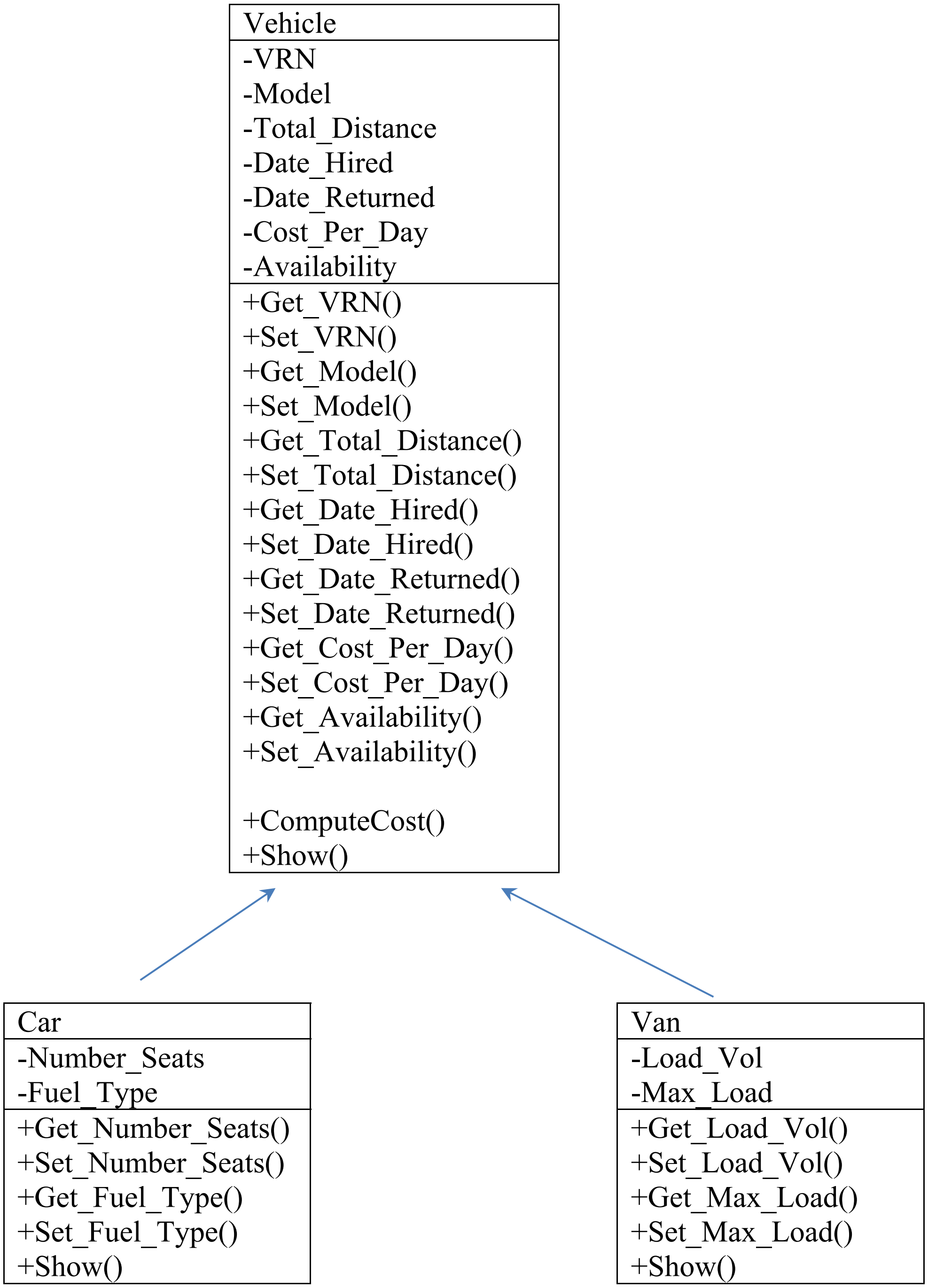
2020 A Level Written Paper Suggested Solution

