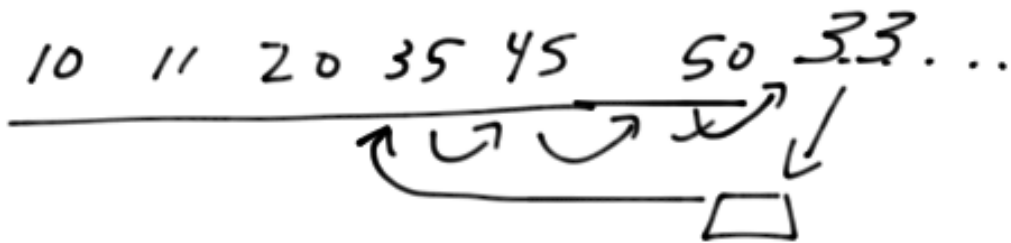
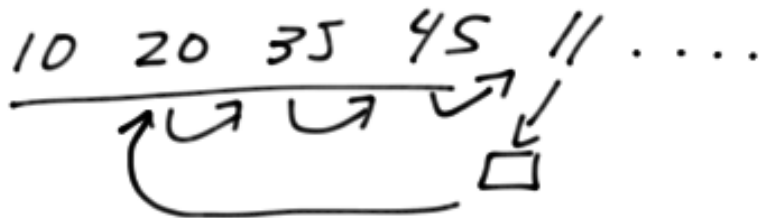
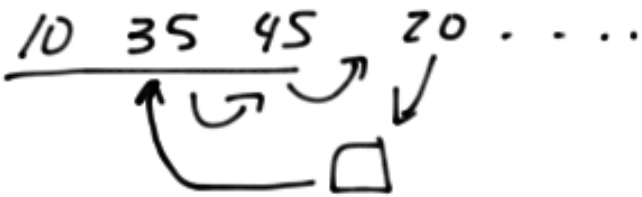
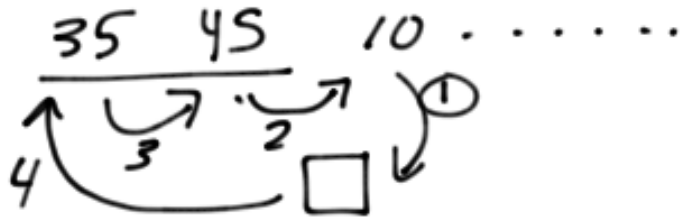
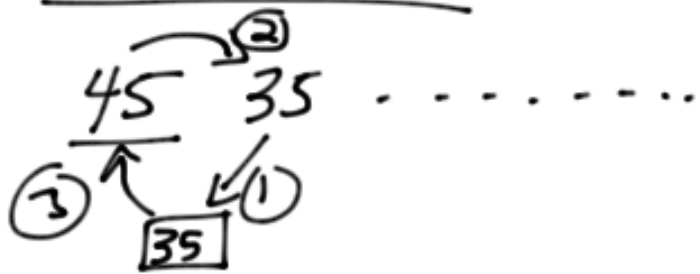


Today - Lecture 16 - CS163

- 1) Topic #7 - Measuring Efficiency
- 2) Topic #12 - Iterative Sorting Algs
 - Insertion sort
 - selection sort
 - exchange sort
 - shell sort
 - Radix sort
- 3) Next: Topic #13 - Recursive Sorting!

45 35 10 20 11 50 33

"Insertion sort"



10 11 20 33 35 45 50

10 20 30 40 50



Best Case - Already sorted

Worst Case - Reverse order

#Move
 \emptyset

#(comparisons)
 $O(N)$

50 40 30 20

\emptyset

\emptyset

40 50 30 20

3

1

30 40 50 20

4

2

20 30 40 50

5

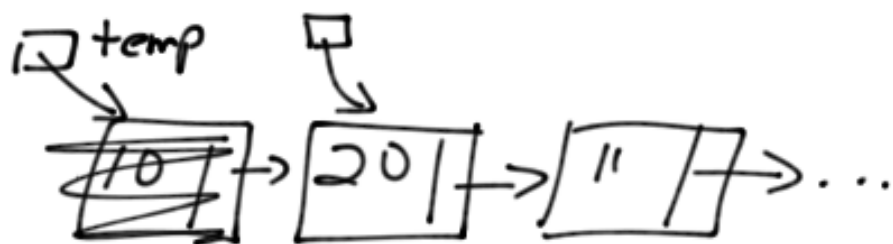
3

\boxed{N}

$N+1$
 $O(N^2)$

$N-1$
 $O(N^2)$

What if a LLL was used??



