

Computer Science Competition

Number 94 (State - 2005)

General Directions (Please read carefully!):

- 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 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. 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, 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.

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 is the sum of 1011011011_2 and $AC4_{16}$?

- A. 6634_8 B. 6635_8 C. 6636_8 D. 6637_8 E. None of these

QUESTION 2

What is output by the static method call
process("tinfoil", 10)?

- A. tinfoil B. liofnit
C. A StringIndexOutOfBoundsException is thrown
D. An ArrayIndexOutOfBoundsException is thrown
E. None of these

```
public static void process(String s, int n)
{
    for (int i=0; i<=n; ++i)
        System.out.print(s.charAt(n-i));
    for (int i=n+1; i<s.length(); ++i)
        System.out.print(s.charAt(i));
}
```

QUESTION 3

What is output by the static method call
process("hat", 1)?

- A. tha B. tah
C. hta D. aht
E. None of these

QUESTION 4

Assume BinarySearchTree correctly implements the traditional binary search tree data structure. In what order would the nodes of the tree created by the code to the right be traversed in a post-order traversal of the tree?

- A. 4 5 7 9 10 16 34
B. 5 4 9 10 7 34 16
C. 7 10 9 4 5 16 34
D. 16 34 10 7 4 9 5
E. None of these

```
BinarySearchTree bst =
    new BinarySearchTree();
bst.add(new Integer(16));
bst.add(new Integer(34));
bst.add(new Integer(7));
bst.add(new Integer(10));
bst.add(new Integer(9));
bst.add(new Integer(4));
bst.add(new Integer(5));
```

QUESTION 5

What is output by the code to the right when x is 18?

- A. A B. B
C. C D. D
E. None of these

```
switch(x % 4) {
    case 0: System.out.print("A"); break;
    case 1: System.out.print("B"); break;
    case 2: System.out.print("C"); break;
    case 3: System.out.print("D"); break;
    default: System.out.print("E");
}
```

QUESTION 6

Which of these replaces <*1> in the code to the right to create an object which holds a list of students?

- A. List l();
- B. new List l();
- C. List(Student);
- D. new List<Student>();
- E. None of these

QUESTION 7

Assume <*1> is filled in correctly. Which of these correctly implements the method
boolean addStudent(Student s)?

The method should add students only if they are not in the class already and the class is not full. It should return true on a successful add and false otherwise. Use the boolean method contains() from the List interface which checks whether an object is in the list.

- A. public boolean addStudent(Student s)


```

    {
        if((students.size()==maxStudents)
           && !students.contains(s))
            return false;
        students.add(s);
        return true;
    }
  
```
- B. public boolean addStudent(Student s)


```

    {
        if((students.size()==maxStudents)
           || students.contains(s))
            return false;
        students.add(s);
        return true;
    }
  
```
- C. public boolean addStudent(Student s)


```

    {
        if(!(students.size()==maxStudents)
           || !students.contains(s))
            students.add(s);
        return true;
        return false;
    }
  
```
- D. Both B and C
- E. None of these

```

// Assume classes Employee and Student
// have been implemented. Date is a
// built-in Java class.

public class SchoolClass {
    public SchoolClass(Employee teacher,
                       int numCredits,
                       int maxStudents,
                       String id, Date firstDay) {
        this.teacher = teacher;
        this.numCredits = numCredits;
        this.maxStudents = maxStudents;
        this.id = id;
        this.firstDay = firstDay;
        this.students = <*1>;
    }

    //other constructors and methods omitted

    private Employee teacher;
    private int numCredits;
    private List students;
    private int maxStudents;
    private String id;
    private Date firstDay;
}
  
```

QUESTION 8

Which of these shows what array a looks like after the call process(a), where a is the array below?

12	-4	11	10	1	20
----	----	----	----	---	----

- A.

24	-8	22	20	2	40
----	----	----	----	---	----
- B.

0	1	10	11	-4	12
---	---	----	----	----	----
- C.

24	-8	22	20	1	20
----	----	----	----	---	----
- D.

12	-8	22	20	2	20
----	----	----	----	---	----
- E. None of these

```
public static void process(int[] a) {
    int i=a.length - 1;
    do a[--i]*=2;
    while (i >= 1);
}
```

QUESTION 9

How many '*'s are output by the code to the right when n has the value 10?

