National
Qualifications
2018

X716/77/11

Computing Science

TUESDAY, 22 MAY

1:00 PM – 3:00 PM

Total marks — 60

Attempt ALL questions.

Write your answers clearly in the answer booklet provided. In the answer booklet you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give your answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

MARKS

Total marks — 60

Attempt ALL questions

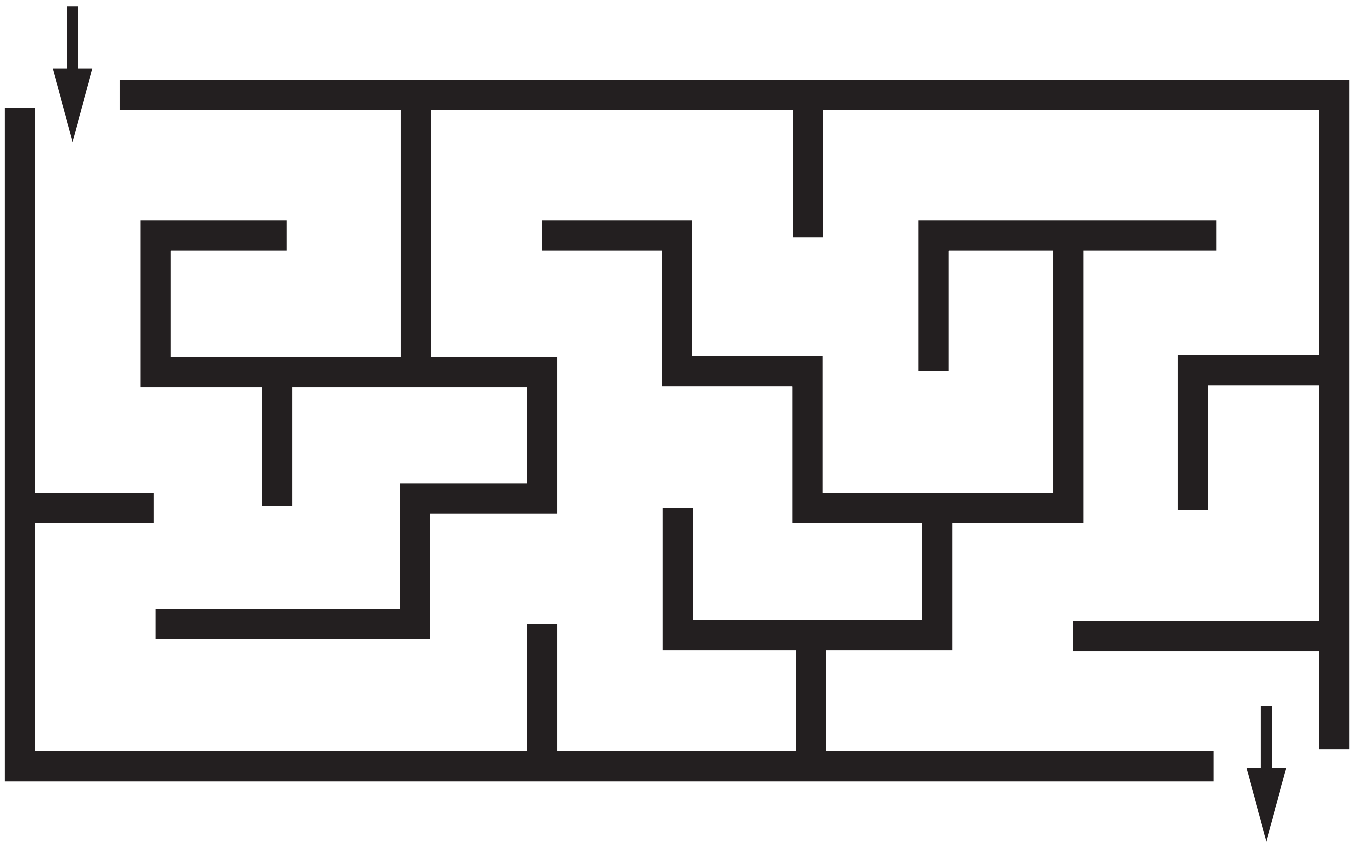
1. In the national RobotMaze competition, teams build a robot and then program their robot to complete a series of challenges.

