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SUBMITTED BY:

NAME – FAZLA PRWEEN

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SUMITTED TO:

AMRITA PRAKASH AND SUNDHIR SINHA

Q1. DEFINE ARTIFICIAL INTELLIGENCE AND IT'S HISTORY.

In today's world, technology is growing very fast, and we are getting in touch with different new technologies day by day.

Here, one of the booming technologies of computer science is Artificial Intelligence which is ready to create a new revolution in the world by making intelligent machines. The Artificial Intelligence is now all around us. It is currently working with a variety of subfields, ranging from general to specific, such as self-driving cars, playing chess, proving theorems, playing music, Painting, etc.

AI is one of the fascinating and universal fields of Computer science which has a great scope in future. AI holds a tendency to cause a machine to work as a human.

Artificial Intelligence is composed of two words Artificial and Intelligence, where Artificial defines *"man-made,"* and intelligence defines *"thinking power"*, hence AI means *"a man-made thinking power."*

So, we can define AI as:

> "It is a branch of computer science by which we can create intelligent machines which can behave like a human, think like humans, and able to make decisions."

Artificial Intelligence exists when a machine can have human based skills such as learning, reasoning, and solving problems

With Artificial Intelligence you do not need to pre-program a machine to do some work, despite that you can create a machine with programmed algorithms which can work with own intelligence, and that is the awesomeness of AI.

It is believed that AI is not a new technology, and some people says that as per Greek myth, there were Mechanical men in early days which can work and behave like humans.

History of Artificial Intelligence

Artificial Intelligence is not a new word and not a new technology for researchers. This technology is much older than you would imagine. Even there are the myths of Mechanical men in Ancient Greek and Egyptian Myths. Following are some milestones in the history of AI which defines the journey from the AI generation to till date development.

Maturation of Artificial Intelligence (1943-1952)

- Year 1943: The first work which is now recognized as AI was done by Warren McCulloch and Walter pits in 1943. They proposed a model of artificial neurons.
- Year 1949: Donald Hebb demonstrated an updating rule for modifying the connection strength between neurons. His rule is now called Hebbian learning.
- Year 1950: The Alan Turing who was an English mathematician and pioneered Machine learning in 1950. Alan Turing publishes "Computing Machinery and Intelligence" in which he proposed a test. The test can check the machine's ability to exhibit intelligent behavior equivalent to human intelligence, called a Turing test.

The birth of Artificial Intelligence (1952-1956)

- Year 1955: An Allen Newell and Herbert A. Simon created the "first artificial intelligence program “Which was named as "Logic Theorist". This program had proved 38 of 52 Mathematics theorems and find new and more elegant proofs for some theorems.
- Year 1956: The word "Artificial Intelligence" first adopted by American Computer scientist John McCarthy at the Dartmouth Conference. For the first time, AI coined as an academic field.

At that time high-level computer languages such as FORTRAN, LISP, or COBOL were invented. And the enthusiasm for AI was very high at that time.

The golden years-Early enthusiasm (1956-1974)

- Year 1966: The researchers emphasized developing algorithms which can solve mathematical problems. Joseph Weizenbaum created the first chatbot in 1966, which was named as ELIZA.
- Year 1972: The first intelligent humanoid robot was built in Japan which was named as WABOT-1.

The first AI winter (1974-1980)

- The duration between years 1974 to 1980 was the first AI winter duration. AI winter refers to the time period where computer scientist dealt with a severe shortage of funding from government for AI researches.
- During AI winters, an interest of publicity on artificial intelligence was decreased.

A boom of AI (1980-1987)

- Year 1980: After AI winter duration, AI came back with "Expert System". Expert systems were programmed that emulate the decision-making ability of a human expert.
- In the Year 1980, the first national conference of the American Association of Artificial Intelligence was held at Stanford University.

The second AI winter (1987-1993)

- The duration between the years 1987 to 1993 was the second AI Winter duration.
- Again, Investors and government stopped in funding for AI research as due to high cost but not efficient result. The expert system such as XCON was very cost effective.

The emergence of intelligent agents (1993-2011)

- Year 1997: In the year 1997, IBM Deep Blue beats world chess champion, Gary Kasparov, and became the first computer to beat a world chess champion.
- Year 2002: for the first time, AI entered the home in the form of Roomba, a vacuum cleaner.
- Year 2006: AI came in the Business world till the year 2006. Companies like Facebook, Twitter, and Netflix also started using AI.

Deep learning, big data and artificial general intelligence (2011-present)

- Year 2011: In the year 2011, IBM's Watson won jeopardy, a quiz show, where it had to solve the complex questions as well as riddles. Watson had proved that it could understand natural language and can solve tricky questions quickly.