Question 1

(a)



Vehicle
-VRN
-Model
-Total_Distance
-Date_Hired
-Date_Returned
-Cost_Per_Day
-Availability
+Get_VRN()
+Set_VRN()
+Get_Model()
+Set_Model()
+Get_Total_Distance()
+Set_Total_Distance()
+Get_Date_Hired()
+Set_Date_Hired()
+Get_Date_Returned()
+Set_Date_Returned()
+Get_Cost_Per_Day()
+Set_Cost_Per_Day()
+Get_Availability()
+Set_Availability()

+ComputeCost()
+Show()

Car
-Number_Seats
-Fuel_Type
+Get_Number_Seats()
+Set_Number_Seats()
+Get_Fuel_Type()
+Set_Fuel_Type()
+Show()

Van
-Load_Vol
-Max_Load
+Get_Load_Vol()
+Set_Load_Vol()
+Get_Max_Load()
+Set_Max_Load()
+Show()

* Optional to have Vehicle_Hire(), Vehicle_Return() in Vehicle class

(b) A superclass is a general class that includes all fundamental properties and methods that all the subclasses inherited to it have. It is used to indicate a clear category of objects, and it can **reuse code** to reduce code duplication. An example of superclass is the Vehicle class, where all its properties and methods are **inherited** by its subclasses Car and Van.

(c) Encapsulation is the **bundling** of attributes and methods that operates on the class. It allows **data hiding** so that internal attributes will not be corrupted by external operations.

(d) Add a modified version of ComputeCost() for **Car** class to change the calculation of charges

(e) Polymorphism is the object's ability to **take different forms**. Its purpose is to allow different objects to be treated independently, such that for instance when calling the methods whose names different objects share, the programme is able to call the correct version of the method depending on the type of object.

Question 2

(a) (i) median of the data set

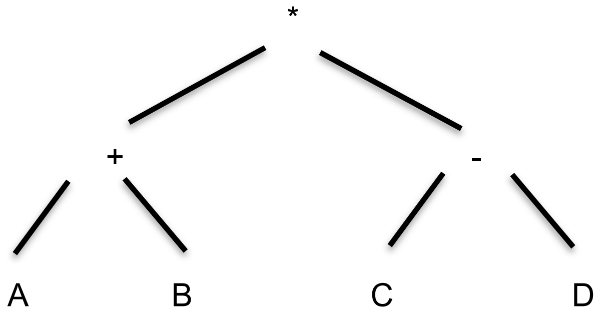
(ii) The entire data set must be processed to locate the median

(b) Since the data set is largely sorted, the first or last item may be the smallest or largest item. Choosing such pivots would result in unbalanced partitions. Instead, a random selection could be closer to the median, and produce more balanced partitions.

(c) Since the data set is largely sorted, each pass of insertion sort will require few movements, making the time complexity close to O(N). But quicksort requires O(NlogN) since partition is still required even if it is largely sorted. Hence insertion sort is better for this situation.

Question 3

(a)



(b) Any answer from 0, 2, 4, 6

(c)

(i) Recursion means a function that is defined in terms of itself.

(ii) 03 and 06 for recursive call

(iii) Line 02 and 05 checks if we have reached the leaf node. This ensures the recursion does not occur on index -1 which represents the null pointer.

Line 02 and 05 defines the terminal condition so that the recursion ends in a finite time.

(d)

Index	Output
1	
0	A
2	B
	+

(e)

Each time when P is **called**, an activation record is generated including its **parameters, local variables and return address**. This activation record is pushed onto the run-time stack.

When a recursive version of P **terminates**, its activation record is popped from the stack.

The **top** activation record in the stack is always the procedure currently executed.

(f) post order traversal

(g) A queue is a data structure which follows first in first out (**FIFO**) protocol. Items are inserted (enqueued) to the rear of the queue and removed (dequeued) from the front of the queue.

