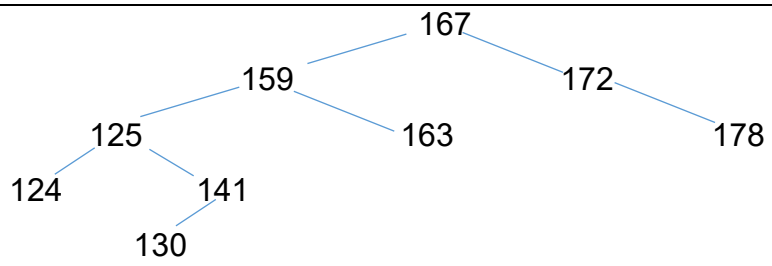
Ds\m2022 JC2 Prelim Exam Paper 1 (Theory) – Suggested Solution

<table>
<tr><td>1 a</td><td>8 comparisons (checking from index 1 to 8)</td><td>1</td></tr>
<tr><td>b</td><td>Line 12: Lo ← Mid + 1
Line 14: Hi ← Mid - 1</td><td>1
1</td></tr>
<tr><td>c</td><td>-1 represents the search key is not found in the array.
Other values from 1 onward represents the index of the key value in the array.</td><td>1
1</td></tr>
<tr><td>d</td><td>
<table>
<tr><th>key</th><th>Lo</th><th>Hi</th><th>Mid</th><th>arr[Mid]</th><th>OUTPUT</th></tr>
<tr><td>33</td><td>1</td><td>11</td><td>6</td><td>24</td><td></td></tr>
<tr><td></td><td>7</td><td></td><td>9</td><td>37</td><td></td></tr>
<tr><td></td><td></td><td>8</td><td>7</td><td>26</td><td></td></tr>
<tr><td></td><td>8</td><td></td><td>8</td><td>33</td><td>8</td></tr>
</table>
</td><td>[1] lo=1, h=11
[1] mid=(lo+hi)//2
[1] arr[mid]=value
[1] output = 8
-1 if no 4 rows</td></tr>
<tr><td>e</td><td>Description must contain the following:
- Hash value used as the index to search for element in the hash table
- If cell is empty, then element does not exists in the hash table
- Mention how collisions are handled and using hash table is still better than linear search
- Compare O(1) for using hash table with O(nlogn) for binary search or O(n) for linear search.</td><td>
1
1
1
1</td></tr>
</table>

2 a	Q is recursive as a base case is seen at lines 7-8 Q also calls itself in line 13.	1 1

b	When P(arr) is called, P will call Q(arr, 2) first.
	If arr[1] > arr[2], the values are swapped, and Q(arr, 1) is called.
	Q(arr, 1) will then lead to an indexing error at line 7.
	To correct this error, an additional base case needs to be included between lines 6 and 7:
	`if i = 1`
	`  return`
		
		1
		1
		
		1

c	Part b describes a runtime error	1
d		First3 1 Right 1 Left 1
e	By first inserting elements into a binary search tree to create an ordered structure, and using in-order traversal to retrieve the elements, we can obtain a result in an ascending order. Disadvantage: Binary search tree is a data structure, not a sorting algorithm. It needs additional memory to store the binary search tree, which consists of not only the score, but also the nodes and pointers. We then require additional steps to traverse the tree, which may cause this method to be slower for small data sets. (We require additional memory to store the result from the traversal. Repeated/Trivial)	1 1 1 1 (Max 3 only)

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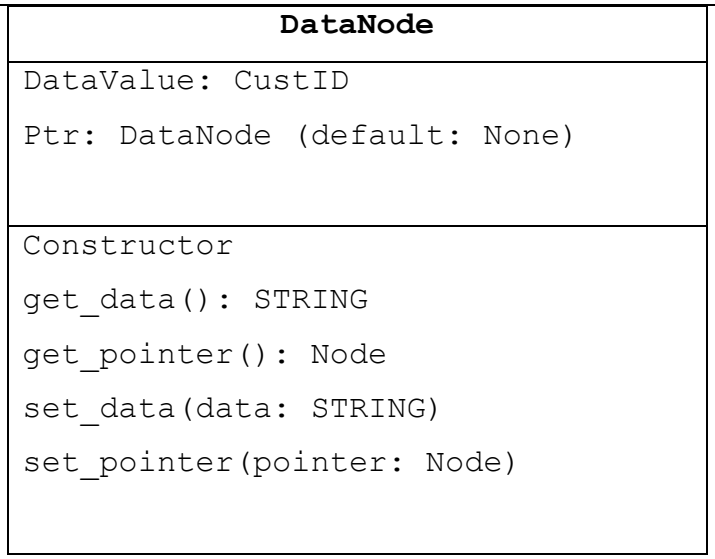
3a i	Linked list has no fixed size and could grow or shrink based on requirement Linked list can be stored in discontiguous disk or memory space, making expansion easy.	1 1
3a ii	Linked list data cannot be accessed randomly, and need to be accessed from the head of the list by traversal	1
3b	 [1m] 2 attributes and correct data types [1m] Constructor [1m] 2 getters [1m] 2 setters Total 4m	4
3c i	1. Check for empty queue, add node if so 2. Start from root node, access the next node via the pointer of the root node. 3. Continue until the current node's pointer is None (last node). 4. Store customer ID in the data of a new node, pointer set as None. 5. Set the current node's pointer to point to the new node.	1 1 1 1
3c ii	1. Set counter as 1. 2. Start from root node, check if data matches customer ID. Return counter if so. 3. If not, access next node through root node's pointer, advance counter by 1 and run same check as step 2 4. Continue until customer ID is found, return the counter	1 1 1 1

