

CS2020: Data Structures and Algorithms (Accelerated)

Discussion Group Problems for Week 2

For: January 19/20, 2011

Problem 1. (Asymptotic Analysis)

For each of the following, give a function $g(x)$ such that $f(x) = O(g(x))$. Choose the simplest possible $g(x)$ that is reasonable.

- a. $f(x) = 2x^3 + 4x^2 - 6x + 12$
- b. $f(x) = \log(8x^2 + 4x)$
- c. $f(x) = (x + 7)2^{2x}$
- d. $f(x) = (x + 6)(2x + 7)^2(4x - 8)$
- e. $f(x) = y^2 + 3y + 4$
- f. (optional) $f(x) = \log x!$

For each of the following, give the performance of the specified procedure in big-O notation as a function of x .

- g.

```
int SlowerFunction(int x)
{
    for (int i=0; i<x; i++)
    {
        for (int j=0; j<i; j++)
        {
            System.out.println("Quack.");
        }
    }
}
```
- h.

```
int FasterFunction(int x)
{
    for (int i=1; i<x; i*=2)
    {
        System.out.println("Quack.");
    }
}
```

```

i.      int RecursiveFunction(int x)
        {
            if (x < 2)
            {
                System.out.println("Quack.");
                return 1;
            }
            else
            {
                int a = RecursiveFunction(x/2);
                int b = RecursiveFunction(x/2);
                return(a+b);
            }
        }

j.      int RecursiveFunctionToo(int x)
        {
            if (x < 2)
            {
                System.out.println("Quack.");
                return 1;
            }
            else
            {
                for (j=1; j<x; j++)
                {
                    System.out.println("Quack.");
                }
                int a = RecursiveFunctionToo(x/2);
                int b = RecursiveFunctionToo(x/2);
                return(a+b);
            }
        }

```

Problem 2. (Object Models) An *object model* is a design for an object-oriented program. For our purposes, an object model consists of a set of objects, the state (i.e., members variables) contained by each object, and the names/descriptions of the public and private methods associated with that object. (There is no need to actually write the code associated with the behavior; however you should describe in one to two sentences what the method should do.)

Problem 2.a. Give an object model for an auction website. The website should allow sellers to list their items for auction, and it should allow bidders to place bids on available items. It should also enable the winning bidder to pay the seller, and it should facilitate the process of sending the item to the winning bidder.

Problem 2.b. Give an object model for an airport runway management system. The system should allow flight controllers, pilots, and maintenance staff all to access the system. It should ensure that there are no collisions (between airplanes and other vehicles), and it should help coordinate the movement of all the relevant people, planes, baggage, and other movable machinery. (Be creative and try to think about what might be useful in such a system.)