(h)

Circular Queue	Linear Queue
Reuse space when wrapping around the array	Space not fully utilized
Front index can be larger than rear index	Front index is always smaller or equal to rear index

Question 4

(a) (i) IP address and MAC address

(ii) Protocol is a set of rules to be followed by **both sender and receiver.** LANs need communication protocols to state a **common rule** for the format and structure of the data being transmitted, so that the recipient will be able to handle the message based on the protocol. Secondly, protocols are needed to provide a systematic **template for network developers and vendors.**

(b)

(i) Data is broken down into **smaller units of packets** to be transmitted over the network. Each packet takes the **best route available** and travels **independently** to reach the destination device. Packets are assigned a sequential number for reassembly at the destination.

(ii) A disadvantage of packet switching is that it requires more time for reassembly at the destination device as packets may **arrive in random order**. To handle this, a **sequential number** is attached to each packet, and efficient algorithms are used to sort the packets into the original order.

(iii) Even with a broken cable, other parts of the network are still interconnected and provide possible routes. Each packet will still be able to transmit via the best route among the remaining routes to reach the destination, circumventing the broken cable.

(c) DNS server first checks if the requested domain name is available in its **cache**. If not found in its cache, it sends request to the **local DNS by the Internet Service Provider**. If still not found, DNS searches from a **hierarchy** of distributed database to locate the domain name. Once found, DNS server **sends the IP address back to the user**.

(d) (i) encryption (ii) digital signature

Question 5

(a) (i) ensure the input data matches the original resource

(ii) double entry of password, proofread before submitting a form

(b) (i) ensure the input data is reasonable

(ii) range check, format check, length check, presence check

(iii) Transposition error (e.g. wrong order of digits), transcription error(e.g. missing digit, wrong digit)

(c) 0*6+2*5+7*4+5*3+7*2 = 67

67 mod 11 = 1

Check digit = 11 - 1 = 10, replaced by ‘X’

Hence the check digit for 02757 is ‘X’

(d) Storing 02757 as an integer will omit the 0 in front.

The check digit is a character, not a digit.

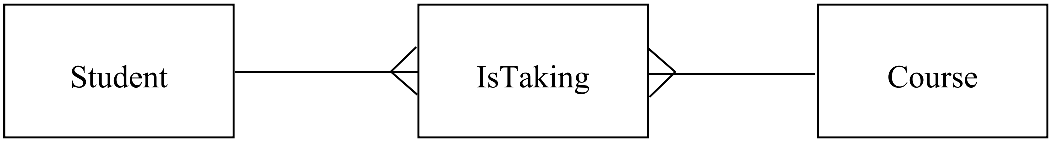
*since the question asking for storing data, answer ‘string is easier to read each character’ works more on the processing of data, hence not very suitable compared to above two

Question 6

(a) The field values are not atomic, each student has multiple courses

(b) (i) Student ID, (ii) Course ID (iii) Student ID and Course ID (composite keys)

(c)



(d) Transitive dependency exists since Teacher Name (or Room Number) depends on Teacher ID and Teacher ID depends on course ID

(e)

Student (StudentID, FirstName, LastName)

Course (CourseID, Subject, TeacherID)

Teacher (TeacherID, RoomNumber, TeacherName)

IsTaking (StudentID, CourseID)

(f) Reducing data redundancy can reduce the chances of data anomalies when inserting, updating, or deleting data. If the same records are being stored more than once, changing only part of the records will thus result in data inconsistency.

(g)

```
SELECT Course.Subject, Teacher.TeacherName, Teacher.RoomNumber

FROM IsTaking

INNER JOIN Course ON IsTaking.CourseID = Course.CourseID

INNER JOIN Teacher ON Course.TeacherID = Teacher.TeacherID

WHERE IsTaking.StudentID = 1395

ORDER BY Course.Subject
```