University Interscholastic League

Computer Science Competition

Number 83 (Invitational A - 2004)

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 number 81_{10} when converted to binary?

A. 1010010 B. 1011010 C. 1100000 D. 1001001 E. None of these

QUESTION 2

Which of the following declares variable `a` to be of type `Address`, and initializes it to the address below?

1600 Pennsylvania Avenue
Washington, DC 20500

A.
```
Address a = new Address("1600",
    "Pennsylvania Avenue",
    "Washington", "DC", "20500");
```

B.
```
Address a = new Address(1600,
    "Pennsylvania Avenue",
    "Washington", "DC", 20500);
```

C.
```
Address a = Address("1600",
    "Pennsylvania Avenue",
    "Washington", "DC", "20500");
```

D.
```
Address a = Address(1600,
    "Pennsylvania Avenue",
    "Washington", "DC", 20500);
```

E. None of these

QUESTION 3

Which of these expressions could be used in the constructor to test that parameter `stat` was two characters long?

A. `stat == 2`

B. `stat.charAt(2) == null`

C. `stat.length == 2`

D. `stat.length() == 2`

E. More than one of these

QUESTION 4

Suppose that there is a second `Address` constructor which has an `int` parameter named `zip` to represent the zip code. Which of these correctly sets the private data member `zipCode` in that constructor?

A. `zipCode = zip;`

B. `zipCode = (String)zip;`

C. `zipCode = zip.toString();`

D. `zipCode = String.valueOf(zip);`

E. None of these

```
public class Address {

  public Address (String hn,
                  String strt,
                  String ci,
                  String stat,
                  String zip) {
    // code to initialize private
    // data members
  }

  // other methods not shown

  private String houseNumber;
  private String street;
  private String city;
  private String state;
  private String zipCode;

}
```

QUESTION 5

What is returned by the static method call `mystery("AdamJackson")`?

A. 0 B. 1

C. 2 D. 11

E. None of these

QUESTION 6

What is returned by the static method call `mystery("bananana")`?

A. 1 B. 3

C. 5 D. 7

E. None of these

```
public static int mystery(String s) {
  int count=0;
  int j = s.length()/2;
  for (int i=0; i<s.length()/2; ++i, ++j)
    if (s.charAt(i)==s.charAt(j))
      ++count;
  return count;
}
```

QUESTION 7

What is the value of `count` after the completion of the outer loop in the code to the right if `getInt()` returns the value 9?

A. 9 B. 45

C. 81 D. 100

E. None of these

QUESTION 8

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

A. $O(1)$ B. $O(n)$

C. $O(n^2)$ D. $O(n^{3.5})$

E. None of these

```
int count=0;
int n = getInt();

for (int i=0; i<n; ++i)
  for (int j=0; j<n; ++j)
    ++count;
```

QUESTION 9

What replaces **<*1>** in the code to the right to state that the methods of the `Book` class include all of those listed in the `Comparable` interface?

A. `is Comparable`

B. `implements Comparable`

C. `extends Comparable`

D. `(Comparable)`

E. None of these

```
public class Book <*1> {
  // methods and data not shown
}
```

QUESTION 10

Which of the following replaces **<*1>** in the code to the right so that the default constructor builds a circle with radius 1?

A. `this(1);`

B. `Circle(1);`

C. `super(1);`

D. `r=1;`

E. More than one of these

QUESTION 11

Assume that **<*1>** has been filled in correctly. Which of the following returns the area of `PlaneCircle pc`?

A. `(Circle)pc.area()`

B. `pc.super.area()`

C. `pc.(Circle)area()`

D. `pc.area()`

E. None of these

QUESTION 12

Given a `Circle c` that is initialized to hold a `Circle` and a `PlaneCircle pc` that is initialized to hold a `PlaneCircle`, which of the following expressions evaluates to `true`?