The competition organisers have developed specialist control software that will be used by all teams in the competition.

(a) The user interface of the robot control software was updated several times based on feedback from end users.

Name the development methodology used to design the user interface and describe one benefit of this approach for the competition organisers. **2**

(b) In the first challenge, the robot must complete the maze below.



Each team programs their robot in advance by entering the set of instructions to be executed.

Within the control software, the list of instructions is stored in a queue structure.

Explain why a queue structure is suitable in this situation. **1**

1. (continued)

(c) The robot control software provides a backtracking option which returns the robot to the start position by retracing its path through the maze.

During the competition, as each instruction is executed by the robot, it is removed from the queue structure mentioned in part (b) and added to a stack structure which is used to store the instructions for the backtracking path. The stack is implemented using a 1D array.

(i) Use pseudocode to design an algorithm which would allow an executed instruction to be added to the stack structure. **3**

(ii) Explain why most programmers would prefer to implement the stack using a linked list rather than a 1D array. **2**

(d) Fifty teams are taking part in the RobotMaze competition.

When completing a challenge, each robot is awarded scores out of ten from five judges. The results are held in a 2D array called `results` as shown below.

Index	`[0]`	`[1]`	`[2]`	`[3]`	`[4]`	`[5]`
`[0]`	A1 Allstars	8	7	8	7	6
`[1]`	Adam’s Aunt	5	4	3	4	4
`[2]`	Allie’s Angels	8	8	8	8	8
…	....					
`[49]`	Zoe’s Zephyrs	10	9	7	8	9

The organisers want to add a search facility to the software.

The search facility will make use of the binary search algorithm. The user will be asked to enter the name of one of the teams and the results for that team should be displayed.

Use pseudocode to design the search facility. You should assume that the contents of the `results` array have already been sorted into ascending order of team name as shown above. **5**

(e) In the last challenge, the robots navigate their own way through the maze by making independent decisions about their route. These robots are examples of intelligent systems.

Similar intelligent systems are used in driverless vehicles.

Describe one ethical and one social implication of the increasing use of intelligent systems in driverless vehicles. **2**

2. A programmer decides to build a social media website. Users of the site will be able to post messages and attach media files.

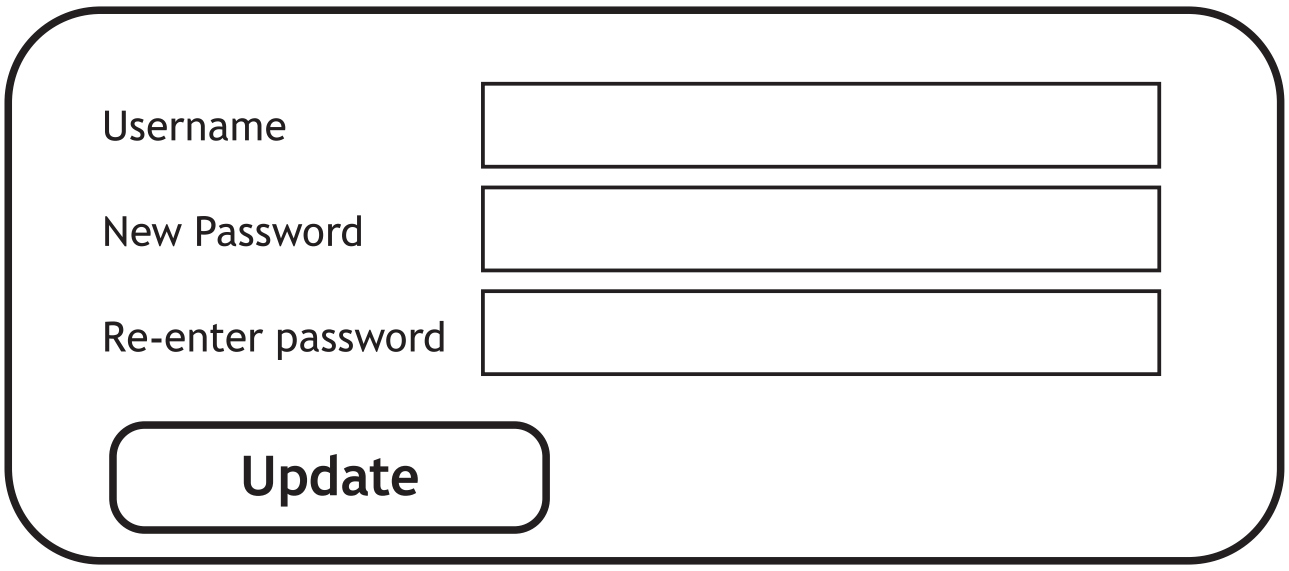
(a) Details of user accounts are stored in a table called `User` with the attributes indicated below.

