International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

COMPUTER SCIENCE
HIGHER LEVEL
PAPER 2

Friday 7 May 2010 (morning)

2 hours 15 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.

© International Baccalaureate Organization 2010

https://xtremepape.rs/

*Answer **all** the questions.*

1. An array of `Player` objects called `topTen[]`, contains the names and scores of the 10 highest scoring players in a computer game. These are stored in descending order of score. A `Player` object is defined by the class `Player` shown below.

```
public class Player
{
  String name;     // name of player
  int score;       // player's score

  public Player(String name, int score)
  {
    this.name = name;
    this.score = score;
  }
}
```

(a) State the purpose of the constructor `public Player()`. *[2 marks]*

The first three members of the array `topTen[]` are shown below.

`topTen[]`

[0]	
Jo	964

[1]	
Pete	900

[2]	
Fernanda	840

(b) State the value of

(i) `topTen[1].name`; *[1 mark]*

(ii) `topTen[2].score`. *[1 mark]*

At the end of each game a new `Player` object is created. The method `compare()` receives this `Player` object with the details of the game and compares the new score with those in the array `topTen[]`. It then returns the position in which the new score should be in this array, or the value `-1` if the score is not high enough.

(c) Construct the method `compare()`, which has been started below.

```
// the array topTen[] is declared globally.
public int compare(Player latest)
{
  // lines of code missing
}
```

[5 marks]

(This question continues on the following page)

https://xtremepape.rs/

(Question 1 continued)

If the value returned by the method `compare()` is not `-1`, the method `updateList()` is called, which inserts the new `Player` object into its correct position in the array.

(d) The method `updateList()` works as follows:
- a temporary array of `Player` objects is created
- the new best 10 results are placed in this temporary array
- the array `topTen[]` is made equal to this temporary array.

Construct the method `updateList()`, which has been started below.

```
public static void updateList(Player latest, int position)
{
  // lines of code missing
}
```

[8 marks]

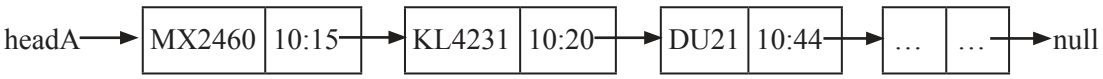
(e) Without writing any code, suggest an alternative way of writing `updateList()` which does **not** create a temporary array. *[3 marks]*

https://xtremepape.rs/

2. A program controlling the arrival of flights at an airport contains two linked lists.

The first list (List A), is continually updated so that it contains data for each flight that will arrive during that day. The list is maintained in order of the expected landing times. These expected landing times often change.

Part of the linked list, showing the flight numbers and expected landing times, is given below.



(a) Explain why a linked list would be a good choice of data structure for this application. *[3 marks]*

(b) Flight number BA3644 has expected landing time 10:40. Explain, with the help of a diagram, how a node containing this data would be added to the list. *[5 marks]*

Part of the class `Node` that defines a linked list node is shown below.

```
public class Node
{
  public String flightNumber;
  public Node next;
  // other data members not shown
}
```

(c) Construct the method `displayListA()`, which displays the flight numbers in List A. *[4 marks]*

(This question continues on the following page)

https://xtremepape.rs/

(Question 2 continued)

The second linked list (List B) contains a list of flights that have landed.

The class that manages the two linked lists is called `Arrivals`. The class is shown below with one of its methods.

```
public class Arrivals
{
  static Node headA;    // points to the 1st node in List A
  static Node headB;    // points to the 1st node in List B

  public static void landed(String flightLanded)
  {
    // lines of code missing
  }
}
```

Part of the method `landed()` is shown above. It receives, as a parameter, the flight number of the flight that has just landed. It then deletes the node representing this flight from List A and adds it to the end of List B.

(d) Construct the method `landed()`.

You can assume that neither of the two lists is empty and that the flight number exists in List A. *[8 marks]*

https://xtremepape.rs/

3. An Employee file contains several employee records stored on disk. Access to a particular record is provided by a partial index which is also stored on disk.

(a) Describe the steps needed to create the partial index for this file. *[4 marks]*

Each day an application is run which updates the Employee file. To make the process more efficient, the partial index is first read into a suitable dynamic data structure in the memory.

(b) Suggest, with reasons, **one** suitable data structure. *[3 marks]*

(c) For the data structure suggested in part (b), explain how the partial index is used to access a particular record. *[6 marks]*

(d) (i) State **two** disadvantages of replacing the partial index with a full index. *[2 marks]*

(ii) Explain **one** advantage of replacing the partial index with a full index. *[2 marks]*

(e) Describe a method of providing fast access to an individual record that does not involve the use of an index. *[3 marks]*

https://xtremepape.rs/

4. *This question involves the use of the case study.*

(a) The construction of Heathrow's Terminal 5 included a new control tower for the whole airport. The changeover was carried out by running the new system in parallel with the old system.

Outline **one** reason for choosing a parallel form of changeover, as opposed to any other. *[2 marks]*

(b) Suggest why the airport authorities chose the particular testing strategy outlined on page 4 of the case study. *[2 marks]*

(c) (i) Identify an airport system that would use real-time processing. *[1 mark]*

(ii) Explain, for the system identified in part (i), why it would require real-time processing. *[3 marks]*

(d) A computerized system is being designed to replace the paper flight strips used in Air Traffic Control. A concern of the controllers is that interacting with a computer system might distract them from their tasks.

(i) Explain why *voice recognition* would **not** be suitable as a *user interface*. *[3 marks]*

(ii) Describe a user interface that would be suitable. *[3 marks]*

(iii) Describe **one** useful feature that could be incorporated into the new user interface, that was not present in the original one. *[2 marks]*

(iv) Suggest **one** possible back-up strategy in case of a system failure in Air Traffic Control. *[2 marks]*

(e) By considering both sides of the argument, discuss whether or not governments should have access to the "passenger name records (PNR)" files (see page 10 of the case study). *[6 marks]*

(f) Explain why more than one firewall might be included in the airport computer network. *[2 marks]*

(This question continues on the following page)

https://xtremepape.rs/

(Question 4 continued)

(g) The movement of aircraft on the ground around the airport is captured by sensors, which are activated when an aircraft breaks a beam of infra-red light.

(i) Explain why an *analog-digital converter* would **not** be needed for this sensor data. *[2 marks]*

The sensor data is used by the Air Traffic Control system to update the display in the control centre.

(ii) Discuss whether the Air Traffic Control operating system should use *polling* or *interrupts* for collecting data from the various sensors. *[4 marks]*

(h) The Flight Information Display System holds flight information for arrivals for the next 24 hours. Each flight is stored as an `Arrival` object.

Similarly a `Departures` object holds data for each flight that will leave the airport.

Discuss how both the `Arrival` object and the `Departures` object could *inherit* characteristics from a common `Flight` object. *[3 marks]*

(i) An airline uses several self-service kiosks and check-in desks for passenger check-in.

(i) Identify the clients and server within this system. *[2 marks]*

(ii) Describe the roles of the clients and server within the check-in system. *[3 marks]*

https://xtremepape.rs/