

# University Interscholastic League

## Computer Science Competition

Number 136 (State - 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 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  $10011_2$  times  $111_2$  equal?

- A.  $11010_2$       B.  $1010_2$       C.  $1111100_2$       D.  $11110101_2$       E.  $10000101_2$

**QUESTION 2**

What is output by the code to the right?

- A. 0      B. 1  
C. 2      D. 1.6666666666666667  
E. There is no output due to a syntax error.

```
double x = 3;
double y = 10;
y /= x / .5;
System.out.print((int)y);
```

**QUESTION 3**

What is output by the code to the right?

- A. 500      B. 29  
C. 20      D. 9  
E. There is no output due to a syntax error.

```
int j = 1;
int val = 0;
for(int i = 0; i<20 && j<500; i++, j*=2)
    val++;
System.out.print(val);
```

**QUESTION 4**

What is output by the code to the right?

- A. 12base45      B. 4950base5152  
C. abbased      D. 3base9  
E. 3base45

```
String c1 = "base";
String c2 = 1 + 2 + c1 + 4 + 5;
System.out.print(c2);
```

**QUESTION 5**

What is output by the code to the right?

- A. [20, 1, 3, 4, 1, 2, 9]  
B. [20, 1, 3, 4, 24, 2, 4]  
C. [20, 1, 3, 4, 36, 2, 4]  
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, 4, 1, 2, 4};
st[st.length - 1] += st[0];
st[4] *= st[st[4]];
st[0] *= st[3];
System.out.print(Arrays.toString(st));
```

**QUESTION 6**

What is output by the code to the right?

- A. 288.0      B. 273.25      C. 272.0  
D. 128.0      E. 83.0

