

# University Interscholastic League

## Computer Science Competition

Number 123 (Regional - 2010)

General Directions (Please read carefully!):

- 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 stated. 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 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) 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  $FB_{16}$  minus  $11000011_2$  equal?

- A.  $1A_{16}$       B.  $11001_2$       C.  $37_{10}$       D.  $111001_2$       E.  $56_{10}$

**QUESTION 2**

What is output by the code to the right?

- A. 7.0      B. 6.25      C. 5.0  
D. 1.25      E. 7

```
double a = 2.5;
double b = a * 5 / 2;
System.out.print(b);
```

**QUESTION 3**

What is output by the code to the right?

- A. 10      B. 12      C. 20  
D. 22      E. 30

```
int result = 0;
for(int i = -5; i <= 5; i++){
    result += 2;
}
System.out.print(result);
```

**QUESTION 4**

What is output by the code to the right?

- A. s s      B. s Wilkes      C. kes  
D. s      E. kes Wilkes

```
String per = "Wilkes";
String st = per.substring(3).substring(2);
System.out.print( st + " " + per );
```

**QUESTION 5**

What is output by the code to the right?

- A. 39 39      B. 42 41      C. 47 46  
D. 41 41      E. 40 39

```
int[] his = {47, 42, 37, 40, 42};
his[0] = his[4];
his[4]--;
System.out.print(his[0] + " " + his[4]);
```

**QUESTION 6**

What is output by the code to the right?

- A. 7 3      B. 3 7      C. 0 0  
D. 7 0      E. 3 3

```
int w = 7;
int z = 3 % w;
w = z;
z = w;
System.out.print( w + " " + z );
```

**QUESTION 7**

Which answer is logically equivalent to the following boolean expression, where w, x, y, z are int variables?

$\neg((x \geq y) \ \&\& \ (w < z))$

- A.  $(x \geq y) \ || \ (w < z)$       B.  $\neg(x \geq y) \ \&\& \ \neg(w < z)$       C.  $\neg(x \geq w) \ \&\& \ \neg(y < z)$   
D.  $\neg(x == y) \ || \ \neg(w == z)$       E.  $(x < y) \ || \ (w \geq z)$

<p><b>QUESTION 8</b></p> <p>What is output by the code to the right?</p> <p>A. 12                      B. 23                      C. 13</p> <p>D. 123                      E. 3</p>	<pre>boolean p = true; boolean q = false; boolean r = p ^ q; if( !p &amp;&amp; r )     System.out.print(1); else     System.out.print(2); if( p &amp;&amp; !q &amp;&amp; r )     System.out.print(3);</pre>
<p><b>QUESTION 9</b></p> <p>What replaces <b>&lt;*1&gt;</b> in the code to the right to indicate that MAX_SCORE is a class constant that is accessible in all other classes?</p> <p>A. public static final</p> <p>B. static final</p> <p>C. public final</p> <p>D. public static</p> <p>E. public class final</p>	<pre>public class Score{     &lt;*1&gt; int MAX_SCORE = 100;     private int score;      public Score(int sc){         score = sc;     }      public int getScore(){         return score;     }      public String toString(){         return getScore() + " points";     } }</pre>
<p>Assume <b>&lt;*1&gt;</b> is filled in correctly.</p>	
<p><b>QUESTION 10</b></p> <p>What is output by the following client code?</p> <pre>CurvedScore cs = new CurvedScore(75, 5); System.out.println(cs);</pre> <p>A. 75 points</p> <p>B. 80 points</p> <p>C. 0 points</p> <p>D. 100 points</p> <p>E. 5 points</p>	<pre>public class CurvedScore extends Score{     private int added;      public CurvedScore(int sc, int ad){         super(sc);         added = ad;     }      public int getScore(){         return super.getScore() + added;     } }</pre>
<p><b>QUESTION 11</b></p> <p>What is output by the code to the right?</p> <p>A. 30                      B. 31                      C. 61</p> <p>D. 51                      E. 11111</p>	<pre>int dx = 30   21 &amp; 10; System.out.print(dx);</pre>
<p><b>QUESTION 12</b></p> <p>What is the maximum possible number of '*'s the code to the right will print when run?</p> <p>A. 1                      B. 4                      C. 5</p> <p>D. 6                      E. 2147483647</p>	<pre>double limit = Math.random() * 5; for(int i = 0; i &lt;= limit; i++)     System.out.print('*');</pre>

