University of Texas at Austin

High School Computer Science Competition - 2013

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 attached to the back of this exam.

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 syntax error is an option among the 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 and scratch paper from the test booklet, but DO NOT DO SO UNTIL THE CONTEST BEGINS.

10) Assume that any necessary import 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 11111110_2 minus AB_{16} equal?

A. $1A9_{16}$ B. $F1_{16}$ C. AB_{16} D. 65_{16} E. 53_{16}

QUESTION 2

What is output by the code to the right?

A. 336 B. -2 C. -5

D. -9 E. -27

```
int x2;
x2 = 5 * 4 + 37 / 10 - 2 * 2 * 2 * 2 * 2;
System.out.print(x2);
```

QUESTION 3

What is output by the code to the right?

A. 3 B. 6

C. 7 D. 9

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

```
int x3 = 0;
for(int j = 0; j <= 3; j++) {
    x3++;
    ++x3;
}
x3++;
System.out.print(x3);
```

QUESTION 4

What is output by the code to the right?

A. 3 B. 6 C. 8

D. 11 E. 12

```
String st1 = "The_Tower";
String st2 = st1.substring(6, 9);
String st3 = st1 + st2;
System.out.print(st3.length());
```

QUESTION 5

What is output by the code to the right?

A. 7 .1 B. 6 0.1 C. 6 5

D. 7 5.0 E. 7 0.1

```
double[] ds = {.1, 5, 0.0, 0, 1.5, 2.1, 0};
System.out.print(ds.length);
System.out.print(" " + (ds[1] + ds[3]));
```

QUESTION 6

What is output by the code to the right?

A. 57 B. 56 C. 55

D. 20 E. 19

```
int x6 = 53;
int y6 = x6 % 17 + 17 % x6;
System.out.print(y6);
```

QUESTION 7

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

A. 1 B. 3 C. 4

D. 7 E. 8

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

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

QUESTION 8

What is output by the code to the right?

A.　01　　　　　B.　013　　　　　C.　1

D.　12　　　　　E.　02

```
System.out.print(0);
int x = 4;
int y = 8;
if(y < x)
  System.out.print(1);
if(x / y == 0)
  System.out.print(2);
else if(x != y)
  System.out.print(3);
```

QUESTION 9

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

```
Residence r1 = new Residence();
Residence r2 = new Residence(-2);
System.out.print(r1 + " " + r2);
```

A.　0 -2

B.　id id

C.　-1 -2

D.　-1 2

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

```
public class Residence {

  private int id;

  public Residence() { id = -1; }

  public Residence(int i) { id = i; }

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

public class Dorm extends Residence {

  private int rooms;

  public Dorm() { rooms = -2; }

  public Dorm(int r) {
    super(r * 2);
    rooms = r;
  }

  public String toString() {
    return rooms + super.toString();
  }
}
```

QUESTION 10

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

```
Residence r3 = new Dorm();
Dorm d4 = new Dorm(150);
System.out.print(r3 + " " + d4);
```

A.　-1 150300

B.　-1 300150

C.　-20 300150

D.　-2-1 150300

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

QUESTION 11

What is output by the code to the right?

A.　72　　　　　B.　64　　　　　C.　63

D.　8　　　　　E.　0

```
int m = 72;
int n = 63;
System.out.print(n & m);
```

QUESTION 12

What is output by the code to the right?

A.　0.0　　　　　B.　3.7　　　　　C.　6.0

D.　6.4　　　　　E.　7.0

```
double x12 = 3.7;
double y12 = Math.floor(x12) +
                      Math.ceil(x12);
System.out.print(y12);
```

What is output by the code to the right?

A.   ACB   B.   A   C.   A
                        C   CB
                        B

D.   A   E.   AC
                     B
  CB

```java
System.out.print("A");
System.out.println("CB");
```

What is output by the code to the right?

A.   -0012.5   B.   val: -12.5

C.   val:-12.500   D.   -12.50

E.   val:-0012.5

```java
double x14 = -12.50;
System.out.printf("val:%07.1f", x14);
```

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

A.   2 3 6   B.   5 5 5

C.   2 3 7   D.   2 3 5

E.   4 1 5

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

A.   20 20   B.   12 35   C.   12 20

D.   35 35   E.   12 19

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

A.   -20   B.   -10   C.   0

D.   10   E.   No output due to runtime error.

What is output by the line in the client code to the right marked //4 ?

