**NANYANG JUNIOR COLLEGE**

**JC2 PRELIMINARY EXAMINATION**

Higher 2

**COMPUTING** **9597/02**

Paper 2 **16** **September 2019**

**3 Hours**

Additional Materials: Answer Paper

**READ THESE INSTRUCTIONS FIRST**

Write in dark blue or black pen on both sides of the paper.

You may use an HB pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

At the end of the examination, fasten your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **4** printed pages.

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| **1** | | **(a)**  **(b)** | | Database management systems are aimed at solving a number of problems associated with traditional file-based systems. Describe three such problems and explain how they are solved by database management systems. [6]   * **Data Redundancy – relational tables allows less duplication of data unlike in file systems.** * **Data Consistency – referential integrity will ensure any updates will be consistent across applications.** * **Data Security – centralized management and use of schema to present different view to end users ensures a more secure system.**   A national car hire company uses a relational database. Cars are available for hire from a large number of depots around the country. Two entities (or records) are CARS-FOR-HIRE and DEPOTS.  **(i)** Suggest four attributes (or fields) associated with the entity CARS-FOR-HIRE. [4]  **CARS-FOR-HIRE(LicenseNo, Model, Vehicle-Type, Capacity, Rental\_Rate, Status, Depot\_location)**  **(ii)** Draw a diagram showing the relationship between the entities CARS-FOR-HIRE and DEPOTS. [1]  DEPOTS  CARS-FOR-HIRE  **(iii)** State one other entity which is related to either or both of the original entities. Describe the relationship(s). Suggest an attribute for this entity. [4]  **One related entity would be Customer.**  **Relationship one to many between Customer and care-for-hire as one car can be hired by one customer at a time but a customer can choose to hire more than one car at a time.**  **One attribute would be Customer\_Name.** | | | |
| **2** | | A stack is to be implemented using an arra y of 20 elements. | | | | | | | |
| **(a)**  **(b)**  **(c)**  **(d)** | | Describe an algorithm to remove an item from a stack and place it in a variable x. [4]  **FUNCTION POP(stack, item)**  **IF stack.top = None**  **PRINT “Stack is empty”**  **ELSE**  **X <- stack.top**  **stack.top <- stack.top – 1**  **ENDIF**  With the aid of examples, explain what nested functions or nested subroutines are. [3]  **Nested function is a function defined inside another function. Or inside function A, you call another function B**  **def functionA(): # outer function**  **print ("Hello from outer function")**  **def functionB(): # nested/inner function**  **print ("Hello from inner function")**  **functionB()**  **function1()**  **def pop(stack, item)**  **if isempty(stack)**  **…..**  Explain with the aid of diagrams or otherwise, how a stack can be used by the operating system to process “nested functions” or “nested subroutines”. [5]  **One common application of stacks is for storing return addresses for closed subroutines. A closed subroutine is written only once. You perform a jump to it every time it is called. When entering a subroutine, the return address is placed on top of the stack. Should a second subroutine be entered from the first (ie. nested subroutines), then the return address will again be placed on the stack. When the time comes to return from the second subroutine to the first, the correct return address will be on top of the stack. The return address will be removed (pop) revealing the return address to the calling program.**  Outline the data attributes and member functions for a class stack abstract data type. You need not go into details as to how they will be implemented. [6] | | | | | |
|  | |  | | **// Assume an integer STACK**  **class Stack**  **private:**  **item : integer**  **top : integer**  **MAXSIZE : integer**  **public:**  **Stack(stacksize: integer);**  **IsEmpty(): boolean**  **IsFull(): boolean**  **Pop()**  **Push()**  **getStacksize()** | | | | | |
| **3** A large national electrical appliances company maintains an extensive inventory of appliances for sale in a country. The company has twelve specialised retail stores targeting the needs of different market segments. Six of these stores are housed in a large mall in the capital, but the other six are in different cities in the country.  The six stores in the capital are linked using a LAN, while the other six are linked via a WAN. | | | | | | |
|  | | **(a)**  **(**  **(b)**  **(b)**  **(c)**  **(d)** | | Explain the difference between a LAN and a WAN. [2]   * **LAN is restricted to a small geographic area/WAN covers a large area typically across states or even countries.** * **LAN usually uses wired as a medium of communication/WAN may requires other types like satellite or wireless** * **LAN can be served by digital information/WAN often needs information type to be altered** * **LAN is secure because it is centralized thus easier to control/WAN is more decentralized with many different type of systems/networks making it difficult to control.**   Wireless technology has become more popular in recent years. Describe two reasons why the company will not replace its LAN network with a wireless one. [4]   * **Wireless is less secure than wired LAN bec. the signals can be received over the air and the encryption used can be easily broken.** * **Wireless transmission today is usually slower and less reliable than wired LAN subjected to interference/noise leading to dropped signals.