<p><b>QUESTION 13</b></p> <p>What is output by the code to the right?</p> <p>A. mas"Miners"</p> <p>B. Owls\"Blaze Miners</p> <p>C. Owls"BlazeMiners</p> <p>D. OwlsBlaze Miners</p> <p>E. "Owls"BlazeMiners"</p>	<pre>String mas = "Owls\"Blaze"; System.out.print(mas); System.out.print("Miners");</pre>
<p><b>QUESTION 14</b></p> <p>What is output by the code to the right? <i>h</i> indicates a blank space.</p> <p>A. +5.00      B. <i>h h</i>5.00      C. (5)</p> <p>D. (5.00)      E. <i>h h h h</i>5</p>	<pre>double value = -2.5 * 2; System.out.printf("%(5.2f", value);</pre>
<p><b>QUESTION 15</b></p> <p>What is returned by the method call <code>tough(3)</code>?</p> <p>A. 77      B. 43      C. 32</p> <p>D. 8      E. 2</p>	<pre>public int tough(int x){     if(x &lt; 0)         return 2;     else         return x + tough(x - 1) + tough(x - 1); }</pre>
<p><b>QUESTION 16</b></p> <p>What is output by the code to the right?</p> <p>A. 21      B. 20</p> <p>C. 10      D. 5</p> <p>E. There is no output due to an infinite loop.</p>	<pre>int result = 0; int i = 20; while( i &gt; 0 ){     result++;     i /= 2; } System.out.print(result);</pre>
<p><b>QUESTION 17</b></p> <p>How many '*'s are output by the code to the right?</p> <p>A. 1002      B. 250      C. 125</p> <p>D. 20      E. 10</p>	<pre>int limit = 5; for(int i = 0; i &lt; limit; i++)     for(int j = 0; j &lt; limit; j++)         for(int k = 0; k &lt; limit * 2; k++)             System.out.print('*');</pre>
<p><b>QUESTION 18</b></p> <p>What is output by the code to the right?</p> <p>A. CPU      B. CPU      RAM RAMNEC      NEC</p> <p>C. CPU      D. CPU RAM      RAM      NEC NEC</p> <p>E. CPURAMNEC</p>	<pre>System.out.print("CPU"); System.out.println("\tRAM"); System.out.print("NEC");</pre>

<p><b>QUESTION 19</b></p> <p>What is output by the code to the right?</p> <p>A. false      B. true      C. null</p> <p>D. There is no output due to a syntax error.</p> <p>E. There is no output due to a runtime error.</p>	<pre>int[] list1 = {2, 4, 6}; int[] list2 = {2, 4, 5}; list2[2] = list1[2]; System.out.print(list1 == list2);</pre>
<p><b>QUESTION 20</b></p> <p>What is output by the code to the right?</p> <p>A. 3628800      B. 55      C. 45</p> <p>D. 11      E. 0</p>	<pre>int limit = 10; int total = 0; for(int i = 1; i &lt;= limit; i++)     total += i; System.out.print(total);</pre>
<p><b>QUESTION 21</b></p> <p>What is output by the code to the right when method two is called ?</p> <p>A. 234      B. 243      C. 2415</p> <p>D. 2154      E. 1524</p>	<pre>public int one(int x){     System.out.print(x);     x *= 2;     return x; }  public void two(){     System.out.print( one(2) + 3 + one(4) ); }</pre>
<p><b>QUESTION 22</b></p> <p>What is returned by the method call toy(3)?</p> <p>A. 5      B. 3      C. 0</p> <p>D. 4      E. 6</p>	<pre>public int toy(int y){     ++y;     y++;     return y++; }</pre>
<p><b>QUESTION 23</b></p> <p>What is output by the code to the right?</p> <p>A. 12      B. 4      C. 7</p> <p>D. 11      E. 10</p>	<pre>String junk; junk = "DELL_640_IBM_360_HP_2020_DEC"; String[] parts = junk.split("\\d+"); System.out.print(parts.length);</pre>
<p><b>QUESTION 24</b></p> <p>What is output by the code to the right?</p> <p>A. 13      B. 5      C. 3</p> <p>D. 1      E. 0</p>	<pre>String name = "william_KAHAN"; int count = 0; for(int i = 0; i &lt; name.length(); i++) {     char ch = name.charAt(i);     if( ch == 'a' &amp;&amp; ch == 'i' )         count++; } System.out.print(count);</pre>

**QUESTION 25**

The `Coord` class to the right will not compile due to a syntax error. Which of the following best describes the syntax error that is present?

