University Interscholastic League

Computer Science Competition

UTCS Open - 2012

General Directions:

1) DO NOT OPEN EXAM UNTIL TOLD TO DO SO.

2) **NO CALCULATOR OF ANY KIND MAY BE USED.**

3) There are 40 questions on this contest exam. You have 45 minutes to complete this contest. If you are in the process of actually writing an answer when the signal to stop is given, you may finish writing that answer.

4) Papers may not be turned in until 45 minutes have elapsed. If you finish the test before the end of the allotted time, remain at your seat and retain your paper until told to do otherwise. Use this time to check your answers.

5) All answers must be written on the answer sheet/Scantron card provided. Indicate your answers in the appropriate blanks provided on the answer sheet or on the Scantron card. Clean erasures are necessary for accurate Scantron grading.

6) You may place as many notations as you desire anywhere on the test paper, but not on the answer sheet or Scantron card which are reserved for answers only.

7) You may use additional scratch paper provided by the contest director.

8) All questions have ONE and only ONE correct (BEST) answer. There is a penalty for all incorrect answers. **All provided code segments are intended to be syntactically correct, unless otherwise UTCS Opend. Ignore any typographical errors and assume any undefined variables are defined as used.**

9) A reference to commonly used Java classes is provided at the end of the test, and you may use this reference sheet during the contest. You may detach the reference sheets from the test booklet, but DO NOT DO SO UNTIL THE CONTEST BEGINS.

10) Assume that any necessary import UTCS Openments for standard Java packages and classes (e.g. `.util`, `ArrayList`, etc.) are included in any programs or code segments that refer to methods from these classes and packages.

Scoring:

1) All questions will receive **6 points** if answered correctly; no points will be given or subtracted if unanswered; **2 points** will be deducted for an incorrect answer.

QUESTION 1

What does 1001_2 minus 111001_2 equal?

A. 110000_2 B. -110000_2 C. -101110_2 D. 1001_2 E. -1001_2

QUESTION 2

What is output by the code to the right?

A. 10 B. 9 C. 8.75

D. 7 E. 3

```
int x = 7 / 2;
int y = x * 2 + x / 2;
System.out.print(y);
```

QUESTION 3

What is output by the code to the right?

A. 38 B. 20 C. -2

D. -20 E. -38

```
int val = 0;
for(int i = 5; i < 24; i += 2)
  val -= 2;
System.out.print(val);
```

QUESTION 4

What is output by the code to the right?

A. CCM

B. CASECOLTMALC

C. CASE_COLT+&$*MALC

D. CASE-COLT+&$8MALC

E. Case-Colt+&$8Malc

```
String c = "Case-Colt+&$8Malc";
c = c.toUpperCase();
System.out.print(c);
```

QUESTION 5

What is output by the code to the right?

A. 3 6 B. 12 3 C. 9 6

D. There is no output due to a syntax error.

E. There is no output due to a runtime error.

```
int[] st = {5, -1, 3, 6, -3};
st[4] += st[3] + st[st[3]];
System.out.print(st[4] + " " + st[3]);
```

QUESTION 6

What is output by the code to the right?

A. 0 B. 2 C. 3

D. 17 E. 50

```
int x1 = 17;
int y1 = 50;
x1 %= y1;
System.out.print(x1);
```

QUESTION 7

How many combinations of values for the `boolean` variables `p`, `q`, and `r` will result in `s` being set to `true`?

A. 2 B. 3 C. 5

D. 6 E. 7

```
boolean p, q, r;
//code to initialize p, q, and r

boolean s = p || q && !r;
```

QUESTION 8

What is output by the code to the right?

A. `1` B. `13` C. `23`

D. `123` E. `2`

```
int[] st2 = {5, 1, 2, 3, 3};
if(st2.length > st2[1]) {
  System.out.print(1);
}
else
  System.out.print(2);
System.out.print(3);
```

QUESTION 9

What is output by the statement in the client code to the right marked `// line 1`?

A. `true1` B. `true0`

C. `false1` D. `false0`

E. There is no output due to a runtime error.

QUESTION 10

What is output by the statement in the client code to the right marked `// line 2`?

A. `this` B. `sc2`

C. `true10` D. `false0`

E. The line causes no visible output.

```
public class School {
  private boolean isPrivate;
  private int numStudents;

  public void show() {
    numStudents = 10;
    isPrivate = true;
    System.out.print(this);
  }

  public String toString() {
    return "" + isPrivate + numStudents;
  }
}

// client code
School sc1 = new School();
System.out.print(sc1 + " "); // line 1
School sc2 = new School();
sc2.show(); // line 2
```

QUESTION 11

What is output by the code to the right?