**   Discuss two security threats faced by the company’s LAN and measures that can be put in place to reduce these threats. [6]   * **Unauthorised access. Use of passwords/login ids to implement authentication and authorisation to allow access.** * **Virus/malware. Install antivirus software that will check for suspicious programs. Must be updated regularly to be effective as new virus signatures are detected constantly.** * **(N.B. firewalls may not be correct as the question did not state anything about the network interfacing with the internet. It is asking only about threats in a LAN and not about the WAN).**   The company is thinking of allowing all its sales personnel access to this inventory. It can store this data on an intranet or cloud storage. Discuss the relative merits and demerits of these two options. [6]   |  |  | | --- | --- | | **Intranet** | **Cloud** | | **+more control over its security** | **- employees of cloud vendor may access the data. Higher risk of data leak.** | | **- more expensive (need own hardware/personnel/software)** | **+ less expensive (pay what you need, no wasted excess capacity)** | | **- harder to scale up if storage needs increases (needs to buy new hardware, configure software. Takes time)** | **+ easy to scale up (ease and speed of deployment)** | | **- less portable (cannot access from home)** | **+ portable (can be accessed as long as internet access is available)** | | **+ easy access to in-house technical support** | **- Technical support may not be as accessible/immediate.** | | | |
| **4** A company has decided to offer an in-house credit system by issuing privileged customers an in-house credit-card which allows customers to charge their purchases from the stores to the card, up to the customers’ credit limits.   1. During a sales promotion, the store offers a discount of 15% if a customer’s total purchase is greater or equal to $200 but less than $500. A discount of 20% is given if the customer’s total purchase is greater or equal to $500. For customers who had exceeded their credit limits, the supervisor’s approval is required. Create a decision table or tree to represent the above conditions and actions. [5]      |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **CONDITIONS** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | | **Purchase >= $200 and < $500** | **-** | **-** | **Y** | **Y** | **-** | **-** | **N** | **N** | | **Purchase >= $500** | **Y** | **Y** | **N** | **N** | **Y** | **Y** | **N** | **N** | | **Card exceeds limit** | **Y** | **N** | **Y** | **N** | **Y** | **N** | **Y** | **N** | | **ACTIONS** |  |  |  |  |  |  |  |  | | **15% discount** |  |  | **√** | **√** |  |  |  |  | | **20% discount** | **√** | **√** |  |  | **√** | **√** |  |  | | **Refer to supervisor** | **√** |  | **√** |  | **√** |  | **√** |  |      1. In order to protect the privacy of data, many countries have passed legislation to address this issue. Describe any 3 features of the Personal Data Protection Act in Singapore that aims to do this. [6]   <https://www.pdpc.gov.sg/Organisations/Organisations-Overview> **1. Consent Obligation** Only collect, use or disclose personal data for purposes for which an individual has given his or her consent.  Allow individuals to withdraw consent, with reasonable notice, and inform them of the likely consequences of withdrawal. Upon withdrawal of consent to the collection, use or disclosure for any purpose, your organisation must cease such collection, use or disclosure of the personal data. **2. Purpose Limitation Obligation** An organisation may collect, use or disclose personal data about an individual for the purposes that a reasonable person would consider appropriate in the circumstances and for which the individual has given consent.  An organisation may not, as a condition of providing a product or service, require the individual to consent to the collection, use or disclosure of his or her personal data beyond what is reasonable to provide that product or service. **3. Notification Obligation** Notify individuals of the purposes for which your organisation is intending to collect, use or disclose their personal data on or before such collection, use or disclosure of personal data. **4. Access and Correction Obligation** Upon request, the personal data of an individual and information about the ways in which his or her personal data has been or may have been used or disclosed within a year before the request should be provided. However, organisations are prohibited from providing an individual access if the provision of the personal data or other information could reasonably be expected to:   * cause immediate or grave harm to the individual’s safety or physical or mental health; * threaten the safety or physical or mental health of another individual; * reveal personal data about another individual; * reveal the identity of another individual who has provided the personal data, and the individual has not consented to the disclosure of his or her identity; or * be contrary to national interest.   