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.

What does 10011_2 times 111_2 equal?

A. 11010_2 B. 1010_2 C. 1111100_2 D. 11110101_2 E. 10000101_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);
```

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);
```

What is output by the code to the right?

A. 12base45   B. 4950base5152

C. abbasecd   D. 3base9

E. 3base45

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

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[st.length - 1]] += st[0];
st[4] *= st[st[4]];
st[0] *= st[3];
System.out.print(Arrays.toString(st));
```

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);
```

QUESTION 7

How many combinations of values for the `boolean` variables p, q, r, and s will result in t being set to false?

A.   5   B.   7   C.   8

D.   9   E.   11

```java
boolean p, q, r, s;
//code to initialize p, q, r, and s

boolean t = p || q && (!r || !s);
```

QUESTION 8

What is output by the code to the right?

A.   12   B.   13   C.   14

D.   23   E.   24

```java
int x2 = 5;
int y2 = 6;
if(x2 > 0 || y2++ > 0)
  System.out.print(1);
else
  System.out.print(2);
if(y2 == 7)
  System.out.print(3);
else
  System.out.print(4);
```

QUESTION 9

Which of the following can replace `<*1>` 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?

I.   `credits > s2.credits`

II.   `this.getCredits() > s2.getCredits()`

III. `this.credits > s2.getCredits()`

A.   II only   B.   I and II only

C.   I and III only   D.   II and III only

E.   I, II, and III

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

```java
public class Student {
  private int credits;

  public Student(int c) {credits = c;}

  public boolean hasMore(Student s2) {
    return <*1>;
  }

  public int getCredits() {
    return credits;
  }
}

// client code
Student st1 = new Student(12);
Student st2 = new Student(16);
boolean hm = st1.<*2>;
```

QUESTION 10

Which of the following can replace `<*2>` in the code to the right so that the client code compiles without error?

I.   `hasMore(st2)`

II.   `getCredits()`

III. `hasMore(st1)`

A.   I only   B.   I and II only

C.   I and III only   D.   II and III only

E.   I, II, and III

QUESTION 11

What is output by the code to the right?

A. 32   B. 37   C. 49

D. 52   E. 53

```
int m = 37;
int n = 57;
int o = 52;
System.out.print(o | m & n);
```

QUESTION 12

What is output by the code to the right?

A. 8.7   B. 9.0   C. 9.4

D. 9.7   E. 10.7

```
double m2 = -15.7;
double n2 = -6.3;
double o2 = Math.ceil(n2) + Math.abs(m2);
System.out.print(o2);
```

QUESTION 13

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

A. a4a-216-4   B. a4-a-216-5

C. a4a-216--4   D. a-2a416-4

E. a-2-a-24--2

```
public int ep(int a){
    System.out.print("a" + a);
    return a * a;
}

public void start(){
    System.out.print( ep(4) + "-" + ep(-2) );
}
```

QUESTION 14

What is output by the code to the right?

A. 37

B. .4

C. 0037.4

D. 37.424242

E. 37.420000

```
double d2 = 37.42;
System.out.printf("%2.6f", d2);
```

QUESTION 15

What is returned by the method call notF(5)?

A. 3   B. 11   C. 27

D. 46   E. 65

```
public int notF(int x) {
    return (x <= 0) ? 3 : notF(x-3) + x +
                                  notF(x-1);
}
```

QUESTION 16

What is output by the code to the right?

A. 2040   B. 2041   C. 2047

D. 2048   E. 4096

```
String stars = "";
for(int i = 8; i <= 1024; i *= 2)
    for(int j = 0; j < i; j++)
        stars += "*";
System.out.print(stars.length());
```

What is output by the code to the right?

A. 50

B. 37

C. 33

D. 11

E. 1

```java
String lets = "ABABC";
int res = 0;
for(int i = 0; i < 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);
```

What replaces **<*1>** in the code to the right so that the value stored in `val1` may not be altered once it is assigned?

A. const   B. static   C. final

D. private   E. None of A - D are correct.

```java
<*1> double val1;
double y1 = Math.random();
val1 = y1 * 100;
```

What is output by the code to the right?

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.

```java
long bigVal = 1234567890123L;
System.out.print(bigVal);
```

What is returned by method `readSome` to the right, if `sc` is connected to a file with the following data?

```
2 6 3 2 ABABAB
1 1 12.323 .2 1
1 3 1 1 32 14 145
```

A. 13   B. 16   C. 21

D. 213   E. 353

```java
public int readSome(Scanner sc) {
  int res = 0;
  for(int i = 0; i < 10; i++) {
    while(!sc.hasNextInt())
      sc.next();
    res += sc.nextInt();
  }
  return res;
}
```

Go on to the next page.

QUESTION 21

What is output by the client code to the right?

A.   0 1 2-3   B.   0 3 6-1

C.   0 1 2-2   D.   2 2 2-1

E.   0 3 60 1 22 2 2-3

QUESTION 22

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.

	Best Case	Worst Case
A.	O(logN)	O(logN)
B.	O(1)	O(1)
C.	O(logN)	O(2^N)
D.	O(1)	O(N)
E.	O(1)	O(logN)

QUESTION 23

Which searching algorithm do methods `search` and `help` implement?

A.   linear search   B.   interpolation search

C.   sequential search   D.   binary search

E.   map search

```java
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 > en)
    return -st - 1;
  else if(dt[m] < tgt)
    return help(dt, tgt, m + 1, en, c + 1);
  else if(dt[m] > 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));
```

QUESTION 24

What is output by the code to the right?

A.   -5 21 -5 12

B.   21 12 -5 -5

C.   -5 12 21

D.   21 12 -5

E.   -5 -5 12 21

```java
PriorityQueue<Integer> pq;
pq = new PriorityQueue<Integer>();
pq.add(-5);
pq.add(21);
pq.add(-5);
pq.add(12);
while(!pq.isEmpty())
  System.out.print(pq.remove() + " ");
```

QUESTION 25

What is output by the code to the right?

A.   13   B.   23

C.   19   D.   29

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

```java
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);
```

Which of the following is not a Java keyword?

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

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.

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.

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.

```java
public class Grade {
  private String symbol;

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

  public String toString() {
    return symbol;
  }
}

// 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


// 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
```

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

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

```java
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);
}

// 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.

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.

	sort1 algorithm	sort2 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
```

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

	`<*1>`	`<*2>`
A.	ArrayList	ListIterator
B.	List	Iterator
C.	LinkedList	Iterator
D.	Collection	ListIterator
E.	More than one of A through D is correct.	

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

What is output by the code to the right?

A. ccss429hhII

B. Ichs444s4c2

C. Ichs429shcI

D. ccss444h4I2

E. Ish4444s2c9

```java
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);
```

Go on to the next page.

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

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

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

```java
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; }
}
```