

# Computer Science

## Invitational

January 14, 2017

### General Directions:

- 1) DO NOT OPEN EXAM UNTIL TOLD TO DO SO.
- 2) **NO CALCULATORS of any kind may be used.**
- 3) 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 forty-five 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. You may 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 except on the answer sheet or Scantron card 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. **All provided code segments are intended to be syntactically correct, unless otherwise stated (i.e. `error` is an answer choice). Ignore any typographical errors and assume any undefined variables are defined as used.**
- 9) A reference to commonly used Java classes is provided with the test and you may use this reference 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 2 Packages and classes (e.g. `.lang`, `.util`, `System`, `Math`, `Double`, etc.) are included in any programs or code segments that refer to methods from these classes and/or 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 each incorrect answer.

Note: Correct responses are based on Java, J2sdk v 1.8.x, from Sun Microsystems, Inc. All provided code segments are intended to be syntactically correct, unless otherwise stated (i. e. error is an answer choice) and any necessary Java 2 Standard Packages have been imported. Ignore any typographical errors and assume any undefined variables are defined as used. For all output statements, assume that the System class has been statically imported... `import static java.lang.System.*;`

## QUESTION 1

What is  $59_{10}$  plus  $29_{16}$ ?

- A.  $73_{16}$       B.  $1110010_2$       C.  $99_{10}$       D.  $88_{16}$       E.  $1100100_2$

$$\begin{array}{r} 1111 \\ 00101001 \\ \hline 01100100 \end{array}$$

## QUESTION 2

What value could  $y$  be such that  $z$  becomes 0 in the code to the right?

- A. 8  
B. 6  
C. 9  
D. 7  
E. 5

$$\begin{array}{r} 8 \\ 7 \sqrt{595} \\ \underline{56} \\ 35 \\ \underline{35} \\ 0 \end{array}$$

```
int x = 595, y = ?, k = 62;
int z = x % y + k % y - y;
(595 % y) + (62 % y) - y
```

## QUESTION 3

What is output by the code to the right?

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

$$\begin{array}{r} 558\overline{)595} \\ 56 \\ \underline{35} \\ 54 \\ \underline{55} \\ 54 \end{array}$$

$\% d$ . 4

$\% .4d$

```
String list = "ALEXANDER";
int k = list.length() / 3 + 1; +
String x = "%" + k + "s\n%" ;
out.printf(x + k + "d" + list, list, k);
```

$\% 4s$

$\% 4d$  ALEXANDER

## QUESTION 4

What is output by the code to the right?

- A. DIARLEROC  
B. IARLE  
C. DIAARLCROC  
D. DIABRLEYROC  
E. IABRLEY

```
String s = "CROC";
String x = "HARLEY";
String y = "DIABLO";
s = y.substring(0, 3) + DIA RLE ROL
     .substring(2, x.length() - 1) +
     s.substring(1);
out.println(s);
```

## QUESTION 5

What values for  $a$ ,  $b$ , and  $c$  make the output to the right true?

- A.  $a = \text{true}$ ,  $b = \text{true}$ ,  $c = \text{false}$   
 B.  $a = \text{false}$ ,  $b = \text{false}$ ,  $c = \text{false}$   
 C.  $a = \text{true}$ ,  $b = \text{true}$ ,  $c = \text{true}$   
 D.  $a = \text{false}$ ,  $b = \text{true}$ ,  $c = \text{true}$   
 E. the output is always false

$$\begin{aligned} d &= \bar{A} (BA + \bar{C}) \\ BA\bar{A} &= \text{false} + \bar{A}\bar{C} \end{aligned}$$

```
boolean a, b, c, d;
d = !a && (b && a || !c);
out.println(d);
```

