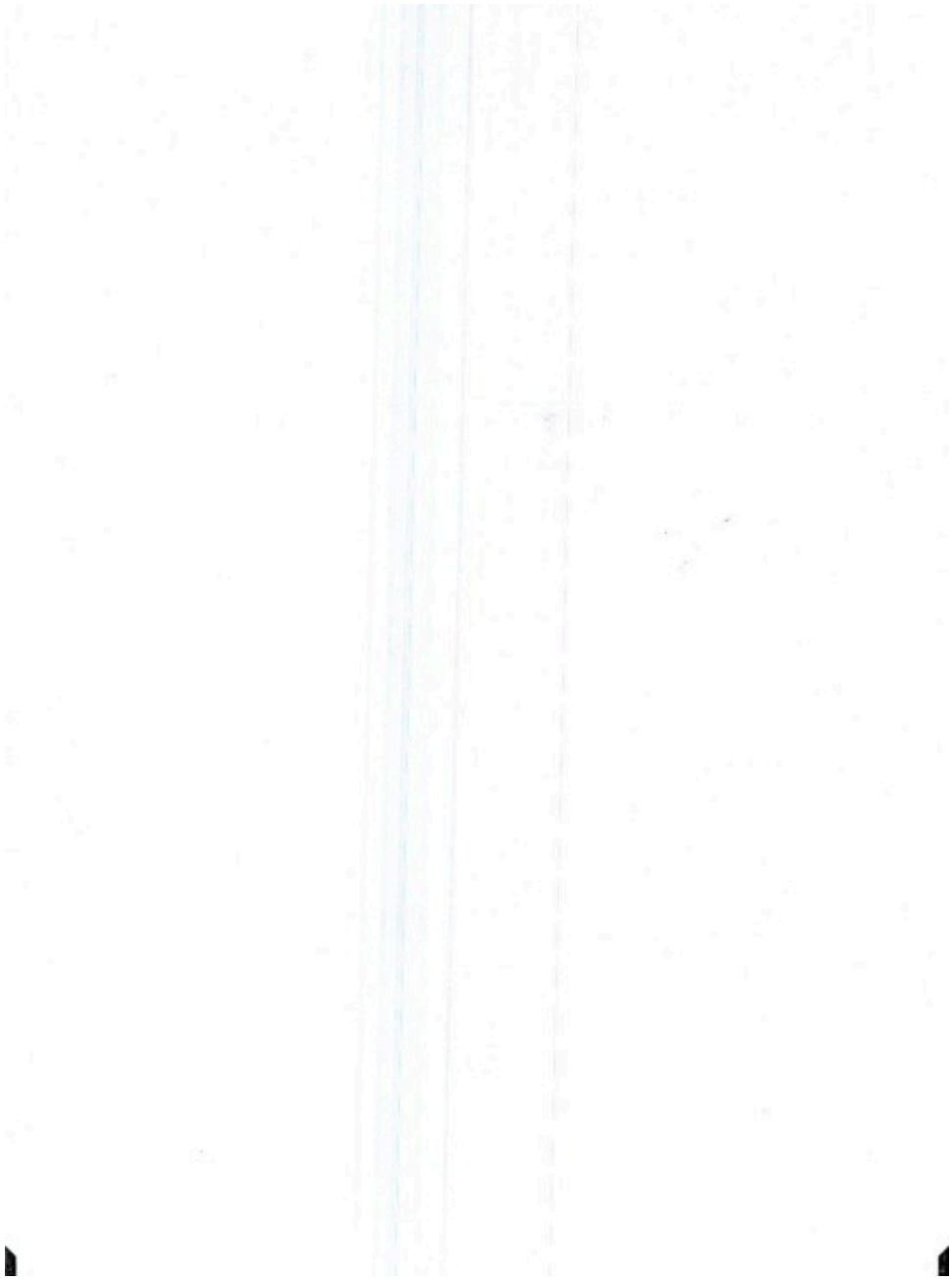






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Q. No. 2 Part (i)

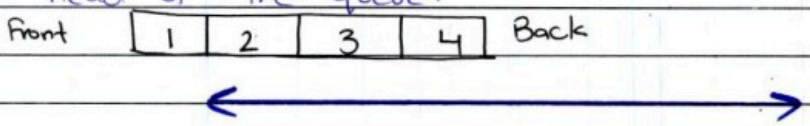
Solution: Queue uses FIFO principle (first in first out) where the first element added is the first one to be removed. Following operations can be performed on queue.

isEmpty: Check if queue is empty or not.

is Full: Check if queue is full or not.

Front: Return to the front / head of the queue, without removing any element.

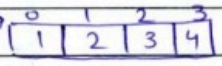
Dequeue: Remove first element from the front or head of the queue.