45 35 10 20 11 50 33 25 5 30

"Insertion Sort"

~ "Best" case - "sorted" -
 ↘ Worst case

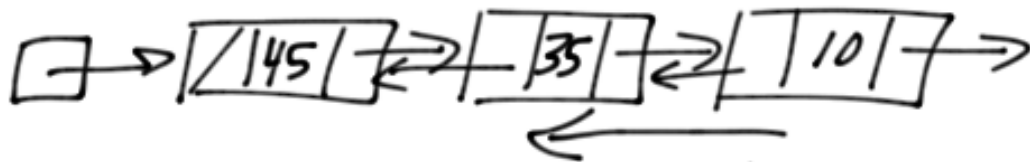
moves compares

\emptyset $O(N^2)$

$O(1)$ $O(N)$

45 35 10 20 11 50 33 25 5 30

"Insertion Sort"

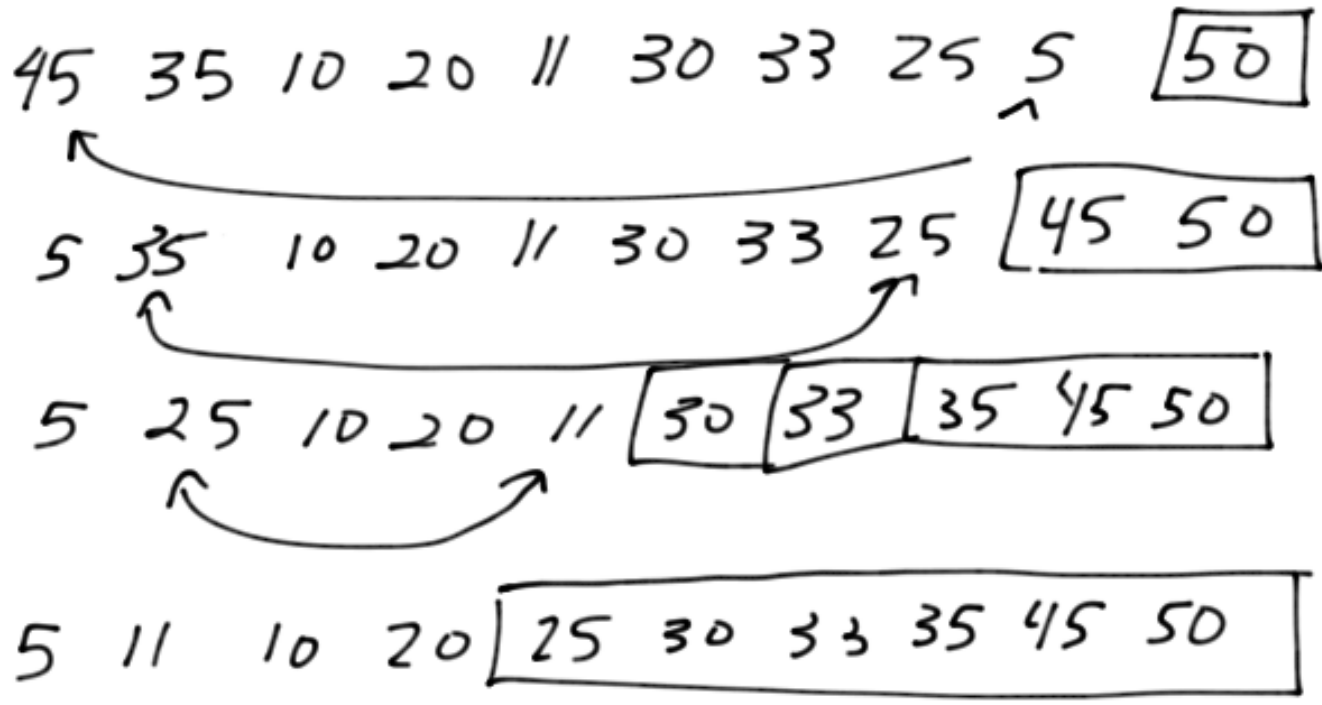


Best case - sorted ϕ moves $O(N)$ compares

Worst case $O(N)$ $O(N^2)$ compares

45 35 10 20 11 50 33 25 5 30

"Selection Sort"



