**HWA CHONG INSTITUTION**

**C2 PRELIMINARY EXAMINATION 2019**

**COMPUTING**

**Higher 2**

**16 September 2019 Paper 2 (9597 / 02) 1400 -- 1700 hrs**



Answer ***ALL*** questions.

Write your answers in the answer booklet provided.

You are reminded of the need for good English and clear presentation in your answers.

The maximum mark for this paper is **100**.

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

1. A bookshop wishes to expand its business from a brick and mortar shop to allow for online sales. A software company has been engaged by the bookshop to develop the online sales system.
2. The analyst decides to adopt a top-down approach to the design. What are the advantages of using top-down design to solve complex problems? [3]

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| * The top-down approach breaks down complex problems into tasks and then divides the tasks into smaller subtasks, avoiding attempting to design and implement a complex system all at once, but instead creating smaller subsystems initially that will be integrated together later. * It makes it easier to identify what needs to be done * Creating subsystems first also allows different teams to work in parallel on different subsystems. |

The project manager decides to use some project management tool in the planning of the project. Below is the list of activities along with their required time for completion.

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| --- | --- | --- |
| Activity | Expected completion time (day) | Preceded by |
| A | 2 | - |
| B | 3 | A |
| C | 1 | B |
| D | 3 | B |
| E | 4 | C |
| F | 3 | D |
| G | 2 | A |
| H | 5 | G |
| I | 3 | E, F, H |

1. Construct the PERT chart for the activities, indicating the earliest start time and latest start time of each activity. [3]

|  |
| --- |
| A --- B --- C --- E --- +  | | |  | +--- D --- F --- + --- I  | |  + --- G --- H --------- +  **Activity: Earliest start time / Latest start time**  A: Day 0 / Day 0  B: Day 2 / Day 2  C: Day 5 / Day 6  D: Day 5 / Day 5  E: Day 6 / Day 7  F: Day 8 / Day 8  G: Day 2 / Day 4  H: Day 4 / Day 6  I: Day 11 |

1. Which tasks are on the critical path of the Program Evaluation and Review Technique (PERT) chart? [1]

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| ABDFI |

1. What is the slack time for Task C and G? [2]

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| Slack time for…  C: 1 day  G: 2 days |

1. The person working on Task C tells the project manager he cannot start work until one day after the scheduled starting date. What impact would this have on the completion date of the project? Why? [2]

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| It would not affect the completion date of the project. Task C has a slack time of 1 day, meaning the person may start work on task C at most 1 day later than the scheduled starting date, assuming the people working on task A, B and E start on time. This is because the final task I requires task E, F and H to be completed before it can begin and the path CE is 1 days faster than path DF assuming everyone starts on time. Hence, as long as the people working on task C or E do not collectively start more than 1 day late, they will still finish faster or at the same time as task E, allowing task I to start on time. |

1. Task A will be delayed by 2 days for some reason. If the project manager still wants to finish the project within the original time frame, he will need to shorten the time for one or more of the tasks. What steps can he take to reduce the number of days allocated to a task? [2]

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| * Split the task into smaller subtasks and allocate more people to work on them. * Work longer hours per day |

1. The project manager decides to reduce the time needed for Tasks D and F by one day each. How effective will this reduction be in achieving his aim of maintaining the original finish time for the project? What can he do for it to be more effective?

[2]

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| The reduction will not help in achieving his aim of maintaining the original finish time as the critical path will now be ABCEI which is still 1 day behind the original finish time. He should reduce the time needed for tasks B, D and F by a total of 2 hours and that for tasks B, C and E by 1 hour. Doing so will reduce the total time for the critical path by 2 days, allowing him to maintain the original finish time. |

(h) Produce a Gantt chart based on the above information. [2]

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| A ==  B ===  C =  D ===  E ====  F ===  G == H =====  I ===  Key:  = represents 1 day |

(i) Give **one** reason why a Gantt chart may be preferred over a PERT chart. [1]

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| Gantt chart is simpler and more straightforward to interpret. |

1. Customers can view a catalogue of books and order from its website. Payment is made by the customer forwarding their credit card details, which are processed immediately. Details of the orders are matched against the stock file to check for availability of items before packing lists are produced and sent to the packing department.

