

# Lecture 11 (Sorting)

Tuesday, September 29, 2020 5:00 PM

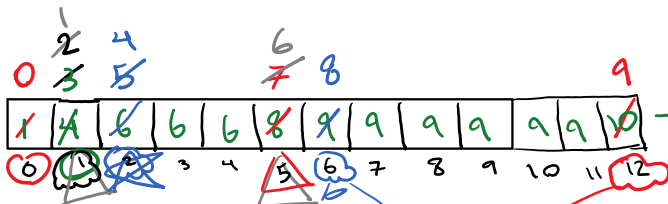
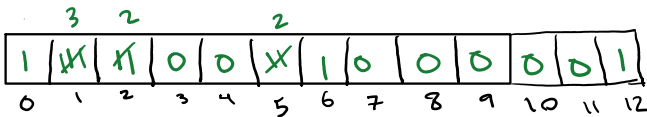
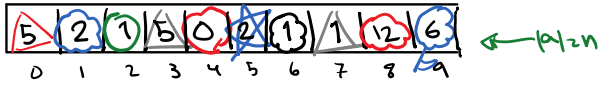
Reminder: \*Lab 2 is due this Sunday.

\*Take a look at extra credit lab

\*exam 1 is on Oct 8th

Counting Sort: Only works for natural nrs (non-negative int)

$|a| = n = 10$



Steps:

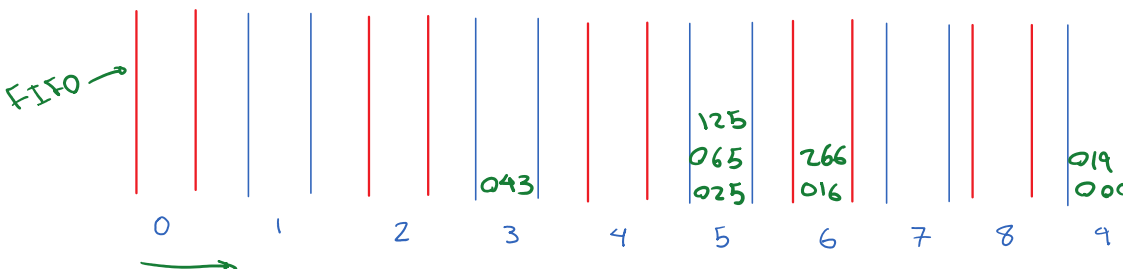
- ① Find max  $\rightarrow \theta(n)$ ,  $mx = k$
- ② define a new array of size  $k+1$
- ③ Fill out new array  $\theta(n)$
- ④ add the nrs to the next ones  $\theta(k)$
- ⑤ sort the nrs  $\theta(n)$

$$T(n) = \theta(n) + \theta(1) + \theta(n) + \theta(k) + \theta(n) \\ = \theta(n) + \theta(k) + \theta(n) \\ = \theta(n+k)$$

Radix Sort:  $a = [025, 065, 016, 009, 125, 266, 019, 043] \rightarrow |a| = n$

non-negative int

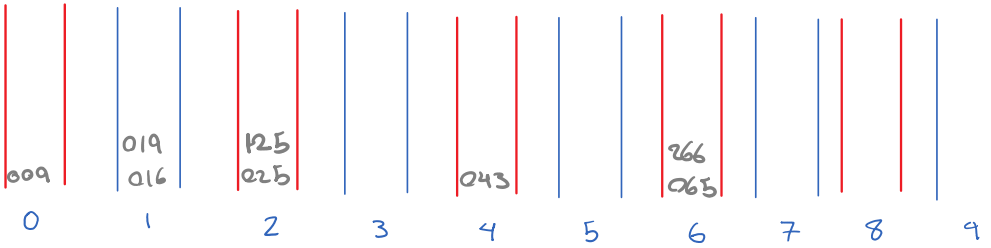
$\theta(n)$   $\leftarrow$  pushing/popping



