First written examination of

Algoritmos e Estruturas de Dados

Outubro 12, 2015 Duration: no more than 30 minutes

Name:

Student number:

4.0 **1:** If $f(n) = \Theta(g(n))$, what can we say about how $f(n)$ is upper and lower bounded?
Answer:

4.0 **2:** Join (using lines do connect the dots) the functions with the same computational complexity.

$20n - 3$ •	• $\log n^3$
$3n + \frac{10^9}{\log n}$ •	• $\frac{n(n+1)}{2}$
$3n \log n + 17n + 100$ •	• 10^{-5}
$n^2 + 2n \log n + 3$ •	• $10^6 + \log n$
$n^3 + 2^n$ •	• $100(2^n + n!)$
2^n •	• $n^2 - 2n + 5$

4.0 **3:** **Sort the following functions in increasing order of complexity (use the function number in your answer):**

Function number	The function	Your answer
1	$0.1n^2 + 10n + 7$	
2	$0.001n^3 + 100n^2$	
3	1.5^n	
4	$n!/2^n$	
5	e^n	
6	$23n + 7n^2/\log n$	
7	$n^2 + 10n \log n$	
8	$n^{2.001}$	

4.0 **4:** **Give an estimate of the computational complexity of the following function:**

```
void init(int n,int *a)
{
  for(int i = 1;i <= n;i++)
    for(int j = i;j <= n;j += i)
      a[j] = i;
}
```

Answer:

4.0 **5:** **What is the value returned by the call `f(5,7)`?**

```
int f(int n,int m)
{
  int i,j,r;

  r = 0;
  for(i = 0;i <= n;i++)
    for(j = i;j <= m;j++)
      r += i;
  return r;
}
```

Answer:

Useful formulas:

- $\sum_{k=1}^{n} 1 = n$
- $\sum_{k=1}^{n} k = \frac{n(n+1)}{2}$
- $\sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}$
- $\sum_{k=1}^{n} k^3 = \left(\frac{n(n+1)}{2}\right)^2$
- $\sum_{k=1}^{n} \frac{1}{k} \approx \log n$
- $\sum_{k=n}^{m} f(k) = \sum_{k=1}^{m} f(k) - \sum_{k=1}^{n-1} f(k)$