2021 Prelim P1 suggested solutions

<table>
<tr><td>No</td><td>Suggested solution</td><td>marks</td></tr>
<tr><td>1</td><td>
<table>
<tr><td>Conditions</td><td>C1</td><td>C2</td><td>C3</td><td>C4</td><td>C5</td><td>C6</td><td>C7</td><td>C8</td></tr>
<tr><td>Raining</td><td>Y</td><td>Y</td><td>Y</td><td>Y</td><td>N</td><td>N</td><td>N</td><td>N</td></tr>
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<tr><td>It’s Monday</td><td>-</td><td>Y</td><td>N</td><td>N</td></tr>
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</table>
</td><td>5</td></tr>
<tr><td>2a</td><td>SP500 3 1 1 5
P500 3 0 1 4
500 3 -1 1 3
00 2 -1 1 2
0 1 -1 1 1
0 -1 1 0
False</td><td>3</td></tr>
<tr><td>2b</td><td>A: len(pw) == i
B: char = pw[i]
C: i+1</td><td>3</td></tr>
<tr><td>2c</td><td>if not (digits < 1 and upper_l < 1 and lower_l < 1 and length < 1):
print(pw + '3'*digits + 'U'*upper_l + 'l'*lower_l + 'x' * length)</td><td>4</td></tr>
<tr><td>3a</td><td>Line 05, Logic Error. Logic error is one which allows a program to run successfully, but produces an unintended or undesired result.</td><td>2</td></tr>
</table>

<table>
<tr><td></td><td>

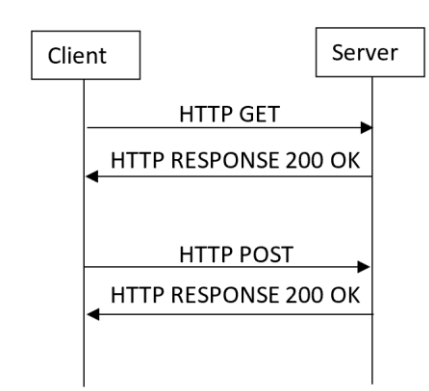
```
new_char = CHR((ORD(char) + 1 - ORD("a")) % 26 + ORD("a"))
```

</td><td></td></tr>
<tr><td>3b</td><td>

Line No.	char	shift	new_char
01	"y"	-24	
11	y	2	-
08	y	1	z
08	z	0	a
03	a	0	-

</td><td>3</td></tr>
<tr><td>4a</td><td>Server – client vs P2P</td><td>1</td></tr>
<tr><td>4b</td><td>1) Centralization: Unlike P2P, where there is no central administration, here in this architecture there is a centralized control. Servers help in administering the whole set-up. Access rights and resource allocation is done by Servers easily.
2) Proper Management: All the files are stored at the same place. In this way, management of files becomes easy. Also it becomes easier to find files.
3) Back-up and Recovery possible : As all the data is stored on server its easy to make a back-up of it. Also, in case of some break-down if data is lost, it can be recovered easily and efficiently. While in peer computing we have to take back-up at every workstation.
4) Up gradation and Scalability in Client-server set-up : Changes can be made easily by just upgrading the server. Also new resources and systems can be added by making necessary changes in server.
5) Accessibility :From various platforms in the network, server can be accessed remotely.</td><td>1</td></tr>
<tr><td>4c</td><td>i. T. When a user accesses a distributed Internet service using a URL, the domain name of the URL is translated to the IP address of a server that is proximal to the user
ii. F. Application, Transport, Network, Datalink
iii. T. Transport layer do the job instead.
iv. F. No G
v. F. 128-bit address
vi. The Internet is a global network of networks while the Web, also referred formally as World Wide Web (www) is collection of information which is accessed via the Internet. Another way to look at this difference is; the Internet is infrastructure while the Web is service on top of that infrastructure.</td><td>6</td></tr>
<tr><td>4d</td><td>HTTP gives users a way to interact with web resources [1] such as HTML files by transmitting hypertext messages (GET/POST/RESPONSE) [1] between clients and servers [1].