<p><b>QUESTION 6</b></p> <p>What is the correct code for the equation to the right?</p> <p>A. <math>y = \text{Math.sqrt}(3 * \text{Math.abs}(t^3));</math>      B. <math>y = \text{Math.pow}(3 * \text{Math.abs}(t*t*t), 1/2);</math>      C. <math>y = (3 * \text{Math.abs}(t*t*t))^{1/2};</math>      D. <math>y = \text{Math.sqrt}(3 * \text{Math.abs}(\text{Math.pow}(t, 3)));</math>      E. More than one of these are correct</p>	$y = \sqrt{3 t^3 }$
<p><b>QUESTION 7</b></p> <p>What is output by the code to the right?</p> <p>A. 3      B. 2      C. 1      D. 0      E. 7</p>	<pre>int a; int k = 3; int x = k + 5; x=8 int y = x - k; 8-3=5 int z = 27 % k; 27%3=0 a = y - k + z % x; 5-3+(0%5) out.println(a); 2</pre>
<p><b>QUESTION 8</b></p> <p>What is output by the code to the right?</p> <p>A. SPEERSAA      B. USEPSRTSRA      C. SUPERSSTRA      D. UUPRSTTR      E. SUPERSTAR</p>	<p>S P E E</p> <pre>String str = "SUPERSTAR"; String s = ""; for(int i=0; i&lt;str.length()-1; i++)     if(str.charAt(i)&gt;str.charAt(i+1))         s+=str.charAt(i+1);     else         s+=str.charAt(i); out.println(s);</pre>
<p><b>QUESTION 9</b></p> <p>What is output by the code to the right?</p> <p>A. 58825      B. 68135      C. 46813      D. 48023      E. 57024</p>	<p>224 3 — 4</p> <p>16 25 — 121</p> <pre>int x = 57; for(int i=x; i&gt;19; i-=9) {     x+=2;     out.print(x%9); } out.println();</pre>
<p><b>QUESTION 10</b></p> <p>What is output by the code to the right? Invalid</p> <p>A. 96 25 10 42 28      B. 96 131 52 42 70      C. 131 25 10 52 122      D. 96 131 141 163 191      E. 131 35 52 70 28</p>	<pre>int[] list = {96, 25, 10, 42, 28}; for(int i=0; i&lt;list.length-1; i++)     if(list[i]&gt;list[i+1]&lt;list[i+1]/2)         list[i]+=list[i+1];     else         list[i+1]+=list[i]; for(int x:list)     out.print(x+" "); out.println();</pre>
<p><b>QUESTION 11</b></p> <p>When reading from the following Scanner object, what order should the Scanner methods be called in such that there is no run time error?</p> <p>Scanner s = new Scanner("17 VT CROOKED 2.6");</p> <p>I. s.next()      II. s.nextLine()      III. s.nextDouble()      IV. s.nextInt()</p> <p>A. IV, I, I, III      B. III, II, I      C. II, I, III, IV      D. I, I, IV, II      E. IV, II, III</p>	<p>IV, I, I</p>

**QUESTION 12**

What is output by the code to the right?

- A. 6
- B. 3
- C. 7
- D. 4
- E. There is not output due to a run-time error

```
int sum = 0; 12 3 4
String ans = "EARTHANGE"; 5
for(int i=0; i<ans.length(); i++) 6
    if(ans.charAt(i)>'K') 7
        sum++; 8
    out.println(sum); 9
```

**QUESTION 13**

Which of the following does not have the same precedent as the others in java?

- A. <=
- B. >=
- C. >>
- D. >
- E. <

**QUESTION 14**

What is output by the code to the right?

- A. 383
- B. 0
- C. -384
- D. 127
- E. -128

```
out.println(Byte.MIN_VALUE*3);
```

**QUESTION 15**

What is output by the code to the right?

- A. [5, 3, 4, 4, 2, 6, 5, 1, 9, 0, 5]
- B. [5, 3, 4, 4, 2, 6, 1, 9, 0, 5]
- C. [0, 5, 3, 4, 4, 2, 6, 1, 9, 5]
- D. [5, 4, 3, 4, 2, 6, 1, 9, 0, 5]
- E. There is no output due to a run-time error

```
ArrayList<Integer> list =
    new ArrayList<>();
int[] x = {5,3,4,2,6,1,7,9,0}
for(int t:x)
    list.add(t);
list.add(0);
list.add(10,5);
list.remove(6);
list.add(2,4);
out.println(list);
```

**QUESTION 16**

Which of the following correctly replaces <\*> in the code to the right?

- A. `this.x = that.x;`
- B. `x = this.x;`
- C.** `this.x = x;`
- D. `x = x;`
- E. more than one of these are correct.