A. `Circle instanceof PlaneCircle`

B. `c instanceof pc`

C. `c instanceof PlaneCircle`

D. `Circle instanceof Object`

E. None of these

```
public class Circle {

  public Circle() {
    <*1>
  }

  public Circle(int r) {
    radius=(r>0)?r:1;
  }

  public double area() {
    return Math.PI * radius * radius;
  }

  private int radius;
}

public class PlaneCircle extends Circle {

  public PlaneCircle(int r, int x, int y) {
    super(r);
    this.x=x;
    this.y=y;
    }

  private int x;
  private int y;
}
```

QUESTION 13

What is output by the code to the right?

A. `ComputerScience`

B. `UIL`

C. `UILComputerScience`

D. `nce`

E. None of these

```
String s = "UILComputerScience";

System.out.print(s.substring(3));
```

QUESTION 14

What will be output by the code to the right during the loop iteration with `i` equal to `1`?

A. `s`

B. `string`

C. `somestringinput`

D. `some string input`

E. None of these

```
String s = "some string input";

StringTokenizer stok =
                    new StringTokenizer(s);

for (int i=1; i<=4; ++i)
  System.out.print(stok.nextToken());
```

QUESTION 15

What will be returned by the fourth call to `nextToken()`?

A. nothing; an exception will be thrown instead

B. `null`

C. the empty string

D. `'e'`

E. None of these

QUESTION 16

What replaces **<*1>** in the code to the right to check whether the object at index `middle` in array `a` is the same as the object being searched for?

A. `c==0`

B. `c>0`

C. `c==-1`

D. `!c`

E. More than one of these

QUESTION 17

What replaces **<*2>** in the code to the right to check whether the object at index `middle` in array `a` is smaller than the object being searched for?

A. `c==0`

B. `c>0`

C. `c==-1`

D. `!c`

E. None of these

```
public static boolean find(Comparable[] a,
                           Object value) {

  int front=0, back=a.length-1;
  int middle;

  do {
    middle=(front+back)/2;
    int c = a[middle].compareTo(value);
    if (<*1>) return true;
    else if (<*2>) front = middle + 1;
    else back = middle - 1;
  } while (front <= back);
  return false;
}
```

QUESTION 18

What is returned by `process(63)`?

A. 1 B. 2
C. 3 D. 4
E. None of these

QUESTION 19

What is returned by `process(27)`?

A. 1 B. 2
C. 3 D. 4
E. None of these

```
public static int process(int x) {
  int y=0;
  x=(x>0)?x:-x;
  while (x!=0) {
    switch(x%4) {
    case 0:
      ++y;
    case 1:
      ++y;
    case 2:
      ++y;
    case 3:
      ++y;
    }
    x/=4;
  }
  return y;
}
```

QUESTION 20

What is the value of this expression?

```
3*7-4*5
```

A. 1 B. 17 C. 45 D. 85 E. None of these

QUESTION 21

What is the value of `intArray[2]`?

A. 16 B. 27
C. 43 D. 55
E. None of these

QUESTION 22

Which of these calls a library method to sort `intArray`?

A. `Arrays.sort(intArray)`
B. `Collections.sort(intArray)`
C. `intArray.sort()`
D. `quicksort(intArray)`
E. None of these

```
int[] intArray = {16, 55, 43, 27, 88};
```

QUESTION 23

Which of the following replaces **<*1>** in the code to the right so that rank is set to be the string "2" when value%13 is 1, the string "3" when value%13 is 2, and so on?

A. `rank=value%13+1;`

B. `rank=value%13+'1';`

C. `rank=""+(value%13+'1');`

D. `rank=""+(char)(value%13+'1');`

E. More than one of these

For the remaining questions, assume that **<*1>** has been filled in correctly.

QUESTION 24

Which of the following is a possible value of a Card's private data member value after the constructor completes?