HTTP is defined as a request-response protocol/Uses the server-client model.</td><td>3</td></tr>
</table>

<table>
<tr><td></td><td> 
</td><td></td></tr>
<tr><td>4e</td><td>divide messages into packets before sending them.</td><td>1</td></tr>
<tr><td>4f</td><td>AI presents three major areas of ethical concern for society: privacy and surveillance, bias, and discrimination</td><td>1</td></tr>
<tr><td>4g</td><td>It is intended to allow for the proper use and management of these resources, provide protection of users' rights, ensure reasonable access, and provide guidelines for accountability.

The Code as a whole is concerned with how fundamental ethical principles apply to a computing professional's conduct.</td><td>2</td></tr>
<tr><td>4h</td><td>Data verification – the check that the data is same is the original copy
Data validation – correctness, usefulness and in correct format</td><td>1</td></tr>
<tr><td>5a</td><td>9
6 10
4 7
2
1</td><td>1</td></tr>
<tr><td>5b</td><td>1,2,4,7,6,10,9 [left node is smaller]</td><td>1</td></tr>
<tr><td>5c</td><td>Add 8
<table><tr><td>root</td><td>7</td></tr><tr><td>nextFree</td><td>-1</td></tr></table>
<table><tr><td>Array Index</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>Data</td><td>8</td><td>7</td><td>10</td><td>6</td><td>1</td><td>4</td><td>2</td><td>9</td></tr><tr><td>leftPtr</td><td>-1</td><td>-1</td><td>-1</td><td>5</td><td>-1</td><td>6</td><td>4</td><td>3</td></tr><tr><td>rightPtr</td><td>-1</td><td>0</td><td>-1</td><td>1</td><td>-1</td><td>-1</td><td>-1</td><td>2</td></tr></table>
9
6 10
4 7
2 8
1

Delete 6
<table><tr><td>root</td><td>7</td></tr><tr><td>nextFree</td><td>0</td></tr></table></td><td>3</td></tr>
</table>

Array Index	0	1	2	3	4	5	6	7
Data	-	**8**	10	**7**	1	4	2	9
leftPtr	-1	-1	-1	5	-1	6	4	3
rightPtr	-1	**-1**	-1	1	-1	-1	-1	2

root	7
nextFree	**3**

Array Index	0	1	2	3	4	5	6	7
Data	**8**	**7**	10	**-/6**	1	4	2	9
leftPtr	-1	5	-1	-1	-1	6	4	1
rightPtr	-1	**0**	-1	-1	-1	-1	-1	2

9
7 10
4 8
2
1

Delete 6

root	7
nextFree	**4**

Array Index	0	1	2	3	4	5	6	7
Data	**8**	7	10	4	1	2	1	9
leftPtr	-1	-1	-1	5	-1	6	-1	3
rightPtr	-1	**0**	-1	1	-1	-1	-1	2

9
4 10
2 7
1 8

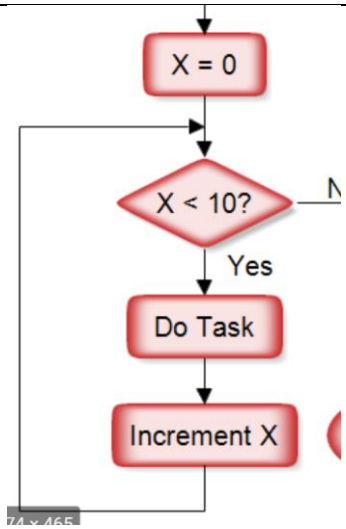
5d

- We can get all keys in sorted order by just doing **Inorder Traversal of BST**. This is not a natural operation in Hash Tables and requires extra efforts.
- Doing order statistics, **finding closest lower and greater elements**, doing **range queries are easy to do with BSTs**. Like **sorting**, these operations are not a natural operation with Hash Tables.
- With **Self-Balancing BSTs**, all operations are **guaranteed** to work in O(Logn) time. But with Hashing, Θ(1) is average time and **some particular operations may be costly, especially when table resizing happens**

