University Interscholastic League
Computer Science Competition

Number 150 (Invitational B - 2015)

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.

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.

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.

Note: Correct responses are based on Java, **J2sdk v 1.7.25**, 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

Which of these is NOT equivalent to $10111000_2 + AB_{16}$?

A. 163_{16} B. 355_{10} C. 543_8 D. 10110001_2 E. All are equivalent

QUESTION 2

What is the result of the expression shown?

A. 1 B. 0.56

C. 2 D. -1 E. 0

```
23 / 9 * 1 % 2 = _____
```

QUESTION 3

What is output by the code to the right?

A.
```
----*----*
    49.2
```

B.
```
----*----*
49.20
```

C.
```
----*----*
9.20
```

D.
```
----*----*
49.2
```

E.
```
----*----*
  49.20
```

```
System.out.println("----*----*");
System.out.printf("%4.2f",49.2);
```

QUESTION 4

What is output by the code to the right?

A. `UILCOMPUTERSCIENCE2015`

B. `UOLCOMPUTORSCOONCO2015`

C. `OUOOLOCOOOMOPOUOTOOROSOCOONOCOO20001050`

D. `UOLCOMPUTORSCONCO2015`

E. `UILCOMPUTERSCONCE2015`

```
String s = "UILCOMPUTERSCIENCE2015";
s = s.replaceAll("IE","O");
out.println(s);
```

QUESTION 5

What is output by the code to the right?

A. `false` B. `true`

```
boolean p = true;
boolean q = false;
out.println(!(p&&q));
```

QUESTION 6

What is output by the code to the right?

A. `17.0` B. `11.5` C. `23.0` D. `12.7`

E. There is no output due to an error.

```
int x = 8;
double y = 15;
out.println(Math.hypot(8,15));
```

QUESTION 7

What is output by the code to the right?

A. 11 B. 11.2 C. 8.0 D. 8

E. There is no output due to an error.

```
int i = 8;
double d = 1.4;
out.printf("%d",i*=d);
```

QUESTION 8

What is output by the code to the right?

A. 16 B. 160

C. 14 D. 40

E. 4

```
int x = 14,y=0;
switch(x%3)
{
 case 0:y+=0;break;
 case 1:y+=1;
 case 2:y+=2;break;
 case 3:y+=3;
 default:y*=10;
}
out.println(x+y);
```

QUESTION 9

What is output by the code to the right?

A. 78 B. 159 C. 128

D. 79 E. There is no output due to an error.

```
int x = 4;
for(;x<75;x++)
 x*=2;
out.println(x);
```

QUESTION 10

What is output by the code to the right?

A. 0 7 4 5 3 6 2 0 B. 0 6 3 4 2 5 1 0

C. 6 3 4 2 5 1 0 0 D. 7 4 5 3 6 2 0 0

E. There is no output due to an error.

```
int a=1;
int[]list1={5,3,1,2,4,0};
int[]list2=new int[8];
for(int x:list1)
 list2[x+1]=++a;
for(int x:list2)
  out.print(x+" ");
```

QUESTION 11

Below is a value in a data file called **"stuff.dat"**.

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In the code segment to the right, which choice is best for **<statement 1>** in order to retrieve the data for output purposes?

A. `String n = f.nextLine();`

B. `int n = f.nextInt();`

C. `double n = f.nextDouble();`

D. `String n = f.next();`

E. All code segments will work properly

```
Scanner f = new Scanner(new
File("stuff.dat"));
<statement 1>
out.println(n);
```

QUESTION 12

What is output by the code to the right?

A. 8

B. 7

C. 6

D. 5

E. 4

```
double d = 100;
int x = 0;
while(d<1000)
{
 d*=1.5;
 x++;
}
out.println(x);
```

QUESTION 13

Here are three lines taken from the Java Order of Precedence chart. Which choice represents the correct order of precedence for these three lines?

I. `||`
II. `|`
III. `expr++ expr--`

A. III, I, II B. I, II, III C. III, II, I D. I, III, II E. II, I, III

QUESTION 14

The integer data type **byte** uses 8 bits of storage, which means it has 2^8, or 256 possible values. Which of the choices below indicates the range of values for this data type.

A. -128 to 128 B. -128 to 127 C. 1 to 256 D. 0 to 255 E. -127 to 128

QUESTION 15

The output for the code to the right is: `0 1 2 0 1 2 0 1 2`

Which choice replaces **<statement>** in the code to the right so that it compiles and runs correctly?

