

# UNIVERSITY OF DUBLIN

## TRINITY COLLEGE

Faculty of Engineering, Mathematics & Science  
School of Computer Science & Statistics

B.A.(Mod.) Computer Science  
B.A.(Mod.) Computer Science  
Linguistics and a Language  
Junior Freshman Examination

Trinity Term 2009

### **1BA2 – Introduction to Programming**

Thursday 21 <sup>st</sup> May 2009	Lower Luce Hall	14:00 – 17:00
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**Prof. V. Cahill**

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#### **Instructions to Candidates:**

- ☐ Attempt **FOUR** questions

#### **Materials permitted for this examination:**

1.

A so-called "star number",  $s$ , is a number defined by the formula:

$$s = 6n(n-1) + 1$$

where  $n$  is the index of the star number, Thus, the first six (ie for  $n = 1, 2, 3, 4, 5$  and  $6$ ) star numbers are:

$$1, 13, 37, 73, 121, 181$$

In contrast, a so-called "triangle number",  $t$ , is the sum of the numbers from 1 to  $n$ :

$$t = 1 + 2 + \dots + (n-1) + n$$

Thus, the first six (ie for  $n = 1, 2, 3, 4, 5$  and  $6$ ) triangle numbers are:

$$1, 3, 6, 10, 15, 21$$

Write a Java application that produces a list of all the values of type `int` that are both star numbers and triangle numbers.

(25 marks)

2.

The Babylonian number system is a base-60 system. In this system the coefficients of the powers of 60 are written using the decimal numbers from 0 to 59 inclusive and separated by commas. Thus, the Babylonian number 1,57,46,40 is equal to  $(1 \times 60^3) + (57 \times 60^2) + (46 \times 60) + (40)$  which, in decimal notation, is 424,000.

Write a Java class whose instances represent Babylonian numbers. Your class should provide at least the following methods:

- a constructor that takes a number expressed in Babylonian form as input ;
- a method to return the value of the current Babylonian number as an integer;
- a method to add the current Babylonian number to another Babylonian number to produce a new Babylonian number;
- a method to subtract another Babylonian number from the current Babylonian number to produce a new Babylonian number.

If there are restrictions on the magnitude of the numbers that can be represented by your class, say what those restrictions are.

(25 marks)

3.

In the video game "Minesweeper" a number of "mines" are initially placed on a rectangular grid of squares representing a "minefield", typically occupying 10%-20% of the total number of squares. An integer representing the number of adjacent squares that contain mines is then stored into each unoccupied square.

Write a Java method that takes a grid in which mines have already been positioned as a parameter and produces a new grid in which the squares that were unoccupied in the original have been updated with the number of adjacent mines.

(25 marks)

4.

Write a Java class whose instances represent playing cards from the standard fifty-two card deck consisting in order of the 2, 3, 4, 5, 6, 7, 8, 9, 10, jack, queen, king and ace of spades, hearts, diamonds, and clubs. Cards are valued based firstly on their suit and then on their rank. Thus, all spades are valued higher than all hearts which are valued higher than all diamonds which are, in turn, valued before all clubs.

Write a method that takes an array of thirteen cards as a parameter and sorts the cards in the array so that cards of lower value precede cards of higher value in the array.

(25 marks)

5.

The *Six Nations Championship* is an international rugby football tournament played annually between Ireland, England, France, Italy, Scotland and Wales in which every team plays every other team once. Each team achieves two championship points for winning a match, one championship point for drawing a match and no championship points for losing a match. The winner of the tournament is the team with the most championship points (ie you may ignore the possibility of more than one team having the same number of championship points).

In addition, if a team beats all of the other teams in the tournament it is said to have won the *Grand Slam*. If any of Ireland, England, Scotland or Wales beats the other three teams it is said to have won the *Triple Crown*.

The result of a single match is described by the number of match points achieved by each of the teams involved, eg,

Wales 15, Ireland 17

means that Ireland beat Wales by 2 match points (pew!) and was hence awarded two championship points.

The state of the tournament is recorded in a league table, ordered by championship points achieved, which records for each team:

- the number of matches played, won, lost and drawn to date,
- the total number of match points scored by and against the team, and
- the number of championship points achieved by the team.

Eg, at the end of the 2009 tournament the league table was:

Team	Matches	Won	Drew	Lost	For	Against	Points
Ireland	5	5	0	0	121	73	10
England	5	3	0	2	124	70	6
France	5	3	0	2	124	101	6
Wales	5	3	0	2	100	81	6
Scotland	5	1	0	4	79	102	2
Italy	5	0	0	5	49	170	0

Write a Java class to represent a Six Nations Championship league table that provides the following methods.

- An appropriate constructor;
- A method to record the result of a single match;
- A method to report whether or not the tournament is finished;
- A method to report the winner of the tournament (if finished);
- A method to retrieve the statistics for a named team;
- A method to retrieve the name of the team in a specified position in the league;
- A method to determine if there is a Grand Slam winner;
- A method to report if there is a Triple Crown winner.

Use any other appropriate classes.

**Hint:** Determining if there is a triple crown winner requires more information to be recorded than is stored in the league table alone as does ensuring that no duplicate match results are recorded.

(25 marks)

6.

Friday the thirteenth is often thought to be an unlucky date. Since "forewarned is forearmed", write a Java program that, when given a date (eg, Wednesday the 23rd of July 1997), will determine which, if any, months of the given year have the thirteenth falling on a Friday.

Note: a leap year occurs every four years, but only every fourth whole century (ie, 100, 200, 300 etc. are NOT leap years but 400, 800, 1200 etc. are).

(25 marks)

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