University of Texas at Austin

High School Computer Science Competition - 2014

General Directions:

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

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

3) There are 40 questions on this contest exam. You have 45 minutes to complete the 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 keep your paper until told to do otherwise. Use this time to check your answers.

5) All answers must be written on the answer sheet provided. Indicate your answers in the appropriate blanks provided on the answer. Ensure your answers are clear and readable.

6) You may place as many notations as you desire anywhere on the test paper, but not on the answer sheet which is 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.

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 statements 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) Questions will receive **6 points** if answered correctly; no points will be given or subtracted if unanswered; **2 points** will be deducted per incorrect answer.

QUESTION 1

What is the sum of 1111_2 and 1_2?

A. $1F_{16}$ B. 11111_2 C. 10_{16} D. 32_{10} E. 16_8

QUESTION 2

What is output by the code to the right?

A. -10 B. 10 C. 26

D. 103-4 E. y + 2 * x - 4

```
int x = 3;
int y = 8;
System.out.print(y + 2 * x - 4);
```

QUESTION 3

What is output by the code to the right?

A. 24 B. 80 C. 84

D. 100 E. 105

```
int total = 0;
for(int i = 0; i <= 20; i++)
  for(int j = 1; j < 5; j++)
    total++;
System.out.print(total);
```

QUESTION 4

What is output by the code to the right?

A. ethods B. formal4

C. Methods D. methods

E. Formal4Methods

```
String area = "Formal4Methods";
area = area.toLowerCase().substring(7);
System.out.print(area);
```

QUESTION 5

What is output by the code to the right?

A. true 4 B. true 5

C. false 4 D. false 5

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

```
boolean[] an = new boolean[5];
System.out.print(an[1] + " " + an.length);
```

QUESTION 6

What is output by the code to the right?

A. 33 B. 23 C. 10

D. 3 E. 2

```
int z = 23;
int y = 10;
System.out.print(z % y);
```

QUESTION 7

How many of the 8 possible combinations of values for the variables a, b, and c result in d being set to true?

A. 1 B. 2 C. 4

D. 7 E. 8

```
boolean a, b, c;
//code to initialize a, b, and c

boolean d = !(a || b || c);
```

QUESTION 8

What is output by the code to the right?

A. A   B. B   C. C

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

E. The code runs, but there is no visible output.

```
int[] data = {5, 2, 5, 1, 3};
if(data[1] == data[2])
   System.out.print("A");
if(data.length != data[2])
  System.out.print("B");
if(data[2] < data[data.length -1])
  System.out.print("C");
```

QUESTION 9

Given the classes `Shirt` and `TShirt` to the right, what is output by the following client code?

```
TShirt ts = new TShirt(4, 5);
System.out.print(ts.getShade());
```

A. 0

B. 1

C. 4

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

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

```
public class Shirt {
  private int shade;

  public Shirt(int s) { shade = s; }

  public void wash() { shade--; }

  public int getShade() { return shade; }
}

public class TShirt extends Shirt {
  private int mult;

  public TShirt(int s, int m) {
    super(s);
    mult = m;
  }

  public void wash() {
    for(int i = 0; i < mult; i++)
      super.wash();
  }
}
```

QUESTION 10

Given the classes `Shirt` and `TShirt` to the right, what is output by the following client code?

```
Shirt s2 = new TShirt(10, 4);
s2.wash();
s2.wash();
System.out.print(s2.getShade());
```

A. 18

B. 10

C. 8

D. 6

E. 2

QUESTION 11

What is output by the code to the right?

A. 32 256   B. 32 3   C. 4 0

D. 32 4   E. true 3

```
int pt = 32;
int xt = pt >> 3;
System.out.print(pt + " " + xt);
```

QUESTION 12

What is output by the code to the right?

A. 9   B. 9.0   C. 8

D. 8.0   E. 6

```
int xv = 65;
String rv = Math.ceil(Math.sqrt(xv)) + "";
System.out.print(rv);
```

QUESTION 13

What is output by the code to the right?

A. \t\t\n\n   B.   \t\t   C.   \\\\

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

E.   The code runs, but there is no visible output.

```
System.out.println("\t\t\n\n");
```

QUESTION 14

What is output by the code to the right?

A.   15.86 15.86

B.   15.86000 15.9

C.   15.86000 15.8

D.   15.8600015.8

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

```
double a2 = 15.86;
System.out.printf("%8.5f %3.1f", a2, a2);
```

QUESTION 15

What is returned by the method call ft1(-3)?