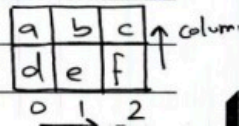
Q. No. 2 Part (ii)

Solution: Array: is a data structure used in computer programming which is used to store different elements of the same size. Contagias memory locations are used to store elements which are identified by indicies. Arrays don't require metadata (additional data) to store elements but they require to declare its size at the beginning and their size can't be changed later i.e not dynamic in size. Arrays are of two types:

1-D Array: in which elements are stored in a single array & can be accessed by a single index. e.g



2D Array: is in the form of matrix & is also called a table, elements can be accessed knowing two indices row & column.



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Q. No. 2 Part (iii)

Solution:

	Security	Usability	Example
Encryption	Encrypting data (Transforming it into a format only accessible with a decryption key for authorized users) steadily increases security and reduces security risks like phising	Encryption delay access to data causing inefficiency & frustration during emergencies. Also handling decryption keys is a complex and very time consuming task.	For instance, encrypting a hospital's patients record helps maintain security & safety but can cause problems during medical and health emergiencies.

Q. No. 2 Part (iv)

Solution:

Null Hypothesis (H_0): Null hypothesis states that there is no change and cause and effect relationship between variables. The differences observed are all due to random changes. For instance, Null hypothesis can be: "Coffee does not increase student's energy levels."

Alternative Hypothesis: (H_1): This hypothesis states that there is a change and cause and effect relationship between variables. For instance, Alternative hypothesis is: "Coffee is responsible for increasing student's energy levels."

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Q. No. 2 Part (v)

Solution:

Security Protocols: are set of rules and procedures to ensure secure and safe transmission of data and information during transmission, processing, storing, handling etc. They are essential in maintaining data security, privacy and integrity. For example:

HTTPS (Hyper text transfer protocol Secure): is a type of security protocol used to ensure safety & security of data & personal information while using web broswers, usually the internet. It safeguards the exchange of information between the website/webapplication and the web browser.

Q. No. 2 Part (vi)

Solution:

Overfitting: is when model trains too well on the ~~test~~ data set learning unnecessary details like noise disruptions etc. In this case model performs well on test data but poorly on new data.

Underfitting: This happens when models trains poorly on test data and is unable to provide correct output of new data as well as test data as it has not practised enough on test data. In underfitting models trains poorly on both test & new data.

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Q. No. 2 Part (vii)

Solution:

P- Value: Refers to how likely a change is due. A lower P-value is a strong evidance against Null hypothesis whereas a higher P-value is a weak evidance against Null hypothesis. For instance if we want to test wheather a fertilizer helps plants grow taller, we'll use fertilizers in some plants (call in group A) and not use in some other plants (group B). If P-value of Null hypothesis in this case is less than 0.02 (very small) then yes, fertilizer makes plants taller otherwise if its greater (like 0.5) then fertilizer has not effect on plant height.

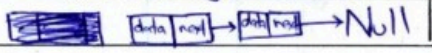
Q. No. 2 Part (viii)

Solutions: Accessibility solutions for users with visual imparements like blindness or low vision, color blindness includ

- Screen Readers: They read out ~~audio~~ video content for users. Effective implementation include semantic HTML and JAWS (Job Access With Speech) for visually impered users.
- High Contrast Color Schemes: Majority of website like Apple include high contrast color mode for users with low visions or color blindness.
- Zoom Function: Web browers like Google and Microsoft have built in zoom functions which enlarge text and images to provide a seemless experience to users with visual imparements.

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Q. No. 2 Part (ix) Solution:

Singly linked List	Doubly Linked List
• It is the most basic and simplest type of linked list.	• It is complex and allows transversal in both directions.
• Each node consists of two parts: data to be stored & reference to next node in sequence	• It's each node has three parts: reference to previous node, data to be stored and reference to next node in sequence.
• It has Null at the end as it doesn't refer to any other node ahead.	• It has Null both at start & end.
• eg: 	• 

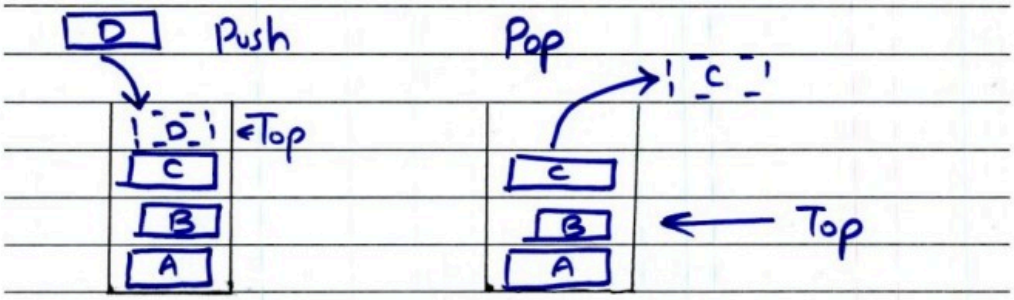
Q. No. 2 Part (x) Solution:

Stack: Uses LIFO principle where the most recent element added is the first to be removed. Stack has following operations:

Push: Add an element on top of the stack.

