

Points off	1	2	3	4	Total off	Net Score

CS 307 – Midterm 1 – Fall 2007

Your Name _____

Your UTEID _____

Circle your TA's name: David Joseph Ola

Instructions:

1. Please turn off your cell phones
2. There are 4 questions on this test.
3. You will 2 hours to complete the test.
4. You may not use a calculator or any other electronic devices while taking this test.
5. Please make your answers legible.
6. When code is required, write Java code.
7. When writing a method, assume the preconditions of the method are met.
8. When writing a method you may add helper methods if you wish.
9. When you complete the test show the proctor your UTID and give them the test and any scratch paper. Please leave the room quietly.

1. (2 points each, 30 points total) Short answer questions. Place your answers on the attached answer sheet. For code sample state the output. If the code would cause a syntax error answer "syntax error". If it would cause an exception error answer "exception". If it would result in an infinite loop answer "infinite loop".

A. What is the output of the following code?

```
int x = 3;
int y = 2;
x *= x + y * 2;
System.out.println( x );
```

B. What is the output of the following code?

```
int a = 13;
int b = 20;
System.out.println( a % b );
```

C. What is the output of the following code?

```
int value = 80;
int inc = 5;
while( value > 0){
    value -= inc;
    inc *= 2;
}
System.out.println( inc );
```

D. What is the output of the following code?

```
int[] data = {4, 2, 5, -1, 3};

for(int i = 1; i < data.length; i++){
    data[i] += data[i-1];
}

for(int i = 0; i < data.length; i++){
    System.out.print( data[i] + " ");
}
```

E. What is output when method one is called?

```
public static int two(int x, int y){
    x = x / 2;
    y++;
    return x + y;
}

public static void one(){
    int a = 5;
    int b = 3;
    System.out.print( two(a, b) + " ");
    System.out.print( a + " " + b );
}
```

F. What is the output when method `three` is called?

```
public static int four(int[] list){
    list[0]++;
    list[1]++;
    return list[0] * list[1];
}

public static void three(){
    int[] data = {2, 3};
    System.out.print( four(data) + " ");
    System.out.print( data[0] );
}
```

G. What is the output when method `five` is called?

```
public static String six(String s){
    s = "abc";
    return "" + s.charAt(0) + s.charAt(2);
}

public static void five(){
    String s1 = "xyz";
    System.out.print( six(s1) );
    System.out.print( s1 );
}
```

H. Can method `firstCharIsLetter` generate an exception? Explain why or why not.

```
// pre: s != null
public static boolean firstCharIsLetter(String s){
    return Character.isLetter( s.charAt(0) );
}
```

For questions I – M consider the following classes and interfaces.

```
public interface Ticket{
    public int getPrice();

    public boolean isDiscounted();
}

public class StandardTicket implements Ticket{

    private int price;

    public StandardTicket(int p){
        price = p;
    }

    public int getPrice(){
        return price;
    }

    public boolean isDiscounted(){
        return false;
    }

    public void addFee(){
        price += 10;
    }
}

public class StudentTicket extends StandardTicket{

    public StudentTicket(int p){
        super(p);
    }

    public int getPrice(){
        return super.getPrice() / 2;
    }

    public boolean isDiscounted(){
        return true;
    }
}
```

I. What is the output of the following code?

```
Ticket t = new Ticket();
System.out.println( t.getPrice() );
```

J. What is the output of the following code?

```
StandardTicket st1 = new StandardTicket( 100 );
System.out.println( st1.isDiscounted() );
```

K. What is the output of the following code?

```
StudentTicket st2 = new StudentTicket( 100 );
StandardTicket st3 = st2;
System.out.println( st2 == st3 );
```

L. What is the output of the following code?

```
StudentTicket st4 = new StudentTicket( 50 );
st4.addFee();
System.out.println( st4.getPrice() );
```

M. Does the following code result in a syntax error? Briefly explain why or why not.

```
StandardTicket st5 = new StandardTicket( 200 );
System.out.println( st5.toString() );
```

N. Will the following class compile? Briefly explain why or why not.

```
public class Coord implements Comparable{

    public int x;
    public int y;

}
```

O. What is the output of the following code?

```
int[][] table = new int[10][5];
System.out.println( table[2][3] );
```

2. Arrays (25 Points) Write a method that returns the maximum *similarity score* between a given `String` and the elements of a native array of `Strings`.

For this question similarity score is determined as follows:

- `Strings` of different lengths have a similarity score of 0.
- for `Strings` of the same length each 'q' or 'k' in the same location add 3 to the similarity score
- for `Strings` of the same length each other letter in the same location add 2 to the similarity score
- for `Strings` of the same length each non letter character in the same location add 1 to similarity score

Here are some examples:

String 1 "hi" Similarity score is 0 because the `Strings` are not the same length.
String 2 "high"

String 1 "high" Similarity score is 0 because none of the characters are in the same location.
String 2 "ihhg"

String 1 "high" Similarity score is 2 because the first char is 'h' in both `Strings`.
String 2 "haaa" 'h' a letter, but is not 'q' or 'k'.

