University Interscholastic League

Computer Science Competition

Number 120 (Invitational B - 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.

What is the sum of AC_{16} and 4_{16}?

A. ACE_{16} B. 100_{10} C. 10110101_2 D. 10110000_2 E. 11_2

What is output by the code to the right?

A. 0   B. 2   C. 5

D. 10   E. 22

```
int y = 5 % (10 + 12) / 2;
System.out.print(y);
```

What is output by the code to the right?

A. 0   B. 5   C. -1

D. 1   E. 4

```
int tally = 0;
for(int i = 5; i > 1; i--)
   tally++;
System.out.print(tally);
```

What is output by the code to the right?

A. LARRYWALLPERL

B. LARRYWALL--PERL

C. LarryWall--Perl

D. LARRYWALL__PERL

E. LARRYWALL++PERL

```
String cser = "LarryWall--Perl";
cser = cser.toUpperCase();
System.out.print(cser);
```

What is output by the code to the right?

A. null   B. 0   C. 6

D. 5   E. 1

```
int[] ts = new int[5];
ts[1] = ts[2] + ts[4];
System.out.print(ts[1]);
```

What is output by the code to the right?

A. 36   B. 22   C. 33

D. 54   E. 20

```
int w = 3;
int z = 2;
z *= (z + 1) * w + z;
System.out.print(z);
```

What is output by the code to the right?

A. false true   B. true false

C. true true   D. false false

E. false true false true

```
boolean p = false;
boolean q = true;
System.out.print( (p && q) + " ");
System.out.print( p || q );
```

QUESTION 8

What is output by the code to the right?

A. 2   B. 1   C. 13

D. 3   E. 23

```
boolean r = true;
boolean s = true;
if( r ^ s )
  System.out.print(1);
else if( r || s )
  System.out.print(2);
else
  System.out.print(3);
```

QUESTION 9

What replaces **<*1>** in the code to the right so that the instance variable `price` is only accessible in the `Rental` class?

A. final   B. public   C. static

D. private   E. implements

Assume **<*1>** is filled in correctly.

QUESTION 5

What is output by the client code to the right?

A. Rental@

B. Movie@

C. movie:

D. 10

E. movie:10

```
public class Rental{
  <*1> int price;

  public Rental(int p){
    price = p;
  }

  public Rental(){
    price = 10;
  }

  public int getPrice(){
    return price;
  }
}

public class Movie extends Rental {

  public String toString(){
    return "movie:" + getPrice();
  }
}

/////////////////////////////////////////
// client code
Movie m = new Movie();
System.out.println(m);
```

QUESTION 11

What is output by the code to the right?

A. 63   B. 64   C. 127

D. 1023   E. 2147483647

```
int bx = 63;
int ax = 64;
int cx = ax | bx;
System.out.print(cx);
```

QUESTION 12

What is output by the code to the right?

A. 3   B. 9   C. 2.99999

D. 81   E. 3.0

```
double res = Math.sqrt(9);
System.out.print(res);
```

QUESTION 13

What is output by the code to the right?

A. 1 2 3   B. "1""2""3"   C. 3

D. One   E. 123
   Two
   Three

```
System.out.print("1");
System.out.print("2");
System.out.print("3");
```

What is output by the code to the right?

A. 00150   B. "%05d"   C. +150

D. 150.00   E. 150

```
int value = 150;
int len = ("" + value).length() + 2;
String fr = "%0" + len + "d";
System.out.printf(fr, value);
```

What is returned by the method call repeat(-3)?

A. -12   B. 2   C. 0

D. -6   E. -4

```
public int repeat(int val){
  int res = 0;
  if( val >= 0 )
    res = 2;
  else
    res = val + repeat(val + 1) + res;
  return res;
}
```

How many '*'s are output by the code to the right?

A. 30   B. 10   C. 20

D. 18   E. 22

```
int lim = 10;
for(int i = 0; i < lim; i++)
  System.out.print('*');

lim *= 2;
for(int i = 0; i < lim; i++)
  System.out.print('*');
```

What is output by the code to the right?

A. false false   B. true true

C. false true   D. true false

E. 1 1

```
String a1 = "DOG";
String a2 = "CAT";
String a3 = "BEAR";
boolean b1 = a1.compareTo(a2) < 0;
boolean b2 = a2.compareTo(a3) > 0;
System.out.print(b1 + " " + b2);
```

What is output by the code to the right?

A. 8   B. 6

C. 9   D. 7

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

```
final int LIMIT;
int x = 3;
int y = 2;
LIMIT = x * y;
System.out.print( LIMIT + x );
```

What is output by the code to the right?