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3d	PROCEDURE enqueue_VIP(CustID: STRING)
	NewNode <- Node(CustID)
	IF Root = None: // empty queue
	THEN
	Root <- NewNode
	RETURN
	ENDIF
	
	//traverse list to find first non VIP custID
	CurrentNode <- Root
	PrevNode <- None
	WHILE 'V' in CurrentNode.GetData() AND CurrentNode.GetPointer <> None:
	PrevNode <- CurrentNode
	CurrentNode <- CurrentNode.GetPointer()
	ENDWHILE
	
	IF CurrentNode.GetPointer = None // if all current nodes are all VIP,
	THEN
	CurrentNode.SetPointer(NewNode)
	ELSE:
	NewNode.SetPointer(CurrentNode)
	PrevNode.SetPointer(NewNode)
	ENDIF
	ENDPROCEDURE
		1
		
		1
		
		1
		
		1
		
		1

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4 a	It is in 1NF. All entries that exists in the table are atomic. Or, No multiple values are seen in any attribute in any record.	1 1
b	Card  UsedOn  Game	2 Crow's foot 1 Order

c	`Card (CardID, CustNRIC, CustHP)`
	`Game (GameID, GameStation)`
	`UsedOn (CardID, GameID, CostPerGame, Date, Time, TicketIssued)`
		1
		1
		1

d	UsedOn is not in 2NF because The non-key attribute CostPerGame depends only on GameID and does not depend on the whole key (CardID,GameID,Date,Time). To fulfil the requirement, The attribute CostPerGame must be removed from the table UsedOn. It should be an attribute in the Game table instead.	1 1 1 1 (max 3m)
e	After removing CostPerGame from UsedOn, it fulfils 2NF And since there are no transitive dependencies, the tables are in 3NF.	1 1
f	To find the card balance in card id 21215, we can sum the attribute CostPerGame in the UsedOn table only for records where the card id is 21215 to get the answer 50 - 2.2 - 3.5 - 3.5 - 3.5 - 2.2 = 35.1	1 identify 1

g	`SELECT GameStation, SUM(TicketIssued)`
	`FROM Game, UsedOn`
	`WHERE Game.GameID = 2551`
	`AND Game.GameID = UsedOn.GameID`
		2 Select/Sum
		1 From
		1 Criteria One
		1 Criteria Two

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5 a	Prevent unauthorised access to the network by any two of the followings: - Network Access Control (eg password) - Antivirus Software - Firewall Protection - Virtual Private Networks (Source: https://www.forcepoint.com/cyber-edu/network-security)	2
b	Data may be lost due to any two of the followings: - result of hardware or software failure - data corruption - a human-caused event, such as a malicious attack (virus or malware) - accidental deletion of data.	2
c	Effective backup strategies include the followings: - Storing the backup copy on separate medium - regularly backing up the data; keep daily, weekly and monthly copies (Source: https://www.netapp.com/cyber-resilience/data-protection/data-backup-recovery/what-is-backup-recovery/#:~:text=The%20purpose%20of%20the%20backup,or%20accidental%20deletion%20of%20data.)	2
d	How HTTPS protocol protects the data in transmission? - When a user connects to a webpage, the web server will send over its SSL certificate which contains the public key necessary for secure communication. - During the session, any input from the user (client) will be encrypted with the public key and only the webserver could decrypt it (with its private key). (Source: https://www.cloudflare.com/learning/ssl/what-is-https/#:~:text=HTTPS%20occurs%20based%20upon%20the,to%20start%20the%20secure%20session.)	2