**QUESTION 17**

Which of the following correctly replaces <\*> in the code to the right?

- A. `public void getX()`  
  { `return x;` }
- B. `public getX()`  
  { `return x;` }
- C.** `public double getX()`  
  { `return x;` }
- D. `public void getX(int x)`  
  { `return x;` }
- E. `public double getX(int x)`  
  { `y = x;` }

**QUESTION 18**

What value is stored in `mat[3][3]`?

- A. T
- B. E
- C. M
- D. O
- E. E

**QUESTION 19**

What is output by the code to the right?

- A. T E I L
- B. Y M
- C. M Y
- D. T I M E
- E. L I E T

**QUESTION 20**

What is output by the code to the right?

- A. 7d6d1
- B. 87953
- C. 88952
- D. 2004
- E. 4002

```
class C
{
    private double x;
    public C(double x)
    {
        <*>
    }

    public void change (double y)
    {
        x += y;
    }
}
```

```
String str = "ONLYTIME";
char[][] mat = new char[4][4];
int r=0, c=0;
int size = 3;
for(int i=0; i<str.length(); i++)
{
    mat[r][c]=str.charAt(i);
    mat[size-r][size-c]=str.charAt(i);
    r = (r+1)%size;
    c = Math.abs(c-1)%size;
}
for(int j=0; j<mat.length; j++)
    out.print(mat[2][j] + " ");
```

A10

1000|0100|0000|0000|0011  
0111|0001|0100|0010|

```
int x = 0x84813;
int y = 0x7142;
int z = x & y;
out.printf("%x", z);
```

0111|1000|1101|0101|110

**QUESTION 21**

What is held by list after the line at <\*1> is run by the code to the right?

- A. [30, 9, 50, 28, 34, 11]
- B. [30, 9, 34, 14, 3, 8]
- C. [30, 9, 42, 17, 15, 11]
- D. [30, 9, 42, 17, 10, 11]
- E. there is a run time error

**QUESTION 22**

What is held by list after the line at <\*2> is run by the code to the right?

- A. [33, -24, 39, -6, 2, 6]
- B. [30, 9, 42, 17, 15, 11]
- C. [27, 17, 72, 69, 17, 40]
- D. [30, 9, 42, 17, -83, 11]
- E. there is a run time error

```
5      3
public void mys1(int[] x, int a, int b)
{
    int start = Math.min(a, b);
    int stop = Math.max(a, b); 5
    for (int i = start; i <= stop; i++)
        if (i <= 0)
            x[i+1] -= x[i]/2;
        else if (i >= x.length-1)
            x[i-1] -= x[i]/2;
        else
            {
                x[i+1] -= x[i]/2;
                x[i-1] -= x[i]/2;
            }
    } 7
// CLIENT CODE 0 7-2 4 5
int[] list = {30, 9, 42, 17, 15, 11};
mys1(list, 5, 3); //<*1>
mys1(list, 30, 11); //<*2>
```

**QUESTION 23**

- What is the correct code for line <\*1>?
- class E extends D
  - class E
  - class E implements D
  - class E extends D implements Comparable <E>
  - more than one of these

**QUESTION 24**

- Assuming all blanks are filled correctly, what is output by the code at <\*2>?
- NCEO
  - HENW
  - ONCE
  - WHEN
  - There is no output due to a runtime error

**QUESTION 25**

- Assuming all blanks are filled correctly, what is output by the code at <\*3>?
- LLWI
  - WAYSAL
  - LWAYSA
  - LWIL
  - WILL