- Year 2012: Google has launched an Android app feature "Google now", which was able to provide information to the user as a prediction.
- Year 2014: In the year 2014, Chatbot "Eugene Goostman" won a competition in the infamous "Turing test."
- Year 2018: The "Project Debater" from IBM debated on complex topics with two master debaters and also performed extremely well.
- Google has demonstrated an AI program "Duplex" which was a virtual assistant, and which had taken hairdresser appointment on call, and lady on other side didn't notice that she was talking with the machine.

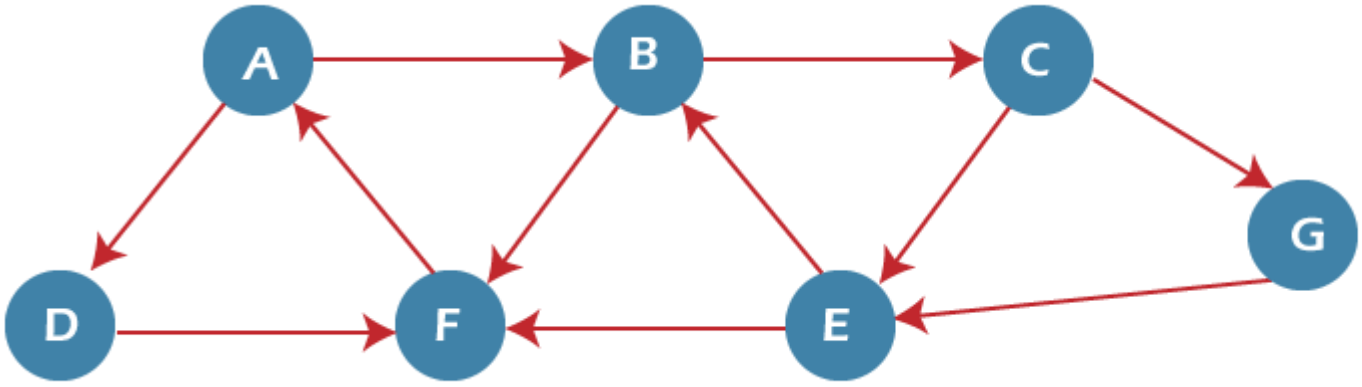
Now AI has developed to a remarkable level. The concept of Deep learning, big data, and data science are now trending like a boom. Nowadays companies like Google, Facebook, IBM, and Amazon are working with AI and creating amazing devices. The future of Artificial Intelligence is inspiring and will come with high intelligence.

Q2. DESCRIBE BREADTH FIRST SEARCH WITH THE HELP OF AN EXAMPLE.

There are many ways to traverse the graph, but among them, BFS is the most commonly used approach. It is a recursive algorithm to search all the vertices of a tree or graph data structure. BFS puts every vertex of the graph into two categories - visited and non-visited. It selects a single node in a graph and, after that, visits all the nodes adjacent to the selected node.

Example of BFS algorithm

Now, let's understand the working of BFS algorithm by using an example. In the example given below, there is a directed graph having 7 vertices.



In the above graph, minimum path 'P' can be found by using the BFS that will start from Node A and end at Node E. The algorithm uses two queues, namely QUEUE1 and QUEUE2. QUEUE1 holds all the nodes that are to be processed, while QUEUE2 holds all the nodes that are processed and deleted from QUEUE1.

Now, let's start examining the graph starting from Node A

Step 1 - First, add A to queue1 and NULL to queue2.

1. QUEUE1 = {A}
2. QUEUE2 = {NULL}

Step 2 - Now, delete node A from queue1 and add it into queue2. Insert all neighbours of node A to queue1.

1. QUEUE1 = {B, D}
2. QUEUE2 = {A}

Step 3 - Now, delete node B from queue1 and add it into queue2. Insert all neighbours of node B to queue1.

1. QUEUE1 = {D, C, F}
2. QUEUE2 = {A, B}

Step 4 - Now, delete node D from queue1 and add it into queue2. Insert all neighbours of node D to queue1. The only neighbor of Node D is F since it is already inserted, so it will not be inserted again.

1. QUEUE1 = {C, F}
2. QUEUE2 = {A, B, D}

Step 5 - Delete node C from queue1 and add it into queue2. Insert all neighbours of node C to queue1.

1. QUEUE1 = {F, E, G}
2. QUEUE2 = {A, B, D, C}

Step 5 - Delete node F from queue1 and add it into queue2. Insert all neighbours of node F to queue1. Since all the neighbours of node F are already present, we will not insert them again.