A.   5 3 7   B.   3 0 5

C.   0 0 0   D.   5 3 0

E.   5 7 3

```java
public int m1(int x, int y) {
  x *= 2;
  y /= 2;
  return x + y;
}

public int m2(int x) {
  int y = x % 10;
  int z = m1(y, x);
  return x + z - y;
}

public int m3(int x, int y) {
  int z = m1(m2(x), m2(y));
  z -= 10;
  return z - 10;
}

// client code
int x = 2;
int y = 3;
int z = m1(x, y);
System.out.print(x + " " + y + " " + z);//1

x = 12;
y = m2(x);
System.out.print(x + " " + y); // 2

x = 0;
y = 0;
System.out.print(m3(x, y)); // 3

z = 5;
x = 3;
y = m3(x, z);
System.out.print(x+ " " + y + " " + z); //4
```

What is returned by the method call `manip(4, 2)`?

A. 23 B. 13 C. 10

D. 5 E. 3

```java
public int manip(int x, int y) {
  int z = x * y;
  x++;
  --y;
  z =  -(x * y) + z;
  return z;
}
```

What is output by the code to the right?

A. 2.35 B. 2.25

C. 0.35 D. 0.25

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

```java
double a1 = 12.350;
double b1 = a1 % 10.1;
System.out.print(b1);
```

What is output by the code to the right?

A. 20 B. 171 C. 180

D. 200 E. 220

```java
String stars = "";
for(int i = 0; i <= 10; i++)
  for(int j = 0; j < 20; j++)
    stars += "*";
System.out.print(stars.length());
```

What is output by the code to the right?

A. 1 3 B. 2 3.0 C. 1 3.0

D. 2 3.6 E. 1 2.999999999

```java
double a22 = 1.6;
int x22 = 3;
System.out.print( (int) a22 + " " +
        (double) x22);
```

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

A. 1 B. 2

C. 3 D. 4

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

```java
boolean p, q;
// code in initialize p and q

boolean r = p ^ q;
```

What is output by the code to the right?

A. false 4 B. false 3 C. true 3

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

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

```java
Object obj = "bevo";
System.out.print(obj.equals(null));
System.out.print(obj.length());
```

What is output by the code to the right?

A. 4, 7, 2, 5 B. 01234 C. 47252

D. iiiii E. 4, 7, 2, 5, 2

```java
int[] data5 = {4, 7, 2, 5, 2};
for(int i : data5)
  System.out.print(i);
```

What is output by the code to the right?

A. ala   B. alamo

C. amo   D. alam

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

```
String st6 = "alamo";
st6 = st6.length() < 5 ? st6.substring(2) :
        st6.substring(0,3);
System.out.print(st6);
```

Given classes Loot and Purple to the right what is output by the following client code?

```
Loot.show();
Loot.drop();
```

A. LootPlunk

B. PlunkLoot

C. LootShiny

D. ShinyLoot

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

```
public class Loot {
  public void show() {
    System.out.print("Loot");
  }

  public void drop() {
    System.out.print("Plunk");
  }
}
```

What is output by the client code marked section 1?

A. false false   B. false true

C. true false   D. true true

E. There is no output due to a syntax error in section 1 of the client code.

```
public class Purple extends Loot {
  public void show() {
    System.out.print("Shiny");
  }
}

// section 1 start
Loot t81 = new Loot();
Loot t82 = new Loot();
System.out.print(t81.equals(t82));
System.out.print(" " + (t81 == t82));
// section 1 stop
```

What is output by the client code marked section 2?

A. ShinyPlunk   B. Loot

C. LootPlunk   D. Shiny

E. There is no output due to a syntax error in section 2 of the client code.

```
// section 2 start
Loot t91 = new Loot();
Purple p91 = new Purple();
t91.show();
p91.drop();
// section 2 stop
```

What is output by the client code marked section 3?

