National University of Singapore
School of Computing
CS1101S: Programming Methodology (JavaScript)
Semester I, 2012/2013

Discussion Group Exercises 1

These questions will be discussed during next week's discussion group meetings. Please be prepared to answer these questions in class.

Problems:

1. Below is a sequence of expressions. What is the result printed by the interpreter in response to each expression? Assume that the sequence is to be evaluated in the order in which it is presented. You should determine the answers to this exercise without the help of a computer, and only later check your answers.

```
==> (3 * 4)

==> (15 > 9.7)

==> ((5 + 3) * (5 - 3))

==> ((((17 - 14) * 5) + 6) / 7)

==> function double(x) { return x * 2; }

==> double

==> var a = 5;

==> a

==> double(a)

==> a

==> double(double(a + 5))

==> var times_2 = double;

==> times_2(a)

==> var b = a;

==> (a === b)

==> if ((a * 6) === times_2(b)) {
        a < b;
    } else {
        a + b;
    }

==> if (a >= 2) {
        b;
    } else if(a === (b - 5)) {
        a + b;
    } else {
        Math.abs(a - b);
    }

==> function attempt(x) { return x(3); }

==> attempt(double)

==> function f(z) { return z; }

==> attempt(f)
```

Observe that some of the examples shown above are indented and displayed over several lines for readability. An expression may be typed on a single line or on several lines; Redundant spaces and carriage returns are ignored. It is to your advantage to format your work so that you (and others) can read it easily.

2. Using the definitions of the symbols `attempt` and `double` in the previous exercise, build a diagram similar to the one in Fig. 1.1 in *Concrete Abstractions*, showing the steps of evaluating the expression `attempt(double)`.

3. Write a succinct English description of the effect of each of the following procedures. Try to express *what* each calculates, not *how* it calculates that.

```
function puzzle1(a, b, c) {
    if (b > c) {
        return a + b;
    } else {
        return a + c;
    };
}

function puzzle2(x) {
    if (x < 0) {
        return -x;
    } else {
        return x;
    }
}
```

4. What could be filled into the blank in the following procedure to ensure that no division by zero occurs when the procedure is applied? Give several different answers.

```
function foo(x, y) {
    if (...) {
        return x + y;
    } else {
        return x / y;
    }
}
```

5. Define a procedure that takes three numbers as arguments and returns the sum of the squares of the two larger numbers.

6. (SICP Exercise 1.5) Ben Bitdiddle has invented a test to determine whether the interpreter he is faced with is using applicative-order evaluation or normal-order evaluation. He defines the following two procedures:

   ```
   function p() {
       return p();
   }

   function test(x, y) {
       if (x === 0) {
           return 0;
       } else {
           return y;
       }
   }
   ```

   Then he evaluates the expression

   ```
   test(0, p())
   ```

   What behavior will Ben observe with an interpreter that uses applicative-order evaluation? What behavior will he observe with an interpreter that uses normal-order evaluation? Explain your answer. (Assume that the evaluation rule for the special form if is the same whether the interpreter is using normal or applicative order: The predicate expression is evaluated first, and the result determines whether to evaluate the consequent or the alternative expression.)

7. Write a procedure `is_leap_year` which takes one integer parameter and decides whether it corresponds to a leap year.

8. Search the Internet for answers to the following questions:

   - What was the first calculating machine?
   - Which was the first mechanical computer?
   - Which was the first electronic computer?
   - Who said "I think there is a world market for maybe five computers?"
   - Who said "Computers in the future may weigh no more that 1.5 tons?"
   - Who said "There is no reason anyone would want a computer in their home?"
   - Find three prominent figures in computing. Who were they? What were they famous for?