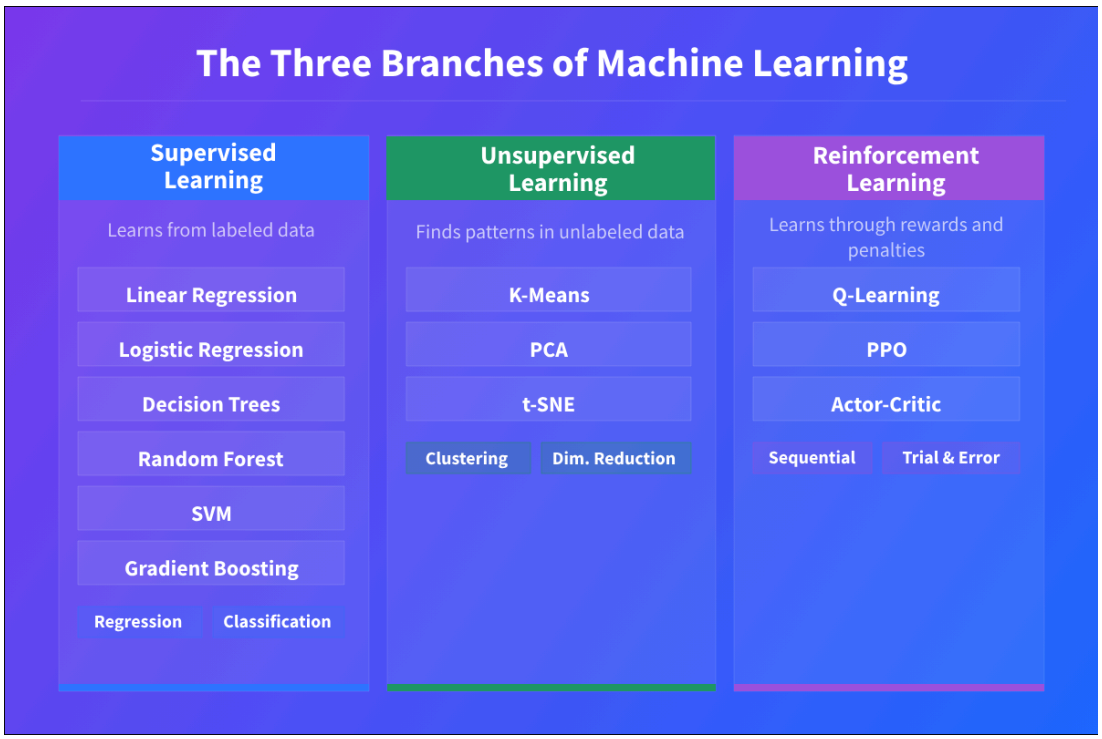
The process of updating weights in a Neural Network is called:

a) Forward propagation b) **Backpropagation**



Which is an Unsupervised Machine Learning algorithm?

a) Linear Regression b) **K-means algorithm** c) Decision Tree

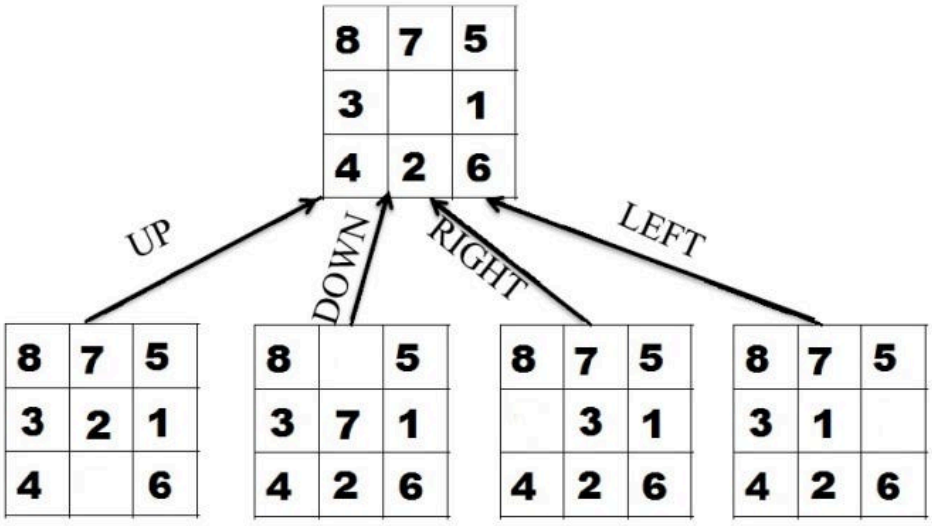


The Expert System "MYCIN" was developed at which university?

a) **Stanford University** b) Oxford University c) MIT

What are the possible moves in the 8-puzzle problem?

a) Diagonal b) **Left, Right, Up, Down**



Decision Trees are primarily used for:

a) **Binary data classification** b) Power management

The time complexity of Breadth-First Search (BFS) is:

a) O(V) b) **O(V + E)**

What is the primary advantage of a linked list over an array?

