Data Structures & Algorithms

What is Data?

1

Data are the raw facts, unorganized facts that need to be processed. Data can be something simple and seemingly random and useless until it is organized.

What is Information?

When data is processed, organized, structured or presented in a given context so as to make it useful, it is called information.

Difference between Data & Information

BASIS FOR COMPARISON	DATA	INFORMATION
Meaning	Data means raw facts gathered about someone or something, which is bare and random.	Facts, concerning a particular event or subject, which are refined by processing is called information.
What is it?	It is just text and numbers.	It is refined data.
Based on	Records and Observations	Analysis
Form	Unorganized	Organized
Useful	May or may not be useful.	Always
Specific	No	Yes
Dependency	Does not depend on information.	Without data, information cannot be processed.

Algorithm, Program & Data Structure?

Algorithm Outline, the essence of a computational procedure, step by step instructions

Program An Implementation of Algorithm in some programming language

Data Structure Organization of data needed to solve the problem

Algorithm V/s Pseudocode

Algorithm	Pseudocode
Systematic logical approach which is a well-defined, step-by-step procedure that allows a computer to solve a problem.	It is one of the methods which can be used to represent an algorithm for a program.
Algorithms can be expressed using natural language, flowcharts, etc.	Pseudocode allows you to include several control structures such as While, If-then-else, Repeat-until, for and case, which is present in many high-level languages.

Data Structure & Algorithm

Types of Data Structure

Data Structures

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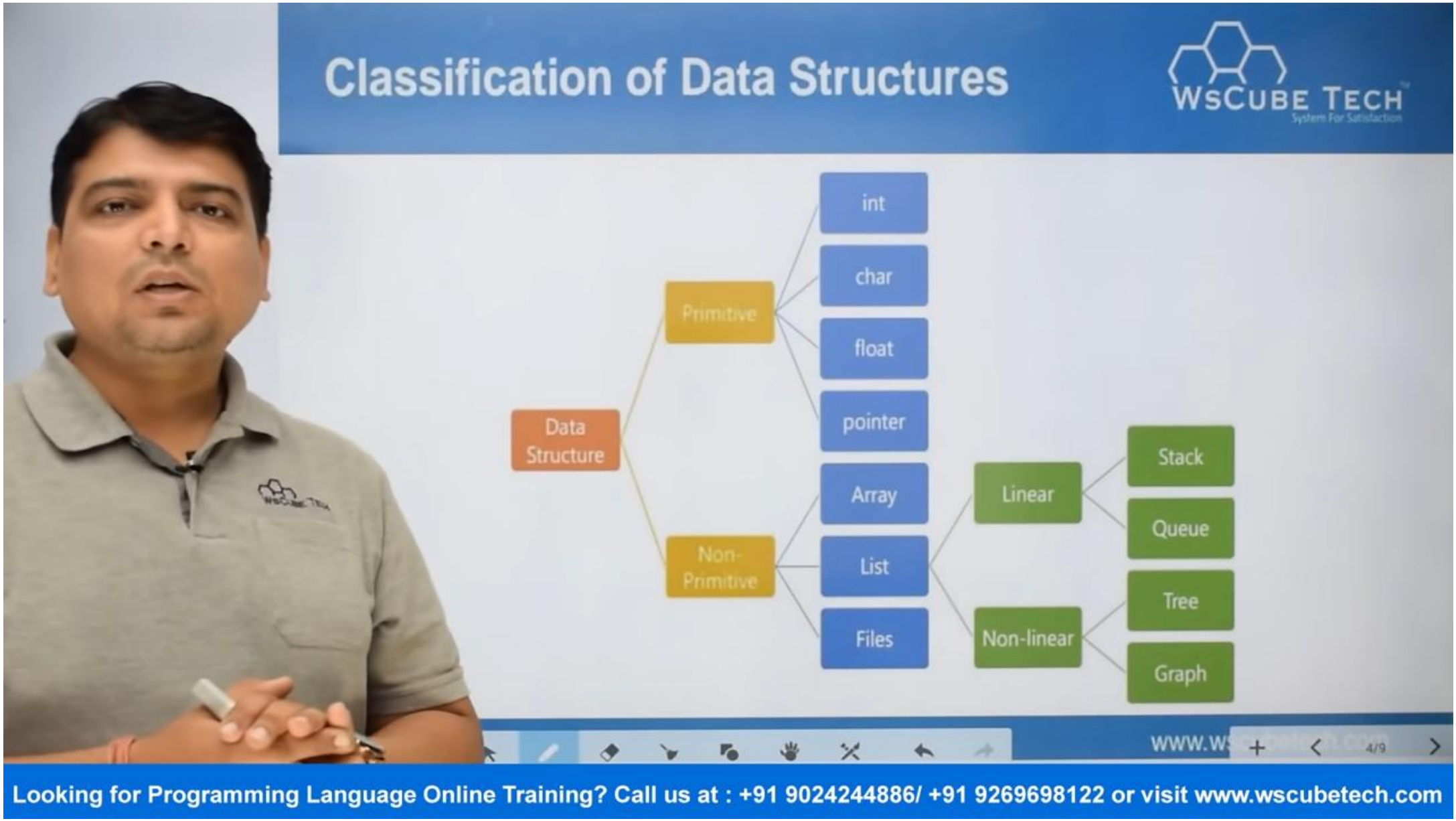
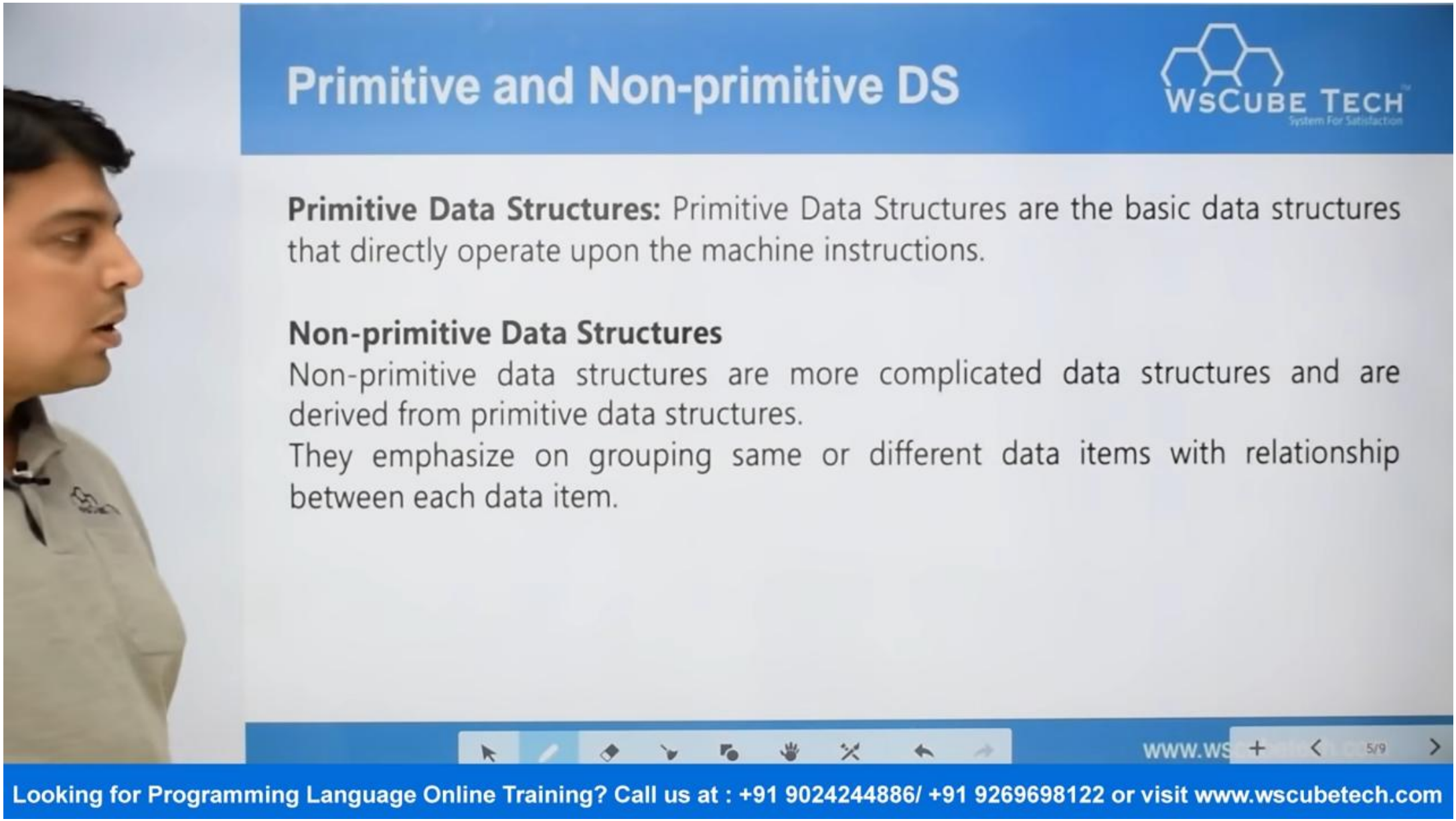
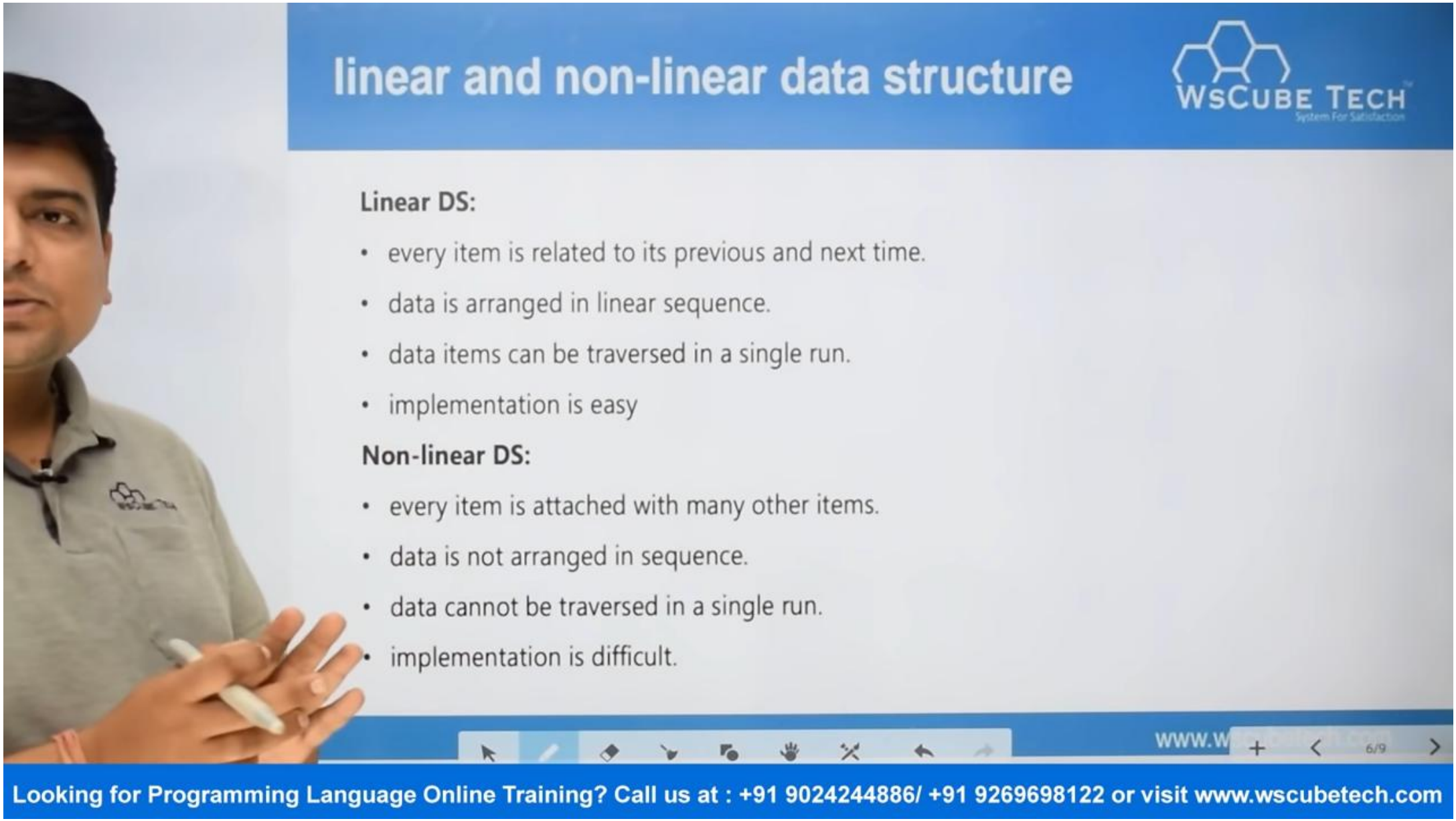
Data Structure is a way of collecting and organizing data in such a way that we can perform operations on these data in an effective way.