Attributes	Sample Data
userName	essdog
email	shaun@myemail.com
password	e22d0g

Write SQL code to create the `User` table. **2**

(b) For security reasons, users are encouraged to update their password on a regular basis.

To update their password, a user must complete the HTML form shown below.

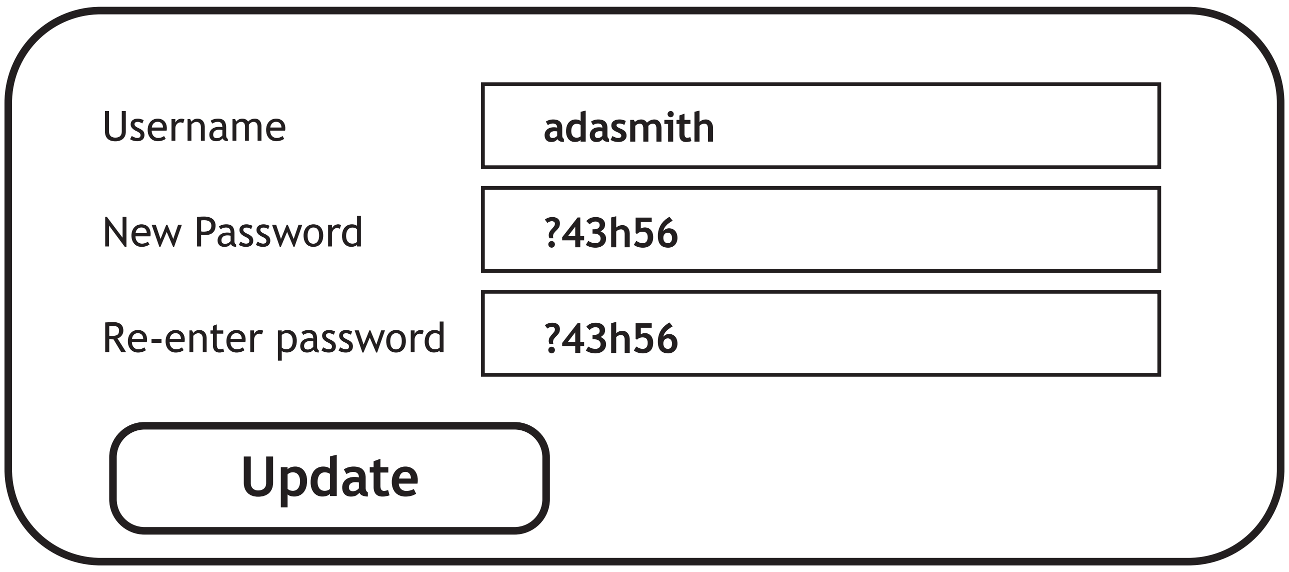


When the user submits the form, the data entered is transmitted securely to a server-side script called `update.php`.

Write the HTML code to create this HTML form. **3**

2. (continued)

(c) A user updates her password with the details shown below.



Username **adasmith**

New Password **?43h56**

Re-enter password **?43h56**

Using a server-side scripting language with which you are familiar, write the script used to process these details. The script should:

- assign the form details to server-side variables
- display an error message when the two passwords do not match
- only update details in the `User` table when the passwords match.