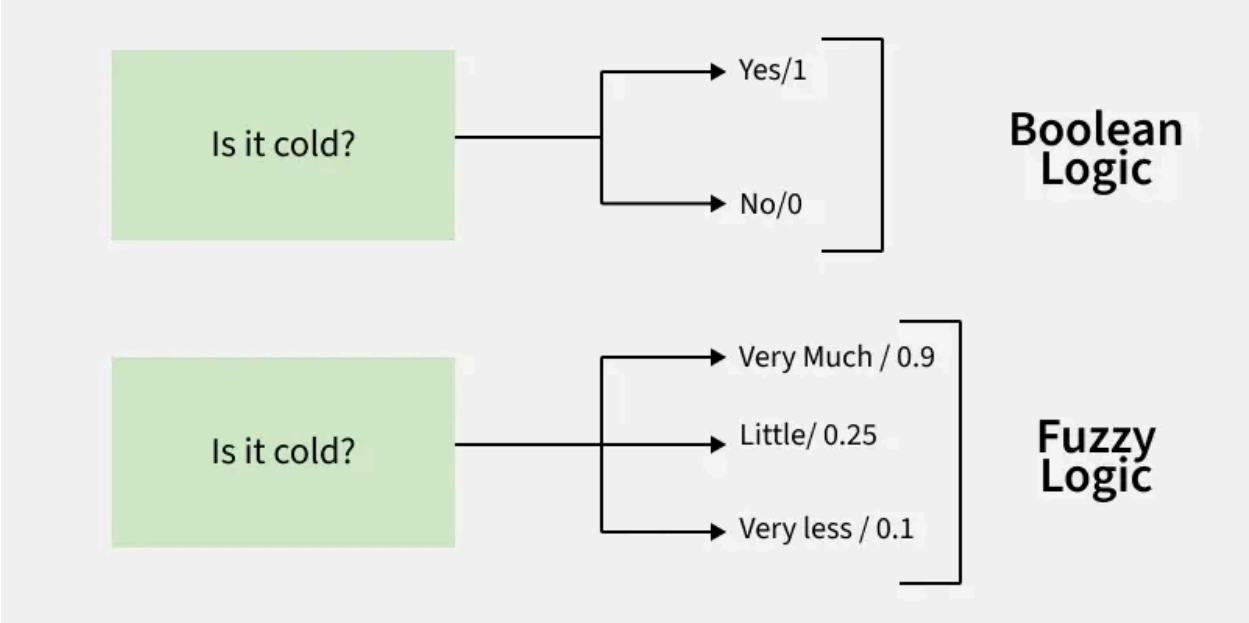
a) Speed b) **Dynamic memory allocation**

The Expert System "PUFF" is used for diagnosing:

a) **Respiratory disease** b) Heart disease c) Kidney disease

Fuzzy logic is best used to describe something that is:

a) True b) False c) **Partially true and partially false**



Chapter 10: Project Planning, Design and Implementation (10%)

Nepal Engineering Council (NEC) members serve for how many years?
a) 2 b) 3 c) **4**

What is the minimum qualification for general engineer registration with NEC?
a) **Bachelor's Degree** b) Master's Degree c) PhD

The Labor Act of Nepal was established in which year?
a) **2074** b) 2075 c) 2076

In which type of depreciation does the amount remain constant each year?
a) Reducing balance b) **Straight line depreciation**

How many articles are in the NEC's Code of Conduct?
a) 5 b) **8** c) 10

The Nepal Engineers Association (NEA) is an:

a) Regulatory Body b) **Association of engineers** c) Government Ministry

Out of 7 NEC council members, at least how many must be female?

a) 1 b) 2 c) **3**

What does PERT stand for?

a) **Program Evaluation and Review Technique**

Which project management method identifies the longest path?

a) Bar chart b) **Critical Path Method (CPM)**

EASY EXPLANATION