

Name:

Instructions

1. Write your name at the top of *this* page.
2. This is a closed-book exam. No form of communication is permitted (eg, talking, texting, etc.), except with the course staff.
3. No electronic devices are permitted.
4. There are 30 multiple-choice/short-answer questions in this exam, each worth 3 points. You have 75 minutes to answer the questions.
5. Each question must be answered *with a pencil* as shown below. It will be marked as incorrect otherwise.

Multiple-choice question: (A) (B) (C) (D) (E)

Short answer question:

6. You may use the blank spaces for any scratch work.
7. Discussing the exam contents with anyone who has not taken the exam is a violation of the academic honesty code.

Problem 1. Consider running a program `Mystery.java` as follows:

```
$ java Mystery Fred Carol Bob Alice Dan Eve
```

a. How many command-line arguments does the program receive?

b. What is the index of the fifth command-line argument?

c. What is the fifth command-line argument?

- (A) "Eve"
(B) "Bob"
(C) "Carol"
(D) "Dan"
(E) "Alice"

Problem 2. Consider the following program `Mystery.java`:

```
import stdlib.Stdout;

public class Mystery {
    public static void main(String[] args) {
        int x = Integer.parseInt(args[0]);
        int y = Integer.parseInt(args[1]);
        int z = x * x + 2 * x * y + y * y;
        StdOut.println(z);
    }
}
```

a. What does the program write when run with inputs 9 and 4?

b. What does the program write in general?

- (A) $y^2 - x^2$
(B) $(x - y)^2$
(C) $(x + y)^2$
(D) $x^2 + y^2$
(E) $x^2 - y^2$

Problem 3. Consider the following program `Mystery.java`:

```
import stdlib.Stdout;

public class Mystery {
    public static void main(String[] args) {
        int n = Integer.parseInt(args[0]);
        int x = 0;
        int i = 1;
        while (i <= n) {
            if (i % 2 != 0) {
                x += i * i;
            }
            i++;
        }
        StdOut.println(x);
    }
}
```

a. What does the program write when run with input 10?

b. What does the program write in general?

- (A) Sum of the squares of even integers less than or equal to n
(B) Sum of the squares of odd integers less than or equal to n
(C) Sum of the squares of integers less than or equal to n
(D) The value n^2
(E) Sum of the integers less than or equal to n

Problem 4. Consider the following program `Mystery.java`:

```
public class Mystery {
    public static void main(String[] args) {
        int[] a = {1, 2, 3};
        int[] b = {4, 5, 6};
        int x = 0;
        for (int i = 0; i < a.length; i++) {
            x += a[i] * b[i];
        }
    }
}
```

a. What is the value of `x` after the first iteration of the for loop?

b. What is the value of `x` after the last iteration of the for loop?

Problem 5. Consider the following program `Mystery.java`:

```
public class Mystery {
    public static void main(String[] args) {
        int[][] a = {{1}, {2, 3}, {4, 5, 6}, {7, 8, 9, 10}};
        int x = 0;
        for (int i = 0; i < a.length; i++) {
            for (int j = 0; j < a[i].length; j++) {
                x += a[i][j];
            }
        }
    }
}
```

a. What is the value of `x` after the first iteration of the outer for loop?

b. What is the value of `x` after the last iteration of the outer for loop?

Problem 6. Consider the following program `Mystery.java`:

```
import stdlib.StdIn;
import stdlib.StdOut;

public class Mystery {
    public static void main(String[] args) {
        String x = StdIn.readString();
        String y = StdIn.readString();
        StdOut.print(x + "L" + y);
        StdOut.print(" ");
        StdOut.print(y + "R" + x);
        StdOut.println();
    }
}
```

Next, suppose that the file `input.txt` contains the two strings `F` and `F` separated by a space.

a. What does the command `java Mystery < input.txt` write?

- (A) FLFLFRFLFRFRFLFLFRFRFLFLFRF FRFRFLFRFLFRFRFLFLFRFLFRF
- (B) FLF FRF
- (C) F F

- (D) FLFLFRF FRFRFLF
 (E) FLFLFRFLFRFRFLF FRFRFLFRFLFRF

b. What does the command `java Mystery < input.txt | java Mystery write?`

- (A) FLFLFRFLFRFRFLFRFRFLFRFLFRF FRFRFLFRFLFRFRFLFRFLFRFRFLF
 (B) FLF FRF
 (C) F F
 (D) FLFLFRF FRFRFLF
 (E) FLFLFRFLFRFRFLF FRFRFLFRFLFRF

Problem 7. Consider the following functions:

```
private static int f(int x, int k) {
    return k * x + 1;
}

private static int g(int x, int k) {
    return x % k;
}
```

a. What does `f(6, 5)` return?

b. What does `g(19, 7)` return?

c. What does `g(f(6, 3), 5)` return?

d. What does `f(g(19, 7), 3)` return?

Problem 8. Consider the following recursive function:

```
public static int mystery(int a, int b) {
    return (b == 0) ? 1 : a * mystery(a, b - 1);
}
```

a. What does `mystery(3, 0)` return?

b. What does `mystery(3, 1)` return?

c. What does `mystery(3, 4)` return?

d. What does `mystery(a, b)` return in general about a and b ?

- (A) a^b
 (B) ab
 (C) $a + b$

(D) $a \bmod b$

(E) $|a - b|$

Problem 9. Consider the following functions:

```
private static int f(String s, char c) {
    int x = 0;
    for (int i = 0; i < s.length(); i++) {
        x += (s.charAt(i) == c) ? 1 : 0;
    }
    return x;
}

private static int g(String s) {
    char[] x = {'a', 'e', 'i', 'o', 'u'};
    int y = 0;
    for (char c : x) {
        y += f(s, c);
    }
    return y;
}
```

a. What does `f("abracadabra", 'b')` return?

b. What does `g("abracadabra")` return?

c. What does `f("alacazam", 'z')` return?

d. What does `g("alacazam")` return?

Problem 10. Consider the following data type called `Mystery`:

```
public class Mystery implements Comparable<Mystery> {
    private int x;

    public Mystery(int x) {
        this.x = x;
    }

    public int f() {
        this.x *= 2;
        return this.x;
    }

    public int g() {
        this.x++;
        return this.x;
    }

    public int compareTo(Mystery other) {
        return this.x - other.x;
    }
}
```

Next, consider two objects `m1` and `m2` of type `Mystery` created as follows:

```
Mystery m1 = new Mystery(3);
Mystery m2 = new Mystery(7);
```

a. What does `m1.f()` return?

b. What does `m2.f()` return?

c. What does `m1.g()` return?

d. What does `m2.g()` return?

e. What does `m2.compareTo(m1)` return?

Solution 1.

- a. 6
- b. 4
- c. D

Solution 2.

- a. 169
- b. C

Solution 3.

- a. 165
- b. B

Solution 4.

- a. 4
- b. 32

Solution 5.

- a. 1
- b. 55

Solution 6.

- a. B
- b. D

Solution 7.

- a. 31
- b. 5
- c. 4
- d. 16

Solution 8.

- a. 1
- b. 3
- c. 81
- d. A

Solution 9.

- a. 2
- b. 5
- c. 1
- d. 4

Solution 10.

- a. 6
- b. 14
- c. 7
- d. 15
- e. 8