Types Of Data Structures

- Primitive data structures
- Non-primitive data structure







Static and Dynamic DS

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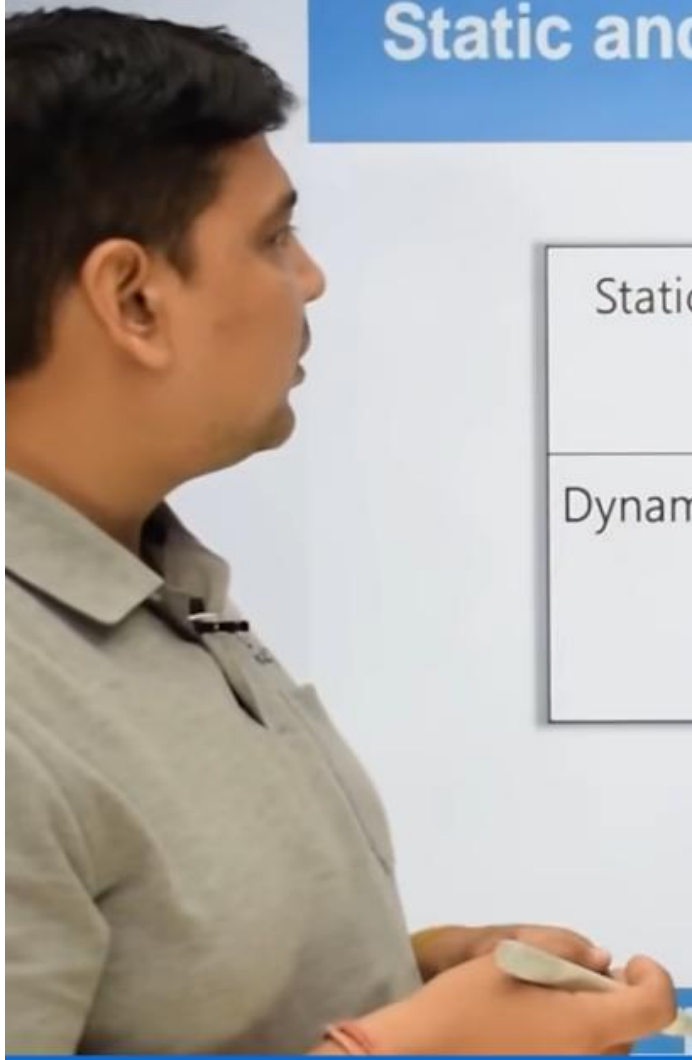
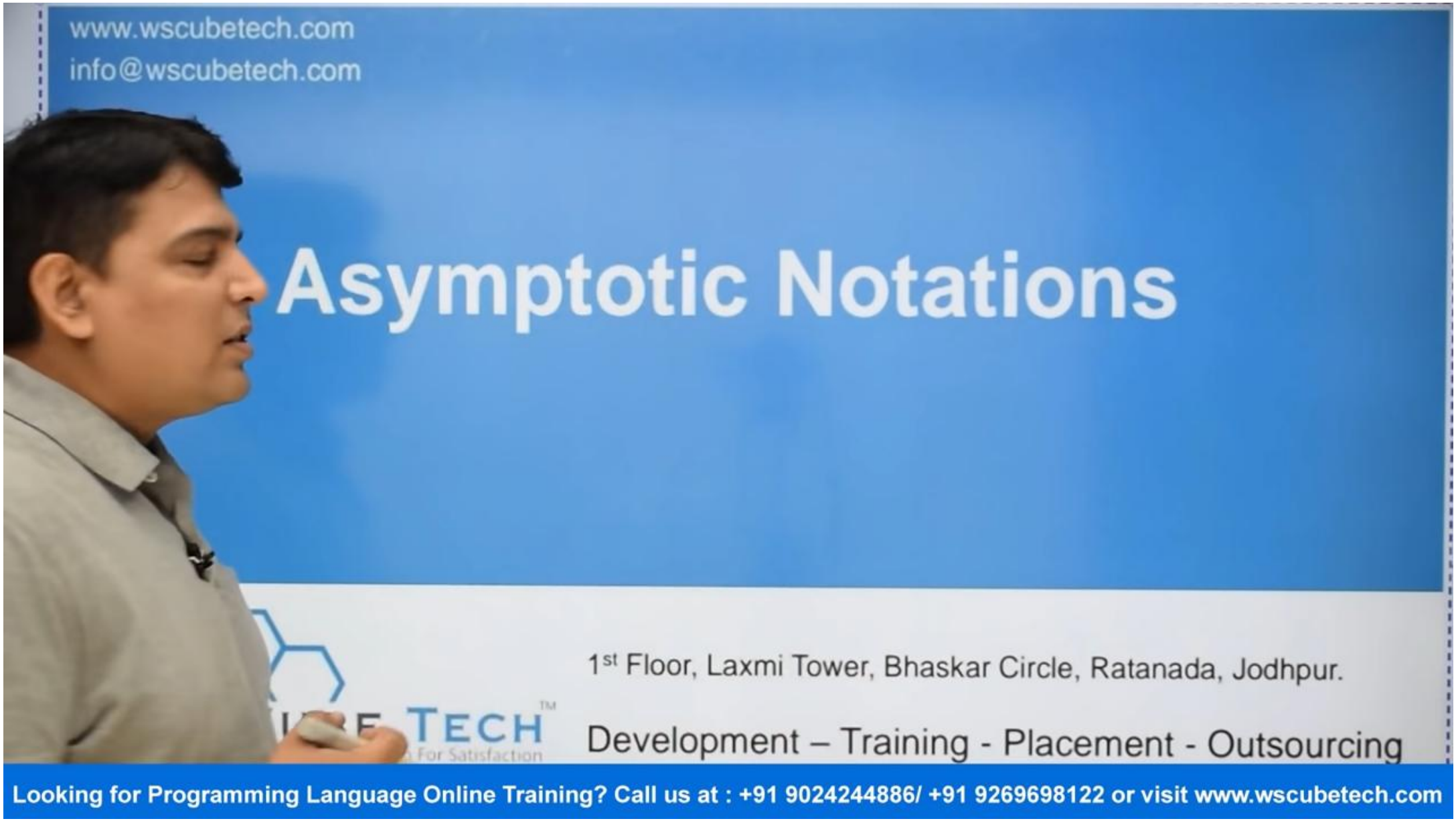
Static	Static data structures are those whose sizes and structures associated memory locations are fixed, at compile time. Example: **Array**
Dynamic	Dynamic structures are those which expands or shrinks depending upon the program need and its execution. Also, their associated memory locations changes. Example: **Linked List created using pointers**