A. `double`
B. `Object`
C. `Integer`
D. `String`
E. `int`

```
Integer [] list={0,1,2};
ArrayList<Integer> aList = new
ArrayList<Integer>();
for(Integer x:list)
 aList.add(x);
<statement> [] list2 =
aList.toArray();
for(Integer x:list)
 out.print(x+" ");
for(Integer x:aList)
 out.print(x+" ");
for(<statement> x:list2)
 out.print(x+" ");
```

QUESTION 16

How many ordered triples make this boolean expression false?

$$\overline{A + B * C}$$

A. 2 B. 3 C. 4 D. 5 E. 6

QUESTION 17

What is output by the code to the right?

A. `-96` B. `78` C. `96` D. `-78`
E. There is no output due to an error.

```
char x = 'A';
char y = 'a';
int z = 3;
out.println((x-y)*z);
```

QUESTION 18

What is output by the code to the right?

A. `0 24 9 0 39`
B. `0 36 21 6 0`
C. `0 12 0 42 27`
D. `0 48 33 18 3`
E. `0 0 45 30 15`

```
int[][]nums = new int[5][5];
for(int x = 3;x<50;x+=3)
 nums[x%5][x%4+1]=x;
for(int x = 0;x<5;x++)
 out.print(nums[2][x]+" ");
out.println();
```

QUESTION 19

The two's complement system is all about representing negative numbers in binary. For example, the positive value 72 in 8-bit binary is **01001000**. To find the binary representation for -72 using two's complement, you use this easy conversion process. Start from the right and keep all zeroes the same until you reach the first 1 digit. Keep that 1 the same also, and flip everything else, with an 8-bit binary result of **10111000** for -72. With that in mind, which of the following choices represents the 8-bit binary representation of -118?

A. 10001100 B. 10001110 C. 10001010 D. 10001011 E. 10001101

QUESTION 20

What is the least restrictive running time for the worst case scenario for the quick sort algorithm?

A. O(N^2)

B. O(N)

C. O(1)

D. O(N log N)

E. O(log N)

QUESTION 21

What is output by the client code to the right?

A. 3 4 5 6 7 9 B. 5 7 3 9 4 6

C. 9 7 6 5 4 3 D. 6 4 9 3 7 5

E. Not possible to determine

QUESTION 22

Which of the six indicated <statements> in the code to the right need to be altered in order to reverse the sorting order?

I. <statement 1>
II. <statement 2>
III. <statement 3>
IV. <statement 4>
V. <statement 5>
VI. <statement 6>

A. II only

B. III and IV only

C. III only

D. IV, V, and VI only

E. I only

```
public static void quickSort (int a[], int
lo, int hi){
  <statement 1>
  if (lo >= hi) return;
  int left = lo;
  int right = hi;
  <statement 2>
  int pivot = a[(lo+hi)/2];

  while ( left < right)  {
    <statement 3>
    while (a[left] > pivot) left++;
    <statement 4>
    while (pivot > a[right]) right--;
    <statement 5>
    if (left <= right)    {
      swap (a, left, right);
      left++;
      right--;
    }
  }
  <statement 6>
  quickSort (a, lo, right);
  quickSort (a, left, hi);
}

public static void swap (int a[],
                         int i, int j){
  int tmp = a[i];
  a[i] = a[j];
  a[j] = tmp;
}

public static void outputList(int[]list)
{
 for(int x=0;x<list.length;x++)
    out.print(list[x]+" ");
 out.println();
}
//client code
 int[]list = {5,7,3,9,4,6};
 quickSort(list);
 outputList(list);
```

QUESTION 23

How many 'o's will be output in the code to the right?

A. 2 B. 3 C. 4 D. 5

E. There is no output due to an error.

```
String s =
"abcdefghijklmnopqrstuvwxyz";
char [] list = s.toCharArray();
char a = list[0];
while(a++!='z')
 for(char b:list)
   if("aeiou".indexOf(b,a-98)>=0)
     out.print(b);
```

QUESTION 24

What is output by the code to the right?

A. 1.7 B. 0.9 C. 0.5

D. 1.0 E. None of these

```
int angle = 45;
out.printf("%.1f\n",
    Math.tan(Math.toRadians(angle)));
```

QUESTION 25

What is output by the code to the right?

A. 01111101 B. 01111010 C. 11111101

D. 00000010 E. 11111110

```
byte c = -10;
c>>=2;
out.println(Integer.toBinaryString(c)
.substring(24));
```

QUESTION 26

On the right is a fairly common version of the binary search algorithm, a standard search process used in computer science. What required process (if any) needs to replace **//line A** in the client code for this algorithm to work properly?