A. -10 B. 0

C. 17 D. 52

E. More than one of these

QUESTION 25

What is output by the code below?

```
Card c = new Card('A', 'S');
System.out.print(c);
```

A. ace of spades

B. Ace of Spades

C. AS

D. 39

E. None of these

```
public class Card {

  public Card(char rank, char suit) {
    int r,s;

    if ('2'<=rank && rank<='9') r=rank-'1';
    else if (rank=='A') r=0;
    else if (rank=='T') r=9;
    else if (rank=='J') r=10;
    else if (rank=='Q') r=11;
    else if (rank=='K') r=12;
    else throw
            new IllegalArgumentException();

    if (suit=='C') s=0;
    else if (suit=='D') s=1;
    else if (suit=='H') s=2;
    else if (suit=='S') s=3;
    else throw
            new IllegalArgumentException();

    value = s*13+r;
    }

  public String toString() {
    String rank, suit;

    switch(value%13) {
    case 0: rank="ace"; break;
    case 9: rank="10"; break;
    case 10: rank="jack"; break;
    case 11: rank="queen"; break;
    case 12: rank="king"; break;
    default: <*1>
    }

    switch(value/13) {
    case 0: suit="clubs"; break;
    case 1: suit="diamonds"; break;
    case 2: suit="hearts"; break;
    case 3: suit="spades"; break;
    default: suit=""; //should never happen
    }

    return rank + " of " + suit;
  }

  private int value;
}
```

QUESTION 26

What is output by the code to the right if the static method call `f()` throws a `NumberFormatException`?

A. nothing

B. `Number format errorRuntime error`

C. `Number format error`

D. `Runtime error`

E. None of these

```
try {
  f();
}

catch(NumberFormatException nfe) {
  System.out.print("Number format error");
}

catch(RuntimeException re) {
  System.out.print("Runtime error");
}
```

QUESTION 27

What is output by the code to the right?

A. output is system dependent

B. `3.14159`

C. `3.141592654`

D. `3`

E. None of these

```
double d = Math.PI;

int i = (int)d;

System.out.print(i);
```

QUESTION 28

Which of these represents array `a` after executing the code to the right?

A.

0	0	0	0
0	0	0	0
0	0	0	0

B.

0	0	0	0
1	1	1	1
2	2	2	2

C.

0	1	2	3
0	1	2	3
0	1	2	3

D.

1	2	3	4
1	2	3	4
1	2	3	4

E. None of these

```
int[][] a = new int[3][4];

for (int i=0; i<3; ++i)
  for (int j=0; j<4; ++j)
    a[i][j] = i;
```

QUESTION 29

What replaces **<*1>** and **<*2>** in the code to the right so that the `Merge()` method merges the two sorted parts of array `A` between indices `front` and `back`?

A.
```
<*1>: temp[++k]=A[++i];
<*2>: temp[++k]=A[++j];
```

B.
```
<*1>: temp[++k]=A[i++];
<*2>: temp[++k]=A[j++];
```

C.
```
<*1>: temp[k++]=A[++i];
<*2>: temp[k++]=A[++j];
```

D.
```
<*1>: temp[k++]=A[i++];
<*2>: temp[k++]=A[j++];
```

E. None of these

For the remaining questions, assume **<*1>** and **<*2>** have been filled in correctly.

QUESTION 30

Which of the following could be passed as a parameter to the public `MergeSort()` method

A. an array of `Strings`

B. an array of `booleans`

C. an array of `TreeMaps`

D. an array of `chars`

E. All of these

QUESTION 31

What is the running time of the `Merge()` method when called with `back - front` equal to `n`? Choose the smallest correct answer.