You should assume that a valid connection already exists and is called `$conn`. **5**

[Turn over

2. (continued)

(d) A second table called `Message` is used to store the user messages. Some sample records from the `Message` table are shown below.

messageID	comment	date	userName	media
309881	Great concert last night at Glasgow Barrowlands.	03/04/2018	adasmith	30981concert.jpg
309882	Beautiful sunny day in Dundee — again!	03/04/2018	kezzam	30982sky.jpg
309884	Who will win the match tonight?	04/04/2018	aliceb	
309885	Heading home for tea!	05/04/2018	adasmith	
309886	Disappointing result yesterday :(	05/04/2018	aliceb	30986score.jpg

Write an SQL query to total the number of messages made by each user. The query should display the username and the total number of messages made. **3**

(e) The terms and conditions of the social media website grant the company a non-exclusive, royalty-free license for all images that are uploaded by users.

Describe one legal and one economic implication for users who share their own photographs on this website. **2**

[Turn over for next question

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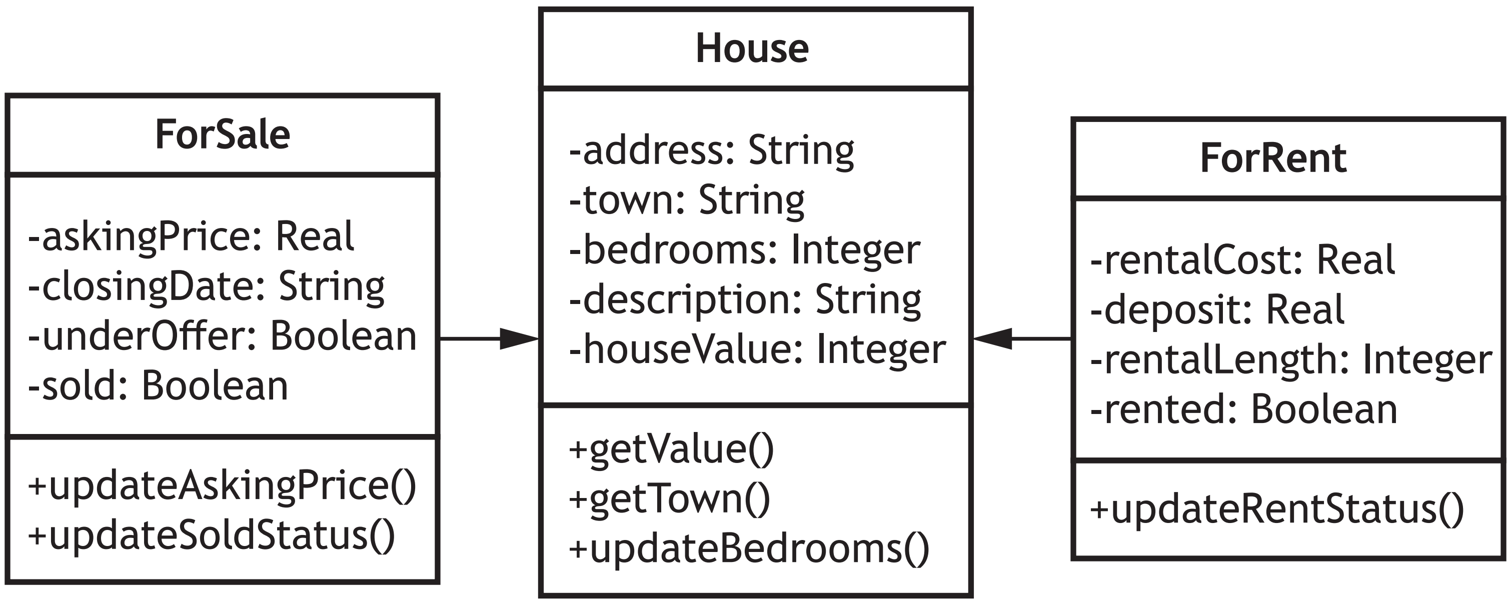
3. A program is being written for an estate agency to store the details of houses for sale or available to rent.