A. Sort the list in ascending order.

B. Reverse the order of the list.

C. There is no required process. The list is fine as is.

D. Sort the list in descending order.

E. Process the list into a hash table.

```
static int binarySearch(int[] elements,
                        int target) {
 int left = 0;
 int right = elements.length - 1;
 while (left <= right) {
  int middle = (left + right) / 2;
   if (target < elements[middle]){
      right = middle - 1;
   }
   else if (target > elements[middle]){
      left = middle + 1;
   }
   else
      return middle;
 }
 return -1;
}
<client code>
int [] list = {5,-7,3,9,4,8,-3, 1,-5, 0};
//line A
out.print(binarySearch(list,5)+" ");
out.println(binarySearch(list,-6));
```

QUESTION 27

What is output by the client code to the right?

A. 0 0

B. 7 -1

C. 7 -2

D. 0 -1

E. 8 -1

QUESTION 28

Which statement best describes the string patterns listed below as each replaces the **<pattern>** segment in the code to the right?

I. ".*" II. ".+" III. ".?"

A. All produce true outputs

B. All produce false outputs

C. II and III produce true, I produces false

D. I and II produce true, III produces false

E. I and III produce true, II produces false

```
String s = "Invitational B";
boolean p = Pattern.matches(<pattern>,s);
out.println(p);
```

QUESTION 29

What is output by the code to the right?

A. 0 -2 3 B. 6 10 -5

C. 5 11 3 D. 5 -2 3

E. There is no output due to an error.

```
 public static int myst(int x)
 {
  if(x<0)return 3;
  if(x==0)return 1;
  return myst(x-3)+2;
 }
//client code
out.print(myst(6)+" ");
out.print(myst(10)+" ");
out.println(myst(-5));
```

QUESTION 30

What is the output of the code to the right?

A. BBBBAAAABBB

B. AAAABBBBAAA

C. AAABBBBBBAA

D. BBBAAAAAABB

E. There is no output due to an error.

```
String s = "UIL 2015 CS";
char[]list=s.toCharArray();
for(char a:list)
 out.print(a>60?"A":"B");
```

QUESTION 31

What is output by the code to the right?

A. 7 28 59

B. 7 34 63

C. 7 42 59

D. 7 42 77

E. None of these

```
out.print(Integer.toOctalString(7));
out.print(Integer.toOctalString(34));
out.println(Integer.toOctalString(63));
```

QUESTION 32

Using the space provided, create a binary search tree using the letters, INVITATIONALB. After creating the tree, select the choice that shows how many parent nodes have only one child, and the height of the resulting tree..

Assume that the initial tree shown has a height of zero, and that duplicate letters **are allowed in the tree**, and slide to the **left** of matching elements.

```
I
/ \
```

A. 5 6

B. 6 5

C. 6 6

D. 5 5

E. None of these

QUESTION 33

What is output by the statements in **section 1** of the client code below?

```
//section 1
ThingOne t1 = new ThingOne();
out.print(t1);
t1.setThing(6);
out.print(t1);
//section 2
t1=new ThingTwo(3);
out.print(t1.getThing());
//section 3
t1.reduceThing(1);
out.println(t1);
```

A. F5F6

B. AFDF

C. AF5DF6

D. A5D6

E. None of these

QUESTION 34

What is output by the statements in **section 2** of the client code in question 33?

A. HAI3

B. AHI3

C. AHI5

D. HI3

E. HAI5

QUESTION 35

What is output by the statements in **section 3** of the client code in question 33?

A. KLF7

B. KL52

C. L52

D. KLF52

E. KL7

```
class ThingOne{
 public ThingOne(){
  thing = 5;
  out.print("A");
}
 public ThingOne(int t){
  thing = t;
  out.print("B");
}
 public int getThing(){
  out.print("C");
  return thing;
}
 public void setThing(int t){
  thing = t;
  out.print("D");
}
 public void reduceThing(int t){
  thing -=t;
  out.print("E");
}
 public String toString(){
  out.print("F");
  return ""+thing;
}
 private int thing;
}
class ThingTwo extends ThingOne{
 public ThingTwo(){
  super();
  out.print("G");
  thing = 4;
 }
 public ThingTwo(int t){
  thing = t;
  out.print("H");
}
 public int getThing(){
  out.print("I");
  return thing;
}
 public void setThing(int t){
  thing = t;
  out.print("J");
}
 public void reduceThing(int t){
  thing -=t;
  out.print("K");
}
 public String toString(){
  out.print("L");
  return super.toString()+thing;
}
 private int thing;
}
```