1

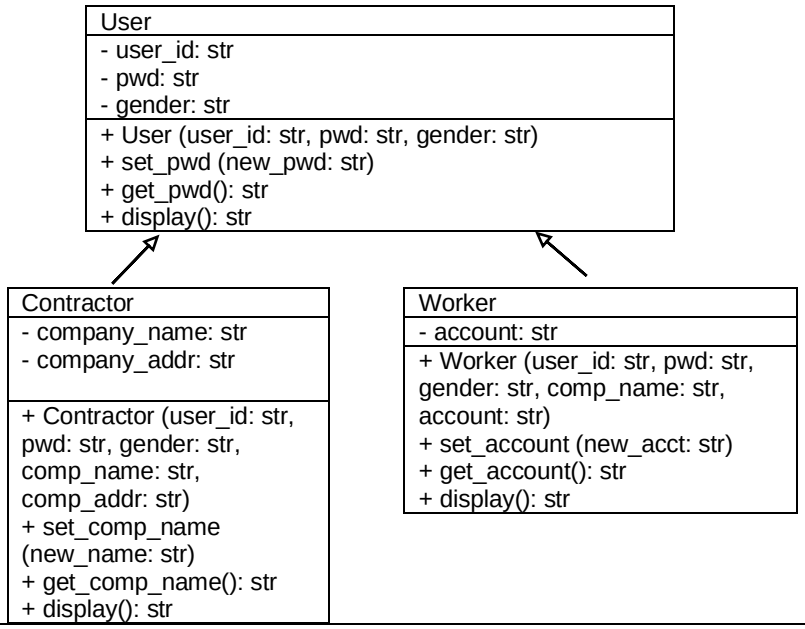
5e	When load factor is high which causes more collisions and clustering. Solution is to expand the hashtable and rehash all items.	2
5f	1) The hash value is fully determined by the data being hashed. 2) The hash function uses all the input data. 3) The hash function "uniformly" distributes the data across the entire set of possible hash values.	2
6a	Quick sort	1
6b	If it is nearly sorted the pivot picked in the algorithm is most of the time the smallest item. This doesn't dividend the lst into the two equal lst and this will affect the sorting time complexity.	1
6c	Change pivot = lst[0] to pivot = lst[midptr]	2
6d	Insertion sort performs **fewer comparisons.** For bubble sort to correct one incorrect item in an array, for example a small value that is found at the back of the array, it will need to take many passes to bring the item to the correct position where each pass invokes n-1 comparisons. For insertion sort to correct one incorrect item in an array just like the example above, it only needs 1 pass.	2

6e	`def minTime(n, k, arr) :`
	`  # Sort in descending order`
	`  arr.sort(reverse = True)`
	`  minTime = 0`
	`  # Iterate through the groups`
	`  for i in range(0, n, k) :`
	`  # Update the time taken for`
	`  # each group`
	`  minTime += (2 * arr[i])`
	`  # Return the total time taken`
	`  return minTime`
	
	**arr[] is integer array representing the destination floors for n people waiting currently at the ground floor*
	**n is the number people waiting*
	**k is the capacity of the elevator.*
	
