Data Structure Homework 1 Writen Part

Hongbo Wang hw2570

February 2017

1 Question 2.1

$\frac{N}{2} < 37 < \sqrt{N} < N < NloglogN < NlogN < Nlog(N^2) < Nlog2N < N^1.5 < N^2 < N^(2)2logN < N^3 < 2^(N/2) < 2^N$

2 Question 2.6

(a): The fine on day N would be:

$$2^{2^{(N-1)}}$$

(b): For reaching D dollars, suppose we need T days, then we have:

$$D = 2^{2^{(T-1)}}$$

Then, take log_2 two times on both sides:

$$logD = 2^{(T-1)}$$

$$loglogD = (T-1)$$

For Big-Oh, we can remove the constant factor, then we will need $O(loglogD)$ days.

3 Question 3

a. The outside loop will run 23 times, and for each time the inside the loop, the inner loop will run N times. So totally the running time for the first loop will be:

$$O(23 \times N) = O(N)$$

b. The outside loop will run N times, and for each time, as the outside loop running, running time of the inner loop will decreases 1, which makes the running time for this loop becomes a arithmetic sequence. So the running time will be:

$$O(\frac{(N+1)\times N}{2}) = O(N^2)$$

c. Since each time, the length N will be divided by k. So the running time for this recursion function will be:

$$O(log_k N)$$

4 Question 2.11

a.

$$\frac{T}{0.5} = \frac{500}{100}$$
$$T = 2.5$$

b.

$$\frac{500log(500)}{100log(100)} = \frac{T}{0.5}$$
$$T = 3.37$$

c.

$$\frac{T}{0.5} = (\frac{500}{100})^2$$
$$T = 12.5$$

d.

$$\frac{T}{0.5} = (\frac{500}{100})^3$$
$$T = 62.5$$

5 Question 2.15

For searching a sorted array of integer, we can use binary search.

```
public static int search(int arr[], int x){

        int start;
        int stop;

        start = 0;
        stop = arr.length - 1;

        int mid;
        while (start <= stop){
                mid = (start + stop) / 2;
```

```
                if ( arr[mid] > x ){
                        stop = mid - 1;
                   } else if ( arr[mid]< x){
                                start = mid + 1;
                            } else {return mid;
                                    }
        }
        return - 1;
}
```

The running time for this Binary Seach is $O(log_2 N)$.