Pop: Remove the topmost element from the stack.

Top: Return to the top element without removing it.



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Q. No. 2 Part (xi) Solution :

Text File	Binary File
• Text files contaiint characters like .txt, .csv, etc.	• They contaiint data in in form of binary numbers (0s & 1s).
• These files can be read by humans, they're human readable files.	• They are not meant for humans & are used for computer programms.
• They include EOL (end of line) "/n" marker to indicate end of a sentence.	• They don't contain EOL (end of line) marker.
• eg: images (.jpg), audio (.mp3) video (.mp4) & excuteable programs (.exe).	• e.g: python, HTML are examples of binary files.

Q. No. 2 Part (xii) Solution :

IoT in healthcare: Some hospitals in Pakistan has implement IoT based integrated systems to help in the healthcare sector's improvement & to improve producitivity of doctors and medical staff.

• Smart wearable are equipped with sensors to help monitor patient's health remotely & to reduce hospital visits.

• Smart beds equipped with sensors and alarms helps monitor patient's vitals & rings alarms for immediate assistance.

• Smart ambulances are equipped with necessary tools that record & send data to hospitals for timely treatment, reducing damage during the way

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Q. No. 2 Part (xiii) Solution:

Tools like Microsoft World and Google Docs are used for efficiently and efficitively presenting large and vast amount of descriptive and text heavy results and conclusions. Microsoft World is a tool that it internationally used for writing and composing text heavy conclusions and results and findings from data. They are the best tools for descriptive analysis of results.



Q. No. 2 Part (xiv)

Solution:

- Poor Error Messages and Handling: Poor error message are those that are vague, ambigious, unclear and cause frustration on how to solve them. An error message should be clear and concise and descriptive (how to solve them).
- Example: During filling an online form we put invalid format of our DOB so they error says "Error 150 : Invalid input" this error message is confusing & doesn't explain how to resolve it, however an error message like "please enter date in correct format : DD/MM/YYYY" is a good error message.

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Q. No. 3 (Page 1)

Tree transversal:

it's the systematic way of visiting the tree in a specific and systematic order such that not even a single element / node is left unvisited. Tree transversal is visiting each node of the tree in such a systematic order that no node is left unvisited.

Types:

Tree transversal has three types. We can choose any type from the three types depending on our desired output and requirements of our output.

- In-order
- Pre-order
- Post-order

In-order transveral:

In order transversal is most commonly used for binary trees. It is used in binary searching algorithm because it traverses the tree is ascending order. It is also helpul when working with data in ascending order: In-order transversal takes place in the following

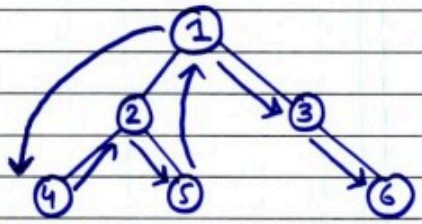
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Q. No. 3 (Page 2)

way:

1. Transverse the left subtree
2. Visit root node
3. Transvers the right subtree.

Example:



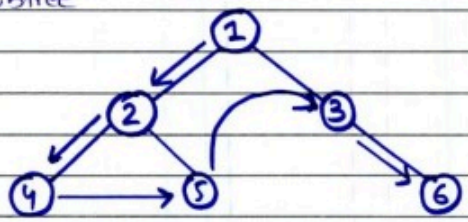
Order of transversal is : 4, 2, 5, 1, 3, 6.
It is used to order data is ascending order.

Pre - order transversal:

Pre - order transversal is used when we want to process the child nodes before the parrent nodes.
It operates in the following way:

1. Visit root node
2. Transverse left subtree
3. Transverse right subtree

Example:



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Q. No. 3 (Page 3)

Order of transversal is: 1, 2, 4, 5, 3, 6.
Algorithms in which interacting with child nodes before parents is crucial, in such algorithms pre-order transversal is used.



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Q. No. 4 (Page 1)

Machine learning algorithms:

Machine learning is a vast field. Machine learning algorithms do not work according to some set of pre-defined rules, rather they adapt from the data provided, learn from it and generate expected output Machine learning algorithms learn from data to make new decisions. For instance if a runner drinks 300ml of water daily at 8 am, eventually (due to implementation of ML algorithm in the water dispenser) the dispenser will start pouring only and exactly 300ml of water in the runner's cup without any instructions. ML algorithms don't need instructions to work properly.