Organisations are also required to correct any error or omission in an individual’s personal data upon his or her request. Unless your organisation is satisfied on reasonable grounds that the correction should not be made, your organisation should correct the personal data as soon as practicable and send the corrected data to other organisations to which the personal data was disclosed within a year before the correction is made (or, with the individual's consent, only to selected organisations). **5. Accuracy Obligation** Make reasonable effort to ensure that personal data collected by or on behalf of your organisation is accurate and complete, if it is likely to be used to make a decision that affects the individual, or if it is likely to be disclosed to another organisation. **6. Protection Obligation** Make reasonable security arrangements to protect the personal data that your organisation possesses or controls to prevent unauthorised access, collection, use, disclosure or similar risks. **7. Retention Limitation Obligation** Cease retention of personal data or remove the means by which the personal data can be associated with particular individuals when it is no longer necessary for any business or legal purpose. **8. Transfer Limitation Obligation** Transfer personal data to another country only according to the requirements prescribed under the regulations, to ensure that the standard of protection provided to the personal data so transferred will be comparable to the protection under the PDPA, unless exempted by the PDPC. **9. Accountability Obligation** Make information about your data protection policies, practices and complaints process available on request.  Designate one or more individuals as a Data Protection Officer to ensure that your organisation complies with the PDPA, including the implementation of personal data protection policies within your organisation. The business contact information of at least one of such individuals should also be made available to the public. Please note that compliance with the PDPA remains the responsibility of the organisation. | | | | | |
| **5** When a customer orders goods over the phone, the cashier will record the order in an order form containing the items ordered and quantity, customer address, delivery date and time and the amount payable. A copy of this form will be given to the storeman who will pick the goods and generate a delivery order (DO). The DO will be given to the delivery man who will deliver the goods. The customer on collecting the goods will sign on the DO and return a signed copy to the delivery man. On his return, the delivery man will give the DO to the accounts department who will generate an invoice. Invoices are kept in a file until the next day where they will be mailed to the customers. | | | | | |
|  | | **(a)** | | | Draw a data flow diagram of the above processes. [8]  **Entities – CUSTOMER, STORE MAN, ACCOUNTS, DELIVERY MAN**  **Data Stores – ORDER FORMS, INVOICES FILE**  **Processes – Generate DO, Generate Invoice, Generate Order**  **Data flow – items ordered, quantity, customer address, delivery date, delivery time, signed DO** |
|  | | **(b)** | | | Goods in the warehouse are divided into 2 main categories – Kitchen appliances (e.g. kettle, toasters and ovens) and Entertainment products (e.g. LCD television, mp3 players and gaming consoles). Each item has an item name, description, unit price and quantity on hand. Kitchen appliances have an item weight, packing volume and colour. Entertainment products have a serial number, country of manufacture and recommended retail price.  **(i)** Draw a class diagram of the above showing inheritance, their private attributes and public methods. [6]  **(ii)** What is the purpose of a public method? [1]  **Public method is to allow other functions to access the class’ private members. It acts as an interface.**  **(iii)** What is the difference between a class and an object? [2]  **A class is a definition of objects of the same data type, very much like a blue-print or template while an object is an instance of a class.** |
|  | | **(c)** | | | In relation to the diagram in part (b), explain the terms:   1. Encapsulation; [2] 2. Inheritance; [2] 3. Data hiding; [2] 4. Polymorphism. [2]   **(i) Encapsulation is the encasing of both private members (e.g. ItemNo, Desc and Price in class Products) and public members (Set\_ItemNo, Get\_ItemNo …) of a class within a container (in this case, the elements within a class definition) where the only access is through a well-defined interface (e.g. Set\_Price, Get\_Price).**  **(ii) Inheritance is the ability to create new classes by inheriting the data and operations of existing classes. The shared knowledge of common traits forms the basis for inheritance relationships, usually hierarchical from general to more specific classes. For instance class Appliances inherits from Products all its public and private members and in addition it has specific attributes of Weight and Dimension while class Entertainment has an additional Color attribute.**  **(iii) Encapsulation provides the mechanism for data hiding, where the data and operations of a class can only be accessed according to the level that it was specified for, e.g. private elements cannot be accessed from outside the class while public elements can be accessed. Private data can be assessed by outside functions only through the class’ public member functions. E.g. to access the ItemNo of class Products, other functions have to call Get\_ItemNo to do so. In this way data hiding is achieved where ItemNo cannot be accessed directly by other functions not in the class.**  **(iv) Polymorphism is the ability of a methods of the same name to behave according to its context, e.g. the Operate method for Appliance will behave differently from the same name Operate method in Entertainment. One may operate an oven while the other plays visual and audio of a TV for instance.** |