All cases

#compares $O(N^2)$ #moves $\emptyset \rightarrow O(N)$

45 35 10 20 11 50 33 25 5 30

"Exchange Sort - Bubble sort"

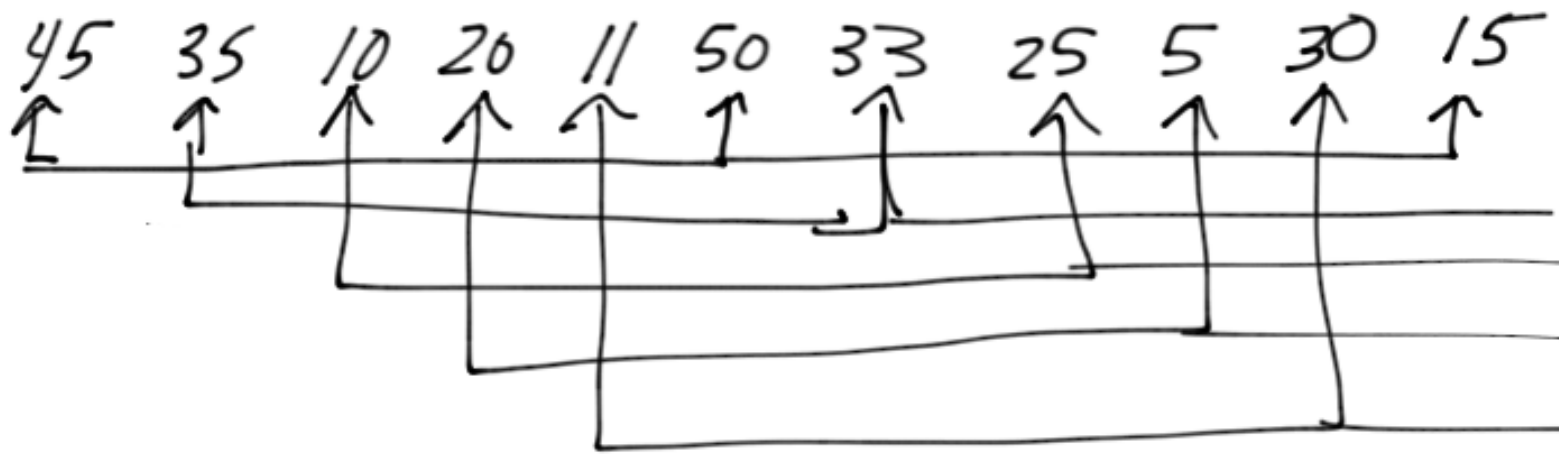
35 ~~45~~ ~~45~~ ~~45~~ 45 50 50 50 50 50
10 20 11 33 25 5 30

10 ~~35~~ ~~35~~ ~~35~~ 45 45 ~~45~~ 45 45 50
20 11 33 25 5 30

10 20 20 ~~35~~ ~~35~~ ~~35~~ ~~35~~ 35 45 50
11 33 25 5 30

Best case - Sorted - $O(N)$ compares \emptyset moves
"trivial rejected"

Worst case - $O(N^2)$ compares, $O(N^2)$ moves



15 33 10 5 11 45 35 25 20 30 50

10 15 33

5 10 15 33

11 15 33 45

35 45

25 33 35 45

20 25 33 35 45

30 33 35 45 50

LAX PDX SFO SEA JFK KTN MST CDG

Compares \emptyset

$\frac{A}{SEA}$ $\frac{G}{CDG}$ $\frac{K}{JFK}$ $\frac{N}{KTN}$ $\frac{O}{SFO}$ $\frac{T}{MST}$ $\frac{X}{LAX}$
PDX

$\frac{A}{CDG}$ $\frac{D}{LAX}$ $\frac{E}{SEA}$ $\frac{F}{JFK}$ $\frac{S}{MST}$ $\frac{T}{KTN}$
PDX

$\frac{C}{CDG}$ $\frac{JK}{JFK}$ $\frac{L}{LAX}$ $\frac{M}{MST}$ $\frac{P}{PDX}$ $\frac{S}{SEA}$
KTN SFO

Moves $O(\frac{N}{K})$

$O(N) \rightarrow O(Klength * N)$

** Memory **