Polytech Nice Sophia

Algorithms and Data Structures 1 - g2

Monsieur Christophe PAPAZIAN
Étudiante: Raquel LOPES DE OLIVEIRA

Lab#1: Proof by Induction, algorithm analysis, recursion

Part 3: Running time complexity

Give an analysis of the running time

```
   sum = 0;
a  for( i = 1; i < n; i++ )
b      for( j = 1; j < i * i; j++ )
c         if( j % i == 0 )
d             for( k = 0; k < j; k++ )
                  sum++;
```

If we disregard the "if" we have:

$$\sum_{i=1}^{n-1} \sum_{j=1}^{i^2} \sum_{k=1}^{j-1} .$$

The loop ***a*** *will be* $\theta(n)$*, the loop* ***b*** *will be* $\theta(n^2)$ *and the loop* ***d*** *should be* $\theta(n^2)$*, but the loop* ***d*** *will only be executed i times for each i because of the if(* ***c****)(verify the multiples of i), so instead of be* $\theta(n^2)$ *will take* $\theta(n)$ *running time.*
So it will be: $\theta(n) * \theta(n^2) * \theta(n)$*, that means the complexity it is* $\theta(n^4)$*.*

Part 4: Complexity growth

An algorithm takes 0.5 ms for input size 100. How long will it take for input size 500 if the running time is the following (assume low-order terms are negligible):

a) Linear

$100 \rightarrow 0,5$
$500 \rightarrow X$

$X = \frac{500*0,5}{100} = 2,5\ ms$

b) $\theta(NlogN)$

$100 \Rightarrow 100log100 \rightarrow 0.5$
$500 \Rightarrow 500log500 \rightarrow X$

$X = \frac{0.5*500log500}{100log100} \approx 3.37$

c) quadratic

$100^2 \rightarrow 0,5$
$500^2 \rightarrow X$

$X = \frac{500^2*0,5}{100^2} = 12,5\ ms$

d) cubic

$100^3 \rightarrow 0,5$
$500^3 \rightarrow X$

$X = \frac{500^3*0,5}{100^3} = 62,5\ ms$