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| **6** A linked list ADT with the following incomplete specification is given as follows:   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | |  | | --- | | LList | | head : Node | | constructor()  addNode(s : Node)  findmiddle(l : LList) -> INTEGER | | |  | | --- | | Node | | data : INTEGER  nextPtr : Node | | constructor()  setData(s : INTEGER)  setnextPtr(x : Node)  getData(): INTEGER | | | | |
|  | **(a)** | Explain the main difference between an array and a linked list data structure. [2] |
|  |  | **Array – fixed size (static). Linked list – dynamic memory. Can grow and shrink dynamically.**  **Array – direct access via index vs link lists which uses pointers to traverse/access items.** |
|  | **(b)**  **(c)**  **(d)** | Using pseudo code, write an algorithm to implement findmiddle that will return the data in the middle of the linked list in **one pass**. [7]  **Traverse the list with two pointers - the first one increments by 1, while the second one increments by 2. This way, the second one will reach the end of the list when the first one is in the middle.**  **FUNCTION findmiddle(Head)**  **FastPtr 🡨 Head**  **SlowPtr 🡨 Head**  **WHILE FastPtr != None AND SlowPtr != None**  **FastPtr 🡨 FastPtr.next.next**  **SlowPtr 🡨 SlowPtr.next**  **RETURN SlowPtr**  State two applications of a linked list. [2]   1. **Implementation of** [**stacks**](https://www.geeksforgeeks.org/stack-data-structure/) **and** [**queues**](https://www.geeksforgeeks.org/queue-data-structure/) 2. **Implementation of graphs :** [**Adjacency list representation of graphs**](https://www.geeksforgeeks.org/graph-and-its-representations/) **is most popular which is uses linked list to store adjacent vertices.** 3. **Maintaining directory of names** 4. **Manipulation of polynomials by storing constants in the node of linked list** 5. **representing sparse matrices**   State two other common methods (including parameters) that should be included in the LList specification. [2]  **IsEmpty(l: LList)**  **DeleteNode(l: LList, item: Node)**  **Len(l : LList)** |

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