- A. 0
- B. 100
- C. 81
- D. 121
- E. None of these

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

QUESTION 10

What is the running time of the code to the right? Choose the smallest correct answer.

- A. $O(1)$
- B. $O(n)$
- C. $O(n \log n)$
- D. $O(n^2)$
- E. None of these

QUESTION 11

Which of these types could replace <*> in the code to the right allowing the initialization without a cast?

- A. short
- B. char
- C. long
- D. byte
- E. More than one of these

```
int x = 17;
<*> y = x;
```

QUESTION 12

Which of these replaces <*> in the code to the right to return the specified definition of the specified word?

- A. ((String[]) (entries.get(word)))
[definition]
- B. lookUpWord(word) [definition]
- C. entries[word] [definition]
- D. Both A and B
- E. None of these

For the remaining questions, assume that <*> has been filled in correctly.

QUESTION 13

What is the maximum number of words that can be added to a Dictionary object?

- A. 1
- B. 10
- C. 100
- D. 1000
- E. None of these

QUESTION 14

Suppose you wished to add a method called addDefinition() to the Dictionary class that added a definition to a word that was already in the dictionary. Which of these could be used inside the method to check whether a word was already in the dictionary?

- A. entries.containsKey(word)
- B. entries.hasKey(word)
- C. !entries.get(word)
- D. !get(entries, word)
- E. More than one of these

QUESTION 15

What is returned by recurse(7)?

- A. 7
- B. 21
- C. 28
- D. 5040
- E. None of these

```
public class Dictionary {
    public Dictionary() {
        entries = new TreeMap();
    }

    public void addWord(String word,
                        String[] definitions) {
        entries.put(word, definitions);
    }

    public String[] lookUpWord(String word) {
        return (String[])entries.get(word);
    }

    public String lookUpWord(String word,
                            int definition) {
        return <*>;
    }

    private Map entries;
}
```

```
public static int recurse(int i) {
    if ((i == 0) || (i == 1)) return 1;
    else return recurse(i-1) + recurse(i-2);
}
```

QUESTION 16

What is output by the `main()` method of class B?

- | | |
|------------------------------------|------------------------------------|
| A. f in B
f in A
g in A
1 | B. f in B
f in A
g in B
2 |
| C. f in B
f in A
g in B
1 | D. f in B
f in A
g in A
2 |
| E. None of these | |

```
public class A {
    public int f() {
        System.out.println("f in A");
        return g();
    }

    public int g() {
        System.out.println("g in A");
        return 1;
    }
}

public class B extends A {
    public int f() {
        System.out.println("f in B");
        return super.f();
    }

    public int g() {
        System.out.println("g in B");
        return 2;
    }

    public static void main(String[] args) {
        B b = new B();
        System.out.println(b.f());
    }
}
```

QUESTION 17

Suppose method `g()` in class A were made private.
What would be output by the `main()` method of class B?

- | | |
|------------------------------------|------------------------------------|
| A. f in B
f in A
g in A
1 | B. f in B
f in A
g in B
2 |
| C. f in B
f in A
g in B
1 | D. f in B
f in A
g in A
2 |
| E. None of these | |

QUESTION 18

Which of these calls returns 42?

- A. `process("17 c17 8def")`
- B. `process("17\tc 17 8 def")`
- C. `process("A")`
- D. Both A and C
- E. None of these

```
public static int process(String s) {
    String regex = "\\s+";
    String[] arr = s.split(regex);
    int sum = 0;
    for (int i=0; i < arr.length; ++i) {
        try { sum+= Integer.parseInt(arr[i]); }
        catch(NumberFormatException e) {}
    }
    return sum;
}
```

QUESTION 19

What is output by the code to the right?

- A. 17 27
- B. 10 54
- C. 27 17
- D. 0 0
- E. None of these

```
int x = 17, y = 27;
x = x^y; y = x^y; x = x^y;
System.out.print(" " + x + " " + y);
```

QUESTION 20

Which of the following calls returns 42?

- A. calculate("300/3-69+1")
- B. calculate("5*11+30/2")
- C. calculate("30/4+14*2-5")
- D. calculate("-15+87/3")
- E. None of these

QUESTION 21

To which of these could operator be initialized instead of START without changing the behavior of the method?

