University of Dublin

Trinity College

Faculty of Engineering, Mathematics & Science

School of Computer Science & Statistics

B.A. (Mod.) Computer Science — Trinity Term 2008

Junior Freshman Examination

1BA2 – Introduction to Programming

Thursday 22 May 2008 — Luce Hall — 14:00-17:00

Prof. Vinny Cahill

Attempt FOUR questions ONLY

1.

The digital root of a positive integer is obtained by summing all the digits of that number and repeating this process for any resulting number until only a single-digit number remains. For example, the digital root of 1729 is 1 as follows:

$1729 \Rightarrow 1 + 7 + 2 + 9 = 19$

$19 \Rightarrow 1 + 9 = 10$

$10 \Rightarrow 1 + 0 = 1$

Write a Java application to calculate the digital root of a number obtained from its user.

(25 marks)

2.

Write a Java application that can be used to maintain the diary for a dental practice with a single dentist who works from 8.00am to 5.00pm Monday to Friday with a one-hour lunch break. The dentist only undertakes the following procedures:

- regular examination takes 15 minutes;
- scaling takes 30 minutes;
- filling takes 45 minutes;
- extraction takes 1 hour and 30 minutes.

The diary should allow booking an appointment for a patient for a particular procedure, cancelling an existing appointment, and determining if an appointment is scheduled during a particular period.

Use appropriate classes.

(25 marks)

3.

The navy of the republic of Inebria has a single naval vessel. Each year the vessel pays a goodwill visit to the port of Whiskey in the Booze islands. There, the sailors are given an evening's shore leave during which they all invariably become intoxicated. To return to their ship at the end of the evening, they must walk the length of the dock at the end of which their vessel is moored.

When intoxicated, a sailor sometimes staggers a step backwards or to either side (i.e. left or right) instead of taking a step forward. The ship's physician has analysed this behaviour and discovered that the probability that a drunken sailor's next step is forward is 0.7 and to the left, right or backwards is, in each case, 0.1. The length of a sailor's stride is (surprisingly) constant and always equal to 1 metre.

The dock is 20 metres long and 5 metres wide. A sailor always starts towards the ship from the centre-line of the dock. When sailors fall in the water, they drift (face-upwards) home to Inebria where they are court martialed. When they back up off the dock and end up in the street they go straight back to the bar, remaining in Whiskey forever.

Given that the entire crew of 50 (yes, even the physician!) go ashore for a few drinks, and that 35 must be on board to run the ship if she is to leave harbour, write a Java application that simulates the behaviour of the crew.

Your application should report how many of the crew make it back to the ship after an evening's shore leave as well as how many are court martialed and how many remain in Whiskey.

Use appropriate classes.

(25 marks)

4.

Write a static Java method that makes (and returns) a copy of a two-dimensional array of `int` passed as a parameter to the method. Be sure that your method works for any possible value of its parameter.

(25 marks)

5.

The Olympic Games is a major international sporting tournament that is held every four years. A feature of the opening ceremony of the Olympic Games is the arrival of the Olympic torch in the host stadium. The torch is traditionally carried from Olympia in Greece to the host city via a number of other cities. Write a Java application that reads a description of a set of cities including Olympia and the host city, giving their names and coordinates, and another separate list of the intermediate cities to be visited in the order in which they are to be visited and which calculates the distance that the torch will travel on its journey.

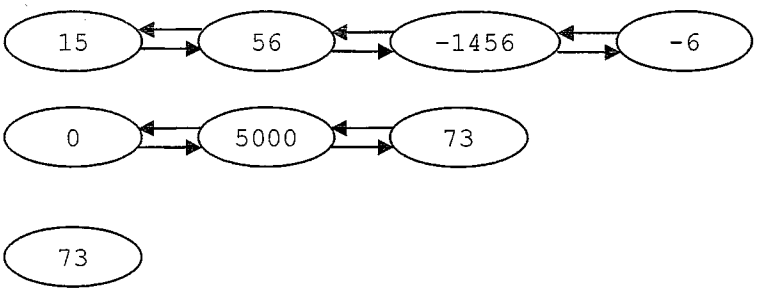
You may assume that the coordinates of the cities are given as points in a two-dimensional Cartesian plane (ie, that the earth is flat!).

Use appropriate classes.

(25 marks)

6.

An alternative way of representing a list of values in Java, ie, other than using an array, is as a so-called " doubly linked list" . In a doubly linked list each value is contained in an object that also contains a *link* to the previous and the next values in the list (if any). The following are examples of doubly linked lists of integers with 4, 3 and 1 elements respectively



Useful features of linked lists are that new values can be added to the end of the list at any time and that values can be inserted into or removed from the middle of the list.

Write a Java class whose instances represent doubly linked lists of integers, including methods to add a value to the end of the list and to remove a specified value from the list if it is present.

(25 marks)

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