PRELIM EXAMINATION
SEPTEMBER 2018

INFORMATION TECHNOLOGY: PAPER II

Time: 3 hours

120 marks

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Moderators: M Ounaceur, D Borchart

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 15 pages. Please check that your question paper is complete.
2. This question paper is to be answered using Object-Oriented Programming principles. Your program must make sensible use of methods and parameters.
3. This paper is divided into two sections. All candidates must answer both sections.
4. This paper is set in programming terms that are not specific to any particular programming language (Java/Delphi) or database (Access/MySQL).
5. Make sure that you answer the questions in the manner described because marks will be awarded for your solution according to the specifications that are given in the question.
6. Only answer what is asked in each question. For example, if the question does not ask for data validation, then no marks are awarded for it, and therefore no code needs to be written.
7. If you cannot get a section of code to work, comment it out so that it will not be executed and so that you can continue with the examination. If possible, try to explain the error to aid the marker.
8. When accessing files from within your code, DO NOT use full path names of the file, as this will create problems when the program is marked on a computer other than the one you are writing on. Merely refer to the files using their names and extensions, where necessary.
9. Your programs must be coded in such a way that they will work with any data and not just the sample data supplied or any data extracts that appear in the question paper. You are advised to look at the supplied data files carefully.
10. Make sure that routines such as searches, sorts and selections for arrays are developed from first principles, and that you do not use the built-in features of a

programming language for any of these routines. You may, however, use built-in sub-routines to deep-copy arrays.

11. All data structures must be defined and declared by you, the programmer. You may not use components provided within the interface to store and later retrieve data.

12. Read the whole question paper before you choose a data structure. You may find that there could be an alternative method of representing the data which will be more efficient considering the questions that are asked in the paper.

13. You must save all your work regularly on the disk you have been given, or the disk space allocated to you for this examination.

14. If there is a technical interruption that prevents you from writing your examination, e.g. a power failure, when you resume writing your examinations, you will only be given the time that was remaining when the interruption began. No extra time will be given to catch up work that was not saved.

15. Make sure that your examination number appears as a comment in every program that you code as well as on every page of hardcopy that you hand in.

16. Print a code listing of all the programs/classes that you code. Printing must be done after the examination. You will be given half an hour to print after the examination is finished. Your teacher will tell you what arrangements have been made for the printing of your work.

SCENARIO:

The number of relatively young, educated people voluntarily moving from country to country is growing. Their motivation is a combination of career related issues and a desire to experience a new culture. These people are commonly referred to as 'expats' and they have become a regular fixture in urban environments around the world.

Expats are faced with a number of specific problems, which locals do not face in terms of finding services and fulfilling needs, especially if they are not proficient in the local language. Cost of living is often very different in their destination city, and currency differences make it harder to relate to familiar amounts. Expatistan.com is a collaborative effort, recording real living costs in cities around the world. Costs recorded include food, accommodation, transport and other everyday living costs. These costs are used to calculate a cost of living index and rank cities according to their cost of living.

For this exercise we will consider food costs only. You are given some data extracted from www.expatistan.com to analyse and compare the cost of living in a few selected cities as it compares to living in South Africa.

Source: https://www.expatistan.com/cost-of-living

SECTION A STRUCTURED QUERY LANGUAGE

QUESTION 1

For this exercise we will consider food costs only. You are given some data extracted from www.expatistan.com to analyse and compare the cost of living in a few selected cities as it compares to living in South Africa.

The database contains information in three tables. You have been supplied with a database called **Living**. The **Countries** table (*Figure 1 & 2*) contains a list of country names and the exchange rate of the local currency relative to South African Rands.

The **Cities** table (*Figure 3 & 4*) contains information about each city. For every city the country is recorded. There may also be a ranking and price index, indicating the relative cost of living in that city.

The **FoodCost** table (*Figure 5 & 6)* stores the cost of food items recorded as part of the cost of living calculation. Each food item is recorded with the city, the cost in the local currency of that country, and the last date when that cost was recorded.

It is recommended that you make a backup copy of the original database.

