Exam 2

CSSE 373 – Formal Methods in Specification and Design

Fall 2007

Name: _____

Instructions

This exam is open book and open notes. You may use your laptop but are not required to do so. You may also reference the course materials on Angel. Network, server, or laptop problems will not be considered an excuse for poor performance on the exam.

You may use the back of pages if you run out of space. Please indicate on the front when you do so.

Score

Problem	Points Available	Points Earned
1	10	
2	10	
3	10	
4	20	
5	20	
6	30	
7	bonus	
Total	100	

1. (10 points) Find the weakest precondition:

```
        //
i = -2*i + y;
        // i > 0
```

2. (10 points) Find the weakest precondition:

```
        //
        //
a = a + b;
        // a*b > 0
```

3. (10 points) Find the weakest precondition:

```
        //
x = x * y;
        //
x = x + y;
        // 1 <= x < 11
```

4. (20 points) Find the weakest precondition:

```
                //
if (a > b) {
                //
                //
        r = a * a;
                //
} else {
                //
                //
        r = b * b;
                //
}
                // r > 1
```

5. (20 points) Show that the following program satisfies its precondition and postcondition:

```
                // true
                //
    j = 1;
                //
    s = 0;
                // s = SUM(b[k]: 1 ≤ k ≤ j - 1), 1 ≤ j ≤ 11
    while (j < 11) {
                //
                //
            s = s + b[j];
                //
            j = j + 1;
                //
    }
                //
                //
                // s = SUM(b[k]: 1 ≤ k ≤ 10)
```

6. (30 points) Assume that the procedures `even` and `odd` have the following specifications:

```
   // a >=0
even(r | a)
   // (a % 2 == 0) ==> r == 1, (a % 2 == 1) ==> r == 0

   // a >=0
odd(r | a)
   // (a % 2 == 0) ==> r == 0, (a % 2 == 1) ==> r == 1
```

Assume that the procedure `even` satisfies its pre- and postconditions. Prove that the following implementation of `odd` satisfies its pre- and postconditions.

```
   // a >=0
odd(r | a) {
      //
   if (a == 0) {
         //
         //
         //
      r = 0;
         //
   } else {
         //
         //
         //
      even(r | a - 1)
         //
         //
   }
      //
}
   // (a % 2 == 0) ==> r == 0, (a % 2 == 1) ==> r == 1
```

7. (Bonus, 5 points) Suppose that the implementation of `even` is as given below and assume that the implementation satisfies its pre- and postconditions. Argue that the mutually recursive procedures `even` and `odd` (as implemented in the previous question) are totally correct.

```
   // a >=0
even(r | a) {
   if (a == 0) {
      r = 1;
   } else {
      odd(r | a - 1)
   }
}
   // (a % 2 == 0) ==> r == 1, (a % 2 == 1) ==> r == 0
```