COSC 1047 EL01 FINAL EXAM
INTRODUCTION TO COMPUTER SCIENCE II

Tuesday, April 14/2005, 9:00 am

Time Allowed: 3 hours

Instructor: Barry G. Adams

Name (PLEASE PRINT) ________________________________

Student # ________________________________

1. Answer ALL questions. Write your answers on this questionnaire.
2. Use back of exam pages for rough work if necessary.
3. Do not write comments in your programs.
4. No aids permitted
5. Number of Questions: 7
6. Total Marks: 60
Question 1 (8 marks)

Assume that an \( n \) row and \( n \) column tic-tac-toe (X’s and O’s) board is defined as a 2-dimensional array of integers called \texttt{board} that is an instance data field in some class. Assume that 0 represents an empty square, 1 represents a square with an ’X’ (player 1) and 2 represents a square with an ’O’ (player 2). A player is a winner if the player has occupied all squares in a row or all squares in a column or all squares in one of the two diagonals.

(a) Write an instance method with prototype

\[
\text{public void initialize()}
\]

that initializes all squares in the board to empty.

\textbf{Answer:}

(b) Write an instance method with prototype

\[
\text{public boolean isFull()}
\]

that returns true if the board is full and false otherwise.

\textbf{Answer:}
(c) Write an instance method with prototype

    public boolean isRowWinner(int player)

    that returns true if the given player (1 for player with 'X', and 2 for player with 'O') is a
    winner in one of the three rows.

    Answer:

(d) Write an instance method with prototype

    public boolean isDiagonalWinner(int player)

    that returns true if the given player (1 for player with 'X', and 2 for player with 'O') is a
    winner in one of the two diagonals.

    Answer:
Question 2 (10 marks)

Write a class called `Person` and three subclasses called `Student` (a subclass of `Person`), `Employee` (a subclass of `Person`) and `StudentEmployee` (a subclass of `Student`) as follows.

(a) The `Person` class encapsulates three private data fields: a `name` of type `String`, a social insurance number of type `String` and a year of birth of type `int`. The class should include a constructor, get methods for the private data fields and a `toString` method.

   Answer:

(b) The `Student` class is a subclass of `Person`. A student is a person that has a major (MATH, COSC, etc) and a student number. Provide the appropriate get methods and a `toString` method.

   Answer:
(c) The Employee class is a subclass of Person. An employee is a person that has a monthly salary. Provide the appropriate get methods and a toString method.

Answer:

(d) A StudentEmployee is a subclass of Student. A student employee is a student with a salary. Provide the appropriate get methods and a toString method.

Answer:
Question 3 (8 marks)

Write a complete class whose constructor takes two String arguments: the name of an input text file and the name of an output text file. Include a method that reads each line of the input file using a BufferedReader and writes to the output file, using a PrintWriter, all lines that are not comment lines. Any line that begins with the two characters // is a comment line. The files can be opened using statements such as

```java
BufferedReader in = new BufferedReader(new FileReader(inFileName));
PrintWriter out = new PrintWriter(new BufferedWriter(new FileWriter(outFileName)));
```

You do not need to write the import statements or include any comments.

Answer:
Question 4 (8 marks)

Using the method prototype

public int search(String[] s, String x, int start, int end)

write the recursive binary search algorithm assuming the string array s is sorted in lexicographical order. Here x is the string to find. The method should return the array index if x is found and -1 otherwise.

Answer:
Question 5 (8 marks)
The selection sort algorithm for an integer array is given by

```java
public static void selectionSort(int[] a, int start, int end)
{
    for (int i = start; i < end; i++)
    {
        int k = i;
        for (int j = i+1; j <= end; j++)
        {
            if (a[j] < a[k])
                k = j;
        }
        int temp = a[k];
        a[k] = a[i];
        a[i] = temp;
    }
}
```

Write a version of this algorithm that sorts an `ArrayList` of `BankAccount` objects in alphabetical order by owner name (use the `compareTo` method). Recall that the `BankAccount` class has a `getName` method and an `ArrayList` has the following methods for getting and setting an array list value at a given index

```java
public Object get(int index)
public void set(int index, Object obj)
```

**Answer:**
Question 6 (10 marks)

Write a GUI application called TemperatureTable that looks as follows for size $450 \times 300$.

if the “Fahrenheit to Celsius” button was clicked, and

if the “Celsius to Fahrenheit” button was clicked.

- The two input fields contain the starting and ending temperatures as integers. These are interpreted as Celsius values if you want to convert from Celsius to Fahrenheit and Fahrenheit values if you want to convert from Fahrenheit to Celsius.
- The buttons determine which type of conversion is desired.
• The first picture was obtained by clicking the “Fahrenheit to Celsius” button.

• The second picture was obtained by clicking the “Celsius to Fahrenheit” button.

• Note that the JTextArea is inside a JScrollPane.

• Do not write any import statements.

• Use a NumberFormatException to determine if valid integers were typed in the input boxes. If not an error message can be displayed in the JTextArea.

• Use inner classes for the two button handlers.

• Recall that the conversion formula from Fahrenheit to Celsius is \( c = \frac{5}{9}(f - 32) \) and the one for Celsius to Fahrenheit is \( f = \frac{9}{5}c + 32 \).

• You can omit comments.

Begin your answer here and continue on next page.
Answer to question 6 continued
Question 7 (8 marks)

The Set interface has methods with prototypes

```java
public boolean add(Object e);
```

```java
public void clear();
```

```java
public int size();
```

as well as many other methods. Also the `Random` class has a method with prototype

```java
public int nextInt(int n);
```

which returns a random integer in the range 0 to n-1. Write a method with prototype

```java
public void generateNumbers()
```

which uses the `TreeMap` class, which implements the `Set` interface, to generate a set of Lotto 649 numbers and display them.