TABLE STRUCTURE

The fields in the database are discussed below. Below each description is a screenshot of the first few rows of data for your convenience. NOTE: The tables do contain more data:

Countries

Field Name	Data Type	Description (Optional)
CountryID	AutoNumber	Unique ID for the country
CountryName	Short Text	Name of the country
RateToZAR	Number	Conversion rate for local currency to ZAR

Figure 1

CountryID	CountryName	RateToZAR
1	Afghanistan	0.18
2	Aland Islands	
3	Albania	
4	Algeria	
5	Andorra	
6	Angola	
7	Anguilla	
8	Antigua and Barbuda	
9	Argentina	
10	Armenia	
11	Aruba	
12	Australia	
13	Austria	15.75

Figure 2

Cities

Field Name	Data Type	Description (Optional)
ID	AutoNumber	Unique ID for the city
City	Short Text	Name of the city
CountryID	Number	ID of the country
Ranking	Number	Cost of living ranking
PriceIndex	Number	Price index used to rank cities

Figure 3

ID	City	CountryID	Ranking	PriceIndex
428	Hamilton	23	1	295
649	Grand Cayman	38	2	245
2438	Geneva	204	3	245
2445	Zurich	204	4	241
1040	Reykjavik	92	6	239
2869	San Francisco,	223	5	239
2897	Walnut Creek,	223	7	234

Figure 4

FoodCost

Field Name	Data Type	Description (Optional)
ID	AutoNumber	Unique ID for this record
CityID	Number	ID of the city
Item	Short Text	Description of the food item
LocalCost	Number	Cost in local currency
DateCollected	Date/Time	Date the cost was recorded

Figure 5

ID	CityID	Item	LocalCost	DateCollect
1	2286	Basic lunchtime menu (including a drink) in t	104	2017/01/01
2	2286	Combo meal in fast food restaurant (Big Mac	58	2017/03/28
3	2286	500 gr (1 lb.) of boneless chicken breast	39	2018/01/20
4	2286	1 liter (1 qt.) of whole fat milk	14	2017/04/13
5	2286	12 eggs, large	34	2018/01/03
6	2286	1 kg (2 lb.) of tomatoes	19	2017/03/02
7	2286	500 gr (16 oz.) of local cheese	64	2017/12/14

Figure 6

You have been supplied with the database named **Living** and an electronic answer sheet named **SQL Answer Sheet Prelim 2018.docx**. Open the word document and paste your SQL queries in the space provided. Ensure that you save your work at regular intervals.

1.1 Write a query to list all the country names starting with 'Turk'. (3)

CountryName
Turkey
Turkmenistan
Turks and Caicos Islands

1.2 Food costs are recorded in the local currency of that country. In order to allow comparison with South Africa, some countries have recorded the exchange rate used to convert that currency to Rands. Write a query to list those countries which have an exchange rate recorded, sorted by exchange rate and country name. (5)

CountryID	CountryName	RateToZAR
1	Afghanistan	0.18
194	South Africa	1
36	Canada	10.07
223	United States	13.34
69	France	15.51
75	Germany	15.51
97	Ireland	15.51
13	Austria	15.75
222	United Kingdom	17.39

1.3 Write a query to update the country record for Australia to add the exchange rate of 9.97. (4)

1.4 Where sufficient data has been recorded, a city is given a ranking which indicates the cost of living in that city. A ranking of 1 indicates this city has the highest cost of living. Write a query to list the cities recorded with the top ten ranking. Show the **ranking** and **city**. (3)

Ranking	City
1	Hamilton
2	Grand Cayman
3	Geneva
4	Zurich
5	San Francisco, California
6	Reykjavik
7	Walnut Creek, California
8	New York City
9	London
10	Oslo

1.5 Cost of living is dependent on many factors. One of these is the cost of food. A variety of food items has been recorded for each city, with the date the cost was recorded. In order to keep the data current, food costs must be refreshed after 120 days. Write a query to list the food items with a collection date older than 120 days. Show the **ID**, **CityID**, **Item**, **date collected** and the age of the record. Calculate the age of the record as the difference between the date of collection and today's date. Label this column 'Days old'. (6)

ID	CityID	Item	DateCollect	Days old
1	2286	Basic lunchtime menu (including a drink) in t	2017/01/01	565
2	2286	Combo meal in fast food restaurant (Big Mac	2017/03/28	479
3	2286	500 gr (1 lb.) of boneless chicken breast	2018/01/20	181
4	2286	1 liter (1 qt.) of whole fat milk	2017/04/13	463
5	2286	12 eggs, large	2018/01/03	198
6	2286	1 kg (2 lb.) of tomatoes	2017/03/02	505
7	2286	500 gr (16 oz.) of local cheese	2017/12/14	218
8	2286	1 kg (2 lb.) of apples	2017/07/18	367
9	2286	1 kg (2 lb.) of potatoes	2017/08/22	332
10	2286	0.5 l (16 oz) domestic beer in the supermarke	2017/05/21	425

1.6 Expatistan.com would like to expand their database. Some countries have only a few cities on record. Write a query to count the number of cities on record for each country and list the **country name** and the number of **cities**. Show only those countries that have fewer than 4 cities listed. (7)

