Monday Oct. 15

Lecture 10

- Lab Test I marks by Friday
- Lab 3

  Tutorial on Java Collections.

Counting # of Primitive Operations

```
findMax (int[] a, int n) {
  currentMax = a[0];
  for (int i = 1; i < n ) {
    if (a[i] > currentMax) {
      currentMax = a[i]; }
    i ++
  return currentMax; }
```

4

n

$1 + n$

$\{ 2 \cdot (n-1)$

$i{+}{+} \Rightarrow i = i + 1$

$i \mathrel{*}= a[i \% 2]$

$\shortparallel$

$i = i * a[i \% 2]$

$i \mathrel{*}= a[i \% a[i]]$

5

$6 \cdot (n-1)$

findMax({2, 1, 4, 5}, 4)

size 4

6

$i \mathrel{*}= a[i]$

$\shortparallel$

$i = i * a[i]$

i	$i < 4$
~~0~~	
1	T
2	T
3	T
4	F

$4 < 4$

5

4

currentMax =

$(a[i] * a[i]) \% a[i]$

```
findMax (int[] a, int n) {
  currentMax = a[0];
  for (int i = 1; i < n; ) {
    if (a[i] > currentMax) {
      currentMax = a[i]; }
    i ++ }
  return currentMax; }
```

$10\ (\cancel{n})$

1

$n + 1$

$2 \cdot (n-1)$

return a[i]

$2 \cdot$

i	i<10
1	T
⋮	⋮
9	T
10	F

10

$(7\overset{10}{\cancel{n}} - 2) * 2\,ms$

$(68 * 2)\,ms$

Method 1

$7n - 2$

Method 2

$8n + 9$

Input size : 100

time for 100 : 2 ms

ms

absolute RT

$n - 2$

$\propto$

$\propto$

$\cancel{\log n}$

$7n - 2$ vs. $8n + 9$

$8 \cdot n^0$

Asymptotically, same

$\cancel{7}\underline{n} - \cancel{2}$

n

Big-O $\rightarrow$ RT of your algo.

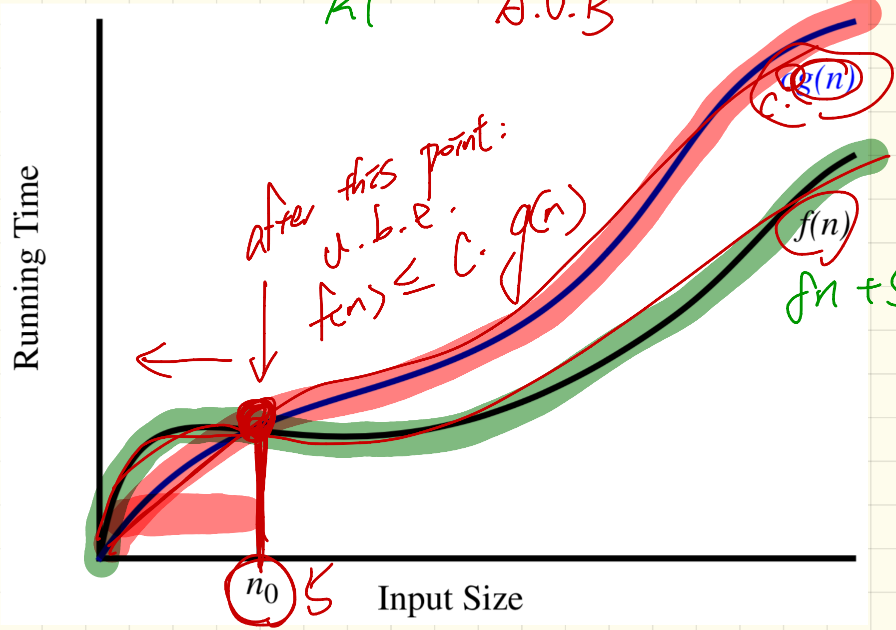
$f(n) \in O(g(n))$ if there are:

- A real constant $c > 0$
- An integer constant $n_0 \geq 1$

such that:

$$\underbrace{f(n)}_{RT} \leq c \cdot \underbrace{g(n)}_{A.U.B} \quad \text{for } n \geq n_0$$

upper bound effect



Example: $f(n) = 8n + 5$

$g(n) = n$

Prove: $f(n) \in O(g(n))$

Choose: $c = 9$

n_0 ?

$O(n)$

$RT_1(n) = 7n - 2$

$RT_2(n) = 6n^2 - 100$

$O(n^2)$

$O(n)$ a set of functions

$7n-2$ is $O(n)$

$O(n)$

$7n^{-2}$

8

$n+2$

$7n-2$

$n-2$

$3n+4$

$\cancel{7n^2-2}$

$\dots$

$a \cdot x + b$

b

$7n^2-2$ is $O(n^1)$

$1M$

$f(n) = a_0 n^0 + a_1 n^1 + \cdots + a_d n^d$

Prove : $f(n)$ is $O(n^d)$

Choose

$\rightarrow C = |a_0| + |a_1| + \cdots + |a_d|$

$n_0 = 1$

② Is $f(n) \le C \cdot n^d$?

① Is $f(1) \le C \cdot 1^d$?

$a_0 1^0 + a_1 1^1 + \cdots + a_d 1^d \le |a_0| \cdot 1^d + |a_1| \cdot 1^d + \cdots + |a_d| 1^d$

$\le$

$f(n) = 3\log n + 2$ is $O(\log n)$

$c = 5$

n_0	$3\log n + 2$	$5 \cdot \log n$	
1	2 ✗	0	
2	5	5	✓