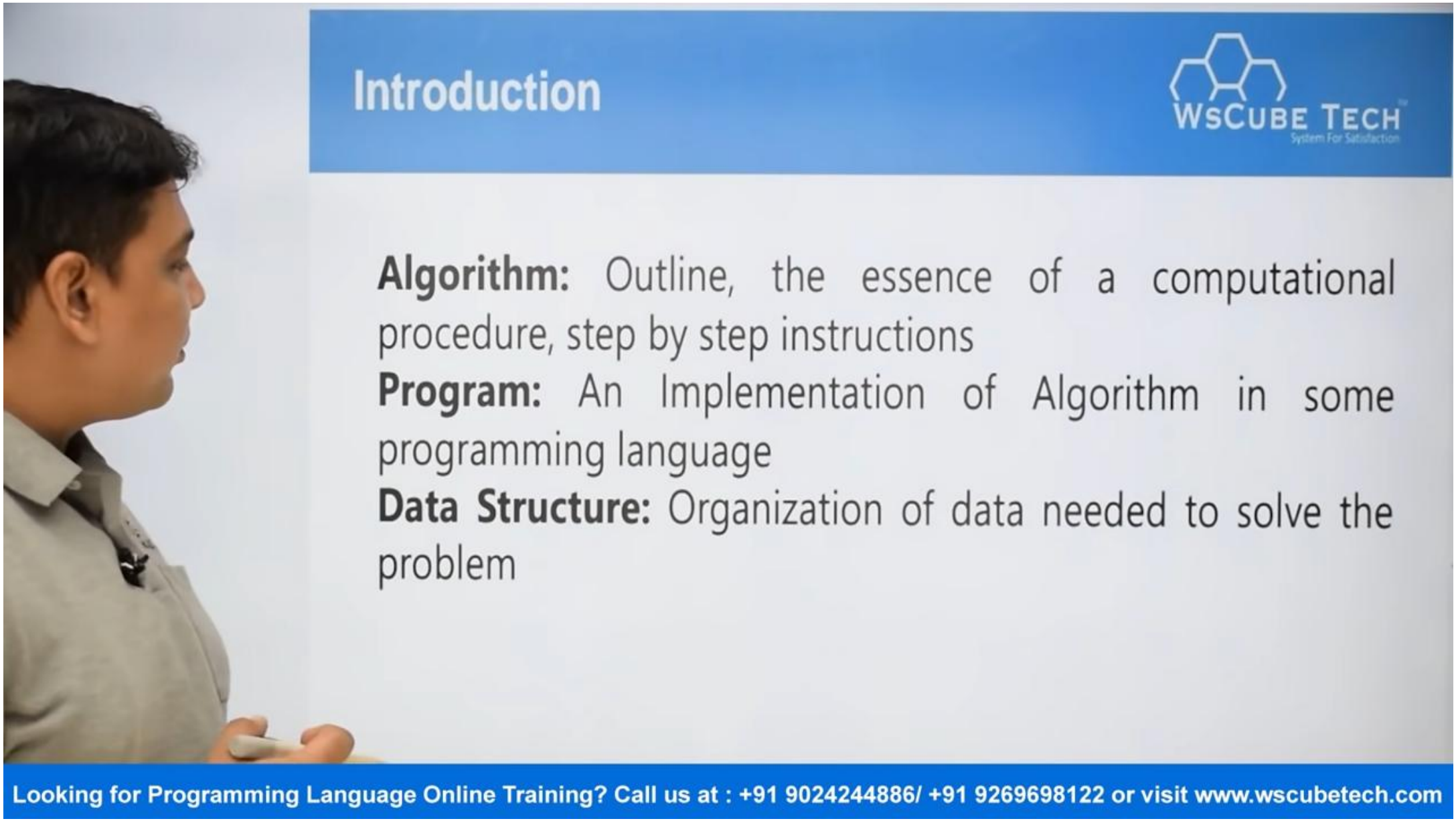
Homogeneous and Non-Homogeneous DS

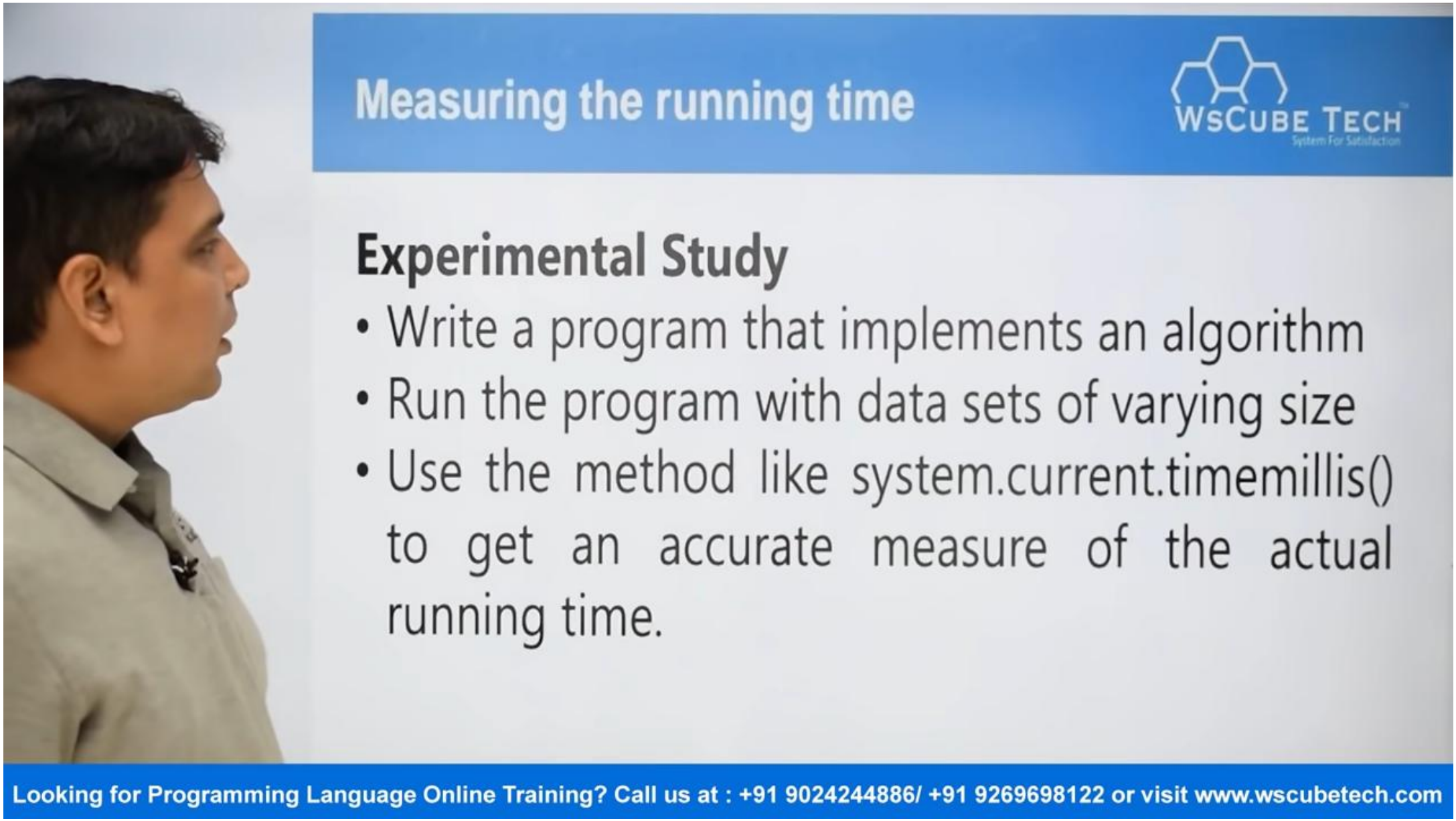
Homogeneous	In homogeneous data structures, all the elements are of same type. Example: **Array**
Non-Homogeneous	In Non-Homogeneous data structure, the elements may or may not be of the same type. Example: **Structures**