- A. PLUS
- B. MINUS
- C. TIMES
- D. DIVIDE
- E. None of these

```
public static int calculate(String s) {
    final int START = 0, PLUS = 1, MINUS = 2,
              TIMES = 3, DIVIDE = 4;
    int total = 0;
    int curr = 0;
    int operator = START;
    for (int i=0; i<s.length(); ++i) {
        if (s.charAt(i) >= '0' &&
            s.charAt(i) <= '9')
            curr = 10*curr + s.charAt(i) - '0';
        else {
            switch(operator) {
                case START: total = curr; break;
                case PLUS: total += curr; break;
                case MINUS: total -= curr; break;
                case TIMES: total *= curr; break;
                case DIVIDE: total /= curr; break;
            }
            curr = 0;
            switch(s.charAt(i)) {
                case '+': operator = PLUS; break;
                case '-': operator = MINUS; break;
                case '*': operator = TIMES; break;
                case '/': operator = DIVIDE; break;
            }
        }
    }
    return total;
}
```

QUESTION 22

What replaces <*> in the code to the right to declare r to be an object capable of generating random numbers?

- A. Random r = new Random();
- B. Random r = new Random;
- C. new Random(r);
- D. Random r = new Random(new Object());
- E. None of these

```
public static void output() {
    <*>
    do System.out.print('*');
    while (r.nextInt(2) != 0);
}
```

QUESTION 23

What is the average number of '*'s output by a call to the method output()?

- A. 1
- B. 1.5
- C. 2
- D. 2.5
- E. None of these

QUESTION 24

What replaces <*> in the code to the right to exit the function if front is at least back minus one?

- A. if (front <= back - 1) return;
- B. if (front + 1 >= back) return;
- C. if (front >= back + 1) return;
- D. if (front + 1 <= back) return;
- E. More than one of these

For the remaining questions, assume that <*> has been filled in correctly.

QUESTION 25

Which sorting algorithm is implemented by the code to the right?

- A. Insertion sort
- B. Selection sort
- C. Merge sort
- D. Quicksort
- E. None of these

QUESTION 26

If `a` begins as the array below, what will it look like after the first call to `partition()` is completed inside the static method call `sort(a)`?

2	12	3	5	1	3
---	----	---	---	---	---

- A.

1	2	3	3	5	12
---	---	---	---	---	----
- B.

1	2	5	3	5	12
---	---	---	---	---	----
- C.

1	2	12	3	5	3
---	---	----	---	---	---
- D.

1	2	3	5	12	3
---	---	---	---	----	---
- E. None of these

```
// sort an array
public static void sort(Comparable[] a) {
    sort(a, 0, a.length);
}

// sort a subarray from index front to
// index back-1
public static void sort(Comparable[] a,
                      int front,
                      int back) {
    <*>
    int mid = partition(a, front, back);
    sort(a, front, mid);
    sort(a, mid+1, back);
}

// place all elements in subarray less
// than or equal to a[front] ahead of
// all elements greater than a[front]
public static int partition(Comparable[] a,
                           int front,
                           int back) {
    Comparable c = a[front];
    Comparable temp;
    int i = front + 1;
    int j = back - 1;
    while (i <= j) {
        while (i < a.length &&
               a[i].compareTo(c) < 1)
            ++i;
        while (j >= 0 &&
               a[j].compareTo(c) > 0)
            --j;
        if (i < j) {
            temp = a[i];
            a[i] = a[j];
            a[j] = temp;
        }
    }
    temp = a[front];
    a[front] = a[j];
    a[j] = temp;
    return j;
}
```

QUESTION 27

What is the value of the expression `Math.min(3.7, -6.8) + Math.floor(3.7)`?

- A. 6.8
- B. -3.8
- C. -3.1
- D. -2.8
- E. None of these

QUESTION 28

Which of these declarations creates an array holding the first five odd integers?

- A. int [] intArray(1, 3, 5, 7, 9);
- B. int [] intArray = {1, 3, 5, 7, 9};
- C. int [5] intArray(1, 3, 5, 7, 9);
- D. int [] intArray = new(1, 3, 5, 7, 9);
- E. None of these

QUESTION 29

What method must be part of MyClass in order for it to implement Comparable?