A. `119` B. `100` C. `87`

D. `51` E. `32`

```
int m = 100;
int n = 51;
System.out.print(m ^ n);
```

QUESTION 12

What is output by the code to the right?

A. `0` B. `4` C. `4.472`

D. `5` E. `20`

```
int m1 = (int) Math.sqrt(20);
System.out.print(m1);
```

QUESTION 13

What is output by the code to the right?

A. `A\tBtC\tD`

B. `A\BtC\D`

C. `A B C D`

D. `A BtC D`

E. `A D`

```
System.out.print("A\tBtC\tD");
```

QUESTION 14

What is output by the code to the right?

A. `35.0(35.0)` B. `(35.0)(35.0)`

C. `35.0-35.0` D. `(35.0)(-35.0)`

E. `35.0-(35.0)`

```
double mon = 35;
System.out.printf("%(4.1f", mon);
System.out.printf("%(4.1f", -mon);
```

QUESTION 15

What is returned by the method call `manip(0.5, -0.5)`?

A. `-6.0` B. `-3.75`

C. `0` D. `1.25`

E. There is no output due to a syntax error in method `manip`.

```
public double manip(double a, double b) {
  a++;
  b--;
  ++a;
  return b * a;
}
```

QUESTION 16

What is output by the code to the right?

A. `55` B. `90` C. `99`

D. `110` E. `3628800`

```
String stars = "";
for(int i = 0; i < 10; i++)
  for(int j = i; j < 10; j++)
    stars += "*";
System.out.print(stars.length());
```

QUESTION 17

Which of the following Java expressions is equivalent to the formula to the right? `F`, `m1`, `m2`, and `r` are variables of type `double`. `G` is a constant of type `double`.

A. `F = G * m1 * m1 / r * r;`

B. `F = Gm1m2/r/r;`

C. `F = G * m1 * m2 / (r * r);`

D. `F = G * m1 * m2 / r ^ 2;`

E. None of A through D is correct.

$$F = \frac{Gm_1m_2}{r^2}$$

QUESTION 18

What is output by the code to the right?

A. `2 5` B. `2 15` C. `4 15`

D. `3 3` E. `5 5`

```
int x2 = 12;
int y2 = x2 + 2;
x2 = x2 - 10;
y2++;
System.out.print(x2 + " " + y2);
```

QUESTION 19

Which answer is logically equivalent to the following `boolean` expression, where `p` and `q` are `boolean` variables?

```
!(p || q || r)
```

A. `!p && q || r` B. `!p || !q || !r` C. `!(p && q) && !(q && r)`

D. `!p && !q && !r` E. `p && q && r`

QUESTION 20

What is output by the code to the right?

A. `[7, 9, 3]` B. `[3, 7, 9]`

C. `[7, 3, 9]` D. `[7, 9, 1]`

E. `[7, 1, 9]`

```
ArrayList<Integer> list1;
list1 = new ArrayList<Integer>();
list1.add(7);
list1.add(9);
list1.add(1, 3);
list1.set(1, list1.set(2, list1.get(1)));
System.out.print(list1);
```

QUESTION 21

What is output by the statement in the client code to the right marked `// line 1`?

A. `6` B. `7` C. `8`

D. `9` E. `10`

QUESTION 22

What is output by the statement in the client code to the right marked `// line 2`?

A. `[nt, smu, tam, tcu, ttu, ut, utd]`

B. `[nt, smu, tam, tcu, ttu, utd, ut]`

C. `[ut, tcu, tam, nt, ttu, smu, utd]`

D. `[ut, utd, ttu, tcu, tam, smu, nt]`

E. `[utd, ut, ttu, tcu, tam, smu, nt]`

QUESTION 23

What sorting algorithm does the `sort` method implement?

A. selection sort B. insertion sort C. radix sort

D. heap sort E. bubble sort

```
public int sort(String[] s) {
  int c = 0;
  for(int i = 1; i < s.length; i++) {
    String temp = s[i];
    int j = i;
    while( j > 0
        && temp.compareTo(s[j - 1]) > 0) {
      c++;
      s[j] = s[j - 1];
      s[j - 1] = temp;
      j--;
    }
  }
  return c;
}

// client code
String[] scs = {"ut", "tcu", "tam", "nt",
                "ttu", "smu", "utd"};

System.out.print(sort(scs)); // line 1

String arr = Arrays.toString(scs);
System.out.print(arr); // line 2
```

QUESTION 24

What is output by the code to the right?