- A. Instance variables such as `x` and `y` cannot be declared final.
- B. The instance variables `x` and `y` must be assigned a value in the line of code where they are declared.
- C. The constructor may not have parameters that use the same identifier as instance variables.
- D. The `Coord` class does not have a `toString` method.
- E. The keyword `this` is not defined in static methods.

```
public class Coord {
    private final int x;
    private final int y;

    public Coord(int x, int y) {
        this.x = x;
        this.y = y;
    }

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

**QUESTION 26**

Given methods `sort` and `swap` to the right, what is output by the following client code?

```
int[] data = {2, -5, 10, -5, 3};
sort(data, 0, 4);
System.out.print(Arrays.toString(data));
```

- A. `[2, -5, 10, -5, 3]`
- B. `[-5, -5, 2, 3, 10]`
- C. `[-5, 2, 3, 10]`
- D. `[10, 3, 2, -5, -5]`
- E. `[10, 3, 2, -5]`

```
public void sort(int[] list, int a, int b){
    if(a < b) {
        int p = (a + b) / 2;
        swap(list, p, a);
        p = list[a];
        int i, j = a;
        for(i = a + 1; i <= b; i++){
            if(list[i] > p) {
                j++;
                swap(list, i, j);
            }
        }
        swap(list, a, j);
        sort(list, a, j - 1);
        sort(list, j + 1, b);
    }
}
```

**QUESTION 27**

Which sorting algorithm do the methods `sort` and `swap` implement?

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

```
public void swap(int[] list, int a, int b){
    int t = list[a];
    list[a] = list[b];
    list[b] = t;
}
```

**QUESTION 28**

What is output by the code to the right?

- A. 1                      B. 520                      C. 521
- D. The output cannot be determined due to overflowing the `int` data type.
- E. There is no output due to a runtime error.

```
System.out.print(521 ^ 520);
```

<p><b>QUESTION 29</b></p> <p>Which of the following can replace <b>&lt;*1&gt;</b> in the code to the right so that the code compiles without error?</p> <p>I.    new Iterator&lt;Integer&gt;(col)  II.    col.iterator()  III.   col.listIterator()</p> <p>A.    I only            B.    II only            C.    III only</p> <p>D.    II and III        E.    I and III</p>	<pre>public int myst(ArrayList&lt;Integer&gt; col) {     int total = 0;     Iterator&lt;Integer&gt; it = &lt;*1&gt;;     while(it.hasNext())         total += it.next();     return total; }</pre>
<p>Assume <b>&lt;*1&gt;</b> is filled in correctly.</p>	
<p><b>QUESTION 30</b></p> <p>What is output by the code to the right when method <code>demo</code> is called?</p> <p>A.    10                B.    5                C.    510</p> <p>D.    105              E.    15</p>	<pre>public void demo(){     ArrayList&lt;Integer&gt; list;     list = new ArrayList&lt;Integer&gt;();     list.add(10);     list.add(0, 5);     System.out.print(myst(list)); }</pre>
<p><b>QUESTION 31</b></p> <p>Which of the following can replace <b>&lt;*1&gt;</b> in the code to the right so that the code segment compiles without error?</p> <p>I.    4  II.    new Integer(4)  III.   4.0</p> <p>A.    I only            B.    II only            C.    III only</p> <p>D.    I and II        E.    II and III</p>	
<p>Assume <b>&lt;*1&gt;</b> is filled in correctly.</p>	
<p><b>QUESTION 32</b></p> <p>What is output by the code to the right?</p> <p>A.    0false            B.    1true            C.    2false</p> <p>D.    2true0           E.    2true</p>	<pre>Map&lt;Integer,String&gt; map; map = new TreeMap&lt;Integer,String&gt;();  map.put(&lt;*1&gt;, "CBS"); map.put(&lt;*1&gt;, "FOX");  System.out.print(map.size()); boolean b = map.keySet().remove(&lt;*1&gt;); System.out.print(b);</pre>
<p><b>QUESTION 33</b></p> <p>Assume method <code>sample(int[] data)</code> is <math>O(N)</math> where <math>N = \text{data.length}</math>. When method <code>sample</code> is passed an array with <code>length = 2,000</code> it takes 1 second for method <code>sample</code> to complete. If method <code>sample</code> is then passed an array with <code>length = 18,000</code> what is the expected time it will take method <code>sample</code> to complete?</p> <p>A.    18 seconds        B.    27 seconds        C.    9 seconds        D.    36 seconds        E.    729 seconds</p>	
<p><b>QUESTION 34</b></p> <p>Which of the following is not a Java keyword?</p> <p>A.    string            B.    null            C.    finally            D.    throws            E.    do</p>	

**QUESTION 35**

If **<\*1>** in method `make` is replaced with the following what is the Big O of method `make`? `vals` contains `N` distinct values. Pick the most restrictive correct set of answers.

	TreeSet	HashSet
A.	$O(N^2)$	$O(N^2)$
B.	$O(\log N)$	$O(1)$
C.	$O(N^2)$	$O(N)$
D.	$O(1)$	$O(\log N)$
E.	$O(N \log N)$	$O(N)$

