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

Ima Student

(Print your name)

Statement of integrity: I did not break the rules of academic integrity on this exam:

(Signature)

123456

(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.
- This test is closed book (no calculators, reference sheets, or any other material allowed).
- Initial or sign 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. ______ (15 points)

2. ______ (15 points)

3. ______ (15 points)

4. ______ (25 points)

5. ______ (30 points)

Subtotal: **______ /100 points**

6. ______ (2 possible bonus points)

Total: ______

Problem 1 *15 points: Short answer questions*

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

1a) (2 points) What is Java? And no, we don't mean coffee.

A programming language.

1b) (3 points) Distinguish between procedural and structured approaches to programming.

Procedural programming breaks problems into series of functions (smaller tasks or modules to perform). Structured programming use smaller element to model real-world components. These elements combine data and functions to form objects.

1c) (4 points) How does an object relate to a class in the context of object oriented programming?

Objects instantiate classes.
An object is an instance of a class.

1d) (3 points) Distinguish between formal and actual parameters.

Formal parameter: the variable in the method header where the method is defined.
Actual parameter: the value or variable passed into a method.
The formal parameter receives a value or reference passed by the actual parameter.

1e) (3 points) Name two reserved words that help Java implement information hiding.

`public`
`private`

Problem 2 *15 points: Code tracing*

What is the output of the following code? Hints: We've given some portions of the 6 lines of output. The comments indicate the order of the output of each line.

```
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("3: " + change(a+1,temp1)); // 3rd 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
    } // method main

    public static int change(int a, Data temp) {
        temp.value = a;
        System.out.println("2: " + a);               // 2nd output
        return ++a;
    } // method change
} // class problem2

class Data {
    int value;
    Data(int input) {
        value = input;
    } // constructor Data
} // class Data
```

Fill in the remaining portions of output from the program:

```
1: 1

2: 2

3: 3

4: 1

5: 2

6: I love CS100B!
```

Problem 3 *15 points: More code tracing*

This program relates a class 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. Report the output the program gives.

```
class Quad {
     String name;
     Quad type;
     Quad(String label) {
          name = label;
     } // constructor Quad
} // class Quad

public class problem3 {
     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

     } // method main
} // class problem3
```

Fill in the remaining portions of output from the program:

```
1: squa

2: rect

3: quad

4: para

5: quad
```

Problem 4 *25 points: Nested loops (20 points correctness, 3 points style, 2 points documentation: all mandatory!)*

Write a program that generates the following tabular output:

```
11 12 13 14
21 22 23 24
31 32 33 34
41 42 43 44
```

Your code should use a nested loop and **`System.out`** to produce output. You must use the provided code and supplied variable names for your program! Hints: Each pair of numbers represents the row and column position of each pair. For instance, element "12" = row 1 and column 2.

```
public class problem4 {
    public static void main(String args[]) {

        int nr = 4;   // number of rows
        int nc = 4;   // number of columns
        int row;      // loop index
        int col;      // loop index

        // print an nr x nc table of pairs of numbers
        // fill in missing code and comments:

        for (row = 1; row <= nr; row++) {

            for (col = 1; col <= nc; col++) {

                System.out.print(row);

                System.out.print(col);

                System.out.print(" "); // print space between each pair

                // Note: System.out.print(row+col+" ") won't work

            }

            System.out.print ("\n"); // skip line between each row

        }

    } // method main
} // class problem4
```

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, $1 + 3\sqrt{-1} = 1 + 3i$, where 1 is the real component, and 3 is the imaginary component. Arithmetic performed on complex numbers uses the following rules:

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

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.

```
public class Complex {
     double re;    // real component
     double im;    // imaginary component

     // constructors
     Complex() {}
     Complex(double R, double I) {
          re = R;
          im = I;
     }

     // complex addition
     public Complex addc(Complex C2) {

     // fill in missing code and comments:

          //a+bi + c+di = (a+c) + (b+d)i

          double real = re+C2.re;         // add real components

          double imag = im+C2.im;         // add complex components

          return new Complex(real,imag);

     } // method addc
```

```
    // complex multiplication
    public Complex mulc(Complex C2) {

    // fill in missing code and comments:

            //(a+bi)*(c+di) = (ac-bd)+(ad+bc)i

            double real = re*C2.re-im*C2.im; // multiply for real component

            double imag = re*C2.im+im*C2.re; // multiply for complex component

            return new Complex(real,imag);

    } // method mulc

    // print a complex number in these forms: a+bi or a-bi.
    // Examples: 7+3i, 8-2i, -1+0i, 0+2i, 0-3i
    public void printc() {

    //fill in missing code and comments:
            if (im >= 0)
                 System.out.print(re+"+"+im+"i\n");

            else
                 System.out.print(re+""+im+"i\n"); // need to separate comps.

    } // method printc

} class Complex

public class problem5 {

    public static void main(String args[]) {

         // Declare components of complex numbers, c1 and c2:

         // c1 = 1 + 2i
         double c1real = 1;
         double c1imag = 2;

         // c2 = 2 - 3i
         double c2real = 2;
         double c2imag = -3;
```

```
        // Declare and instantiate necessary objects (like c1 and c2)
        // Remember to use the class Complex
        // fill in missing code and comments:

        Complex c1 = new Complex(c1real,c1imag); // 1st complex number
        Complex c2 = new Complex(c2real,c2imag); // 2nd complex number

        // some students might do:
        // c3 = c1+c2 or c1*c3
        Complex c3 = new Complex();

        // 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
        // Remember to use the class Complex
        // fill in missing code and comments:

        if (choice == 1) {
             c3 = c1.addc(c2); // c1+c2
             c3.printc();

             // or, c1.addc(c2).printc();

             }

        else if (choice == 2) {
             c3 = c1.mulc(c2); // c1*c2
             c3.printc();

             // or, c1.mulc(c2).printc();

             }

        else

             System.out.println("Don't understand choice. Try again!");

             // also, System.exit(<integer>)
    } // method main
} // class problem5
```

Problem 6 *2 points: Bonus problems (optional). Before working on these, be sure to proofread the entire test! (If you answer 7–8 questions correctly: 2 points; 4–6 correctly: 1 point; 0–3 correctly: 0 points. Regrade requests very unlikely to be accepted.)*

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

object oriented programming

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

independence: any value can be chosen from any interval
extremes: all operations between intervals must generate minimum and maximum values

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

R. E. Moore or just Moore

6d) What does the expression $\{x \mid \underline{x} \le x \le \bar{x}\}$ mean?

the set of all values of x between $\underline{x}$ and $\bar{x}$
or, an interval of values of x
or, an interval

6e) What is the interval $\boldsymbol{x}$ given a percent uncertainty of 10% and center value $x^c = 10$?

[9, 11]

6f) What does an amplifier do?

produces an output signal from an input signal
or, boosts or lowers an input signal (modifies signal)

6g) What does a sheet pile do?

shores up soil
(prevents ground collapse, blocks dirt, protects construction workers)

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

Deterministic Interval Uncertainty Methods for Structural Analysis