String 1 "...!" Similarity score is 2 because there are 2 matching, non letter characters.
String 2 ".--!"

String 1 "queen.king" Similarity score is 21. q is +3, k is +3, 7 more letter matches +14,
String 2 "queen.king" period +1.

The following static method from the `Character` class can be used to determine if a given character is a letter.

```
// from the Character class
static boolean isLetter(char ch)
    Determines if the specified character is a letter.
```

Complete the following method:

```
/*    pre: list != null, list.length > 0,
      source != null, source.length() > 0
      post: return the maximum similarity score of the elements of list
           to source. list is not altered as a result of this method call.
*/
public static int getMaxSimilarityScore(String[] list, String source){
```

Complete this method on the next page.

```
/* pre: list != null, list.length > 0,  
   source != null, source.length() > 0  
   post: return the maximum similarity score of the elements of list  
   to source. list is not altered as a result of this method call.  
*/  
public static int getMaxSimilarityScore(String[] list, String source){  
    assert list != null && list.length > 0 && source != null  
        && source.length() > 0;
```

3. Matrices (30 points) Consider a rectangular 2d array of chars. Write a method to determine the location and size of the *minimum bounding box* for a given character. A minimum bounding box is the rectangle of minimum size that if drawn at the proper location would encompass all the characters in the 2d array equal to some target character.

For example, consider the following 2d array.

a	b	c	c	c	c
a	d	a	a	a	b
d	c	c	c	a	b
b	c	a	a	a	a
a	d	a	a	a	c
a	d	d	b	e	a
a	c	d	a	c	a
c	c	c	c	f	f

If the target character was d the minimum bounding box would be the dotted line shown below.

a	b	c	c	c	c
a	d	a	a	a	b
d	c	c	c	a	b
b	c	a	a	a	a
a	d	a	a	a	c
a	d	d	b	e	a
a	c	d	a	c	a
c	c	c	c	f	f

The minimum bounding box for the character d starts at row 1 and column 0. It would have width of 3 columns and a height of 6 rows. This would be a rectangle with x, y coordinates of (0,1), a width of 3, and a height of 6.

If the target character was e the minimum bounding box would be the dotted line shown below.

a	b	c	c	c	c
a	d	a	a	a	b
d	c	c	c	a	b
b	c	a	a	a	a
a	d	a	a	a	c
a	d	d	b	e	a
a	c	d	a	c	a
c	c	c	c	f	f

The minimum bounding box for e has coordinates of (4, 5), a width of 1, and a height of 1.

For the other characters that appear in the sample here is there minimum bounding box

char	col(x)	row(y)	width	height
a	0	0	6	7
b	0	0	6	6
c	0	0	6	8
f	4	7	2	1

If the target character does not appear in the 2d array then the minimum bounding box has coordinates (0,0), a height of 0, and a width of 0.

Use the following `Rectangle` constructor in your method:

[Rectangle](#)(int x, int y, int width, int height)

Constructs a new `Rectangle` whose upper-left corner is specified as (x, y) and whose width and height are specified by the arguments of the same name.

Complete the following method. Your method shall be case sensitive. Thus 'a' and 'A' are distinct characters.

```
/*   pre: table != null, table is a rectangular 2d array
   post: return the minimum bounding box for the target character.
   table is not altered as a result of this method call.
*/
public static Rectangle getMinBoundingBox(char[][] table, char tgt){
    assert table != null && isRectangular(table);
```

4. (Implementing classes, 15 points)

Complete a class that models the ticket record for a police officer.

A ticket record has the following properties:

- The number of tickets given. This should always be 0 or more. Fractional tickets cannot be given.
- The total value of all tickets given. This should always be 0 or more and can have a fraction part.
- The number of tickets that are contested. This cannot have a fractional part. A contested ticket does not affect the number of tickets given or the total value of all tickets given.

Complete a `TicketRecord` class that has the following properties.

- Instance variables to store all of the relevant information for a ticket record as explained above.
- A default constructor. All instance variables should initially be set to 0.
- A method that is called when a ticket is given. It should increment the number of tickets and accept the value of the ticket.
- A method that is called when a ticket is contested. It should increment the number of tickets that have been contested.
- A method that returns the average value per ticket. Contested tickets do not affect this calculation.

Complete the class below. You may add other methods if you wish. State your preconditions and use assert statements to check them.

```
// more room on the next page if necessary
```

```
// more room for the TicketRecord class if necessary
```

Scratch paper

Question 1 answer Sheet

Name _____

A. _____

I. _____

B. _____

J. _____

C. _____

K. _____

D. _____

L. _____

E. _____

M. _____

F. _____

N. _____

G. _____

O. _____

H. _____

Scratch Paper

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