**QUESTION 26**

- What is the composition of the list after the code at <\*4> is completed?
- [WILL, ALWAYS, ONCE, WHEN]
  - [ALWAYS, ONCE, WHEN, WILL]
  - [LLWI, WAYSAL, NCEO, HENW]
  - [LWIL, LWAYSA, NCEO, HENW]
  - [LLWI, WAYSAL, CEON, ENWH]

```

class D implements Comparable<D>
{
    private String x;
    public D(String str)
    {
        x = str;
        change();
    }
    public void change()
    {
        x = x.substring(1)+x.substring(0,1);
    }
    public int compareTo(D other)
    {
        String a = x.substring(1);
        String b = other.x.substring(1);
        return a.compareTo(b);
    }
    public String toString()
    {
        return x;
    }
}

//<*1>
{
    public E(String str)
    {
        super(str);
        change();
    }
    private String rev(String str)
    {
        String a = "";
        int i=str.length()-1;
        while(i>=0)
        {
            a+=str.charAt(i);
            i--;
        }
        return a;
    }
    public int compareTo(D other)
    {
        String a = rev(toString());
        String b = rev(other.toString());
        return a.compareTo(b);
    }
}
// CLIENT CODE
D[] list = new D[4];
list[0] = new D("WHEN");
list[1] = new D("ONCE");
if(list[0].compareTo(list[1])<0)
    out.println(list[0]); //<*2>
else
    out.println(list[1]); //<*2>
list[2] = new E("WILL");
list[3] = new E("ALWAYS");
if(list[2].compareTo(list[3])<0)
    out.println(list[2]); //<*3>
else
    out.println(list[3]); //<*3>
Arrays.sort(list); //<*4>

```

**QUESTION 27**

What is output by the code on the right?

- A. [1, 4, 13, 38, 37, 18, 11, 45]
- B. [4, 13, 38, 37, 18, 11, 45, 1]
- C. [1, 4, 11, 13, 18, 37, 38, 45]
- D. [1, 4, 11, 38, 37, 18, 13, 45]
- E. [1, 4, 11, 37, 45, 18, 13, 38]

```
PriorityQueue<Integer> pq;
pq = new PriorityQueue<Integer>();
int[] list = {1, 4, 13, 38, 37, 18, 11, 45};
for(int x:list)
    pq.add(x);
pq.add(pq.remove());
out.println(pq);
```

14 11 13 18 37 38 45

**QUESTION 28**

What is returned by the method call mys2(8, 2)?

- A. 9
- B. 31
- C. 61
- D. 45
- E. There is no output due to a stack overflow exception

```
public static int mys2(int x, int y)
{
    if (x == y)
        return x;
    x++;
    y+=3;
    out.println(x+" "+y);
    return x|y + mys2(x, y);
}
```

8 2

**QUESTION 29**

Which of the following method calls do not result in a stack overflow error?

- A. mys2(4, 9)
- B. mys2(9, 4)
- C. mys2(21, 14)
- D. mys2(16, 4)
- E. mys2(64, 61)

**QUESTION 30**

What is output by the code to the right?

- A. 0
- B. 55
- C. 17
- D. 51
- E. 38

A  
X  
O

35 771

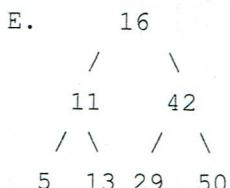
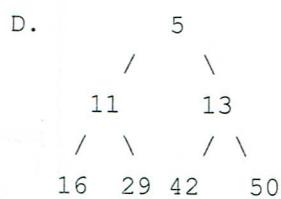
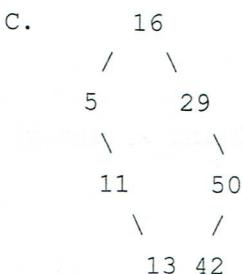
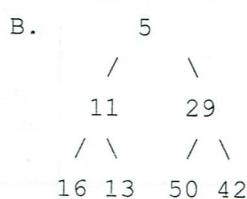
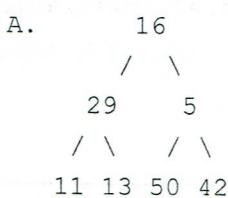
```
out.println(38 ^ 21 & 17 | (35 >> 1));
100110
 10101
 10001
 01001 17
```

17

**QUESTION 31**

Which of the following is an example of a red black tree if the following values were entered in the following order?

16 29 5 11 13 50 42

**QUESTION 32**

What is output by the code on the right?