CountryName	No of Cities
Afghanistan	1
Aland Islands	1
Andorra	1
Anguilla	1
Antigua and Barbuda	1
Armenia	3
Aruba	1
Bahamas	1
Bahrain	1
Barbados	1
Belize	2
Bermuda	1
Bhutan	1

1.7 Write a query to compare the cost of a fast food meal (Starts with 'combo meal') between countries, in Rands. Show the **country name**, the name of the **city**, the **Item name** and the **cost** in Rands as 'Rand cost'. Multiply the LocalCost by RateToZAR to get the cost in Rands. (6)

CountryName	City	Item	Rand cost
South Africa	Johannesburg	Combo meal in fast food restaurant (Big Mac	58
France	Paris	Combo meal in fast food restaurant (Big Mac	124.08
United States	New York City	Combo meal in fast food restaurant (Big Mac	120.06
United Kingdom	London	Combo meal in fast food restaurant (Big Mac	104.34
Ireland	Dublin	Combo meal in fast food restaurant (Big Mac	124.08

1.8 Food costs have been recorded for individual items. You would like to summarise these into one record and add this to the FoodCost table for each city. Write a query to calculate the total local cost of all the food items for each city and insert that as an item called 'Basket', for each city in the FoodCost table. Use today's date for the DateCollected. (6)

40 marks

SECTION B OBJECT-ORIENTED PROGRAMMING

Expats can also use the information provided by expatistan.com to plan tourist opportunities. One such an opportunity is to follow the Tour de France's last few stages. Cyclists competing in the Tour start in one city or town, and race to the finish line in another town, covering 150km on average.

One expat of South African origin collected information about Stages 16 to 21. This included a night in a hotel in the city where the stage ended, packed lunch, drinks for the day and dinner.

He compiled a text file ("letour.txt") with the data as he recorded it. The file is in no particular order:

```
Line1. 16,Bagnréres-de-Luchon,Haute-Garonne,Mondran,48.73
Line2. 17,Saint-Lary-Soulan,Hautes-Pyrénées,Le Chalet D'Artagnan,74.30
Line3. 18,Pau,Pyrénées-Atlantiques,Altica Pau,39.68
Line4. 16,bread,1.7
Line5. 16,local beer,1.5
Line6. 16,coke,1.91
Line7. 17,breakfast,12
Line8. 19,Laruns,Pyrénées-Atlantiques,Gîte Cornau,58.98
```

The first three lines were hotels that he found where he would stay the night after each Stage:

Stage number, Town, District, Hotel name, price per night (in Euro).

Lines 4 to 6 are food items he found for his day at Stage 16:

Stage number, food item, price (in Euro).

Line 7 is breakfast for the day of Stage 17. He regarded breakfast or dinner as a single food item expense.

There may not be the same number of items for every day, as some hotels offer breakfast or dinner as part of their price.

QUESTION 2

Create a new class called **Item** based on the class diagram below. This class will be used to store the detail of a food item (breakfast and dinner are regarded as single items).

Item
Properties - String stageID - String description - double value
Methods + constructor(String id, String d, double v) + getValue() : double + getStageID : String + toString : String

2.1 Write code to create a new class called **Item**. (1)

2.2 Write code to create the three properties of the class as indicated above. (3)

2.3 Write code to create a constructor that will accept new values as parameters for the properties. This method should be named appropriately. (2)

2.4 Write code to create the two accessor methods (**getStageID** and **getValue**) as indicated in the class diagram. These methods should be named appropriately and return the correct types and values for **stageID** and **value**. (2)

2.5 Write code to create a **toString** method that will return a single string representing the item. The format should be as follows (value formatted to two decimals): (3)

Description <tab> value " euro"

Example:

```
bread   1.70 euro
```

[11]

QUESTION 3

Create a new class called **City** based on the class diagram below. This class will be used to store the detail of a city and hotel where the tourist will spend a night.

City
Properties - String stageID - String name - String district - String hotelName - double cost - Item[ ] itemArr
Methods + constructor(String id, String n, String d, String h, double c) + setItemArr(Item[] iArr) + getHotelCost() : double + getStageID : String - abbreviate(String d) : String + toString : String

3.1 Write code to create a new class called City. (1)

3.2 Write code to create the properties that will store the details of a city or town where the tourist will spend the night and the food items to be bought during that day. These properties should have the correct data types as indicated in the class diagram. (3)

3.3 Write code to create a helper method called **abbreviate**. This method should accept a district name as a parameter and abbreviate it according to the following format:

If the name is not hyphenated, like "Yvelines", the first three characters should be returned in capital letters, e.g. "YVE".