```
public Set<Double> make(double[] vals) {
    Set<Double> result = new <*1><Double>();
    for(double d : vals)
        result.add(d);
    return result;
}
```

**QUESTION 36**

Given the `Point` and `Point3D` classes to the right what is output by the following client code?

```
Point3D p1 = new Point3D();
System.out.print(p1);
```

- A. `-5:5:3`
- B. `0:0:3`
- C. `0:0:0`
- D. There is no output due to a syntax error in the client code.
- E. The output will vary from one run of the program to the next.

```
public class Point {
    private int x, y;

    public Point() { x = -5; y = 5; }

    public Point(int xx, int yy) {
        x = xx;
        y = yy;
    }

    public void move() { x = y; }

    public void inc() {
        x++;
        y++;
    }

    public String toString(){
        return x + ":" + y;
    }
}
```

**QUESTION 37**

Given the `Point` and `Point3D` classes to the right, what is output by the following client code?

```
Point p2 = new Point3D(1, 2, 3);
p2.inc();
System.out.print(p2.toString());
```

- A. `2:3:3`
- B. `2:2:3`
- C. `1:2:3`
- D. `1:2:4`
- E. `2:3:4`

```
public class Point3D extends Point {
    private int z;

    public Point3D() { this(3); }

    public Point3D(int zz) { z = zz; }

    public Point3D(int x, int y, int zz) {
        super(x, y);
        z = zz;
    }

    public void inc() { z++; };

    public String toString() {
        return super.toString() + ":" + z;
    }
}
```



**QUESTION 38**

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

```
Struct<String> str1;
str1 = new Struct<String>();
str1.add("a");
str1.add("m");
str1.add("s");
str1.add("c");
System.out.println( str1.checkMid() );
```

- A. a
- B. c
- C. s
- D. m
- E. There is no output.

**QUESTION 39**

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

```
Struct<String> str2;
str2 = new Struct<String>();
str2.add("S");
str2.add("C");
str2.add("T");
str2.add("U");
System.out.println( str2.remove() );
```

- A. T
- B. C
- C. U
- D. S
- E. true

**QUESTION 40**

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

- A. A min heap
- B. A stack
- C. A max heap
- D. A set
- E. A binary search tree

```
public class Struct <E extends Comparable>{
    private ArrayList<E> con;

    public Struct(){
        con = new ArrayList<E>();
    }

    public void add(E item) {
        con.add(item);
        int i = con.size() - 1;
        while ( (i != 0) &&
            (con.get(p(i)).compareTo(item) < 0)) {

            con.set(i, con.get(p(i)));
            con.set(p(i), item);
            i = p(i);
        }
    }

    public E remove() {
        E it = con.get(0);
        con.set(0, con.remove(con.size()-1));
        int i = 0;
        while( l(i) < con.size() ) {
            int le = l(i), ri = r(i);
            int si;
            if( ri >= con.size() )
                si = le;
            else if ( ch(le, ri) > 0)
                si = le;
            else
                si = ri;
            if ( ch(i, si) < 0) {
                E temp = con.get(i);
                con.set(i, con.get(si));
                con.set(si, temp);
                i = si;
            }
            else
                i = con.size();
        }
        return it;
    }

    private int ch(int x, int y) {
        E fi = con.get(x);
        return fi.compareTo(con.get(y));
    }

    private int l(int i) { return 2 * i + 1;}
    private int r(int i) { return 2 * i + 2;}
    private int p(int i) { return (i-1) / 2;}

    public E checkMid(){
        return con.get( con.size() / 2 );
    }
}
```