	Example of loop
		4

		
7a (new)	1NF means all columns must be atomic, which means there can be no multi-valued columns. In the current table, multiple workers are corresponding to the same contractor.	2
7b	A composite key is a combination of two or more fields in a table that can be used to uniquely identify each record in a table.	1
7c	(WorkerID, Job) 2NF states that every non-key attribute must be fully dependent on the entire primary key. For worker's table, the worker's name depends on worker's id only. [just parking here] 3NF states that there should not have transitive dependencies; or there should not be interdependencies among the non-key attributes.	3
7d	Contractor (ContractorID, ContractorName, ContractorContact) JobSkillInfo (Job, SkillLevel, HourlyRate) WorkerJob (WorkerID, Job*, SKillLevel*) Worker(WorkerID, WorkerName) ContractRecord(ContractorID, WorkerID*, Job*, Date, StartingTime, EndingTime)	6
7e	Contractor - 1:n - ContractRecord - n:1 - WorkerJob - n:1 – JobSkillInfo n:1 Worker	3
7f	Data integrity refers to the requirement for data to be accurate and up to date. A flat file system have redundant data and hence when updating or deleting records, some records might not be updated/deleted properly, and hence lead to them being inaccurate/not up to date.	3

<table>
<tr><td></td><td>A RDBMS system on the other hand do not need to worry for such issues, because the tables are normalised and when one record is updated, the change will be reflected to all the related records.

E.g. if hourly rate changed for a (job, skilllevel), then all workers will be affected automatically.</td><td></td></tr>
<tr><td>7g</td><td><pre>SELECT Contractor.ContractorName,
ContractRecord.Job, WorkerJob .SkillLevel,
ContractRecord.Date
FROM Contractor, ContractRecord, WorkerJob
WHERE Contractor. ContractorID =
ContractRecord.ContractorID
AND ContractRecord.WorkerID = WorkerJob.WorkerID
AND ContractRecord.Job = WorkerJob.Job
AND Contract.ContractorName = "Su Ming De"
ORDER BY ContractRecord.Date ASC</pre></td><td>5</td></tr>
<tr><td>8</td><td>1 mark for 3 classes
1 mark for correct use of public and private
1 mark for correct distribution of attributes
1 mark for identification of appropriate methods
1 mark for correct inheritance shown (upward pointing arrows)
1 mark for polymorphism (circle display())

 
</td><td></td></tr>
<tr><td>8b</td><td>Inheritance refers to a subclass (or child class) can retain similar implementations of attributes and behaviour methods from another class, called the superclass (or parent class).

Contractor and Worker class can inherit attributes and methods from User class without coding them again.

Inheritance allows reusability.</td><td></td></tr>
<tr><td>8c</td><td>New sub class from user
Home owner with properties such as contact and address</td><td>3</td></tr>
</table>

	Methods such as setters and getters of contact/address and function to display all workers came to their home over a period a time.	
8d	New table of Customer is created, with attributes such as CustomerID, CustomerName, CustomerContact, CustomerAddr etc… CustomerContractorRel table created, with CustomerID and ContractorID as composite key. Customer 1:n CustomerContractorRel n:1 Contractor	3
8e	• Relational databases have a **predefined schema** that is difficult to change. Even if you wish to add a field to a small number of records, you still need to include the field for the entire table. Therefore, it can be difficult to support the processing of unstructured data using relational databases compared to NoSQL databases. • Unlike NoSQL databases, relational databases **do not usually support hierarchical data storage** where less frequently-used data is moved to cheaper, slower storage devices. This means that the cost of storing data in a relational database is more expensive than storing the same amount of data in a NoSQL database. • Relational databases are mainly **vertically scalable** while NoSQL databases are mainly horizontally scalable. Vertically scalable means that improving the performance of a relational database server usually requires upgrading an existing server with faster processors and more memory. Such high-performance components can be expensive and upgrades are limited by the capacity of a single machine. On the other hand, horizontally scalable means that the performance of a NoSQL database can be improved by simply increasing the number of servers. This is relatively cheaper as mass-produced average-performance computers are easily available at low prices. • **Relational databases are stored in a server, which makes the database unavailable when the server fails**. NoSQL databases are designed to take advantage of multiple servers so that if one server fails, the other servers can continue to support applications.	4
8f	It is against Purpose Limitation Obligation stated in the PDPA, which states that organisation should “Only collect, use or disclose personal data for the purposes that a reasonable person would consider appropriate under the given circumstances and for which the individual has given consent.” Worker’s contact is meant for contractors to engage their services, instead of passing them directly to home owner.	