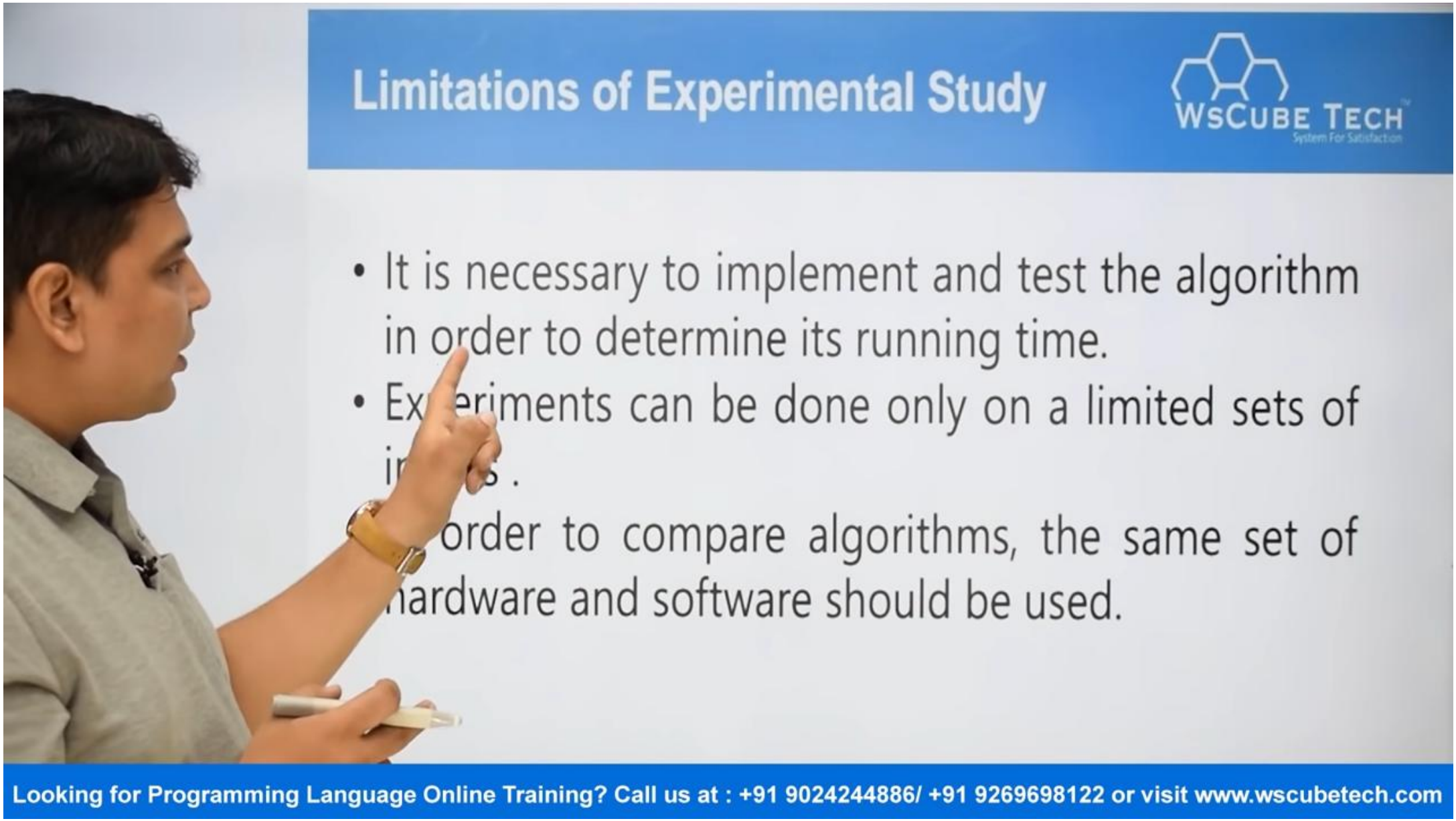


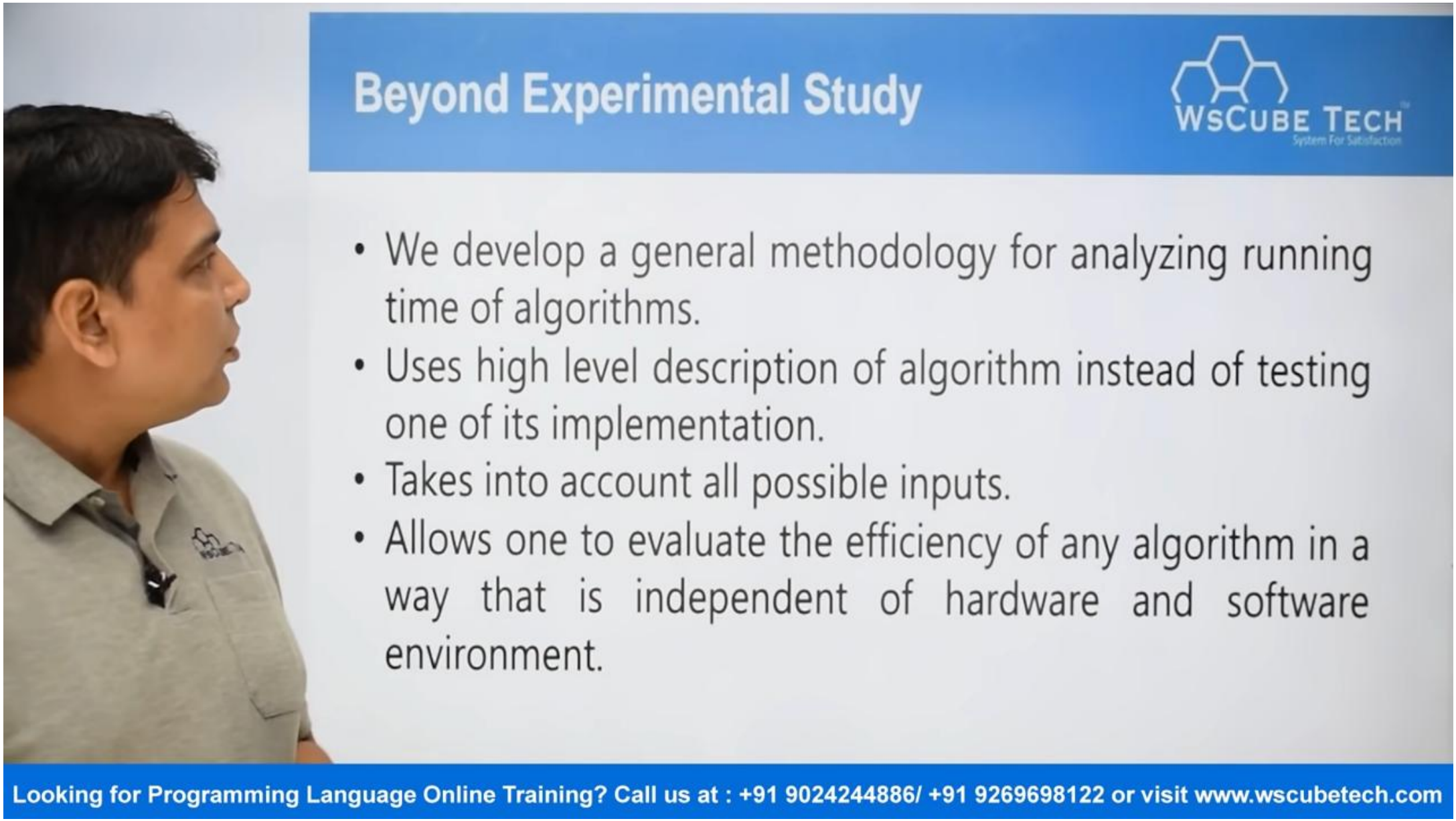
Data Structure & Algorithm

Asymptotic Notation

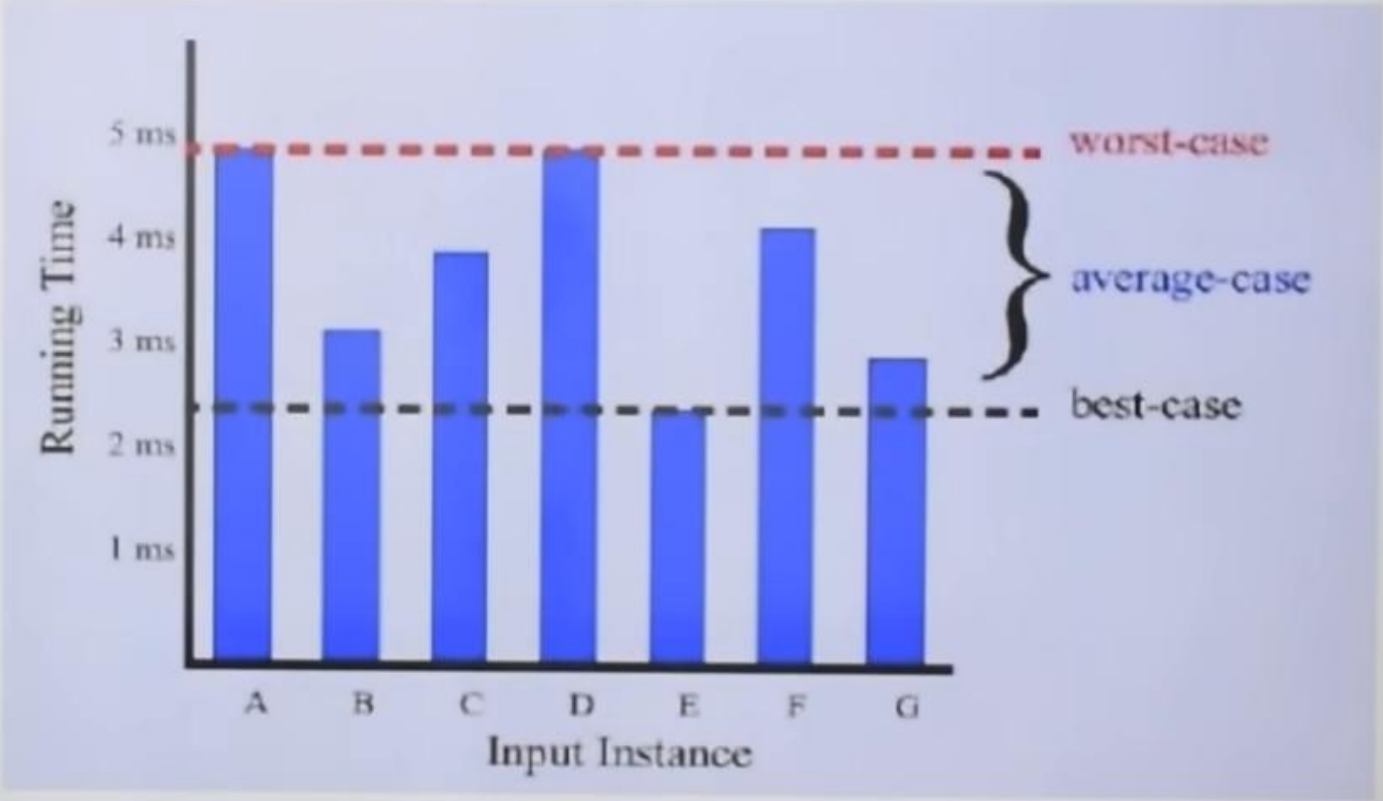


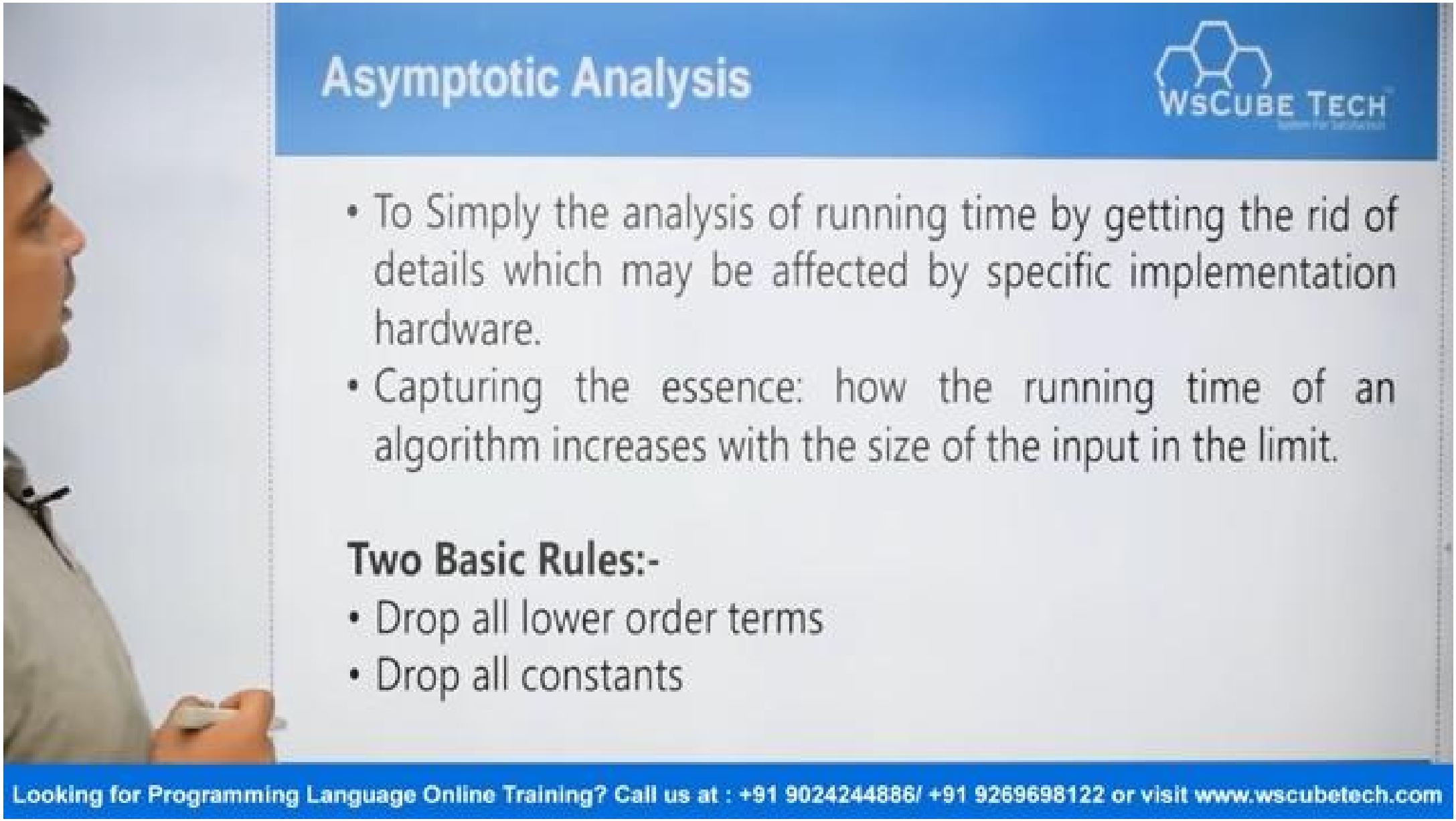


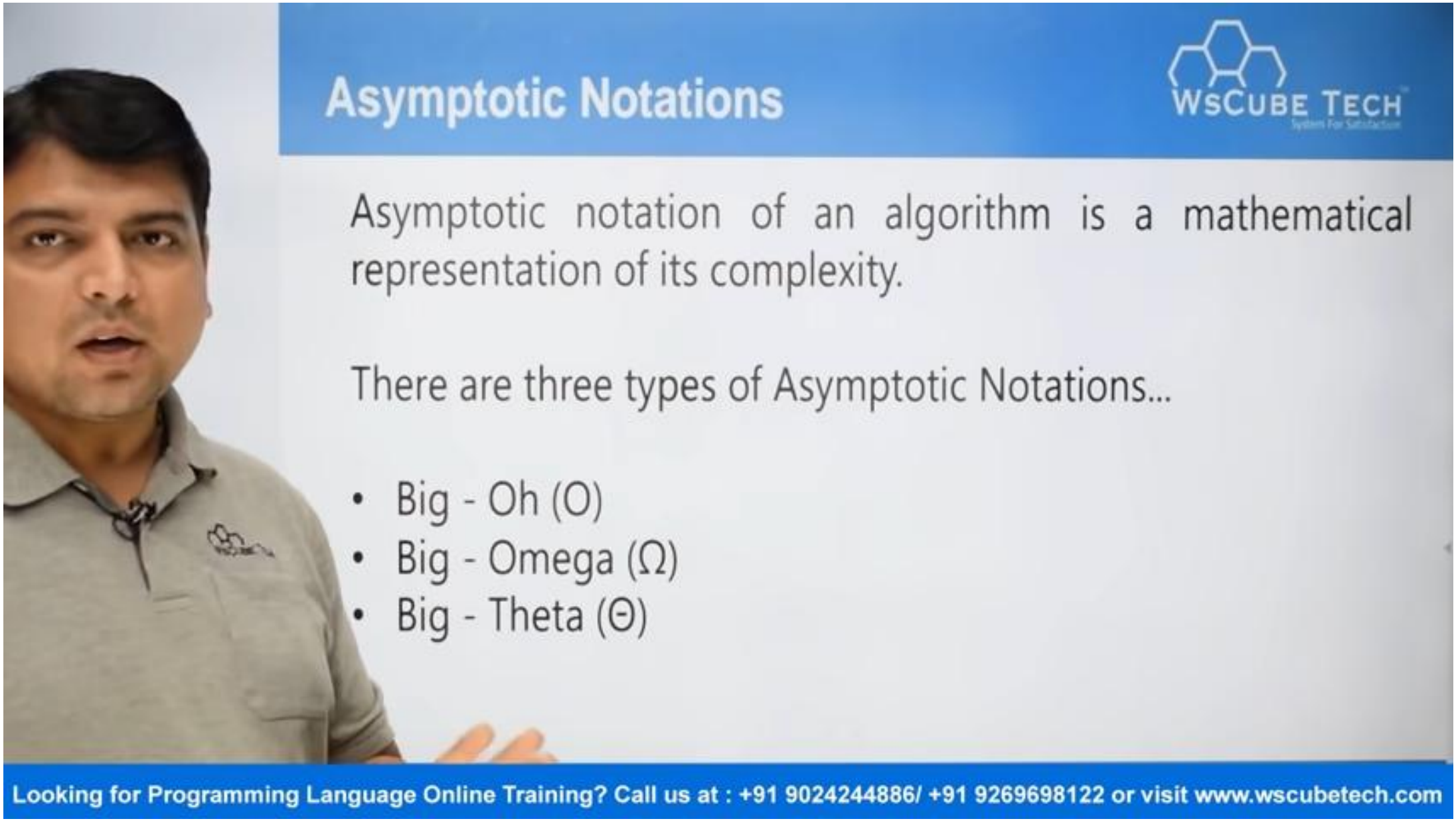




Best/Worst/Average Case






Asymptotic Notations