- A. [ADISON, ADISO, DISO, ISO, IS, I]
- B. [NOSIDA, OSIDA, DISO, OSI, IS, S]
- C. [NOSIDA, ADISO, OSID, DIS, SI, I, ]
- D. [NOSIDA, OSIDA, OSID, OSI, SI, I, ]
- E. no output due to an infinite loop

```

String str = "MADISON";
Stack<Character> st = new Stack<>();
Stack<String> st2 = new Stack<>();
while(!str.isEmpty())
{
    str = str.substring(1);
    for(int i=0;i<str.length(); i++)
        st.push(str.charAt(i));
    str = "";
    while(!st.isEmpty())
        str+=st.pop();
    out.println(str);
    st2.add(str);
}
out.println(st2);
  
```

**QUESTION 33**

- What is output by the code at <\*1>?
- [LONELIEST, ONE, IS, THE]
  - [ONE, IS, THE, LONELIEST]
  - [IS, LONELIEST, ONE, THE]
  - [ONE, LONELIEST, IS, THE]
  - [THE, LONELIEST, ONE, IS]

```
TreeSet<String> set;
set = new TreeSet<String>();
set.add("ONE");
set.add("IS");
set.add("THE");
set.add("LONELIEST");
out.println(set); //<*1>
TreeMap<String,Character> map =
    new TreeMap<String,Character>();
set.add("NUMBER");
set.add("TWO");
set.add("IS");
int i=0;
for(String k:set)
{
    i++;
    map.put(k, k.charAt(i));
}
out.println(map.values()); //<*2>
```

**QUESTION 34**

- What is output by the code at <\*2>?
- [S, N, B, N, H, O]
  - [I, L, N, O, T, T]
  - [I, O, M, O, T, W]
  - [S, N, B, O, T, W]
  - there is no output due to an out of bounds exception

**QUESTION 35**

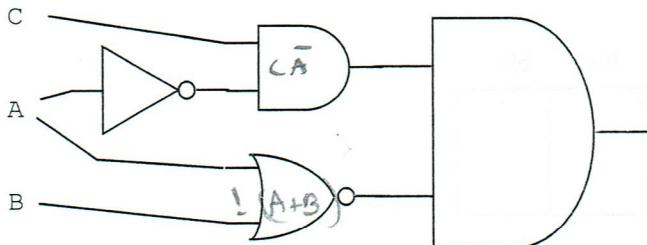
How many empty strings are in `list` after the code on the right has executed?

- 10
- 5
- 11
- D** 0
- 6

```
String x = "LAUNDRYDAYSSEYOUHERE";
String[] list = x.split("[ADYE]+");
```

**QUESTION 36**

Which of the following best represents the circuit given below.



- $\neg A \mid\mid \neg B \And \neg C \And \neg A$
- B**  $\neg(A \mid\mid B) \And (C \And \neg A)$
- $\neg(A \And C) \And (A \mid\mid B)$
- $\neg A \mid\mid C \mid\mid \neg A \And B$
- $\neg(A \mid\mid C) \mid\mid \neg(A \And B)$

**QUESTION 37**

Simplify the following Boolean algebra expression:

$$\neg(A+B)A!\neg B+A!\neg((CA)+\neg(BCB))+\neg(BC)$$

- A!B+C
- A+!CB
- C** !A!B+C
- ABC+!B+!C
- E A

**QUESTION 38**

Convert the prefix notation equation to the right into a infix notation equation.

- A.  $A/B+C/D+E+F$
- B.  $A+B+C/D/E+F$
- C.  $(A+B+C/D) / (E+F)$
- D.  $A/B/(C+D+E+F)$
- E.  $(A+B+C+D) / (E/F)$

$/++AB/CD+EF$

$(A/B+C+D)/E+F$

**QUESTION 39**

*OPEN ENDED QUESTION – Find the answer and write it on your answer sheet. If you are using a ScanTron form, write the question number and the answer on the bottom of the ScanTron.*

What is the binary value of -124?

bit							
1	0	0	0	0	1	0	1

0111010

124

10000101

**QUESTION 40**

*OPEN ENDED QUESTION – Fill in the blank spaces with the proper bits (1 or 0) and write it on your answer sheet. If you are using a ScanTron form, write the question number and the answer on the bottom of the ScanTron.*

What could be the value of X in the following equation?

$$\text{RCIRC-3}(X \text{ OR } 10100100) = 10110110$$

bit							