1. QUEUE1 = {E, G}
2. QUEUE2 = {A, B, D, C, F}

Step 6 - Delete node E from queue1. Since all of its neighbours have already been added, so we will not insert them again. Now, all the nodes are visited, and the target node E is encountered into queue2.

1. QUEUE1 = {G}
2. QUEUE2 = {A, B, D, C, F, E}

Q3 (a). WHAT DO YOU MEAN BY QUANTIFIERS?

Quantifier is used to quantify the variable of predicates. It contains a formula, which is a type of statement whose truth value may depend on values of some variables. When we assign a fixed value to a predicate, then it becomes a proposition. In another way, we can say that if we quantify the predicate, then the predicate will become a proposition. So quantify is a type of word which refers to quantifies like "all" or "some".

There are mainly two types of quantifiers that are universal quantifiers and existential quantifiers. Besides this, we also have other types of quantifiers such as nested quantifiers and Quantifiers in Standard English Usages. Quantifier is mainly used to show that for how many elements, a described predicate is true. It also shows that for all possible values or for some value(s) in the universe of discourse, the predicate is true or not.

Q3 (b). EXPLAQIN CNF AND DNF WITH EXAMPLES.

Conjunctive Normal Form (CNF) :
A formula which is equivalent to a given formula and which consists of a product of elementary products is called a conjunctive normal form of given formula.
Example :
$(P\sim \vee Q) \wedge (Q \vee R) \wedge (\sim P \vee Q \vee \sim R)$

- The CNF of formula is not unique.
- If every elementary sum in CNF is tautology, then given formula is also tautology.

p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

Example: if statement p is "6<7" and statement q is "-3>-4" then the conjunction of p and q is true as both p and q are true statements.

Disjunctive Normal Forms (DNF) :
A formula which is equivalent to a given formula and which consists of a sum of elementary products is called a disjunctive normal form of given formula.
Example :
$(P \wedge \sim Q) \vee (Q \wedge R) \vee (\sim P \wedge Q \wedge \sim R)$

- The DNF of formula is not unique.

p	q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

Example: - if p is "4 is a positive integer" and q is "$\sqrt{5}$ is a rational number", then $p \vee q$ is true as statement p is true, although statement q is false.

Q4. DIFFERENTIATE THE FOLLOWING:-

(a). HUMAN EXPERTAND ARTIFICIAL EXPERT SYSTEM

S.No.	Human experts	Expert System
1.	Use knowledge in the form of rules of thumbs or heuristics to solve problem in a narrow domain.	It process knowledge expressed in the form of rules and use symbolic reasoning in narrow domain.

S.No.	Human experts	Expert System
2.	In a human expert we deal with human brain in which knowledge exists in a compiled form.	It provide a clear separation of knowledge from its processing.
3.	It is capable of explaining line of reasoning and providing the details.	Expert system helps in tracing the rules that produced during a solving a problem and also explain how a that particular conclusion was reached and why specific data was needed.
4.	It uses inexact reasoning and also able to deal with incomplete, uncertain and fuzzy information.	It permits inexact reasoning and but able to deal with incomplete, uncertain and fuzzy data.
5.	It enhances the quality of problem solving because of years of learning and practical training.	It enhances the quality of problem solving by the addition of new rules or by adjusting the old ones in the knowledge base and when new knowledge is acquired, changes are easy to observe.
6.	Human expert can be available at a specific working day.	Expert system can be available wherever and at any time.
7.	To solve any problem, human expert can take variable time.	To solve any problem, expert system takes a very short interval of time.
8.	It is not replaceable.	It can be replaced.

(B). Database and knowledge base

Database	Knowledge Base
1. Database doesn't consist of fuzzy facts.	1. Knowledge base may consist of fuzzy facts.
2. Database doesn't contain the more sophisticated relationship between facts.	2. Knowledge base contains more sophisticated relationships between facts.
3. Database doesn't contain factual and heuristic knowledge.	3. Knowledge base contains both factual and heuristic knowledge.
4. It doesn't emulate the decision making.	4. It emulates the decision-making processes of humans.
5. It doesn't capture and distribute knowledge.	5. It captures and distributes knowledge.
6. These systems are sometimes not consistent.	6. These systems are accurate and consistent.
7. Database systems aren't dependable.	7. Knowledge base systems are dependable.
8. A database expert is needed to update databases.	8. An expert knowledge of the domain is needed for updating Knowledge Base.
9. These systems are sometimes not profitable.	9. These systems are profitable.