A. Shinytruefalse

B. Loottruefalse

C. Loottruetrue

D. Shinytruetrue

E. There is no output due to a syntax error in section 3 of the client code.

```
// section 3 start
Loot t31 = new Purple();
t31.show();
System.out.print(t31 instanceof Object);
System.out.print(t31 instanceof Purple);
// section 3 stop
```

What is output by the code to the right?

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

B.   true[3, 1, 3, 2][3, 3]

C.   true[1, 2, 3][3]

D.   false[3, 1, 3, 2][3, 3]

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

```java
int[] data = {3, 1, 3, 2};
TreeSet<Integer> ts;
ts = new TreeSet<Integer>();
HashSet<Integer> hs;
hs = new HashSet<Integer>();
for(int x31 : data) {
  ts.add(x31);
  hs.add(x31);
}

System.out.print(ts.equals(hs));
hs.remove(1);
hs.remove(2);
System.out.print(ts);
System.out.print(hs);
```

What is output by the code to the right?

A.   15

B.   30

C.   34

D.   68

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

```java
public String stManip(String st) {
  if(st.length() < 3)
    return st + st;
  else
    return stManip(st.substring(1)) +
        stManip(st.substring(3));
}

// client code
String st30 = "The_Drag";
String st31 = stManip(st30);
System.out.print(st31.length());
```

What is output by the code to the right?

A.   Infinity Infinity

B.   Infinity NaN

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

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

E.   2000000000 and then a runtime error occurs

```java
double a33 = 1.5;
double b33 = a33 - 1.5;
double c33 = -a33 + 1.5;
System.out.print(a33 / b33); // 1
System.out.print(" " + (b33 / c33));  // 2
```

Which sorting algorithm has a best case, average case, and worst case order of $O(N^2)$ for its traditional implementation?

A.   merge sort   B.   radix sort   C.   insertion sort   D.   quicksort   E.   selection sort

What is output by the code to the right?

A.   [6, 4, 3]   B.   [5, 3, 1, 2, 0, 6]

C.   [6, 5, 4]   D.   [5, 4, 1, 2, 0, 6]

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

```java
List<Integer> list5;
list5 = new ArrayList<Integer>();
list5.add(5);
list5.add(3);
list5.add(1, 2);
list5.set(4, 2);
list5.add(0, 6);
list5.remove(2);
System.out.print(list5);
```

Which of the following Java expressions is equivalent to the formula to the right? `r1`, `r2`, and `r3` are variables of type `double`.

A. `1.0 / 1.0 / r1 + 1.0 / r2 + 1.0 / r3`

B. `1 / 1 / r1 + 1 / r2 + 1 / r3`

C. `1 / r1 + 1 / r2 + 1 / r3`

D. `1 / (1 / r1 + 1 / r2 + 1 / r3)`

E. None of A through D are correct.

$$\frac{1}{\dfrac{1}{r1} + \dfrac{1}{r2} + \dfrac{1}{r3}}$$

Assume method `sample(int[] data)` is $O(N^2)$ where N = `data.length`. When method `sample` is passed an array with `length` = 2,000 it takes 1 second for method `sample` to complete. If method `sample` is then passed an array with `length` = 10,000 what is the expected time it will take method `sample` to complete?

A. 25 seconds   B. 20 seconds   C. 10 seconds   D. 5 seconds   E. 1 second

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

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

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

```java
public int[] build(String data) {
  int[] result
       = new int[data.length()];
  final int LIMIT = data.length() - 5;
  for(int r = 0; r < LIMIT; r++)
    for(int c = 0; c < 5; c++)
      result[r] = data.charAt(r + c);
  return result;
}
```

Which of the following can replace **#1** in the code to the right so that the Structure class compiles without error?

A. E   B. Set

C. _1   D. anyType

E. All of A through D are correct.

Assume **#1** has been replaced correctly.

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

A. min heap   B. linked list   C. set

D. queue   E. array based list

```java
public class Structure<#1> {
  private ArrayList<#1> con;

  public Structure() {
    con = new ArrayList<#1>();
  }

  public void add(#1 e) { con.add(e); }

  public #1 get() { return con.get(0); }

  public #1 remove() {
    return con.remove(0);
  }

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