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Asymptotic notation of an algorithm is a mathematical representation of its complexity.
There are three types of Asymptotic Notations...
• Big - Oh (O)
• Big - Omega (Ω)
• Big - Theta (Θ)
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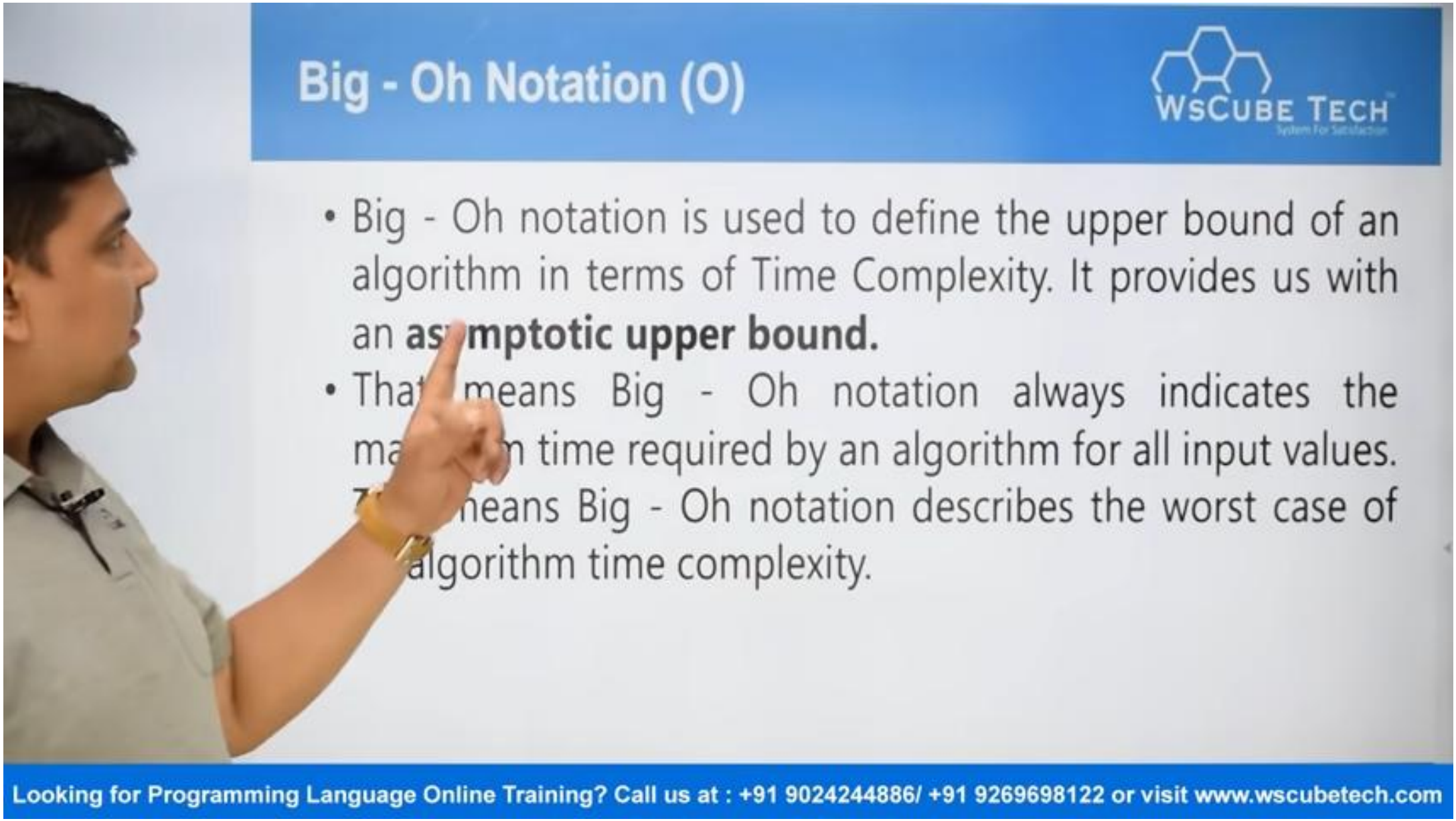

Big - Oh Notation (O)

