

- Selection sort
- Merge sort
- Quick sort

Selection sort:

- First, find the smallest element and swap it into the front



- Next, find the smallest element in the rest of list and move to index 1



- Repeat until finished.

Function SelectionSort(A, n):

$i \leftarrow 0$

While $i < n$:

$j \leftarrow$ FindIndexOfSmallest(A, i, n)

swap $A[i]$ with $A[j]$

$i \leftarrow i + 1$

EndWhile

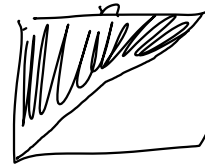
EndFunction

$$1 + 2 + \dots + n - 1 + n = \frac{n^2 + n}{2}$$

n times

$O(n)$

06)



Merge sort

Have: Two sorted stacks
 Want: One sorted stack

- 2
- 3
- 5
- 6
- 7
- 9

First, split the array in half
 (Both halves need to be sorted)

Merge the sorted halves

Function merge(A, na, B, nb, C):
 assume sorted
 assume size of C is size of A + size of B

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ia ← 0
ib ← 0
While ia < na and ib < nb:
    If A[ia] < B[ib]:
        C[ia+ib] ← A[ia]
        ia ← ia + 1
    Else:
        C[ia+ib] ← B[ib]
        ib ← ib + 1
    End If
End While

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While ia < na:
    C[ia+ib] ← A[ia]
    ia ← ia + 1
End While
While ib < nb:
    C[ia+ib] ← B[ib]
    ib ← ib + 1
End While

```

EndFunction

Function mergeSort(C, n):

If $n \geq 2$:

A, na ← take first half of C

B, nb ← take second half of C

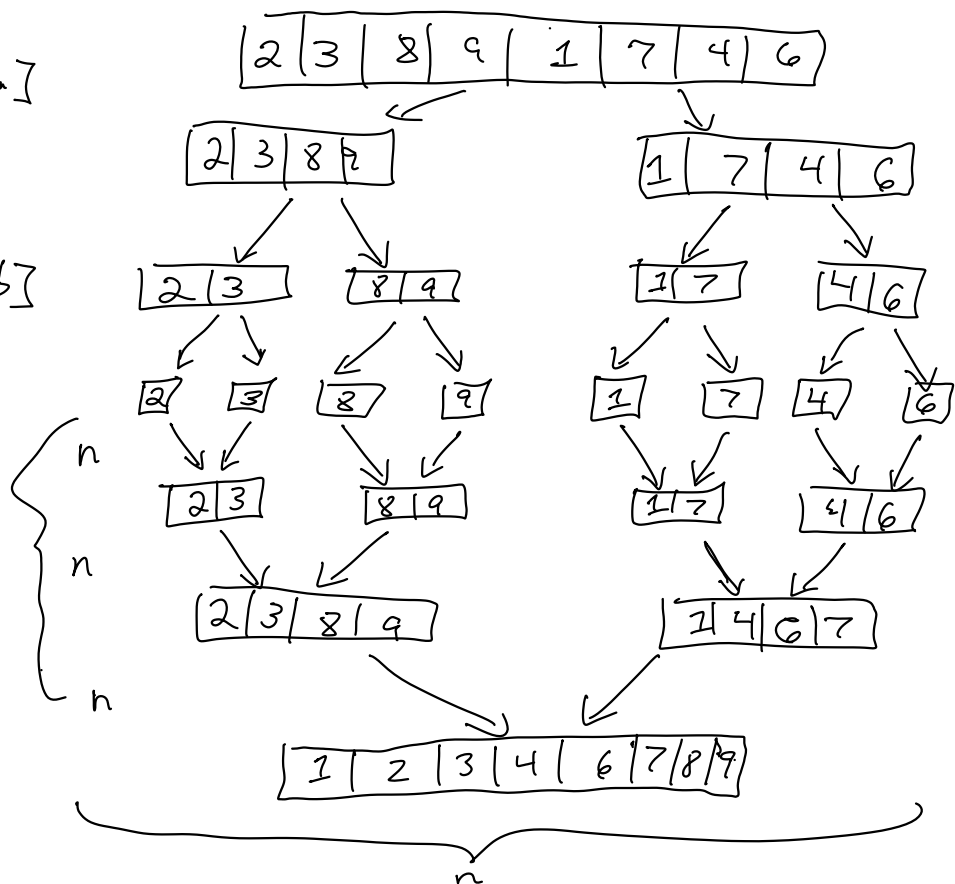
mergeSort(A, na)

mergeSort(B, nb)

merge(A, na, B, nb, C)

EndIf

EndFunction



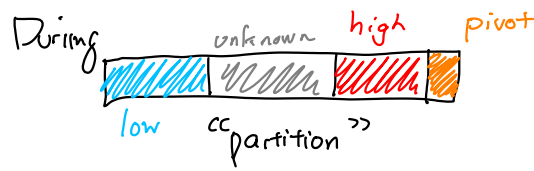
$$\log_2 8 = 3$$

$$8 = 2^3$$

Merge sort is $O(n \log n)$

Quicksort

- In-place sort



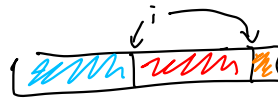
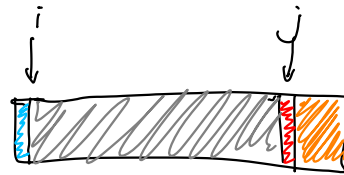
After partitioning:

low region of elements smaller than pivot (or equal)
 high region of elements larger than pivot (or equal)
 swap pivot between them



Then recurse on both sides

returns index of pivot when finished



inclusive
 ↙
 ↘

Function partition(A, left, right):

$i \leftarrow \text{left}$

$j \leftarrow \text{right} - 1$

$\text{pivot} \leftarrow A[\text{right}]$

While $i < j$:

While $i < j$ and $A[i] \leq \text{pivot}$:

$i \leftarrow i + 1$

End While

While $i < j$ and $A[j] \geq \text{pivot}$:

$j \leftarrow j - 1$

End While

If $i \neq j$:

Swap $A[i]$ and $A[j]$

End If

End While

If $A[i] \geq A[\text{right}]$

Swap $A[i]$ with $A[\text{right}]$

Return i

Else

Return right

End If

End Function