043 / 025 / 065 / 125 / 016 / 266 / 009 / 019

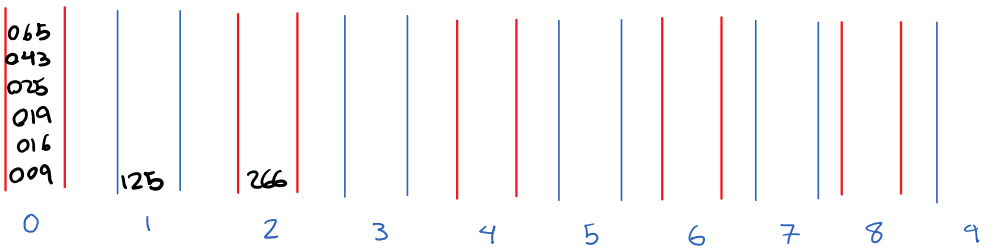
$\theta(n)$

$\Theta(n)$



009/016/019/025/125/043/065/266

$\Theta(n)$



009/016/019/025/043/065/125/266 ✓

$$T(n) = \overbrace{\Theta(n) + \Theta(n) + \Theta(n)}^{\text{total nr of digits} = k} = \boxed{\Theta(nk)}$$

## Bubble Sort

$a = [5, 1, 2, 0]$   
 $[1, 5, 2, 0]$   
 $[1, 2, 5, 0]$   
 $[1, 2, 0, 5]$   
 $[1, 2, 0, 5]$

number of comparisons  
min nr of comparisons

Best-case:  $\Omega(n)$

$a = [1, 4, 8, 9]$   
 $[1, 4, 8, 9]$   
 $[1, 4, 8, 9]$

worst-case:  $O(n^2)$

$a = [5, 4, 2]$   
 $[4, 5, 2]$   
 $[4, 2, 5]$

[1, 2, 0, 5]

[1, 0, 2, 5]

[0, 1, 2, 5] ✓

[1, 4, 8, 9]

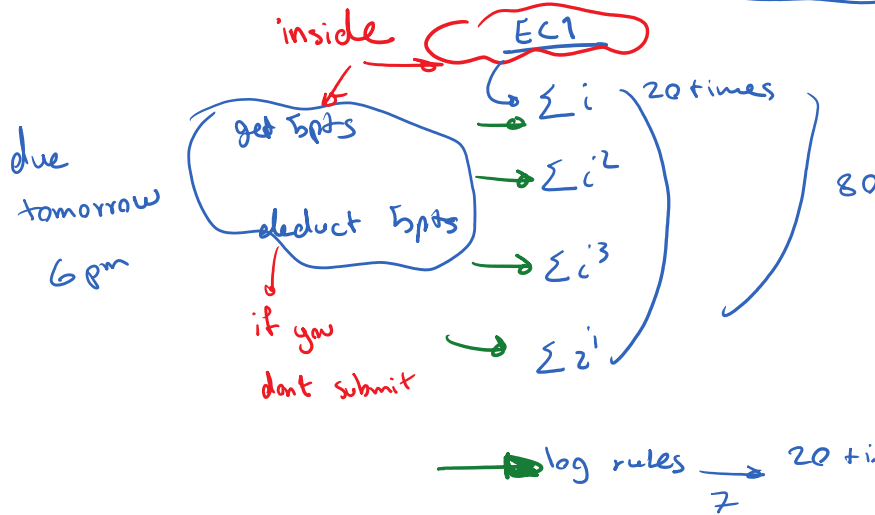
[2, 4, 15]

$$T(n) = (n-1) + (n-2) + \dots + 1$$

$$= \sum_{i=1}^{n-1} n-i = \sum_{i=1}^{n-1} i = O(n^2)$$

look at it  
from the end  
to start

avg-case:  $O(n^2)$



220 times

Lab 2:

Q1:  $\lceil \sqrt{10} \rceil = \lceil 3.16 \rceil = 4$  ← you should not have an array

$\sqrt{10} \rightarrow 0 \sim 10$

guess = 5

$sq = mid * mid$

if  $5 \times 5 > 10$

too big

else  $5 \times 5 < 10$

too small

6 ~ 10

$sq = 3 \times 3 < 10 < 4 \times 4$

$\frac{mid+mid}{2}$

print/return 4

Q7 [0 1 5 6 8]  $\rightarrow$  return 2 BS

$\rightarrow$  [0 1 | 2 3 4]  $\rightarrow$  return 5  
X  $\downarrow$   $\uparrow$   
mid=2

if  $a[mid] == mid$

// all the nrs on the  
LHS are present