A simplified version of the UML class diagram and the code used to define the `House` class is shown below.



```
Line 1   CLASS House IS {STRING address, STRING town, INTEGER
         bedrooms, STRING description, INTEGER houseValue}

Line 2   METHODS

Line 3       CONSTRUCTOR (STRING address, STRING town, INTEGER
             bedrooms, STRING description, INTEGER houseValue)
Line 4           DECLARE THIS.address INITIALLY address
Line 5           DECLARE THIS.town INITIALLY town
Line 6           DECLARE THIS.bedrooms INITIALLY bedrooms
Line 7           DECLARE THIS.description INITIALLY description
Line 8           DECLARE THIS.houseValue INITIALLY houseValue
Line 9       END CONSTRUCTOR

Line 10      PROCEDURE updateBedrooms (INTEGER noOfBedrooms)
Line 11          SET THIS.bedrooms TO noOfBedrooms
Line 12      END PROCEDURE

Line 13      FUNCTION getTown() RETURNS STRING
Line 14          RETURN THIS.town
Line 15      END FUNCTION

Line 16      FUNCTION getValue() RETURNS INTEGER
Line 17          RETURN THIS.houseValue
Line 18      END FUNCTION

Line 19  END CLASS
```

(a) Line 1 of the code begins the definition of the `House` Class.

Using a programming language with which you are familiar, write the equivalent line of code for the `ForSale` Class. **2**

3. (continued)

(b) Using appropriate object-oriented terminology, explain the operation and effect of executing the following code.

(i)

```
DECLARE saleHouse1 INITIALLY ForSale ("12 Albert Road",
"Dundee", 2, "Well presented bungalow", 140000, 150000,
"20/6/18", FALSE, FALSE)
```

2

(ii) `saleHouse1.updateBedrooms(3)` **2**

(c) Using appropriate object-oriented terminology, explain why the following statements would be invalid.

(i)

```
SET saleHouse1.description TO "Well presented house with
garden."
```

2

(ii) `saleHouse1.updateRentStatus(TRUE)` **1**

(d) As the program stores the details of over one million houses for sale, the management of the estate agency is keen to use this data to analyse trends in specific towns.

Within the program, the house data is stored in an array of `House` objects called `houseList` and the name of the town to be analysed is stored in a variable called `targetTown`.

Using a programming language with which you are familiar, write the code needed to calculate the average house value for a given town. **4**

(e) Maintenance is needed to allow the program to store details of whether rental houses are furnished or unfurnished.

(i) Explain the type of maintenance that is needed. **1**

(ii) Explain how this additional feature could be implemented in this program. **1**

[Turn over

4. A one-day music festival is being held with a maximum of 4000 tickets available.

Those who wish to attend the festival can submit their details via a website. No applicant can ask for more than four tickets.

The data collected on the website is validated before being stored in a table called `applicants` which is part of the database called `hopeful.dbase`. Sample records from the `applicants` table are shown below.

Reference Number	Last Name	First Name	Contact Number	Contact e-mail	Number of Tickets
1234	Smith	John	09987654321	js@hello.net.uk	3
1235	Anderson	Louise	01999999999	louise@a.org.uk	2
1236	Ali	Hussain	08876767676	hali@house.com	4

By the closing date, 6129 applications had been received.

(a) The program used to allocate tickets reads the data from the file called `hopeful.dbase` and stores it in an array of records.

(i) Using a programming language with which you are familiar, write the code needed to define a record structure and matching array of records that could be used to store the 6129 applications. **2**

(ii) The data is to be read from the database file `hopeful.dbase` so it can be used within the program.

To read the data, the program must connect to the database using the connection details:

server name: `festival18`
user: `admin`
password: `ticket18`

Using a server-side scripting language with which you are familiar, write the script required to connect to the database, read the data from the database file and store it in a server-side variable. **3**

(b) A procedure is needed to sort the application details in order of last name.

The sort procedure will use a bubble sort algorithm that makes use of a Boolean variable.

Use pseudocode to design a procedure to sort the array of records in ascending order of last name. Your design should make use of the data structure defined in part (a) (i) above. **5**

4. (continued)

(c) The people who are allocated tickets will be chosen at random from the full list of 6129 applications. Depending on the number of tickets requested by individual applicants, it may not be possible to allocate exactly 4000 tickets.

Use pseudocode to design a procedure which would allocate the tickets for the festival.

Your design should:

- randomly select an applicant from the full list
- check that an applicant has not been previously selected
- ensure successful applicants receive their full allocation
- make appropriate use of the array of records defined in part (a) (i) above
- allocate at least 3997 and no more than 4000 tickets.

State any assumptions you make about how the allocation of tickets will be recorded. **5**

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