A. `0` B. `1` C. `2`

D. `3` E. `4`

```
double[] d1 = {Integer.MAX_VALUE,
  Long.MAX_VALUE, Float.MAX_VALUE,
  Short.MAX_VALUE};
double[] d2 = {Long.MAX_VALUE,
  Float.MAX_VALUE, Double.MAX_VALUE,
  Byte.MAX_VALUE};
int c2 = 0;
for(int i = 0; i < d1.length; i++)
  if(d1[i] > d2[i])
    c2++;
System.out.print(c2);
```

QUESTION 25

What is output by the statement in the client code to the right marked `// line 1`?

A. `0`

B. `1`

C. `2`

D. `5`

E. `7`

QUESTION 26

What is output by the statement in the client code to the right marked `// line 2`?

A. `0 180`

B. `0 190`

C. `180 190`

D. `190 190`

E. `190 200`

QUESTION 27

What is output by the statement in the client code to the right marked `// line 3`?

A. `null`

B. `0`

C. There is no visible output.

D. The output varies from one run of the program to the next.

E. There is no output due to a runtime error.

QUESTION 28

Assume the following method is added to the `Test` class.

```
public static void show() {
  System.out.print(this);
}
```

What is output by the following client code?

```
Test t3 = new Test(50);
t3.bump();
Test.show();
```

A. `this`

B. `t3`

C. `50`

D. `55`

E. There is no output due to a syntax error in method `show`.

```
public class Test {
  private static int mys = 0;
  private int score = -1;

  public Test() { mys++; }

  public Test(int s) {
    mys++;
    score = s;
  }

  public String toString() {
    return score + "";
  }

  public void bump() {  this.score += 5; }

  public static int getMys() {
    return mys;
  }
}

// client code
Test[] ts = new Test[5];
ts[1] = new Test();
ts[3] = new Test(180);
System.out.print(Test.getMys()); // line 1

ts[1] = new Test();
ts[3] = new Test(180);
ts[1] = ts[3];
ts[3].bump();
ts[3].bump();
String tStr = ts[1] + " " + ts[3];
System.out.print(tStr); // line 2

System.out.print(ts[2]); // line 3
```

QUESTION 29

What is output by the code to the right?

A. `[5, 7, 2] 6`

B. `[5, 7, 2] 3`

C. `[2, 5, 7] 6`

D. `[2, 5, 7, 7] 3`

E. The output varies from one run of the program to the next.

```
int[] ds1 = {5, 7, 3, 3, 7, 2};
int[] ds2 = {4, 6, 1, 2, 5, 7};
Set s1 = new TreeSet();
Set s2 = new HashSet();
for(int i = 0; i < ds1.length; i++) {
  s1.add(ds1[i]);
  s2.add(ds2[i]);
}

s1.retainAll(s2);
System.out.print(s1 + " " + s2.size());
```

QUESTION 30

Consider the following interface and classes to the left. All classes have a default constructor. Which of the following statements will compile without error?

I. `TimeStamp t1 = new StockTrade();`

II. `StockTrade t2 = new SPut();`

III. `ShortS t3 = new StockTrade();`

IV. `Trade t4 = new ShortS();`

A. I only B. II only

C. II and III only D. II and IV only

E. I, II, and IV only

```
public interface TimeStamp

public interface Mg

public abstract class Trade

public class StockTrade extends Trade
                        implements TimeStamp


public class Call extends StockTrade

public class Put extends StockTrade

public class ShortS extends StockTrade

public class SPut extends Put implements Mg
```

QUESTION 31

Consider the following interface and classes to the left. All classes have a default constructor. Which of the following statements will compile without error?

I. `TimeStamp t5 = new SPut();`

II. `Mg t6 = new Put();`

III. `TimeStamp t7 = new TimeStamp();`

IV. `Object t8 = new Trade();`

A. I only B. IV only

C. I and IV only D. II and III only

E. I, II, III, and IV

QUESTION 32

What is returned by method `check(-1.5)`?

A. `Infinity` B. `NaN` C. `0`

D. There is no output due to a syntax error in method `check`.

E. There is no output due to a runtime error.

```
public double check(double a) {
  int x = 0;
  double b;
  a = a * b;
  a = a / x;
  return a;
}
```

QUESTION 33

What is output by the statement in the client code to the right marked `// line 1`?