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6 a	Any one of the followings: - Password storage. User passwords are hashed and stored in the server in a scrambled form. When a user logs in with his username/password, the password entry will be hashed to compare with the record in the server. - Digital signatures. A checksum is generated with the hashing function and send together with the original data. The receiver will then use the same hashing function to generate the checksum to compare; if same, then the original data has not been altered. - Document management. When sending a document or group of files, a hashed value is also sent to the receiver so that the receiver an use the same hashing function to generate the hash value for the document or group of files. If the two are equal, the data is considered genuine. If they don't match, the document has been changed. - File management. Some companies also use hashes to index data, identify files, and delete duplicates. If a system has thousands of files, using hashes can save a significant amount of time. (Source: https://www.okta.com/sg/identity-101/hashing-algorithms/#:~:text=A%20hashing%20algorithm%20is%20a,And%20that's%20the%20point.)	2
b	The sender encrypts the email message with the receiver's public key before sending to the receiver, the encrypted message can only be deciphered by the receiver's private key.	2
c	The sender encrypts the with the sender's private key before sending to the receiver, when the receiver receives the encrypted message, he can try to decipher the message using the sender's public key. If the decryption is successful, then the receiver has authenticated the sender's identity. (Source: https://www.sciencedirect.com/topics/computer-science/asymmetric-encryption)	2

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7 a	Suggested Solutions: - installing botnet on internet-connected devices thru malware sent via email attachment or some social engineering - when the attacker launches an attack, these botnets will work simultaneously to send large amount of network traffic in the direction of the target server cos it to be overloaded and out of service.	 1 1
b	Suggested Solutions: - install Intrusion Prevention System (IPS) to monitor the network and take action to prevent any malicious activity by reporting, blocking or dropping it when it occurs. [0] Install Intrusion Detection System (IDS) alone, because it only monitors the network. [0] Install Firewall because DDOS entry point is usually an open firewall port. Any other reasonable strategy: - Scalable bandwidth and server capacity; Or - Use eg. Captcha to accept only genuine human request (Sources: https://www.malwarebytes.com/ddos and https://www.cisa.gov/uscert/ncas/tips/ST04-015#:~:text=A%20distributed%20denial%2Dof%2Dservice%20(DDoS)%20attack%20occurs,carry%20out%20large%20scale%20attacks.)	2 2

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8a	Any 2 of the following 4, with relevant examples • Consent Obligation – Valid consent from end-users to collect data + purpose of data. A company explains that they need to collect the fingerprint of users in order to let them enter the premises. • Protection Obligation – To actively prevent unauthorised access, use, or disclosure of personal data. Company requires employees to apply to access personal data for very specific use cases. • Retention Obligation – To securely remove data that is no longer required for the original purpose. Company deletes personal data collected for a previous publicity campaign, instead of using it for an unrelated new project. • Transfer Limitation – To transfer personal data to another company, permission must be obtained from the user. The recipient must also sign a letter of undertaking to safeguard the data. When 2 companies merge, permission must be sought from users of both companies to allow their data to be shared to the new merged company. 1 mark for explaining 1 obligation (max 2) 1 mark for giving relevant example for the same obligation (max 2)	4
8b i	<u>Integrity</u> • Protect customer privacy by letting them set their own passwords • Not retain any network login details after installation • Withhold responses to customer queries if unsure or outside scope of work, and redirect these requests to a colleague. <u>Responsibility</u> • Arrive at customer's location on time with the right tools • Ensure that installations are carried out to meet the specifications of the company • Explain to customers the issues of installing hardware not in accordance with company specifications. <u>Competence</u> • Be proactive in signing up for on-job training • Work with more experienced colleagues and get advice from them	4

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	• Be aware of information technology and security, and advise customers accordingly <u>Professionalism</u> • To not peddle extra services or hardware to customers if they do not suit the customers' needs • To not degrade a previous colleague's ability when coming to do a repair job 1 mark for stating the rule (max 2) 1 mark for stating a relevant example (max 2) Total 4 marks	
8b ii	• System generates a random password that is made known only to the customer • Technician allows the customer to set a password on the spot, hence ensuring that only the customer knows the password • Technician uses the generic password but advises the customer to change the password subsequently Any 1 of the above 1 mark for stating the measure (max 1) 1 mark for stating a relevant reason (max 1) Total 2 marks	2
8c	• Company raises ticket and sends automated email to acknowledge receipt of report • Security team to investigate report, and directs different teams in company to fix flaws. • CS dept to provide feedback to reporter regarding fixes • PR dept to issue vulnerability notice to users, advising them to follow steps to remediate issues • Raise a case for investigation • Halt all unauthorised access to others' video footages • Update network setting or software programme to prevent unauthorised access	2

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	• Assess the extend of 'leakage' and inform the customers • Report to PDPC Any 2 relevant points (1 mark each) Total 2 marks	
8d	• Allows a CSO to login to another CSO's account and access personal data of customers who are not under his charge (need-to-know basis) • Makes it easy for former employee to continue accessing personal data via the company portal Any relevant point	1
8e	- All employee to attend a workshop on "good password setting" - Passwords that have been used by others will not be accepted - Renew passwords every 3 months 2 points given without description: 1 mark 1 point given with 1 description: 1 mark 2 point given with 1 description: 2 marks	2

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