

15-103 HOMEWORK 1 - Spring 2008

due in class on Sunday, January 20

1. Find a written algorithm in everyday life that describes a common familiar procedure that contains a loop. Do not pick a recipe, tax form, or knitting procedure (or any other algorithm discussed in class). Make a copy of this algorithm to hand in with your homework and show where the loop is.

2. A precise algorithm is typically made up of instructions that consist of a set of known primitive operations that do not need explanation. For example, in arithmetic, the primitives *add*, *subtract*, *multiply* and *divide* are easily understood. Each of these operations can combine only two values at a time (e.g. "Add 2 and 3."). You may make reference to previous results in your instructions (e.g. "Multiply the result from step 3 by 10."). Using only these four arithmetic primitive operations, write an algorithm that explains how to perform the following computation:

$$x^{16}$$

The result of your last algorithmic step should be the final answer.

NOTE: I would like you to give some thought to using as small a sequence of instructions as you can for this algorithm.

3. Trace the following algorithm using $n = 15$ and $n = 105$, and state what this algorithm does in general.

1. Input a positive integer n
2. Set $a = n + (n + 1)$
3. Set $b = (a + 9) / 2$
4. Set $c = b - n$
5. Output c

4. Trace the following algorithm (all variables but y are real numbers – y is the only int) and state what it does in general:

1. Set $x = 0$
2. Set $y = 1$
3. Set $z = 1$
4. Set $x' = x + 4 / z$
5. While $|x' - x| > 0.00001$ do the following:
 - a. Set $x = x'$
 - b. Add 1 to y
 - c. Add 2 to z
 - d. If y is odd, set $x' = x + 4 / z$
else, set $x' = x - 4 / z$
6. Output x'

5. Write an algorithm that inputs a value (an integer) and then uses a loop to count and output the number of values in an array, A (that is already initialized with N values), which are greater than or equal to the input value.