A. `O(1)`

B. `O(log n)`

C. `O(n)`

D. `O(n log n)`

E. None of these

```
public class Sort {

  public static void MergeSort
                (Comparable[] A) {
    MergeSort(A, 0, A.length);
  }

  private static void MergeSort
      (Comparable[] A, int front,
                       int back) {
    int mid=(front+back)/2;
    if (mid==front) return;
    MergeSort(A,front,mid);
    MergeSort(A,mid,back);
    Merge(A,front,back);
  }

  private static void Merge(Comparable[] A,
                     int front, int back) {
    Comparable[] temp =
           new Comparable[back-front];
    int i=front, j=(front+back)/2, k=0;
    int mid=j;

    while(i<mid && j<back) {
      if (A[i].compareTo(A[j])<0)
        <*1>
      else
        <*2>
    }

    while (i<mid) <*1>
    while (j<back) <*2>

    for(i=0; i<back-front; ++i)
      A[front+i]=temp[i];

  }

}
```

QUESTION 32

What is returned by the static method call `f(-5)`?

A. no return value
B. `NumberFormatException` thrown
C. `-5`
D. `0`
E. None of these

QUESTION 33

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

A. `4` B. `6`
C. `8` D. `10`
E. None of these

QUESTION 34

What is returned by the method call `f(100)`?

A. `100` B. `2500`
C. `200` D. `500000`
E. None of these

```
public static int f(int x) {
  if (x<=0) return 0;
  else return f(x-2) + g(x-1);
}

public static int g(int y) {
  if (y<=0) return 0;
  else return 1 + g(y-1);
}
```

QUESTION 35

Assume that the `IntQueue` class has been implemented to represent a queue of `int` values, and that the `dequeue()` method returns the `int` being dequeued. What is output by the code to the right?

A. nothing
B. `45`
C. `101520`
D. `201510`
E. None of these

```
IntQueue q = new IntQueue();

q.enqueue(10);
q.enqueue(15);
q.enqueue(20);

System.out.print(q.dequeue());
System.out.print(q.dequeue());
System.out.print(q.dequeue());
```

QUESTION 36

Which of these is not a keyword in Java?

A. `final` B. `break` C. `finally` D. `class` E. None of these

QUESTION 37

Assume the `getLine()` method returns a `String` of input from the keyboard. What replaces **<*1>** in the code to the right to convert the `String` to an `int`?

A. `Integer.parseInt(s);`

B. `s.parseInt();`

C. `(int)s;`

D. `s.parse(int i);`

E. None of these

```
String s = getLine();

int i = <*1>
int count=0;

for (int j=0; j<i; ++j) {
  if ((i-j)%2==0 && count++<10)
    System.out.print('*');
  }
```

QUESTION 38

Assume that **<*1>** is implemented correctly. How many `*`'s are output by the code to the right if the `getLine()` method returns the string `"17"`?

A. 0 B. 8

C. 4 D. 17

E. None of these

QUESTION 39

Assume the `getLine()` method returns a `String` of input from the keyboard. What is checked by the expression `s1==s2`?

A. whether `s1` and `s2` have the same length

B. whether `s1` and `s2` have the same characters in the same order

C. whether `s1` and `s2` are both String objects

D. whether `s1` and `s2` are references to the same object

E. None of these

```
String s1 = getLine();
String s2 = getLine();

if (s1==s2) System.out.print("==");
```

QUESTION 40

What is the result of applying the logical exclusive or operation to the binary representations of the hexadecimal numbers $4BA_{16}$ and 132_{16}?

A. 588_{16} B. $5BA_{16}$ C. $5EC_{16}$ D. 032_{16} E. None of these

COMPUTER SCIENCE ANSWER KEY
UIL INVITATIONAL A 2004

1.	E	11.	D	21.	C	31.	C
2.	A	12.	E	22.	A	32.	D
3.	D	13.	A	23.	D	33.	B
4.	D	14.	E	24.	E	34.	B
5.	A	15.	A	25.	A	35.	C
6.	B	16.	A	26.	C	36.	E
7.	C	17.	E	27.	D	37.	A
8.	C	18.	C	28.	B	38.	B
9.	B	19.	E	29.	D	39.	D
10.	A	20.	A	30.	A	40.	A

IMPORTANT NOTE TO GRADERS: Correct answers receive **6 points**, and incorrect answers receive a deduction of **2 points**. No points are given or deducted for unanswered questions.