

Algorithms and Data Structures

Homework3

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1 Problem 3.1

1.1 a

for $f(n) = 9n$ and $g(n) = 5n^3$

let us compute: $\lim_{n \rightarrow \infty} \frac{f(n)}{g(n)} = \lim_{n \rightarrow \infty} \frac{9n}{5n^3} = \lim_{n \rightarrow \infty} \frac{9}{5n^2} = 0$

let us compute: $\lim_{n \rightarrow \infty} \frac{g(n)}{f(n)} = \lim_{n \rightarrow \infty} \frac{5n^3}{9n} = \lim_{n \rightarrow \infty} \frac{5n^2}{9} = \infty$

so we deduce:

$f(n) \in \omega(n), f(n) \in \Omega(n), f(n) \notin o(n), f(n) \notin O(n), f(n) \notin \Theta$
 $g(n) \in (n), g(n) \notin \Omega(n), g(n) \in o(n), g(n) \in O(n), g(n) \notin \Theta$

1.2 b

for $f(n) = 9n^{0.8} + 2n^{0.3} + 14\log(n)$ and $g(n) = n^{0.5}$

let us compute: $\lim_{n \rightarrow \infty} \frac{f(n)}{g(n)} = \lim_{n \rightarrow \infty} \frac{9n^{0.8} + 2n^{0.3} + 14\log(n)}{n^{0.5}} = \infty$

let us compute: $\lim_{n \rightarrow \infty} \frac{g(n)}{f(n)} = \lim_{n \rightarrow \infty} \frac{n^{0.5}}{9n^{0.8} + 2n^{0.3} + 14\log(n)} = 0$

so we deduce:

$f(n) \notin \omega(n), f(n) \notin \Omega(n), f(n) \in o(n), f(n) \in O(n), f(n) \notin \Theta$
 $g(n) \in \omega(n), g(n) \in \Omega(n), g(n) \notin o(n), g(n) \notin O(n), g(n) \notin \Theta$

1.3 c

for $f(n) = n^2 \overline{\log(n)}$ and $g(n) = n(n)$

let us compute: $\lim_{n \rightarrow \infty} \frac{f(n)}{g(n)} = \lim_{n \rightarrow \infty} \frac{\frac{n^2}{\log(n)}}{n \times \log(n)} = \lim_{n \rightarrow \infty} \frac{n}{\log^2(n)} = \infty$

let us compute: $\lim_{n \rightarrow \infty} \frac{g(n)}{f(n)} = \lim_{n \rightarrow \infty} \frac{\log^2(n)}{n} = 0$
so we deduce:

$f(n) \notin \omega(n), f(n) \notin \Omega(n), f(n) \in o(n), f(n) \in O(n), f(n) \notin \Theta$
 $g(n) \in \omega(n), g(n) \in \Omega(n), g(n) \notin o(n), g(n) \notin O(n), g(n) \notin \Theta$

1.4 d

for $f(n) = \log^3(3n)$ and $g(n) = 9(n)$

let us compute: $\lim_{n \rightarrow \infty} \frac{f(n)}{g(n)} = \lim_{n \rightarrow \infty} \frac{\log^3(3n)}{9(n)} = \infty$

let us compute: $\lim_{n \rightarrow \infty} \frac{g(n)}{f(n)} = \lim_{n \rightarrow \infty} \frac{9(n)}{\log^3(3n)} = 0$

so we deduce:

$f(n) \notin \omega(n), f(n) \notin \Omega(n), f(n) \in o(n), f(n) \in O(n), f(n) \notin \Theta$
 $g(n) \in \omega(n), g(n) \in \Omega(n), g(n) \notin o(n), g(n) \notin O(n), g(n) \notin \Theta$

2 Problem 3.1

2.1 a

for $i = 0$ to $n-1$
 $\text{key} = i$
 for $j=i+1$ to n
 $j = \text{key}$
 if i not key
 $\text{swap}(i, \text{key})$

2.2 b

```

main.cpp
1 #include <iostream>
2 using namespace std;
3
4 void selection_sort(int A[], int n){
5     for(int i=0; i<n-1; i++){
6         int key=i;
7         for(int j=i+1; j<n; j++){
8             if(A[j]<A[key]){
9                 key = j;
10            }
11        }
12        if (A[i] != A[key])
13        {
14            swap(A[i], A[key]);
15        }
16    }
17 }
18
19 int main(){
20     int arr[]={10,12,4,6};
21     int n=4;
22     selection_sort(arr,n);
23     for(int i=0; i<n; i++){
24         cout<<arr[i]<<" ";
25     }
26 }
27

```

```

Console
1 C:\Program Files\Microsoft Visual Studio\2019\Community\VC\Tools\MSVC\14.29.30133\bin\Hostx64-Windows\x64\Shell\cmd.exe -c "g++ main.cpp -std=c++17 -o main.exe"
2 main.exe
3 4 5 6 10

```

2.3 c