Washington State University
School of Electrical Engineering and Computer Science
Spring 2022

CptS 223 Advanced Data Structures in C++
Homework 1
Due: January 19, 2022 (11:59pm pacific time)

General Instructions: Put your answers to the following problems into a PDF document and upload the document as your submission for Homework 1 for the course CptS 223 Pullman on the Canvas system by the above deadline.

1. For not shoveling the snow off your sidewalk, the city fined you $2 for the first day. Each subsequent day, until you shovel the snow, the fine is squared (i.e., the fine progresses as follows: $2, $4, $16, $256, $65,536, . . .).
    a. What would be the fine on day *N*? Show your work.
    b. How many days would it take for the fine to reach *D* dollars? Hint: Use floor or ceiling. Show your work.

2. Use mathematical induction to prove your formula for problem 1a.

3. Write an efficient iterative (i.e., loop-based) algorithm *Fibonacci(n)* that returns the *nth* Fibonacci number. Your algorithm may only use a constant amount of memory (i.e., no auxiliary array). Argue that the running time *T(n)* of the algorithm is linear in *n*, i.e., $T(n) \le cn$ for some constant *c*.

4. Consider the function *IndexEqual(A,i,j)* that returns true if there exists an index *x* ($i \le x \le j$) such that A[x] = x; otherwise, returns false. You may assume *A* is a sorted integer array in which every element is unique.
    a. Write an efficient recursive algorithm for *IndexEqual(A,i,j)*.
    b. What is the situation resulting in the best-case running time of your function, and give an expression for that running time?
    c. What is the situation resulting in the worst-case running time of your function, and give an expression for that running time in terms of *n,* where *n=j-i+1*?