A. true

B. false

C. LO

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

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

```
ArrayList<String> list1;
list1 = new ArrayList<String>();

ArrayList<String> list2;
list2 = new ArrayList<String>();

list1.add("LO");
list2.add( list1.get(0) );

System.out.print(list1 == list2);
```

Consider the following problem description. In the game Monopoly there are spaces on the board that represent properties that players can own. There are various behaviors and data common to all types of properties. Railroads are a kind of property with behaviors that are unique to railroads. Utilities are another kind of property with behaviors that are unique to utilities. Which of the following set of class headers best represents the relationships between properties, railroads, and utilities?

```
A.    public class Property
      public class Railroad
      public class Utility
```

```
B.    public class Utility
      public class Railroad extends Utility
      public class Property extends Railroad
```

```
C.    public class Railroad
      public class Utility
      public class Property extends Railroad, Utility
```

```
D.    public class Property
      public class Railroad extends Property
      public class Utility extends Property
```

```
E.    public class Property
      public class Railroad extends Property
      public class Utility extends Railroad
```

QUESTION 21

What is output by the code to the right?

A.   0123

B.   0123445566778899

C.   0123456789

D.   456789

E.   012344

```java
for(int i = 0; i < 10; i++){
  System.out.print(i);
  if( i > 3 ){
    System.out.print(i);
    break;
  }
}
```

QUESTION 22

How many combinations of values for the `boolean` variables a, b, and c will result in d being set to `true`?

A.   1   B.   4   C.   7

D.   5   E.   3

```java
boolean a, b, c;
//code to initialize a, b, and c

boolean d = ( a || !(b || c) );
```

QUESTION 23

Which of the following is not a valid Java identifier?

A.   _length   B.   prop386Time   C.   3times   D.   MAGIC_NUM   E.   finalClass

QUESTION 24

The intent of the code to the right is to print out the values of (N!) as N goes from 1 to 30. However the code does not work as intended. Which of the following best explains why the code does not correctly print out all values of (N!) as N goes from 1 to 30?

A.   The variable `fact` needs to be initialized to `0`.

B.   The computation of factorial is wrong. The code segment `fact = fact * i;` must be changed to `fact = fact + i;`

C.   The range of the data type `long` is not adequate to represent N! except for small values of N.

D.   The expression `fact * i` evaluates to a `double` not a `long`.

E.   `long`s cannot be concatenated with `String`s.

```java
long fact = 1;
for(int i = 1; i <= 30; i++){
  fact = fact * i;
  System.out.println( i + " " + fact );
}
```

QUESTION 25

What is output by the code to the right when `nums` is the following array?

`{2, 1, 2, 3, 3, 4, 3}`

A.   0

B.   -4

C.   8

D.   4

E.   22

```java
public void process(int[] nums){
  int total = 0;
  for(int i : nums){
    switch( i ) {
      case 1 : total++; break;
      case 2 : total -= 1; break;
      case 3 : total *= 2; break;
      default: total += 2;
    }
  }
  System.out.print( total );
}
```

QUESTION 26

What is output by the code to the right?

A.   5   B.   8   C.   1

D.   0   E.   7

```java
String nm;
nm = " Charles,William,Bach";
int index = nm.indexOf(',');
String part;
part = nm.substring(index).substring(5);
System.out.print( part.length() );
```

QUESTION 27

What is returned by the method call `tough(5)`?

A.   -25   B.   -11   C.   -45

D.   20   E.   -13

```java
public int tough(int n){
  if( n <= 0 )
    return -3;
  else
    return -n + tough(n - 2)
       +  tough(n - 4);
}
```

QUESTION 28

What is output by the code to the right?

A.   false true   B.   true true

C.   true false   D.   false false

E.   true false true

```java
char ans = 'Y';
boolean b1, b2;
b1 = ans != 'Y' || ans != 'y';
b2 = ans > 'A';
System.out.print( b1 + " " + b2);
```

What is output by the code to the right when method `gamma` is called?

A. 2 2

B. 2 4

C. 2 0

D. 0 2

E. 4 4

```
public int alpha(int x, int y){
  x *= 2;
  y -= 2;
  return x - y;
}

public int beta(int z){
  z++;
  z = alpha(z, z / 2);
  return z;
}

public void gamma(){
  int x = 2;
  System.out.print( alpha(x, x + 2) );
  System.out.print( " " + x );
}

public void delta(){
  int x = beta(3);
  System.out.print( x );
}
```

What is output by the code to the right when method `delta` is called?

A. 2

B. 0

C. 7

D. 11

E. 8

Consider method `instrumentedSort` to the right. If `nums.length` equals 10, what will method `instrumentedSort` return?

A. 45

B. 55

C. 10

D. 3628800

E. The output cannot be determined unless the code is actually run.

```
public int instrumentedSort(int[] nums){
  int comps = 0;
  int lim1 = nums.length - 1;
  int lim2 = nums.length;
  for(int i = 0; i < lim1; i++){
    int min = i;
    for(int j = i + 1; j < lim2; j++){
      comps++;
      if( nums[j] < nums[min] )
        min = j;
    }
    int temp = nums[i];
    nums[i] = nums[min];
    nums[min] = temp;
  }
  return comps;
}
```

Which sorting algorithm does the method `instrumentedSort` implement?

