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- Attributes of Queue
  - front/rear: front/rear index
  - counter: number of elements in the queue
  - maxSize: capacity of the queue
- Operations of Queue
  - IsEmpty: return true if queue is empty, return false otherwise
  - IsFull: return true if queue is full, return false otherwise
  - Enqueue: add an element to the rear of queue
  - Dequeue: delete the element at the front of queue
  - DisplayQueue: print all the data

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Search

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## Searching and Sorting

HEXAWARE

- Searching refers to finding whether a data item is present in the set of items or not
- Sorting refers to the arrangement of data in a particular order. That is, arranging items in a particular way
- Sorting and searching have many applications in the area of computers

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## Searching Algorithms

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- The time required to search depends on the following factors:
  - Whether the data is arranged in a particular order or not
  - The location of the data to be searched
  - The total number of searches to be done
- When the data is arranged in a particular order then, the time taken to search for the item is less.
- Searching algorithms
  - Linear Search
  - Binary Search

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## Merge Sort

HEXWARE

- Merge sort is a divide-and-conquer algorithm based on the idea of breaking down a list into several sub-lists until each sublist consists of a single element and merging those sublists in a manner that results into a sorted list.
- Idea:
  - Divide the unsorted list into  $N$  sublists, each containing 1 element.
  - Take adjacent pairs of two singleton lists and merge them to form a list of 2 elements.  $N$  will now convert into  $N/2$  lists of size 2.
  - Repeat the process till a single sorted list of obtained.

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## Quick Sort

HEXWARE

- Quick Sort is based on the **Divide and Conquer rule**.
- It is also called **partition-exchange sort**. This algorithm divides the list into three main parts:
  - Elements less than the **Pivot** element
  - Pivot element(Central element)
  - Elements greater than the pivot element

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## The Scenario

- We have a sorted array
- We want to determine if a particular element is in the array
  - Once found, print or return (index, boolean, etc.)
  - If not found, indicate the element is not in the collection

7	12	42	59	71	86	104	212
---	----	----	----	----	----	-----	-----

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## Binary Search

HEXWARE

- Requires a sorted array or a *binary search tree*.
- Cuts the "search space" in half each time.
- Keeps cutting the search space in half until the target is found or has exhausted the all possible locations.

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## Binary Search Algorithm

look at "middle" element

if no match then  
look *left* (if need *smaller*) or  
*right* (if need *larger*)

1	7	9	12	33	42	59	76	81	84	91	92	93	99			
---	---	---	----	----	----	----	----	----	----	----	----	----	----	--	--	--

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The Binary Search Algorithm

HEXAWARE

calculate middle position

if (first and last have "crossed") then  
"Item not found"

elseif (element at middle = to\_find) then  
"Item Found"

elseif to\_find < element at middle then  
Look to the left

else  
Look to the right

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Binary Search :

90 20 50 60 40 30 100

Search Element : 90

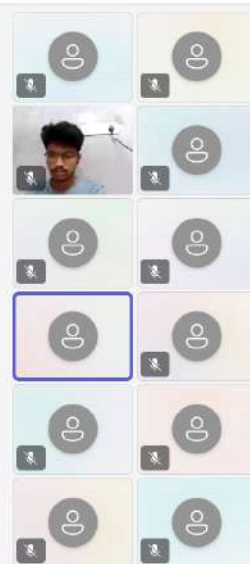
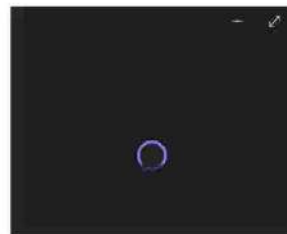
1) Apply search  
2) Each Comparision (L,F)

-----

40 50 60 70 90 100  
Search Element: 90

Result of comparis: Index of Last Element, First Element

a) 4 b) 0 c) 2 d) 5



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## Looking Right

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- Use indices "first" and "last" to keep track of where we are looking
- Move **right** by setting **first = middle + 1**

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## Trees

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- A **tree** is a **non-linear** data structure that consists of a **root node** and potentially many levels of additional nodes that form a hierarchy
- Nodes that have no children are called **leaf nodes**
- Non-root and non-leaf nodes are called **internal nodes**

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# Trees

Organization chart represented via a tree data structure

```
graph TD; MD[Mark Davis CEO] --> SD[Sam Wise Marketing Director]; MD --> OD[Stan West Operations Director]; MD --> HE[Kale Nate Head of Engineering]; SD --> FH[Future Hire Marketing Writer]; SD --> JM[Jon Lancel Sales Manager]; OD --> SM[Rendi Dent Senior Manager]; HE --> SE[Rick Kross Senior Engineer]; HE --> DEV[Rob Wayne Developer]; HE --> MD2[Clive Das Mobile Developer];
```

Legend

- 1+ year tenure
- Low performers
- Future Employee

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## Tree Traversal

HEXWARE

- Two main methods:
  - Inorder
  - Preorder
  - Postorder
- Inorder
  - visit the root
  - traverse in preorder the children (subtrees)
- Preorder:
  - visit the root
  - traverse in preorder the children (subtrees)
- Postorder:
  - traverse in postorder the children (subtrees)
  - visit the root

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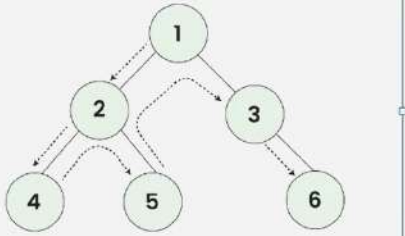
Tree\_Traversal - Microsoft Word

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**Preorder Traversal**  
Preorder traversal visits the node in the order: Root -> Left -> Right

### Preorder Traversal of Binary Tree



Preorder Traversal: 1 → 2 → 4 → 5 → 3 → 6

Algorithm for Preorder Traversal  
*Preorder(tree)*

Page: 2 of 3 Words: 296 English (India)

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## Binary Search Tree

Binary Search Tree is a node-based binary tree data structure which has the following properties:

- The left subtree of a node contains only nodes with keys lesser than the node's key.
- The right subtree of a node contains only nodes with keys greater than the node's key.
- The left and right subtree each must also be a binary search tree.

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### creating a binary search tree

**Step 9 - Insert 50.**

50 is greater than 45 but smaller than 79 and 55. So, it will be inserted as a left subtree of 55.

```
graph TD; Root((Root)) --> 45((45)); 45 --> 15((15)); 45 --> 79((79)); 15 --> 10((10)); 15 --> 20((20)); 10 --> 12((12)); 20 --> 50((50)); 79 --> 55((55)); 79 --> 90((90));
```

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