(a) Draw a data flow diagram to explain the flow of data through this system. [6]

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1. Using examples from your DFD, explain how the diagram helps to inform a database solution for the new computerized system. [4]

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1. Give **two** parts of the database design that is not possible from the DFD. [2]

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1. (a) Explain the difference between synchronous and asynchronous data transmission. [2]

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| Synchronous data transmission transfers data in blocks or frames while asynchronous data transmission transfers data in bytes.  Synchronous data transmission is fast while asynchronous data transmission is slow. |

(b) Describe the three modes of data transmission: simplex, half-duplex and full-duplex. [3]

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| Simple mode is one directional transmission.  Half-duplex mode is two way transmission, but only one direction at a time.  Full-duplex mode can transmit data two ways simultaneously. |

(c) Give **two** advantages of packet switching over circuit switching. [2]

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| Packet switching is more efficient than circuit switching.  It is also faster than circuit switching. |

1. Sing Airline Company uses a website to provide ticket purchasing services to customers.

1. Customers are required to fill up a form with their name, passport number, hand phone number and flight information. Give **two** examples of data validation and **one** example of data verification for the company to validate the customers’ data.

[3]

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| Data validation:   * Data type check for hand phone number. Check that the hand phone number is all digits. * Length check for password number and hand phone number.   Data verification:   * Send a verification code to the hand phone number to ensure that the user entered their hand phone number correctly. |

1. Explain the purpose of using client and server scripting and give **one** scripting language for each. [4]

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| Client-side scripting improves the user experience on the website by making it more interactive and responsive. It is also used for faster validation checks before submission due to it being executed in the user’s device instead of sending data to the server and back to the client. Data validation should still be done on the server-side after submission and client-side scripting can be disabled by the user. An example of a client-side scripting language is JavaScript.  Server-side scripting is needed for data processing. It also prevents users from seeing sensitive and important data like customer and booking details. An example of a server-side scripting language is Python. |

1. The company uses a web server to handle the customers’ orders. Describe **two** possible threats that the web server may encounter and suggest **one** strategy for each threat. [4]

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| Threat 1: Distributed Denial of Service (DDoS) attacks  Strategy 1: Use DDoS protection services like Cloudfare that combines many different DDoS mitigation techniques into one solution.  Threat 2: SQL injection  Strategy 2: Do not construct queries with users’ input. Clean users’ input before using it to make queries. |

1. Due to large amount of information to maintain and protect, the company is planning to use cloud computing to store and access data. Give **one** advantage and **one** disadvantage of using this technology. [2]

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| Advantage: Cloud computing is easily scalable if the company requires more storage or processing power in the future. They can just buy more resources from the cloud service provider instead of buying and setting up more of their own hardware.  Disadvantage: Cloud computing requires internet access to access resources. If the internet at the company were to fail, no work that requires the cloud can be done. |

1. The company’s staff handbook must include rules and regulations for IT staff. Suggest **two** code of conduct for the company. [2]

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| * Be responsible for your work. Put in the effort to meet deadlines. * Be respectful to colleagues and clients. |

1. Below is the manner in which the school library will process its overdue list:

* If a book is overdue then a reminder letter would normally be sent.
* However, if the book is more than 5 days overdue, 2 further checks are made to see whether the reminder should be replaced by a warning letter:
* If the student has had a previous warning letter the student will not only receive the warning letter but, in addition, a copy will be sent to the parents of the student.
* If the student has more than 4 books overdue, but no previous warning letter, the reminder letter is replaced by a warning letter.

1. Create a decision table showing all the possible outcomes and results. [4]

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| |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Condition** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | | Is it > 5 days overdue? | N | N | N | N | Y | Y | Y | Y | | Previous warning letter? | N | Y | N | Y | N | Y | N | Y | | Number of overdue > 4? | N | N | Y | Y | N | N | Y | Y | | **Outcomes** | - | - | - | - | - | - | - | - | | Reminder letter | X | X | X | X | X |  |  |  | | Warning letter to student |  |  |  |  |  |  | X |  | | Warning letter to student and parents |  |  |  |  |  | X |  | X | |

1. Simplify your decision table by removing redundancies. [2]

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Condition** | **1** | **2** | **3** | **4** | | Is it > 5 days overdue? | N | Y | Y | Y | | Previous warning letter? | - | N | Y | - | | Number of overdue > 4? | - | N | - | Y | | **Outcomes** | - | - | - | - | | Reminder letter | X | X |  |  | | Warning letter to student |  |  |  | X | | Warning letter to student and parents |  |  | X |  | |

1. A company manages subscriptions to thirty different magazines. Customers can subscribe to receive one or more of the magazines.

* Each magazine has a category such as Gardening or Current Affairs.
* Each magazine has a subscription rate, which is the cost of subscribing to receive the magazine for 12 months.

Details of the subscriptions are to be stored in a flat file.