```
double a1 = 0.125;
double b1 = 10 / a1 + (24 * a1);
System.out.print(b1);
```

<p><b>QUESTION 7</b></p> <p>How many combinations of values for the boolean variables p, q, r, and s will result in t being set to false?</p> <p>A. 5                      B. 7                      C. 8</p> <p>D. 9                      E. 11</p>	<pre>boolean p, q, r, s; //code to initialize p, q, r, and s  boolean t = p    q &amp;&amp; (!r    !s);</pre>
<p><b>QUESTION 8</b></p> <p>What is output by the code to the right?</p> <p>A. 12                      B. 13                      C. 14</p> <p>D. 23                      E. 24</p>	<pre>int x2 = 5; int y2 = 6; if(x2 &gt; 0    y2++ &gt; 0)     System.out.print(1); else     System.out.print(2); if(y2 == 7)     System.out.print(3); else     System.out.print(4);</pre>
<p><b>QUESTION 9</b></p> <p>Which of the following can replace &lt;*1&gt; in the code to the right so that method hasMore returns true if the value stored in the credits variable of the calling Student object is greater than the valued stored in the credits variable of s2, false otherwise?</p> <p>I.    credits &gt; s2.credits</p> <p>II.   this.getCredits() &gt; s2.getCredits()</p> <p>III. this.credits &gt; s2.getCredits()</p> <p>A.   II only                      B.   I and II only</p> <p>C.   I and III only              D.   II and III only</p> <p>E.   I, II, and III</p> <p>Assume &lt;*1&gt; is filled in correctly.</p>	<pre>public class Student {     private int credits;      public Student(int c) {credits = c;}      public boolean hasMore(Student s2) {         return &lt;*1&gt;;     }      public int getCredits() {         return credits;     } }</pre>
<p><b>QUESTION 10</b></p> <p>Which of the following can replace &lt;*2&gt; in the code to the right so that the client code compiles without error?</p> <p>I.    hasMore(st2)</p> <p>II.   getCredits()</p> <p>III. hasMore(st1)</p> <p>A.   I only                      B.   I and II only</p> <p>C.   I and III only              D.   II and III only</p> <p>E.   I, II, and III</p>	<pre>// client code Student st1 = new Student(12); Student st2 = new Student(16); boolean hm = st1.&lt;*2&gt;;</pre>

<p><b>QUESTION 11</b></p> <p>What is output by the code to the right?</p> <p>A. 32                      B. 37                      C. 49</p> <p>D. 52                      E. 53</p>	<pre>int m = 37; int n = 57; int o = 52; System.out.print(o   m &amp; n);</pre>
<p><b>QUESTION 12</b></p> <p>What is output by the code to the right?</p> <p>A. 8.7                      B. 9.0                      C. 9.4</p> <p>D. 9.7                      E. 10.7</p>	<pre>double m2 = -15.7; double n2 = -6.3; double o2 = Math.ceil(n2) + Math.abs(m2); System.out.print(o2);</pre>
<p><b>QUESTION 13</b></p> <p>What is output by the code to the right when method start is called?</p> <p>A. a4a-216-4              B. a4-a-216-5</p> <p>C. a4a-216--4            D. a-2a416-4</p> <p>E. a-2-a-24--2</p>	<pre>public int ep(int a){     System.out.print("a" + a);     return a * a; }  public void start(){     System.out.print( ep(4) + "-" + ep(-2) ); }</pre>
<p><b>QUESTION 14</b></p> <p>What is output by the code to the right?</p> <p>A. 37</p> <p>B. .4</p> <p>C. 0037.4</p> <p>D. 37.424242</p> <p>E. 37.420000</p>	<pre>double d2 = 37.42; System.out.printf("%.2f", d2);</pre>
<p><b>QUESTION 15</b></p> <p>What is returned by the method call notF(5)?</p> <p>A. 3                      B. 11                      C. 27</p> <p>D. 46                      E. 65</p>	<pre>public int notF(int x) {     return (x &lt;= 0) ? 3 : notF(x-3) + x +                                 notF(x-1); }</pre>
<p><b>QUESTION 16</b></p> <p>What is output by the code to the right?</p> <p>A. 2040                      B. 2041                      C. 2047</p> <p>D. 2048                      E. 4096</p>	<pre>String stars = ""; for(int i = 8; i &lt;= 1024; i *= 2)     for(int j = 0; j &lt; i; j++)         stars += "*"; System.out.print(stars.length());</pre>

<p><b>QUESTION 17</b></p> <p>What is output by the code to the right?</p> <p>A. 50 B. 37 C. 33 D. 11 E. 1</p>	<pre>String lets = "ABABC"; int res = 0; for(int i = 0; i &lt; lets.length(); i++) {     char ch = lets.charAt(i);     switch(ch) {         case 'A': res += 2;         case 'B': res += 3;         case 'D': res += 4;         default: res += 1; break;     } } System.out.print(res);</pre>