Rule-based algorithms:

Rule based algorithms work on a set of pre-defined instructions and rules. They can not update or change their instructions until we delibrately act on it or update it. They're often more straight forward as compared to machine learning algorithms. They don't make decisions on their own from data.

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Q. No. 4 (Page 2)

Advantages of ML algorithms:

ML algorithms can handle complex data and situations. They can learn patterns from data. They are most efficient in handling large data sets because their efficiency depends upon the size of data set. Whereas, Rule based algorithms can not handle complex situations as they require different set of rules for each senario and problem. Small amounts of data can only be processed and learned by rule based algorithms, big data sets decrease their efficiency. ML algorithms are mostly used in advanced technologies.

Limitations of ML algorithms:

ML algorithms can not handle small and simple data sets, as their accuracy is directly proportional to the size of data set, therefore small and inadequadete problems can not be solved using ML algorithms, however in this case rule based algorithms are often more efficient as they are simple and straight forward. ML algorithms are complex to implement and the setup is very costly whereas rule based algorithms

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Q. No. 4 (Page 3)

are more cost efficient.

Advantages of Rule-based Algorithms:

- Cost efficient
- Simpler to implement and utalize.
- More feasible and easily available

~~Advantages~~ Limitations of rule based algorithms:

- Cannot handle complex and large data sets
- Cannot learn and adapt from data



(Section C)

Q. No. 5 (Page 1)

Cybersecurity:

Cybersecurity refers to the practices and techniques used by individuals and systems to protect their data's security, integrity and to maintain its confidentiality. Most common cyber-security attacks include: DDoS (Distributed Denial of service attack), Ransomeware (hackers encrypt our data and demand a ransom usually money in return of the decryption key) and Spyware (secretly gathering information about someone without them knowing). Viruses and malware also possess significant threats.

Methods to improve cybersecurity:

Improving cybersecurity involves using various security techniques like: 2FA (2 Factor authentication) that requires two factors to provide access. Another prominent method is Biometric verification, which utalizes facial features to grant access to user to authorized data (for authorized individuals only).

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Q. No. 5 (Page 2)

2 - Factor Authentication:

2 factor authentication requires two distint factors for authorized individuals to gain access to their private information. It requires a password as well as any other source of authentication like a verification code or an OTP sent to their phone to grant them access to their device / system. It consists of the following parts:

i. Something you know, like a PIN or password.
ii. Something you have, like a token, smart card or smart phone.
iii. Something you are, like fingerprints or voice recognition or facial recognition.

In this way even if an attacker gains access to the first factor (like a password), the second factor will still maintain data security and be an epitome of cybersecurity practices.

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Q. No. 5 (Page 3)

Biometric - Verification:

Biometric verification uses unique physical / facial feature and behavioral traits to grant access to authorized individuals to sensitive information to implement strong cybersecurity practices. Facial features like face recognition, finger-prints, voice recognition, iris pattern even walking and typing patterns can be kept as biometric verification parameters. Biometric verification is hard to copy, imitate and hack. But it also raises some privacy concerns. Overall it is expensive as compared to two factor authentication but more safe and reliable in terms of safety and security.

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Q. No. 6 (Page 1)

MVP:

Minimum Viable Product (MVP) refers to the most basic version of our product that solely features the whole focus on the most basic functionality of the product. For instance the Apple's Ipod was a great epitome in this regard, the design of the Apple's Ipod which focus on the core function which was traversing between video and audio. The circular wheel interface focused purely on functionality. Airbnb also launched its first version only in San Francisco to focus on the appartment & houses matters in a region before interrational operations. Following are core pillars in building and developing an MVP:

i Feature Priortization
ii Simplicity
iii Testing
iv User Onboarding
v Scalibility

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Q. No. 6 (Page 2)

Feature Prioritization:

It focus primarily on the main functionality of the product, allowing user to ask questions, guide them and answer any possible queries or confusions.

Example: Spotify, a music player application is a great example of feature prioritization in which the app's main focus is on streaming music and podcasts while addressing frequent issues and confusions. Although other features like search, add to playlist etc are also there but the layout is designed in such an engaging way that core functionalities like play/pause, next, previas don't hide behind. Feature prioritization is very crucial in determining the success of a application/product because it irradicates the factors of confusion leading to abandonment of product.

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Q. No. 6 (Page 3)

Scalibility:

The product (MVP) should be easily scalable. it should have all essentials for further iterations and implementations of reguler patches for bug fixes and update practices.

Example: The most early version of the PayPal app went through multiple iterations and updates to fix and find certain errors and to improve overall operatability and functiondity of an app / product or system.

Scalibility offers updates that promotes a feeling of goodness and trust among user that their suggestions were kept in considerations and the app after undergoing multiple iteration becomes more engaging and popular which directly influences the sucess of an product.