A. `3` B. `4`

C. `12` D. `16`

E. The statement marked `// line 1` does not produce any visible output.

QUESTION 34

What is output by the statement in the client code to the right marked `// line 2`?

A. `0` B. `1` C. `5`

D. `25` E. `125`

```
public int algo(int x, int y) {
  int z = 0;
  while(y != 0) {
    int t = y;
    y = x % y;
    x = t;
    z += 4;
  }
  System.out.print(z);
  return x;
}

// client code
int res = algo(125, 1900); // line 1

System.out.print(res); // line 2
```

QUESTION 35

What is returned by method `handle` if `t` is the matrix shown below?

2	4	0	2	1	9
0	-1	5	4	0	-4
2	2	7	1	5	2
5	1	3	2	5	1
4	1	-1	3	1	4
10	4	-9	2	1	5

A. `"1 0"` B. `"3 5"` C. `"4 5"`

D. `"5 3"` E. `"5 4"`

QUESTION 36

What is printed by method `handle` `t.length == 10`, and all rows of `t[x].length == 10` for all `x` such that `0 <= x < 10`?

A. `1000` B. `100`

C. `10` D. `0 0`

E. The output cannot be determined without knowing the elements in the matrix `t`.

```
public String handle(int[][] t) {
  int c = 0;
  String res = "NONE";
  int m = Integer.MAX_VALUE;
  for(int x = 0; x < t.length; x++)
    for(int y = 0; y < t.length; y++) {
      int t1, t2;
      t1 = t2 = 0;
      for(int z=0; z<t.length; z++,c++) {
        t1 += t[x][z];
        t2 += t[z][y];
      }
      if(Math.abs(t1 - t2) < m) {
        m = Math.abs(t1 - t2);
        res = x + " " + y;
      }
    }
  System.out.print(c);
  return res;
}
```

QUESTION 37

Consider method `count` to the right. When `sc` is connected to a file named t1.txt and `set` is a `HashSet` the method takes 10 seconds to complete and outputs the following:

```
500000 25000
```

When `sc` is connected to the same file named t1.txt and `set` is a `TreeSet` the method takes 20 seconds to complete and output is the same.

What is the expected time for method `count` to complete when `sc` is connected to a file that produces the following output:

```
1500000 50000
```

when `set` is a `HashSet` and when `set` is a `TreeSet`?

	HashSet	TreeSet
A.	360 seconds	720 seconds
B.	60 seconds	132 seconds
C.	60 seconds	120 seconds
D.	20 seconds	60 seconds
E.	30 seconds	64 seconds

```
// pre: set != null, set.size() == 0
public void count(Scanner sc,
                          Set<String> set) {
  int tot = 0;
  while(sc.hasNext()) {
    tot++;
    String t = sc.next();
    set.add(t);
  }
  System.out.print(tot + " " + set.size());
}
```

QUESTION 38

What are the best case and worst case order (Big O) of method `create`? N = `d.length`. Pick the most restrictive correct set of answers.

	Best Case	Worst Case
A.	O(1)	$O(N^2)$
B.	O(N)	O(N)
C.	O(N)	$O(N^2)$
D.	$O(N^2)$	$O(N^2)$
E.	O(N)	$O(N^3)$

```
public ArrayList<Integer> create(int[] d) {
  ArrayList<Integer> res;
  res = new ArrayList<Integer>();
  for(int x : d)
    if(!res.contains(x))
      res.add(res.size() / 2, x);
  return res;
}
```

Go on to the next page.

QUESTION 39

Given the `Structure` class to the right what is output by the following client code?

```
int[] ds = {0, -2, 2, -2, 3, 4};
Structure<Integer> str;
str = new Structure<Integer>();
for(int xd : ds)
  str.add(xd);

for(int i = 0; i < str.size(); i++)
  System.out.print(str.remove() + " ");
```

A. `4 3 -2 2 0` B. `0 -2 2 -2 3 4`

C. `4 3 -2` D. `4 3 -2 2 -2 0`

E. There is no output due to a syntax error in the client code.

QUESTION 40

What type of data structure does the `Structure` class implement?

A. a set B. a stack C. a queue

D. a max heap E. an array based list

```
public class Structure<E> {

  private List<E> con;

  public Structure() {
    con = new LinkedList<E>();
  }

  public void add(E x) { con.add(0, x); }

  public E get() { return con.get(0); }

  public E remove() {return con.remove(0);}

  public boolean isEmpty() {
    return con.size() == 0;
  }

  public int size() { return con.size(); }

  public String toString() {
    return con.toString();
  }
}
```