A.   14

B.   12

C.   -3

D.   4

E.   -6

```
public int ft1(int x) {
  x++;
  x = ft2(x, x);
  x--;
  return x;
}

public int ft2(int x, int y) {
  x++;
  y *= 2;
  return x + y;
}
```

QUESTION 16

What is output by the code to the right?

A.   false false   B.   false true

C.   true false   D.   true true

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

```
boolean p1 = false;
boolean q1 = true;
boolean r1 = false;
System.out.print(p1 || q1 && r1);
System.out.print(" " + !q1);
```

QUESTION 17

What is output by the code to the right?

A.   14 6   B.   12 8

C.   14 5   D.   12 2

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

```
int x3 = 12;
int y3 = x3 / 2;
x3++;
++x3;
System.out.print(x3 + " " + y3);
```

What is returned by the method call `mst(7)`?

A. -3   B. -1

C. 0   D. 1

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

What is returned by the method call `mst(10)`?

A. 12   B. 8

C. 3   D. -3

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

```java
public int mst(int n) {
  if(n == 0)
    return -3;
  return n / 2 + mst(n - 2);
}
```

What is output by the code to the right?

A. 6   B. 5

C. 1   D. 9

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

```java
String cls = "tsP&^k2dj";
int rs2 = 0;
cls = cls.toUpperCase();
for(int i = 0; i < cls.length(); i++)
  if(Character.isUpperCase(cls.charAt(i)))
    rs2++;
System.out.print(rs2);
```

What is output by the code to the right?

A. -126   B. -3

C. 128   D. 130

E. The output is different each time the program is run.

```java
byte b5 = 120;
for(int i = 0; i < 10; i++)
  b5++;
System.out.print(b5);
```

What is output by the code to the right?

A. [C, B, A, E]

B. [C, A, B, E]

C. [E, B, C, A, D]

D. [C, B, A, E, D]

E. [E, B, C, A]

```java
ArrayList<String> a1;
a1 = new ArrayList<String>();
a1.add("D");
a1.add("A");
a1.add("E");
a1.add(1, "C");
a1.add("D");
a1.add(2, "B");
a1.remove("D");
System.out.print(a1);
```

What is output by the code to the right?

A. 1 1   B. 0 0   C. 1 0

D. 0 1   E. There is no output due to a syntax error.

```java
int t2 = 12;
int s2 = 6;
int r2 = (t2 % s2 < 2) ? 0 : 1;
int u2 = (t2 < s2) ? 0 : 1;
System.out.print(r2 + " " + u2);
```

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

```
VideoStats v1 = new VideoStats(100);
v1.watch();
v1.watch();
v1.clip();
System.out.print(v1);
```

A. 2 100

B. 0 100

C. 2 15

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

E. The output varies each time the program is run.

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

```
VideoStats v2 = new VideoStats(50);
VideoStats v3 = v2;
v2.watch();
v3 = new VideoStats(50);
v3.watch();
boolean e1 = v2 == v3;
boolean e2 = v1.equals(v3);
System.out.print(e1 + " " + e2);
```

A. false false

B. false true

C. true false

D. true true

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

```
public class VideoStats{
  private int views;
  private int length;

  public VideoStats(int len) {
    length = len;
  }

  public void watch() {
    views++;
  }

  public void clip() {
    if(views == 0)
      length = 5;
    else if(views < 10)
      length = 15;
    else
      length = 30;
  }

  public String toString() {
    return views + " " + length;
  }
}
```

What is output by the code to the right?

A. 20   B. 10   C. 1

D. 0   E. There is no output due to a
               syntax error.

```
ArrayList<Integer> a5;
a5 = new ArrayList<Integer>(20);
System.out.print(a5.size());
```

What is output by the code to the right?

A. n i   B. d n   C. d a

D. i n   E. There is no output due to a
               runtime error.

```
String name = "Melinda";
char c1 = name.substring(2).charAt(3);
char c2 = name.charAt(4);
System.out.print(c1 + " " + c2);
```

QUESTION 28

What is output by the code to the right?

A. 13   B. 6   C. 5

D. 4   E. 0

```
String garbage;
garbage = "&aj*ja&&gg87:uu#hack)";
String[] res;
res = garbage.split("[a-z]+");
System.out.print(res.length);
```

QUESTION 29

What is output by the code to the right?

A. 512   B. 1024   C. 2048

D. 4096   E. There is no output due to an infinite loop.

```
int total = 1;
int limit = 1000;
while(total <= limit) {
  total *= 2;
  limit += 10;
}
System.out.print(total);
```

QUESTION 30

What is output by the code to the right?