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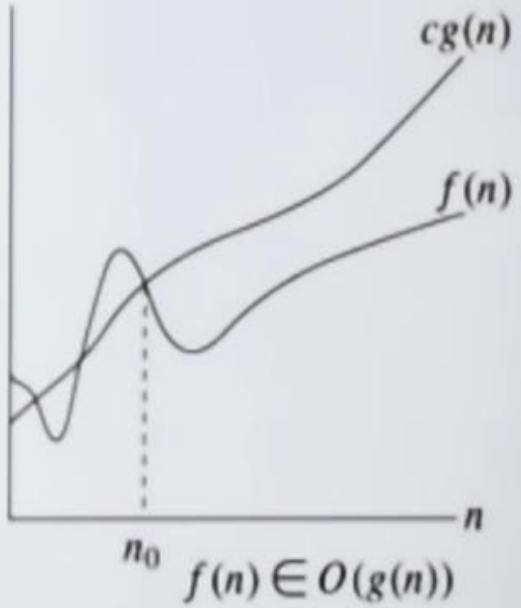
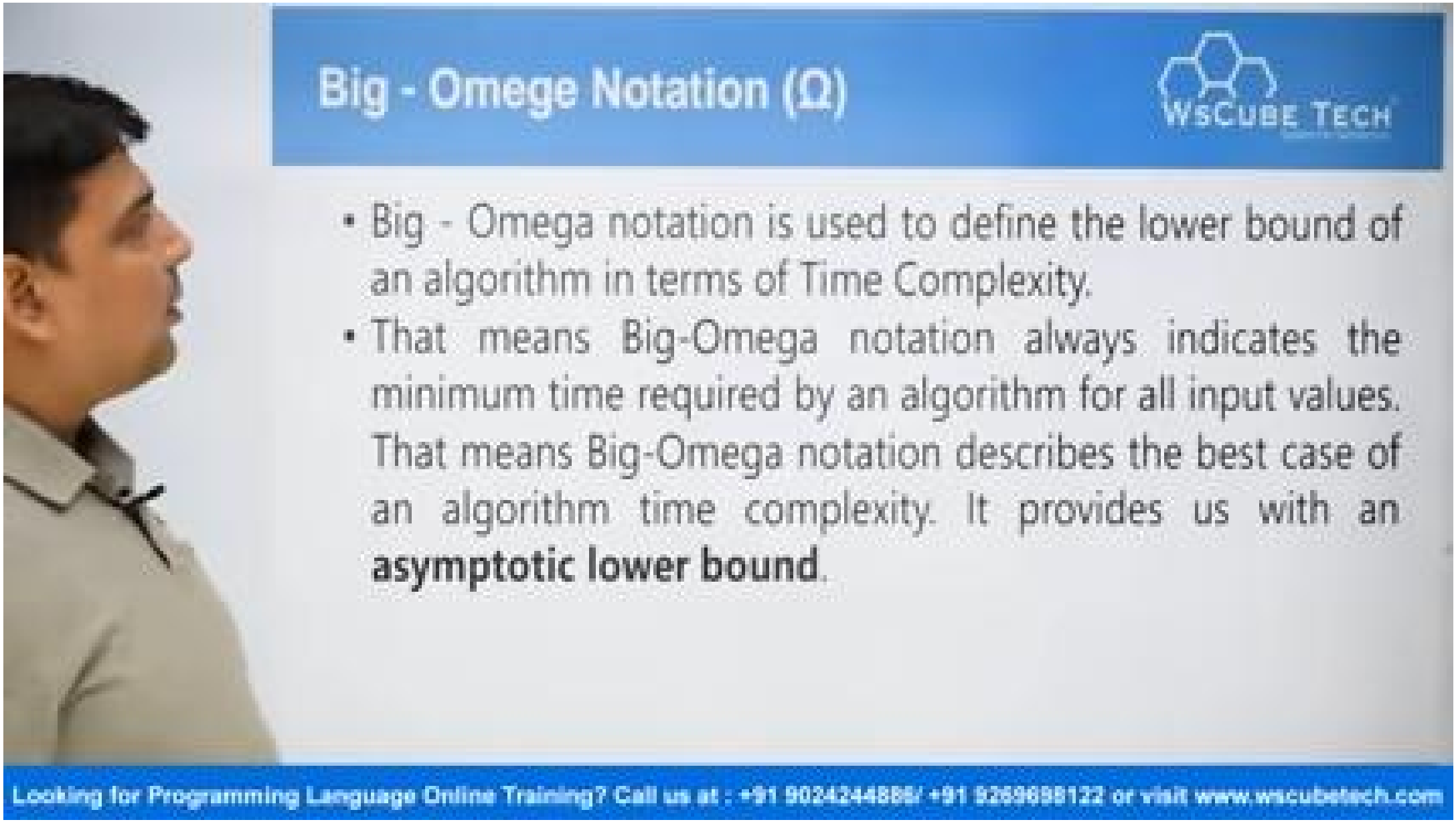
- f(n) is your algorithm runtime, and g(n) is an arbitrary time complexity you are trying to relate to your algorithm. f(n) is O(g(n)), if for some real constants c (c > 0) and n0, f(n) <= c g(n) for every input size n (n > n0).