A. Quicksort   B. Radix sort

C. Merge sort   D. Insertion sort

E. Selection sort

The following values are inserted one at a time into a binary search tree using the traditional insertion algorithm. How many leaves are in the resulting tree?

```
13, 0, -5, 5, 10, 7, 15, 21
```

A. 1   B. 8   C. 0   D. 3   E. 6

Which of the following can be sent as an argument to method `showAll` so that the elements in `c` are guaranteed to be printed out in ascending order?

A. HashSet<Integer>

B. LinkedList<Integer>

C. Stack<Integer>

D. ArrayList<Integer>

E. TreeSet<Integer>

```java
public void showAll(Collection<Integer> c){
  for(Integer val : c)
    System.out.println( val );
}
```

What is returned by method `op` if `mat` is the matrix shown below?

2	3	2	12	-3	-6
2	-1	-5	9	3	0
-3	7	7	-2	-1	3
11	5	3	3	5	10

A. 4   B. 11   C. 7

D. 41   E. 21

```java
public int op(int[][] mat){
  int total = 0;
  for(int r = 0; r < mat.length; r += 2){
    final int LIM = mat[r].length;
    for(int c = r; c < LIM; c += 2){
      total += mat[r][c];
    }
  }
  return total;
}
```

The intent of method `freq` to the right is to create and return a `map` with a tally of the number of times each letter occurs in the file that the `Scanner sc` is connected to, but it does not work as intended. What must be changed to make the method work as intended?

A. Change the segment
    `result.put( (char)('A' + i), 0)` to
    `result.put(0)`

B. Change the `boolean` expression
    `Character.isLetter(ch)` to
    `ch != null`

C. Change the segment `x++` to
    `result.put(ch, x + 1)`

D. Change the `boolean` expression
    `Character.isLetter(ch)` to
    `Character.isLetter(ch) == true`

E. Change the statement
    `int x = result.get(ch)` to
    `int x = result.get(i)`

```java
public Map<Character, Integer> freq(
                         Scanner sc){
  Map<Character, Integer> result =
       new TreeMap<Character, Integer>();

  for(int i = 0; i < 26; i++)
    result.put( (char)('A' + i), 0);

  while( sc.hasNextLine() ){
    String line = sc.nextLine();
    for(int i = 0; i < line.length(); i++){
      char ch = line.charAt(i);
      if( Character.isLetter(ch) ){
        ch = Character.toUpperCase(ch);
        int x = result.get(ch);
        x++;
      }
    }
  }

  return result;
}
```

Assume method `sample(int[] data)` is $O(N^2)$ where $N =$ `data.length`. When method `sample` is passed an array with `length` = 4,000 it takes 4 seconds for method `sample` to complete. If method `sample` is then passed an array with `length` = 6,000 what is the expected time it will take method `sample` to complete?

A.   4 seconds   B.   6 seconds   C.   9 seconds   D.   32 seconds   E.   16 seconds

What is output by the following client code?

```
int[] data = { 2, 9, 9, 7, 9, 2};
Structure<Integer> st1;
st1 = new Structure<Integer>();

for(int i : data)
  st1.add(i);

st1.remove();
st1.remove();
System.out.print( st1.remove() + " "
    + st1.remove() );
```

A.   7 9   B.   9 9   C.   2 9

D.   9 2   E.   9 7

Assume method `myst` is uncommented. What is output by the following client code?

```
 int[] data = { 2, 9, 9, 7, 9, 2};
Structure<Integer> st2;
st2 = new Structure<Integer>();

for(int i : data)
  st2.add(i);
st2.add( st2.access() );

Structure<Integer> st3 = st2.myst();
st2.remove();
st2.remove();
System.out.print( st3.remove() + " " +
                  st3.remove() );
```

A.   7 9   B.   9 7   C.   2 9

D.   There is no output due to a syntax error in method `myst`.

E.   There is no output due to a runtime error caused by method `myst`.

What type of data structure does the `Structure` class implement assuming method `myst` is commented out?

A.   A stack   B.   A heap   C.   A set

D.   A hashtable   E.   A queue

```
public class Structure<E>{

  private ArrayList<E> con;

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

  public void add(E obj){
    con.add(obj);
  }

  public E access(){
    return con.get(con.size() - 1);
  }

  public E remove(){
    return con.remove(con.size() - 1);
  }

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

  /*
  public Structure<E> myst(){
    Structure<E> result
                = new Structure<E>();
    result.con = this.con;
    return result;
  }
  */

}
```