If the name is hyphenated, like "Haute-Garonne", the first character and the two following the hyphen should be returned in capital letters, e.g. "HGA". (6)

3.4 Write code to create a constructor that will accept parameters for the new values as indicated in the class diagram. The values for **stageID**, **name**, **hotelName** and **cost** should be stored as they are received as parameters, but the **district** should be changed using the **abbreviate** method you created in Question 3.3 (3)

3.5 Write code to create a mutator method for the **itemArr** of the **City** class. This method should be named appropriately. It must accept an array of **Items** and assign the values in this array to the **itemArr.** (3)

3.6 Write code to create the two accessor methods (**getHotelCost** and **getStageID**) that will return their respective property values. (2)

3.7 Write code to create the **toString** method for this class. It should return a string representing the city details in the following format: (2)

Name (District)
HotelName <tab> HotelCost " euro"

Example:

```
Bagnréres-de-Luchon (HGA)
Mondran                 48.73 euro
```

[20]

QUESTION 4

4.1 Write code to create a new class called **Controller**. (1)

4.2 Write code to declare the following as instance variables:

- An array to store 6 **City** objects
- A counter to keep track of the number of **City** objects stored
- An array to store 36 **Item** objects
- A counter to keep track of the number of **Item** objects stored (4)

4.3 Write code to create a constructor for the class. The constructor must accept the name of the text file as a parameter. Check if the file exists. If it does not, display an error message.

The lines from the text file will represent either an **Item** or a **City** object. Loop through the lines of the file to split the data into the values for either a **City** or **Item** object, and create and place the correct object in the appropriate array. (14)

4.4 Write code to create a new method called **listAllCities**. This method should return a single string that contains the information from all City objects in the City array. Each City's details should be on a new line. (5)

[24]

QUESTION 5

5.1 Write code to create a simple user interface called **LeTourUI** that will allow simple output. (1)

5.2 Declare and instantiate a **Controller** object. Send the name of the text file as an argument. (1)

5.3 Display all the City information by calling the appropriate method from the **Controller** class. (1)

Example:

```
Bagnréres-de-Luchon (HGA)
Mondran                 48.73 euro

Saint-Lary-Soulan (HPY)
Le Chalet D'Artagnan    74.3 euro

Pau (PAT)
Altica Pau              39.68 euro

Laruns (PAT)
Gîte Cornau             58.98 euro

Espelette (PAT)
Logis Hôtel Euzkadi     80.12 euro

Houilles (YVE)
Maisons-Laffitte        50 euro
```

[3]

QUESTION 6

Return to the **Controller** class.

6.1 Write code to create a new method called **populateList** that will populate each **City** object's **itemArr** array. Each object in the array of city objects should now store the details of the city and the items to be bought.

Use the **getStageID** of the **Item** class and the **getStageID** method in the **City** class to match the **City** and **Item** objects for each Stage day.

The method should return a string consisting of all output of the **toString** method of each **City** of the six Stage days. (10)

Return to the **City** class.

6.2 Add code to the **toString** method that should determine if the **itemArr** array contains any items. If it contains Items they should also be added to the string. (3)

Example:

```
Bagnréres-de-Luchon (HGA)
Mondran                 48.73 euro
bread                   1.70 euro
local beer              1.50 euro
coke                    1.91 euro
dinner                  16.00 euro
cheese                  4.00 euro
breakfast               15.00 euro
```

6.3 The **LeTourUI** class should now display the following output: (1)

Example:

```
Bagnréres-de-Luchon (HGA)
Mondran                 48.73 euro
bread                   1.70 euro
local beer              1.50 euro
coke                    1.91 euro
dinner                  16.00 euro
cheese                  4.00 euro
breakfast               15.00 euro

Saint-Lary-Soulan (HPY)
Le Chalet D'Artagnan    74.3 euro
breakfast               12.00 euro
. . .
```

[14]

QUESTION 7

The South African expat would like to know how much he will spend per day during Stages 16 to 21.

Make the necessary changes to your existing methods to give him the information as displayed below. Make use of a class constant called EXCHANGE_R that will represent the current Rand to Euro exchange rate as R 15.80 per Euro.

The **LeTourUI** class should now display the following output: (8)

```
Bagnréres-de-Luchon (HGA)
Mondran                 48.73 euro
bread                   1.70 euro
local beer              1.50 euro
coke                    1.91 euro
dinner                  16.00 euro
```

```
cheese                    4.00 euro
breakfast                 15.00 euro
Total cost per day: R1403.67

Saint-Lary-Soulan (HPY)
Le Chalet D'Artagnan   74.3 euro
breakfast                 12.00 euro
Total cost per day: R1363.54
...
```

[8]

80 marks

Total: 120 marks