<p><b>QUESTION 18</b></p> <p>What replaces <b>&lt;*1&gt;</b> in the code to the right so that the value stored in <code>vall</code> may not be altered once it is assigned?</p> <p>A. <code>const</code>      B. <code>static</code>      C. <code>final</code> D. <code>private</code>      E. None of A - D are correct.</p>	<pre>&lt;*1&gt; double vall; double y1 = Math.random(); vall = y1 * 100;</pre>
<p><b>QUESTION 19</b></p> <p>What is output by the code to the right?</p> <p>A. 1234567890123 B. 2147483647 C. 1234567890123L D. There is no output due to a syntax error. E. There is no output due to a runtime error.</p>	<pre>long bigVal = 1234567890123L; System.out.print(bigVal);</pre>
<p><b>QUESTION 20</b></p> <p>What is returned by method <code>readSome</code> to the right, if <code>sc</code> is connected to a file with the following data?</p> <pre>2 6 3 2 ABABAB 1 1 12.323 .2 1 1 3 1 1 32 14 145</pre> <p>A. 13      B. 16      C. 21 D. 213      E. 353</p>	<pre>public int readSome(Scanner sc) {     int res = 0;     for(int i = 0; i &lt; 10; i++) {         while(!sc.hasNextInt())             sc.next();         res += sc.nextInt();     }     return res; }</pre>

**Go on to the next page.**

<p><b>QUESTION 21</b></p> <p>What is output by the client code to the right?</p> <p>A. 0 1 2-3      B. 0 3 6-1</p> <p>C. 0 1 2-2      D. 2 2 2-1</p> <p>E. 0 3 60 1 22 2 2-3</p>	<pre>public int search(int[] dt, int tgt) {     return help(dt, tgt, 0, dt.length, 1); }  public int help(int[] dt, int tgt,                 int st, int en, int c) {     int m = st + ((en - st) / 2);      // start debug section     if(c == 2)         System.out.print(st+" "+m+" "+en);     // end debug section      if(st &gt; en)         return -st - 1;     else if(dt[m] &lt; tgt)         return help(dt, tgt, m + 1, en, c + 1);     else if(dt[m] &gt; tgt)         return help(dt, tgt, st, m - 1, c + 1);     else         return m; }  // client code int[] data = {-6, -3, -1, 0, 5, 6, 9}; System.out.print(search(data, -2));</pre>																		
<p><b>QUESTION 22</b></p> <p>What are the best case and worst case orders (Big O) of method search? N= dt.length. Pick the most restrictive, correct set of answers.</p> <table><thead><tr><th></th><th>Best Case</th><th>Worst Case</th></tr></thead><tbody><tr><td>A.</td><td>O(logN)</td><td>O(logN)</td></tr><tr><td>B.</td><td>O(1)</td><td>O(1)</td></tr><tr><td>C.</td><td>O(logN)</td><td>O(2<sup>N</sup>)</td></tr><tr><td>D.</td><td>O(1)</td><td>O(N)</td></tr><tr><td>E.</td><td>O(1)</td><td>O(logN)</td></tr></tbody></table>		Best Case	Worst Case	A.	O(logN)	O(logN)	B.	O(1)	O(1)	C.	O(logN)	O(2 <sup>N</sup> )	D.	O(1)	O(N)	E.	O(1)	O(logN)	
	Best Case	Worst Case																	
A.	O(logN)	O(logN)																	
B.	O(1)	O(1)																	
C.	O(logN)	O(2 <sup>N</sup> )																	
D.	O(1)	O(N)																	
E.	O(1)	O(logN)																	
<p><b>QUESTION 23</b></p> <p>Which searching algorithm do methods search and help implement?</p> <p>A. linear search      B. interpolation search</p> <p>C. sequential search      D. binary search</p> <p>E. map search</p>																			
<p><b>QUESTION 24</b></p> <p>What is output by the code to the right?</p> <p>A. -5 21 -5 12</p> <p>B. 21 12 -5 -5</p> <p>C. -5 12 21</p> <p>D. 21 12 -5</p> <p>E. -5 -5 12 21</p>	<pre>PriorityQueue&lt;Integer&gt; pq; pq = new PriorityQueue&lt;Integer&gt;(); pq.add(-5); pq.add(21); pq.add(-5); pq.add(12); while(!pq.isEmpty())     System.out.print(pq.remove() + " ");</pre>																		
<p><b>QUESTION 25</b></p> <p>What is output by the code to the right?</p> <p>A. 13      B. 23</p> <p>C. 19      D. 29</p> <p>E. There is no output due to a syntax error.</p>	<pre>int x3 = 3; int y3; if((y3 = x3) == 3)     System.out.print(1); else     System.out.print(2); if(x3 == y3)     System.out.print(x3); else     System.out.print(x3 * y3);</pre>																		

**QUESTION 26**

Which of the following is not a Java keyword?

- A. float      B. long      C. String      D. instanceof      E. byte

**QUESTION 27**

Given class Grade to the right, what is output by the line marked // line 1 in the client code to the right?

- A. B+      B. A+      C. null  
D. There is no output due to a syntax error in the line in the client code marked // line 1.  
E. The output will vary from one run of the program to the next.