Big - Omege Notation (Ω)
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• Big - Omega notation is used to define the lower bound of an algorithm in terms of Time Complexity.
• That means Big-Omega notation always indicates the minimum time required by an algorithm for all input values. That means Big-Omega notation describes the best case of an algorithm time complexity. It provides us with an asymptotic lower bound.
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Big - Omege Notation (Ω)

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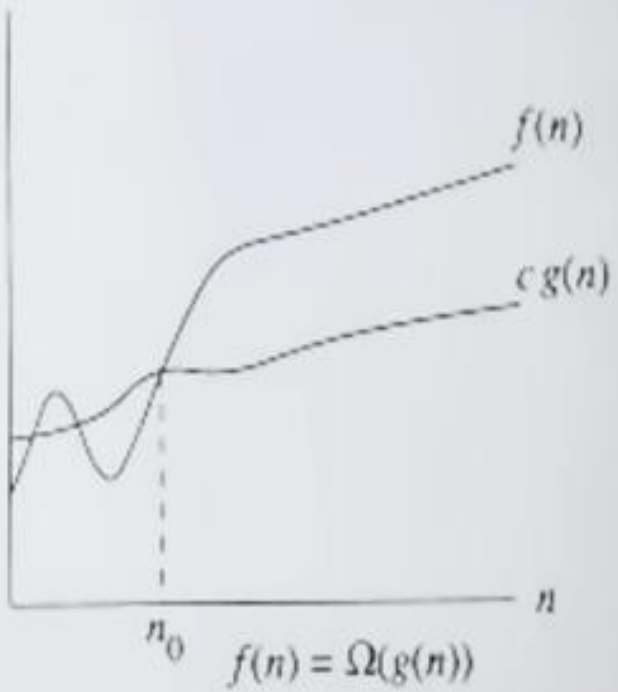
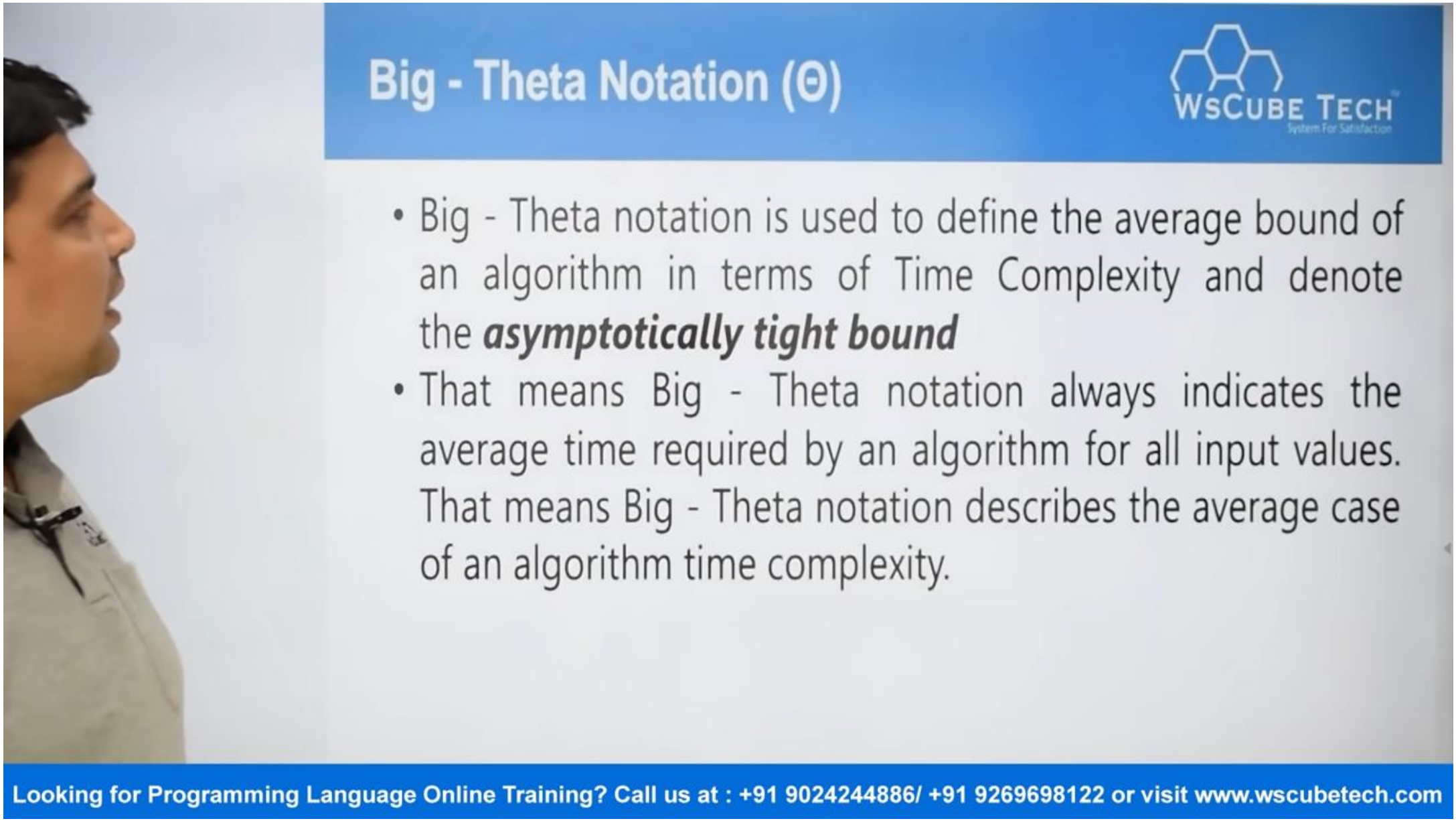
- f(n) is Ω(g(n)), if for some real constants c (c > 0) and n0 (n0 > 0), f(n) is >= c g(n) for every input size n (n > n0).





Big - Theta Notation (Θ)

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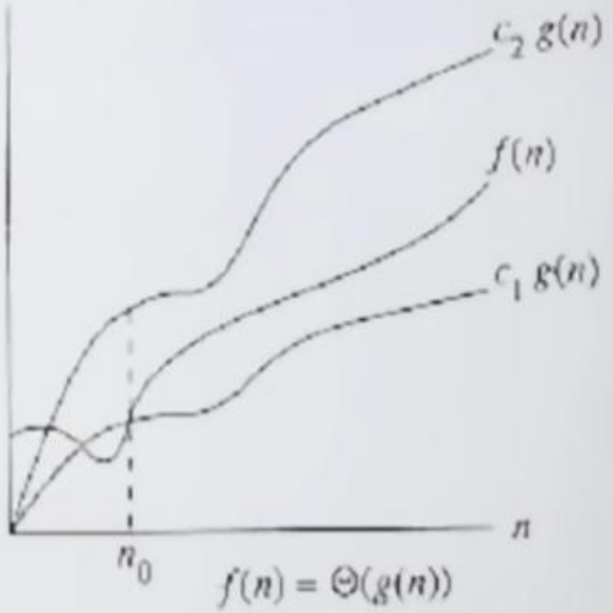
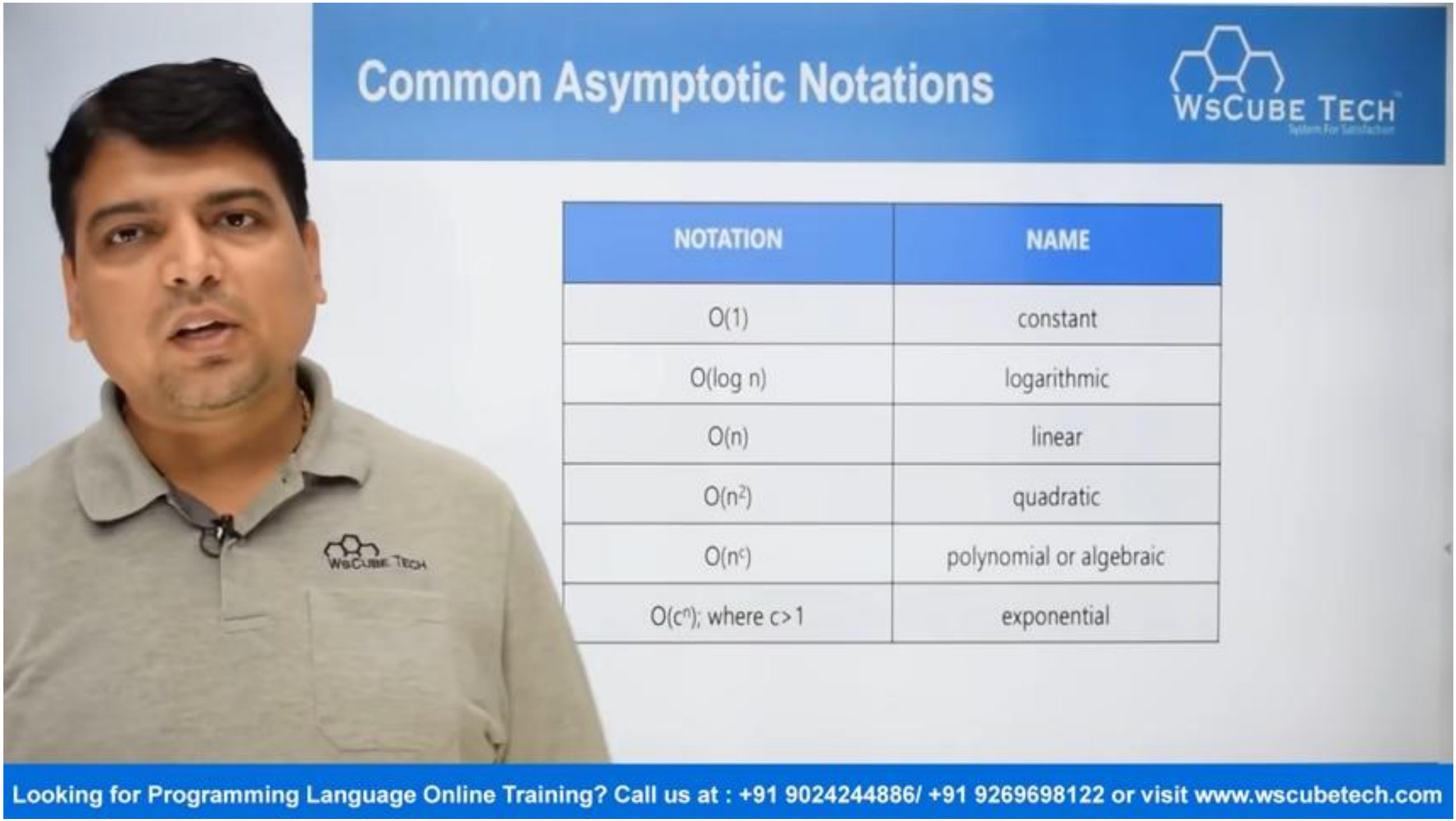
- function f(n) as time complexity of an algorithm and g(n) is the most significant term. If C1 g(n) <= f(n) <= C2 g(n) for all n >= n0, C1 > 0, C2 > 0 and n0 >= 1. Then we can represent f(n) as Θ(g(n)).




