Unit

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Analysis of Algorithm

- Efficiency of Algorithm checked by:
- Correctness
- Implementation
- Simplicity
- Execution time and memory requirements

– Three types of analysis:
- Worst Case
- Best case
- Average case

x Worst case:
- Provide an upper bound on running time.
- An absolute guarantee that the algorithm would not run longer, no matter what the inputs are

x Best case:
- Provides a lower bound on running time.
- Input is the one for which the algorithm runs the fastest

x average case:
- Provides a prediction about the running time

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- Assumes that the input is random

Lower Bound ≤ Running time ≤ upper Bound

* Complexity of Algorithm:
  - Running time of an algorithm as a function of input size n is called Complexity.
  - Expressed using only the highest order term instead of exact running time.

* Types:
  - Space Complexity: Amount of memory required to run an algorithm
  - Time Complexity: Amount of time required to run an algorithm

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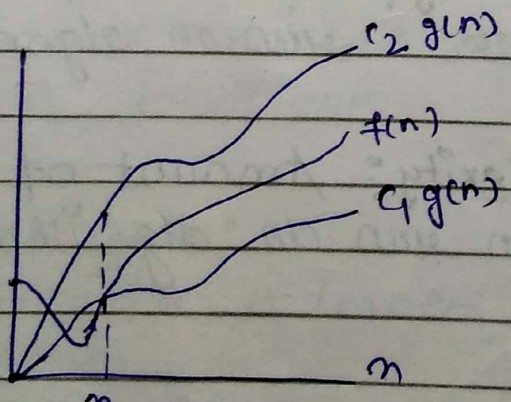
* Asymptotic Notation :-

- O (Big Oh) notation :
  asymptotic "less than"
  $(f(n) = O(g(n)))$ implies : $f(n)$ "$\leq$" $g(n)$

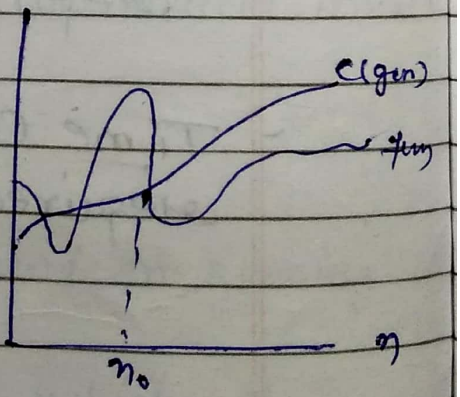
- Ω (Big omega) notation :
  asymptotic "greater than"
  $f(n) = \Omega(g(n))$ implies : $f(n)$ "$\geq$" $g(n)$

- Θ (Theta) notation : asymptotic "equality"
  $f(n) = \Theta(g(n))$
  implies : $f(n)$ "$=$" $g(n)$



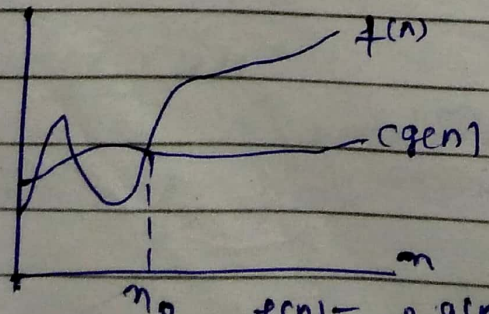
$f(n) = \Theta g(n)$

(a)



$f(n) = O g(n)$

(b)



$f(n) = \Omega g(n)$.

(c)

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* Searching Algorithm:
(i) Linear (ii) Binary.

- Linear:
- step-1 : Input array 'A' of 'n' element, 'data' to be searched.
step-2 : Initialize i=0
step 3 : Repeat step 4 & 5 while i<n
step 4 : if (data == A[i])
go to step 6.
step 5 : i = i+1
step 6 : if (i<n)
element found at i+1
else
element not found
step 7 : exit.

- Binary:
- element must be sorted (~~Arranged~~).

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* Complexity of Algorithms:

Algorithm	Best Case	Avg. case	worst case
Linear Search	O(1)	O(n)	O(n)
Binary Seach	O(1)	O(logn)	O(logn)
Bubble Sort	O(n)	O(n^2)	O(n^2)
insertion Sort	O(n)	O(n^2)	O(n^2)
selection Sort	O(n^2)	O(n^2)	O(n^2)
Quick Sort	O(nlogn)	O(nlogn)	O(n^2)
Merge Sort	O(nlogn)	O(nlogn)	O(nlogn)

* Binary Search: (Apply when Algorithm is sorted)

Step.1 Input array 'A' of 'n' elements, 'Data' to be Searched

Step.2 Set LB = 0, UB = n-1, MID = int((LB+UB)/2)

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step-3 Repeat step 4 & 5 while LB <= UB and A[MID] != Data

step-4 if (Data < A[MID])

UB = MID - 1

else

LB = MID + 1

step 5. MID = int((LB + UB)/2)

step 6: If (A[MID] == Data)

Element found at MID+1

else

Element not found

Step 7: Exit

* Bubble sort :

① (40) (10) 70 30 50

10 (40) (70) 30 50

10 40 (70) (30) 50

10 40 30 (70) (50)

10 40 30 50 70

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(II) 10 40 30 50 70

10 40 30 50 70

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(III) 10 30 40 50 70

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(iv) 10 30 40 50 70

10 30 40 50 70

Step-1 Input array 'A' of 'n' elements

Step-2 initialize $i=0$ and repeat through step 6 while $i<n-1$

Step-3 Initialize $j=0$ and repeat step 4 & 5 while $j<n-i-1$

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Step-4 if (A[j] > A[j+1])
(a) temp = A[j]
(b) A[j] = A[j+1]
(c) A[j+1] = temp.

Step.5 j = j+1
step.6 i = i+1
step.7 Print the sorted array 'A'
stp-8 exit.

* Insertion Sort:

Step.1 Input array 'A' of 'n' elements
step.2 Initilize i=1 and repeat through step 8 while i<n
step.3 Initialize key = A[i] and j = i-1
step.4 Repeat step 5 & 6 while j>=0 and A[j] > key
Step.5 A[j+1] = A[j]
step.6 j = j-1
step7 A[j+1] = key
Step8 i = i+1
step 9 Print the sorted array 'A'
step 10 Exit

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Eg:

70 30 60 10 40 20 50

30 70 60 10 40 20 50

30 60 70 10 40 20 50

10 30 60 70 40 20 50

10 30 40 60 70 20 50

10 20 30 40 60 70 50

10 20 30 40 50 60 70

* Selection sort:

20 60 10 30 50 70 40

10 60 20 30 50 70 40

10 20 60 30 50 70 40

10 20 30 60 50 70 40

10 20 30 40 50 70 60

10 20 30 40 50 70 60

10 20 30 40 50 60 70