```
public class Grade {
    private String symbol;

    public Grade(String s) { symbol = s;}

    public String toString() {
        return symbol;
    }
}
```

**QUESTION 28**

Given class Grade to the right, what is output by the line marked // line 2 in the client code to the right?

- A. C-      B. Object      C. null  
D. There is no output due to a syntax error in the line in the client code marked // line 2.  
E. The output will vary from one run of the program to the next.

```
// client code section 1
String str = "B+";
Grade g1 = new Grade(str);
str = "A+";
System.out.print(g1); // line 1
```

```
// client code section 2
Object ob2 = new Grade("C-");
System.out.print(ob2.toString()); // line 2
```

**QUESTION 29**

Given class Grade to the right, what is output by the line marked // line 3 in the client code to the right?

- A. A+, A, A-  
B. A, A+, A-  
C. A, A-, A+  
D. There is no output due to a syntax error in the line in the client code marked // line 3.  
E. There is no output due to a runtime error in client code section 3.

```
// client code section 3
TreeSet<Grade> ts;
ts = new TreeSet<Grade>();
ts.add(new Grade("A+"));
ts.add(new Grade("A"));
ts.add(new Grade("A-"));
System.out.print(ts.toString()); // line 3
```

**QUESTION 30**

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

- A. 17      B. 12      C. 2  
D. -5      E. -10

```
public int rec2(int[] d, int s, int[] c) {
    c[0]++;
    if(s == 0)
        return d[0];
    else if(d[s] < rec2(d, s - 1, c))
        return d[s];
    else
        return rec2(d, s - 1, c);
}
```

**QUESTION 31**

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

- A. 0      B. 1      C. 3  
D. 31      E. 65

```
// client code
int[] dat = {5, 2, -5, 3, 5, 12, -10, 17};
int[] c = new int[1];
int res2 = rec2(dat, 5, c);
System.out.print(res2); // line 1
System.out.print(c[0]); // line 2
```

**QUESTION 32**

Method `countLines` shown to the right will not compile due a syntax error. Which of the following changes will allow the method to compile without error?

- I. Change the method header to  

```
public int countLines(String f)
    throws FileNotFoundException {
```
  - II. Add this code after the line marked `// 3`  

```
if(FileNotFound()) System.exit();
```
  - III. Add this code after the line marked `// 1`  

```
try {
    and add this code after the line marked // 7
} catch(FileNotFoundException fnf) {
    c = -1;
}
```
- A. III only  
 B. I and II only  
 C. I and III only  
 D. II and III only  
 E. I, II, and III

```
public int countLines(String f) {
    int c = 0; // 1
    Scanner sc;
    sc = new Scanner(new File(f)); // 3
    while(sc.hasNextLine()) {
        c++;
        sc.nextLine();
    } // 7
    return c;
}
```

**QUESTION 33**

What is output by the code to the right?

- A. 0 4  
 B. 1 3  
 C. 2 2  
 D. 4 0  
 E. There is no output due to a syntax error.

```
int sm, dif;
sm = dif = 0;
for(int i = 0, g = 25; i < 2; i++, g += 30)
    for(int j = 0, h = 16; j < 2; j++, h*=2) {
        if(g % h == (g & (h - 1)))
            sm++;
        else
            dif++;
    }
System.out.print(sm + " " + dif);
```

**QUESTION 34**

What is output by the code to the right?

- A. [3, 2]    B. [2, 3]    C. [1, 3, 2]  
 D. There is no output due to a syntax error.  
 E. There is no output due to a runtime error.

```
HashMap<String, int[]> hm2;
hm2 = new HashMap<String, int[]>();
hm2.put("A", new int[]{3, 2});
hm2.get("A")[1]++;
hm2.get("A")[0]--;
String sth = Arrays.toString(hm2.get("A"));
System.out.print(sth);
```

**Go on to the next page.**



**QUESTION 35**

Based on the timing data for methods `sort1` and `sort2` to the right, which sorting algorithms do methods `sort1` and `sort2` implement? `sort1` and `sort2` both sort an array of `ints` into ascending order.

<code>sort1</code> algorithm	<code>sort2</code> algorithm
A. merge sort	quicksort
B. merge sort	selection sort
C. quicksort	selection sort
D. quicksort	merge sort
E. merge sort	insertion sort

Time to sort 1,000,000 distinct elements in random order:  
`sort1`: 4 seconds  
`sort2`: 3 seconds

Time to sort 4,000,000 distinct elements in random order:  
`sort1`: 17.6 seconds  
`sort2`: 13.2 seconds

Time to sort 250,000 distinct elements in descending order:  
`sort1`: 0.9 seconds  
`sort2`: 60 seconds

Time to sort 1,000,000 distinct elements in descending order:  
`sort1`: 4 seconds  
`sort2`: 960 seconds

**QUESTION 36**

What can replace `<*1>` and `<*2>` in the code to the right so that the entire code segment compiles without error?

<code>&lt;*1&gt;</code>	<code>&lt;*2&gt;</code>
A. <code>ArrayList</code>	<code>ListIterator</code>
B. <code>List</code>	<code>Iterator</code>
C. <code>LinkedList</code>	<code>Iterator</code>
D. <code>Collection</code>	<code>ListIterator</code>
E. More than one of A through D is correct.	

