CS100B: Prelim 2
October 19, 1999
7:30 PM – 9:00 PM

(Print your name)

(Signature)

(Student ID)

Sections 10 11 12 13 14 15
(circle one) Mon Mon Mon Tue Tue Tue
1:25 2:30 3:35 10:10 2:30 3:35

Instructions:

• CIRCLE YOUR SECTION! Otherwise, your test will be sent to Carpenter.
• Answer all questions by yourself! Respect academic integrity.
• Sign or initial each page.
• Show all work and comment code fragments to receive partial credit
• Use the back of each page if you need more space.
• Remember to breathe! Relax, it’s only a test.

Points:

1. ______ (10 points)

2. ______ (15 points)

3. ______ (20 points)

4. ______ (25 points)

5. ______ (30 points)

Subtotal: ______ /100 points

6. ______ (2 possible bonus points)

Total: ______
Problem 1 10 points: Short answer questions

Answer the following questions. Try to keep your answers clear and concise.

1a) (2 points) What is Java?

1b) (2 points) Distinguish between procedural and structured approaches to programming.

1c) (2 points) How does an object relate to a class in the context of object oriented programming?

1d) (2 points) Distinguish between formal and actual parameters.

1e) (2 points) Name two identifiers that help Java implement information hiding.
Problem 2      15 points: Code tracing

What is the output of the following code? Hints: Yes, this code does in fact compile and run. We’ve given some portions of the 6 lines of output. The comments indicate the order of the output of each line.

```java
public class problem2 {
    public static void main(String args[]) {
        int a = 1;
        Data temp1 = new Data(a);
        Data temp2 = new Data(a-1);
        temp2 = temp1;
        System.out.println("1: "+temp2.value); // 1st output
        System.out.println("2: "+change(a,temp1)); // 2nd output
        System.out.println("4: "+a); // 4th output
        System.out.println("5: "+temp1.value); // 5th output
        System.out.println("6: I love CS100B!"); // 6th output
    }
    public static int change(int a, Data temp) {
        a = 2;
        temp.value = a;
        System.out.println("3: "+a); // 3rd output
        return 3;
    }
    class Data {
        int value;
        Data(int input) {
            value = input;
        }
    }
}
```

Fill in the remaining portions of output from the program:

1: _____

2: _____

3: _____

4: _____

5: _____

6: ____________________
Problem 3 20 points: Nested loops

Write a program that generates the following tabular output:

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

Your code should use a nested loop and fill in the blanks of the provided code. Hints: Each pair of numbers represents the row and column position, respectively, of each pair. For instance, element “12” = row 1, column 2. You must use all given variable names!

```java
public class problem3 {
    public static void main(String args[]) {
        int nr = _____; // number of rows
        int nc = _____; // number of columns
        int row;       // loop index
        int col;       // loop index

        // print an nr x nc table of pairs of numbers
        for (row = 1; row <= _____; row++) {
            for (_____ = _____; _____ <= _____; ______) {
                System.out.print(_____); // output row number
                System.out.print(_____); // output col number
                System.out.print(_____); // output space between each pair
            } // inner for loop
            // insert new line at end of each row
            ________________________________;
        } // outer for loop
    } // method main
}
```
Problem 4  25 points: Filling in code (15 points) and tracing (10 points) for objects

Write a program that relates different classes of quadrilaterals which are 4 sided polygons. In general a square is a type of rectangle, which is a type of parallelogram, which is a type of quadrilateral. Fill in the blanks for missing code, and report the output the program gives. Note that you must use the given variable names and make sure the code in method main can call class Quad. Also, do not try to implement encapsulation.

```java
public _________ _________ { // hint: the first blank is class
    _________ _________; // name of quad
    _________ _________; // the quad’s type is another Quad
    _________ ( _________ input) {
        _________ = _________; // assign quad’s name
    }
} // constructor Quad

} // class Quad

public class problem4 {

    public static void main(String args[]) {

        // assign objects
        Quad shape1 = new Quad("squa"); // square
        Quad shape2 = new Quad("rect"); // rectangle
        Quad shape3 = new Quad("para"); // parallelogram
        Quad shape4 = new Quad("quad"); // quadrilateral

        // instantiate relationships between objects
        shape1.type = shape2;
        shape2.type = shape3;
        shape3.type = shape4;

        // program output
        System.out.println("1: " + shape1.name); // 1st output
        System.out.println("2: " + shape1.type.name); // 2nd output
        System.out.println("3: " + shape1.type.type.type.name); // 3th output
        System.out.println("4: " + shape2.type.name); // 4th output
        System.out.println("5: " + shape2.type.type.name); // 5th output
    }
}

} // class problem4

(See next sheet for program output)
(Problem 4 continued) Output from program:

1: ______________________

2: ______________________

3: ______________________

4: ______________________

5: ______________________
Problem 5 30 points: Program (20 points correctness, 5 points style, 5 points documentation: all mandatory!)

Recall that an imaginary number \( i = \sqrt{-1} \). A complex number combines real and imaginary numbers. For instance, \( 1 + 3i = 1 + 3\sqrt{-1} \). Arithmetic performed on complex numbers uses the following rules:

- Addition: \((a + bi) + (c + di) = (a + c) + (b + d)i\)
- Multiplication: \((a + bi) \times (c + di) = (ac - bd) + (bc + ad)i\)

Complete the following code. Your program should prompt the user to decide to add or multiply two complex numbers already declared in the code. Your program must compute and output the result of the complex arithmetic. You do not need to use encapsulation. You must use the variables, methods, and classes provided below.

```java
public class Complex {
    double re; // real component
    double im; // imaginary component
    Complex() { }
    Complex(double R, double I) {
        re = R;
        im = I;
    }
    // complex addition
    public Complex addcomplex(Complex C2) {
        // fill in missing code and comments:
    }
    // method addcomplex

    // complex multiplication
    public Complex mulcomplex(Complex C2) {
        // fill in missing code and comments:
    }
    // method mulcomplex
```

// print a complex number
public void printcomplex() {
    // fill in missing code and comments:
}
} // method printcomplex

} // class Complex

public class problem5 {
    public static void main(String args[]) {

        // c1 = 1 + 2i
        double c1real = 1;
        double c1imag = 2;
        // c2 = 2 - 3i
        double c2real = 2;
        double c2imag = -3;

        // Declare and instantiate c1, c2, and c3 objects
        // fill in missing code and comments:

        // User chooses arithmetic operation
        TokenReader in = new TokenReader(System.in);
        System.out.println("Choose operation [1=add,2=multiply]");
        int choice = in.readInt();

        // Compute and output results based on user’s choice
        // fill in missing code and comments:

    } // method main
} // class problem5
Problem 6  2 points: Bonus problems (optional)

6a) (0.5 points) What does “OOP” stand for (in the context of Java programming)?

6b) (0.5 points) Describe the two fundamental principles that guarantee containment of an interval arithmetic operation.

6c) (0.1 points) Who applied Interval Analysis to contain computer round-off error in 1966?

6d) (0.1 points) What does the expression \( \{ x | x \leq x \leq x \} \) mean?

6e) (0.1 points) What is the interval \( x \) given a percent uncertainty of 10% and center value \( x^c = 10 \)?

6f) (0.1 points) What does an amplifier do?

6g) (0.1 points) What does a sheet pile do?

6h) (0.5 points) What is the title David I. Schwartz’s Ph.D. dissertation?