ICCS200: Assignment 3

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The date

2: Stuttering Substring

(2)

```
For n=a.length
and m=b.length
public static boolean isSubstr(String a, String b){
       int c=0;
       boolean ans=false;
       if(a.length()==0){
           return true;
       }
       for(int i=0;i<b.length();i++){.      //O(m)
           if(a.charAt(c)==b.charAt(i)){.   //O(1) n times = O(n)
               c++;
           }

       if(a.length()==c) {
           ans = true;
           break;
           }
       }
       return ans;
    }
```

While the other lines take O(1),therefore
Run time = O(n+m)

(5)

```
For n=a.length
and m=b.length
public static int maxStutter(String a, String b){
       int low=0;
       int high=(b.length()/a.length())+1;
       if((a.length()==0)){
           return 0;
       }
       int i=(b.length()/a.length())/2;
       while(high-low>1){ //It runs log n time as the value of either high
                           or low is being halved everytime = O(log n)

           if(isSubstr(stutter(a,i),b)){ //Each time it is called it takes O(m+n)
               low=i;
               i=(high+low)/2;
```

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```
        }
        else if(!isSubstr(stutter(a,i),b)){ //O(m+n)
            high=i;
            i=(high+low)/2;
        }
    }
    if(isSubstr(stutter(a,i),b)){ //O(m+n)
        return i;
    }
    else{
        return i-1;
    }
}
```

The other lines take O(1),therefore

Run time = O((m+n).log n)

4: Quick Sort Recurrence

(2)

g(n) = $\frac{f(n)}{n+1}$

(Given)

n.f(n)=2n+(n+1).f(n-1)

Divide both sides by n(n+1)

$\frac{n.f(n)}{n.(n+1)} = \frac{2n}{n.(n+1)} + \frac{(n+1).f(n-1)}{n.(n+1)}$

$\frac{f(n)}{n+1} = \frac{2}{n+1} + \frac{f(n-1)}{n}$

g(n) = $\frac{2}{n+1}$ + g(n-1)

(3)

g(n) = $\frac{2}{n+1}$ + g(n-1)

g(n) = $\frac{2}{n+1} + \frac{2}{n}$ + g(n-2)

g(n) = $\frac{2}{n+1} + \frac{2}{n} + \frac{2}{n-1}$ + g(n-3)

g(n) = $\frac{2}{n+1} + \frac{2}{n} + \frac{2}{n-1}$ + ... + 2

g(n) = 2($\frac{1}{n+1} + \frac{1}{n} + \frac{1}{n-1}$ + ... + 1)

Since $H_n = \frac{1}{n+1} + \frac{1}{n} + \frac{1}{n-1} + ... + 1$

$g(n) = H_n + \frac{1}{n+1}$

(4)

g(n) $= \frac{f(n)}{n+1}$

$(H_n + \frac{1}{n+1})$(n+1) = f(n)

H_n (n+1) = f(n)

f(n) $\leq$ (1 + ln(n))(n+1)

f(n) $\leq$ nlog n

Therefore f(n) = O(nlog n)