```
String sd = "cs429hI";
List<Character> cList;
cList = new <*1><Character>();
for(int i = 0; i < sd.length(); i++)
    cList.add(0, sd.charAt(i));

<*2><Character> it = cList.listIterator();
int index = 0;
while(it.hasNext())
    if(Character.isLetter(it.next()))
        it.add(sd.charAt(index++));
    else
        it.set(sd.charAt(index));
for(char ch : cList)
    System.out.print(ch);
```

Assume `<*1>` and `<*2>` are filled in correctly.

**QUESTION 37**

What is output by the code to the right?

- A. `ccss429hhII`
- B. `Ichs444s4c2`
- C. `Ichs429shcI`
- D. `ccss444h4I2`
- E. `Ish4444s2c9`

**Go on to the next page.**

**QUESTION 38**

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

```
Structure str1 = new Structure();
int[] sData1 = {11,14,9,15,9,12,16,10};
for(int i : sData1)
    str1.add(i);
str1.show();
```

- A. 0 16 15 14 12 11 10 9 9
- B. 16 14 15 11 9 9 12 10
- C. 16 15 14 12 11 9 9 10
- D. 16 15 14 12 11 10 9
- E. 16 15 14 12 11 10 9 9

**QUESTION 39**

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

```
Structure str2 = new Structure();
int[] sData2 = {3,7,15,8,3,5,6,10};
for(int i : sData2)
    str2.add(i);
while(!str2.isEmpty())
    str2.remove();
System.out.print(str2.getCt());
```

- A. 15 10 8 7 6 5 3 3 8
- B. 15 10 8 7 6 5 3 3 0
- C. 7
- D. 10
- E. 9

**QUESTION 40**

What type of data structure does the Structure class to the right implement?

- A. a binary search tree
- B. a min heap
- C. a hash table
- D. an array based list
- E. a max heap

```
public class Structure {

    private int s;
    private int[] con;
    private int ct;

    public Structure() {
        con = new int[2];
    }

    public void add(int x) {
        if ( s >= con.length - 1 ) {
            int[] t = new int[con.length*2 + 1];
            System.arraycopy(con, 1, t, 1, s);
            con = t;
        }
        s++;
        int i = s;
        while ( i > 1 && x > con[i / 2] ) {
            con[i] = con[i / 2];
            i /= 2;
        }
        con[i] = x;
    }

    public void show() {
        for(int i = 1; i <= s; i++)
            System.out.print(con[i] + " ");
    }

    public int remove() {
        int r = con[1];
        int x = 1;
        boolean d = false;
        while ( x * 2 < s && !d ) {
            ct++;
            int y = x * 2;
            if(con[y] < con[y + 1])
                y++;
            if(con[s] < con[y]) {
                con[x] = con[y];
                x = y;
            }
            else d = true;
        }
        con[x] = con[s];
        s--;
        return r;
    }

    public boolean isEmpty(){ return s == 0;}

    public int getCt() { return ct; }
}
```

# Computer Science Answer Key

## UIL State 2012

1. E	11. E	21. A	31. D
2. B	12. D	22. E	32. C
3. D	13. A	23. D	33. D
4. E	14. E	24. E	34. B
5. B	15. D	25. A	35. A
6. E	16. A	26. C	36. A
7. A	17. B	27. A	37. B
8. C	18. C	28. A	38. B
9. E	19. A	29. E	39. E
10. C	20. C	30. D	40. E

**Notes:** The clause "Choose the most restrictive correct answer." is necessary because per the formal definition of Big O, an algorithm that is  $O(N^2)$  is also  $O(N^3)$ ,  $O(N^4)$ , and so forth.

8. Because the first part of the boolean expression `x2 > 0 || y2++ > 0` evaluates to true the expression will evaluate to true and the `||` operator short circuits. The second part of the expression, `y2++ > 0`, is not evaluated.

11. The `&` operator has a higher precedence than the `|` operator. Thus `m & n` is evaluated first.

17. Without `break` statements on the first three cases, fall through occurs until a `break` is found.

26. `String` is not a Java keyword. It may be used as an identifier. (The following code compiles: `int String = 12;`)

29. A runtime error (`ClassCastException`) occurs on the second call to `add` because the `Grade` class does not implement the `Comparable` interface.

36. The `Iterator` class does not have an `add` method. If the declared data type of `it` is `Iterator`, a syntax error occurs on the method call `it.add`.