A. 00

B. 01

C. 10

D. 11

E. 33

```
String n1 = "gates";
String n2 = "dell";
String n3 = "deal";

if(n1.compareTo(n2) < 0)
  System.out.print(0);
else
  System.out.print(1);

if(n2.compareTo(n3) < 0)
  System.out.print(0);
else
  System.out.print(1);
```

QUESTION 31

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

```
Nd n1 = new Nd(3, null);
Nd n2 = new Nd(1, n1);
n1.n = new Nd(5, new Nd(4, n2));
int res1 = n1.n.n.n.d;
int res2 = n2.n.d;
System.out.print(res1 + " "  + res2);
```

A. 1 3

B. 3 4

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

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

E. There is no output due to an infinite loop.

```
public class Nd {
  public int d;
  public Nd n;

  public Nd(int d, Nd n) {
    this.d = d;
    this.n = n;
  }
}
```

QUESTION 32

Assume method `sample(int[] data)` is $O(N^3)$ where N = `data.length`. When method `sample` is passed an array with `length` = 10,000 it takes 3 seconds for method `sample` to complete. If method `sample` is then passed an array with `length` = 40,000 what is the expected time it will take method `sample` to complete?

A. 576 seconds   B. 192 seconds   C. 64 seconds   D. 27 seconds   E. 12 seconds

What is the best case order (Big O) of the method to the right? N = data.length.
Pick the most restrictive correct answer.

A. O(1) B. O(N) C. O(NlogN)

D. $O(N^2)$ E. O(N!)

```java
public int test(int[] data) {
  final int LEN = data.length;
  int res = 0;
  for(int i = 0; i < LEN; i++) {
    if(data[i] < 10)
      res += i;
    for(int j = LEN - 1; j > i; j--) {
      if(data[j] * data[i] < data[0])
        res += i + j;
    }
  }
  return res;
}
```

What is output by the code to the right?

A. {A=3, B=3, C=2, F=5}

B. {A=3, C=2, F=5}

C. {2=C, 3=A, 5=F}

D. {2=C, 3=A, 5=F, 7=C}

E. The output is different each time the program runs.

```java
TreeMap<Integer, String> stuff;
stuff = new TreeMap<Integer, String>();
stuff.put(5, "F");
stuff.put(3, "B");
stuff.put(7, "C");
stuff.put(2, "C");
stuff.put(3, "A");
System.out.print(stuff);
```

What is output by the code to the right?

A. [6]

B. [2, 2]

C. [3]

D. []

E. [2]

```java
int[] data = {6, 2, 1, 2, 2, 2, 2, 2, 1, 4,
              2, 1, 6, 2, -2, 2, 4 / 2, 3};
Stack<Integer> st = new Stack<Integer>();
for(int x : data) {
  if(st.isEmpty())
    st.push(x);
  else if(st.peek().equals(x))
    st.push(x);
  else
    st.pop();
}
System.out.print(st);
```

What is returned by the method call recH(5)?

A. 2 B. 29 C. 71

D. 88 E. 91

What is the order (Big O) of method recH? N = n. Pick the most restrictive correct answer.

A. O(logN) B. $O(N^2)$ C. $O(2^N)$

D. O(N!) E. $O(N^N)$

```java
public int recH(int n) {
  if(n <= -1)
    return 2;
  return n/2 + recH(n - 2)
             + recH(n - 1) + 1;
}
```

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

```
Level vel2 = new Level(-15);
System.out.print(vel2);
```

A. 0.0 15

B. 0 15

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

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

E. The output is different each time the program runs.

```java
public class Level {
  private int[] data;

  public Level(int s) {
    s = Math.abs(s);
    double[] data = new double[s];
  }

  public String toString() {
    return data[0] + " " + data.length;
  }
}
```

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

```
Structure str = new Structure();
str.add(3);
str.add(5);
str.add(-1);
str.add(3);
str.add(-2);
str.remove();
System.out.print(str);
```

A. [3, 3, -1, -2]

B. [5, -1, 3, -2]

C. [-1, 3, 3, 5]

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

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

```java
public class Structure {
  private ArrayList<Comparable> con
    = new ArrayList<Comparable>();

  public void add(Object o) {
    Comparable c = (Comparable) o;
    int p = 0;
    while(p < con.size() &&
            c.compareTo(con.get(p)) >= 0)
      p++;

    con.add(p, c);
  }

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

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

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

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

A. a list

B. a priority queue

C. a set

D. a stack

E. a queue