- A. boolean compareTo(MyClass other)
- B. int compareTo(MyClass other)
- C. boolean compareTo(Object other)
- D. int compareTo(Object other)
- E. Either A or C

```
public class MyClass implements Comparable{
    // methods and data not shown
}
```

QUESTION 30

If MyClass does not specify any constructors, what happens to its data members of type int when an object of type MyClass is built?

- A. They are not initialized, and methods must initialize them before use
- B. They must be initialized in a static block
- C. They are initialized to 0
- D. It is not valid to build objects when no constructor has been specified
- E. None of these

QUESTION 31

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

- | | |
|------------------|------|
| A. 2 | B. 6 |
| C. 7 | D. 8 |
| E. None of these | |

```
int i = 7;
while (i >= 0) {
    System.out.print('*');
    --i;
    if (i % 3 == 0) continue;
}
```

QUESTION 32

Which binary operator computes boolean AND without using short-circuit evaluation?

- A. &&
- B. &
- C. ||
- D. %
- E. None of these

QUESTION 33

What must be added to the `Geometry` class to prevent the building of an object of type `Geometry` outside the `Geometry` class?

- A. `private Geometry() {}`
- B. `public Geometry() {}`
- C. `Geometry() = void;`
- D. Nothing; it is already illegal
- E. None of these

QUESTION 34

Which of these correctly calls `slopeIntercept()` from inside a class other than `Geometry`?

- A. `Geometry.slopeIntercept(1,5,3,7)`
- B. `Geometry::slopeIntercept(1,5,3,7)`
- C. `slopeIntercept(1,5,3,7)`
- D. Both A and C
- E. None of these

QUESTION 35

What is output by the `main()` function?

- A. `"y = " + f[0] +
"x + " + f[1]`
- B. `y = 1.0x + 7.0`
- C. `y = x + 4.0`
- D. `y = 1.0x + 4.0`
- E. None of these

QUESTION 36

Which of these modifies `sb` to contain "UILCS"?

- A. `sb.append(s.charAt(0)).
append(s.charAt(9));`
- B. `sb.append(s.charAt(9)).
insert(3,s.charAt(0));`
- C. `sb.append(s).delete(4,11).
delete(5,11);`
- D. More than one of these
- E. None of these

```
public class Geometry {
    public static float [] slopeIntercept(
        int x1, int y1,
        int x2, int y2) {
        if (x2 == x1)
            throw new IllegalArgumentException();
        float [] answer = new float[2];
        answer[0] = ((float)(y2-y1))/(x2-x1);
        answer[1] = y1 - answer[0]*x1;
        return answer;
    }

    public static void main(String[] args) {
        int x1 = 1, y1 = 5, x2 = 3, y2 = 7;
        float[] f = slopeIntercept(x1,y1,
                                   x2,y2);
        System.out.print("y = " + f[0] +
                         "x + " + f[1]);
    }
}
```

```
StringBuffer sb = new StringBuffer("UIL");
String s = "ComputerScience";
```

QUESTION 37

When should a sequential search be used to search a list of objects instead of a binary search?

- A. When the list is unsorted
- B. When the list contains items that are Comparable
- C. When accessing an arbitrary element of the list requires linear time instead of constant time
- D. Both A and C
- E. A, B, and C

QUESTION 38

Which of these keywords indicates that this method does not operate on an implicit object so there is no "this" object?

- A. public
- B. static
- C. int
- D. return
- E. None of these

QUESTION 39

What is output by the code below?

```
Number [] values =
    {new Integer(17),
     new Double(2.4),
     new Integer(-84)};
System.out.print(sum(values));
```

- A. -66
- B. -67
- C. -68
- D. -69
- E. None of these

QUESTION 40

What is output by the code below?

```
Number [] values =
    {new Integer(-2),
     new Double(3e10)};
System.out.print(sum(values));
```

- A. 0
- B. 2147483643
- C. 2147483645
- D. 2147483647
- E. None of these

```
// Number is the superclass of Integer,
// Double, and some other classes which
// represent numbers. All of these
// classes must override the abstract
// method intValue() which returns the
// number as an int, using the same
// rules as casting basic types if
// necessary
```

```
public static int sum(Number [] a) {
    int answer = 0;
    for (int i=0; i<a.length; ++i)
        answer += a[i].intValue();
    return answer;
}
```