Magazine(MagazineID, MagazineName, Category, SubscriptionRate, CustomerID,

StartDate, EndDate, CustomerName, Address, PostCode, TelephoneNumber)

1. What is the difference between a flat file and a relational database? [2]

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| Flat file stores all records in a single table while relational databases store records in multiple connected tables. |

1. Identify and state **three** potential problems with the flat file implementation for the magazine subscriptions. [3]

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| * Repeated fields in multiple records * Changing a customer’s address/postcode/telephone number requires changing multiple records * Does not store data of magazines without subscriptions |

1. Improved on the flat file and determine the relations needed in the relational database for the above. Explain the purpose of each relation. [6]

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| Customer(CustomerID, CustomerName, Address, PostCode, TelephoneNumber)  Customer table to store customers' information  Magazine(MagazineID, MagazineName, Category, SubscriptionRate)  Magazine table to store all available magazine subscriptions  Subscription(CustomerID#, MagazineID#, StartDate, EndDate)  Subscription table to store current subscriptions  Key:  Underline - Primary key  # - Foreign key |

1. In what way can your database solve the three problems in **part (b)**. [3]

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| * CustomerName, Address, PostCode, TelephoneNumber will only be stored in 1 record in Customer table. MagazineName, Category, SubscriptionRate will only be stored in 1 record in Magazine table. * Changing Address, PostCode, TelephoneNumber only requires changing 1 record in Customer table. * All available magazines are stored in Magazine table, not just those with active subscriptions. |

1. Draw the Entity-Relationship diagram between the relations you have in **part (c)**. Explain your answer. [6]

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| --- |
| Customer --< Subscription >-- Magazine  1 Customer can have many subscriptions.  1 Subscription can only have 1 customer and 1 magazine.  1 Magazine can have many subscriptions. |

1. The algebraic expression X = 2 \* A + B could be held in a binary tree as:



=



X +



\* B



1. A

This tree can then be read using the following algorithm:

process left subtree

process right subtree

read root node

This will give X 2 A \* B + = which is the reverse Polish form of the expression.

1. Using diagrams to help the explanation, or otherwise, show how a computer can use a stack to evaluate the expression from its reverse Polish form. [4]

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| - Stack follows First In Last Out (FILO).  - Scanning the expression "X2A\*B+=" from left to right, when an operand is encountered, add it to the stack.  - When an operator is encountered, pop the top 2 operands and conduct the operation. Add the result back to the top of the stack.  A \* B + =  2 → 2A → 2A + B → X = 2A+B  X X X |

1. The tree in the example could be stored in an array called TREE.

|  |  |  |  |
| --- | --- | --- | --- |
| TREE [9] |  |  |  |
| TREE [8] |  | -1 |  |
| TREE [7] |  | 5 |  |
| TREE [6] |  |  |  |
| TREE [5] | 2 |  |  |
| TREE [4] |  |  |  |
| TREE [3] | X |  |  |
| TREE [2] |  |  |  |
| TREE [1] | B |  |  |
| TREE [0] | = | 3 | 4 |

The values in each location in the array are: node value; left pointer; right pointer. Where no left or right pointer exists the rouge value -1 is used. Copy and complete the array for the example. (Note that, since in the example there are only seven nodes, three rows of the array will be unused.) [5]

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| |  |  |  |  | | --- | --- | --- | --- | | TREE [9] |  |  |  | | TREE [8] | A | -1 | -1 | | TREE [7] | \* | 5 | 8 | | TREE [6] |  |  |  | | TREE [5] | 2 | -1 | -1 | | TREE [4] | + | 7 | 1 | | TREE [3] | X | -1 | -1 | | TREE [2] |  |  |  | | TREE [1] | B | -1 | -1 | | TREE [0] | = | 3 | 4 | |

1. Draw a tree similar to the one in the example which would represent the expression:

Y = 2 \* (A + B) – (A ^ 2)

[3]

where x ^ y means xy.

|  |
| --- |
| =  / \  Y -  / \  \* ^  / \ / \  2 + A 2  / \  A B |

1. Using the algorithm in the example, and your tree, write out the reverse Polish form of the expression in **part (c)**. [3]

|  |
| --- |
| Y 2 A B + \* A 2 ^ - = |

1. Using the following numbers as an example, show how the numbers can be sorted in ascending order using a **quick sort**. For each pass, show the numbers swapped and the sub lists after splitting. [7]

435, 646, 344, 54, 23, 98

|  |
| --- |
| [435, 646, 344, 54, 23, 98]  / | \  [54, 23] [**98**] [435, 646, 344]  / | \ / | \  [] [**23**] [54] [344] [**435**] [646]  Key:  **Bold** - Pivot |