Homework 3: Recursion

Data Structures

Write pseudo-code for problems requiring code. Do not write Java, Python or C++.

You are responsible for the appropriate level of detail. For the questions asking for

justification, please provide a detailed mathematically oriented discussion. A proof

is not required.

Q1 and Q2 are intended to help you get comfortable with recursion by thinking

about something familiar in a recursive manner. Q3 – Q6 are practice in working

with non-trivial recursive functions. Q7 deals with the idea of conversion between

iteration and recursion.

1. Write a recursive algorithm to compute a+b, where a and b are nonnegative

integers.

2. Let A be an array of integers. Write a recursive algorithm to compute the

average of the elements of the array. Solutions calculating the sum recursively,

instead of the average, are worth fewer points.

3. If an array contains n elements, what is the maximum number of recursive calls

made by the binary search algorithm?

4. The expression m % n yields the remainder of m upon (integer) division by n.

Define the greatest common divisor (GCD) of two integers x and y by:

gcd(x, y) = y if ( y  x and x%y == 0)

gcd(x, y) = gcd(y, x) if (x < y )

gcd(x, y) = gcd(y, x%y) otherwise

Write a recursive method to compute gcd(x,y).

5. A generalized Fibonacci function is like the standard Fibonacci function,, except

that the starting points are passed in as parameters. Define the generalized

Fibonacci sequence of f0 and f1 as the sequence gfib( f0, f1, 0), gfib(f0, f1, 1),

gfib(f0, f1, 2), ..., where

gfib(f0, f1, 0) = f0

gfib(f0, f1, 1) = f1

gfib(f0, f1, n) = gfib(f0, f1, n-1) + gfib(f0, f1, n-2) if n> 1

Write a recursive method to compute gfib(f0,f1,n).