

CSE331.

Note Title

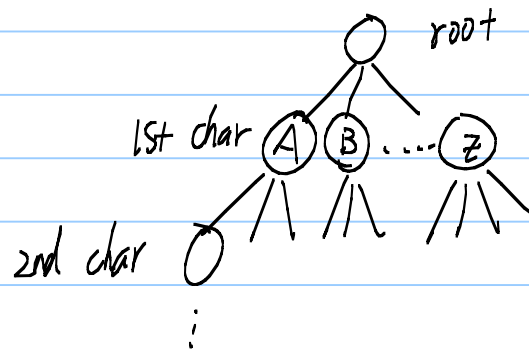
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Goals:

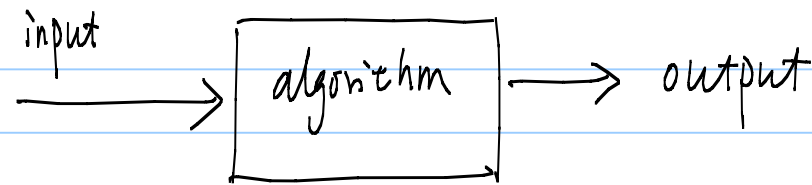
Basic data structures & algorithms

I. data structure provides a way to organize data items. Each data structure has associated operations.

e.g linear data structures: insertion/deletion/search etc.



## II Algorithms: "a bag of tricks"



— basic algorithms: sorting, searching

analytical techniques — asymptotic notation, lower bounds

Summary: data structures & algorithms are practical & basic to computer Science culture. (more than just writing code)

First problem: Sorting problem

Input: a sequence of  $n$  numbers  $\langle a_1, a_2, \dots, a_n \rangle$

Output: a permutation (re-ordering)  $\langle a'_1, a'_2, a'_3, \dots, a'_n \rangle$

of the input sequence. s.t.  $a_1' \leq a_2' \leq a_3' \leq \dots \leq a_n'$

50 100 1 0  $\Rightarrow$  0 1 50 100  
 $a_1$   $a_2$   $a_3$   $a_4$   $a_1'$   $a_2'$   $a_3'$   $a_4'$

Insertion Sort: basic operation: insertion  
(insert an element into a sorted list s.t. the final list is still sorted)

e.g. 1 50 55 70 80 60  
1 50 55 70 80

$\Rightarrow$  1 50 55 60 70 80

e.g. input: 5 2 4 6 1 3

Insertion sort example.

$j=1$     5    2    4    6    1    3

$j=2$     5    2    4    6    1    3  
           ↓  
           2    5    4    6    1    3  
           2    5

$j=3$     2    5    4    6    1    3  
           ↓  
           2    4    5    6    1    3  
           2    4    5

$j=4$     2    4    5    6    1    3  
           ↓  
           2    4    5    6    1    3  
           2    4    5    6

$j=5$     2    4    5    6    1    3  
           ↓  
           2    4    5    6    1    3  
           1    2    4    5    6

Insertion-Sort(A) // A is the  
                           input array of  
                           size n

1. for  $j=2$  to  $\text{length}[A]$
2.    do  $\text{key} \leftarrow A[j]$
3.    //insert  $A[j]$  to sorted list  $A[1..j-1]$
4.         $i \leftarrow j-1$
5.        while  $i > 0$  and  $A[i] > \text{key}$
6.            do  $A[i+1] \leftarrow A[i]$
7.             $i \leftarrow i-1$
8.         $A[i+1] \leftarrow \text{key}$

$\hat{j}=6$     1   2   4   5   6    $3 \leftarrow \hat{j}=6$

e.g.   1   2   3   4   5   6

6   5   4   3   2   1