QUESTION 36

Infix notation is the kind normally used in algebraic expressions, such as `3 + 5 * 6`, where the operators are between the operands. However, there is also prefix notation, where the operators are before the operands, such as `+ 3 * 5 6`, and postfix notation, operators after operands, like this: `3 5 6 * +`. Notice carefully that the operands never move around: only the operators change places. Here is another example: the infix expression `6 * 7 + 9 - 8 * 2` translates the prefix expression `- + * 6 7 9 * 8 2`, and `6 7 * 9 + 8 2 * -` for postfix. Given these examples to examine and study carefully, which of the prefix expressions below matches the infix expression shown?

A+B-C*D+E^F

A. **+AB+*CD-^EF**

B. **+-AB-*CD^EF**

C. **+-+AB*CD^EF**

D. **++-AB*CD^EF**

E. None of these

QUESTION 37

Which of the following logical statements is represented by the digital electronics diagram shown?

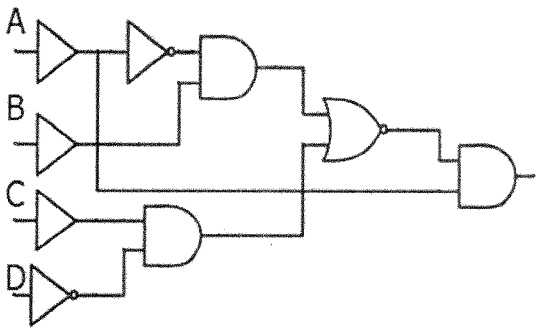
A. $\overline{(\overline{A}+B)*(C+\overline{D})}+A$

B. $(\overline{A}*B+C*\overline{D})*A$

C. $\overline{(\overline{A}*B+C*\overline{D})}*A$

D. $\overline{(\overline{A}*B+C*\overline{D})*A}$

E. None of these



QUESTION 38

Find f(-10) according to the recursive function definition shown below.

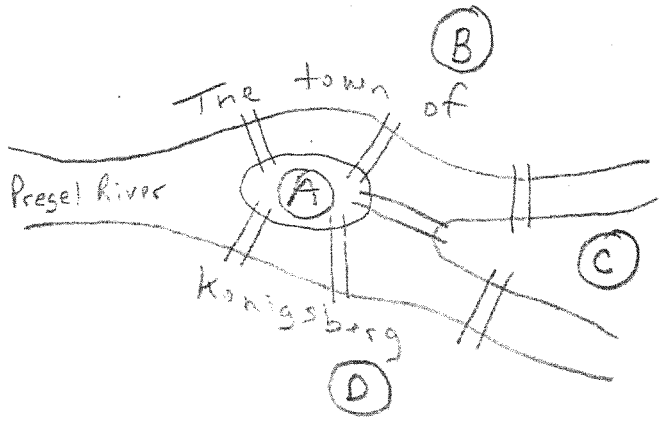
f(-10) =

```
f(x)=     f(x+5)+f(x+8)     when x<=0
f(x)=     2                 if x>0 and even
f(x)=     -1                if x>0 and odd
```

A. 0 B. 1 C. 2 D. 3 E. 4

QUESTION 39

A well-known graph problem studied by Leonard Euler had to do with the town of Konigsberg, in which there was an island at the point where the river Pregel forked. There were seven bridges connecting the island with the two banks of the river and the land between the forks, as shown in the picture. His question was whether or not there was a way to cross the seven bridges in a continuous walk through town without recrossing any of them. For example, he might start a path starting on the B side of town, cross over one of the two bridges to the island (A) and then on across to the south bank (D), and then across to the land area between the forks of the river (C). This path would be indicated by the letter sequence BADC. In this case study of the **Seven Bridges of Konigsberg**, a complete **Euler path**, or **Euler tour,** would be indicated by 8 letters. There could be any number of combinations.



Write the **sequence of eight letters** that represent your version of the Euler path for the seven bridges of Konigsberg. If you determine that it is not possible, write the answer "NOT POSSIBLE".

_ _ _ _ _ _ _ _

QUESTION 40

Simplify this expression to have only two operators and two NOTs. The allowable operators include AND(*), OR(+), XOR(⊕), and NOT (over bar).

$A * (\overline{B} + \overline{C}) + A * \overline{(B + C)}$