Common Asymptotic Notations
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NOTATION
NAME
O(1)
constant
O(log n)
logarithmic
O(n)
linear
O(n²)
quadratic
O(nᶜ)
polynomial or algebraic
O(cⁿ); where c>1
exponential
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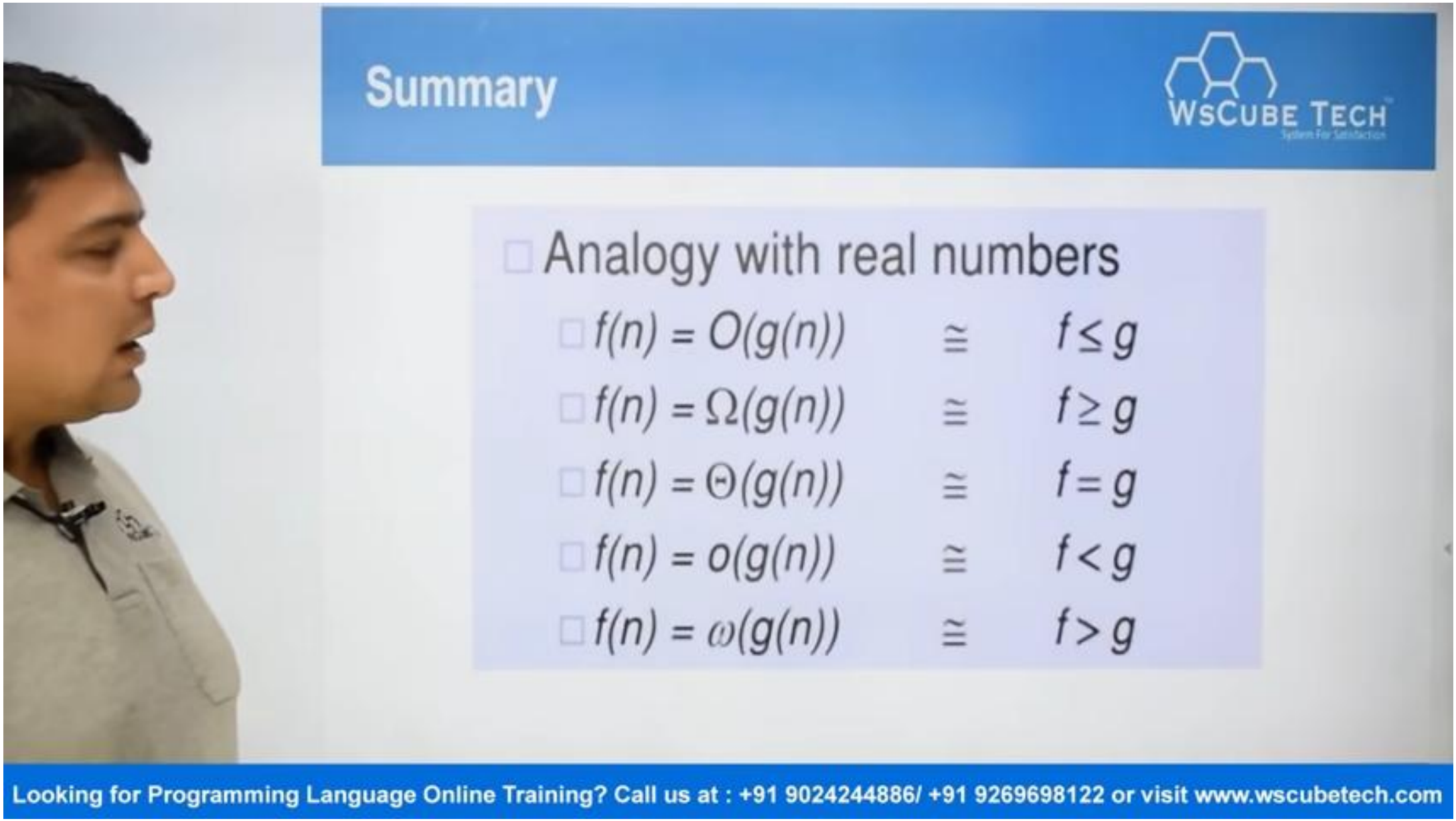

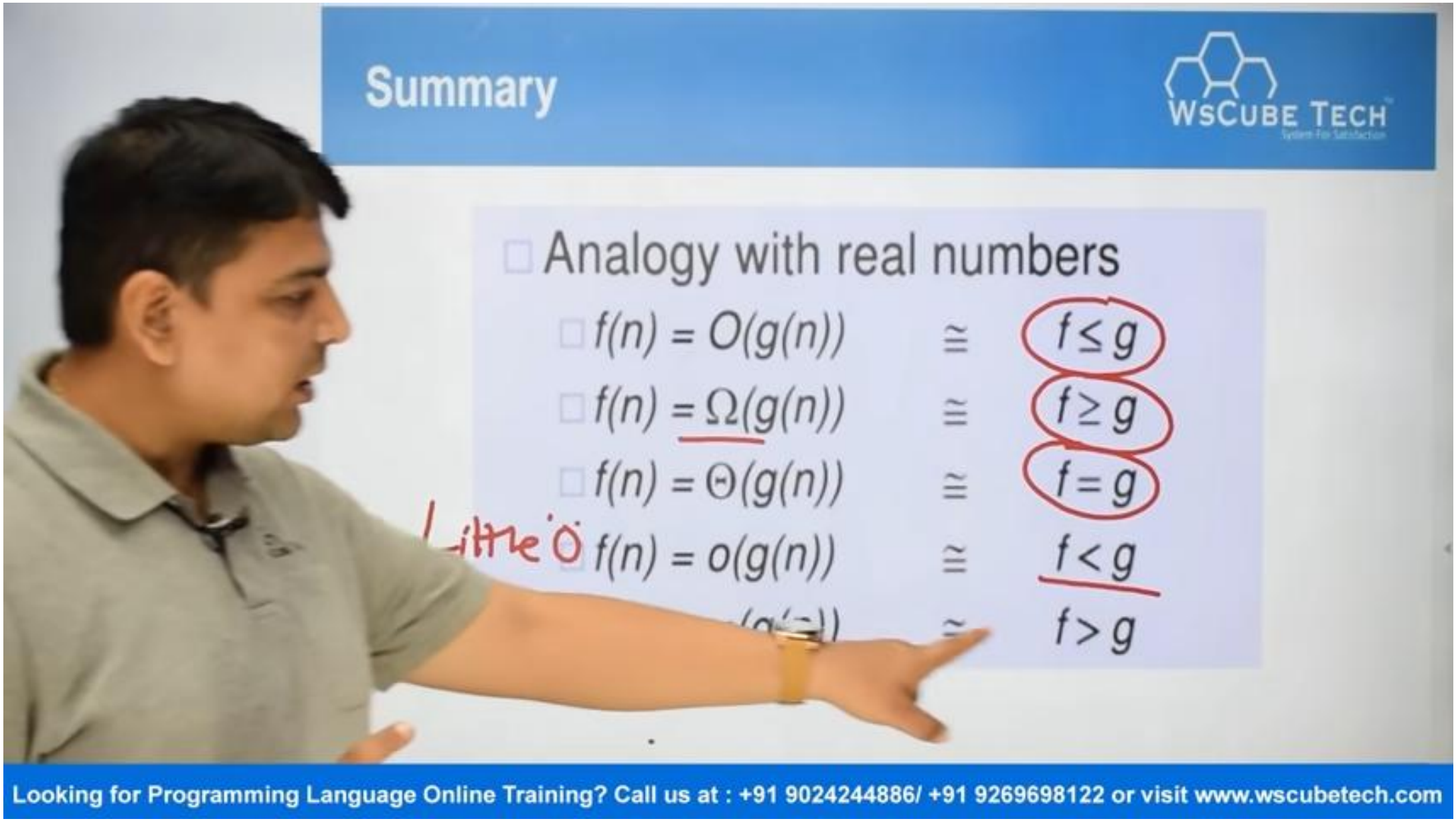

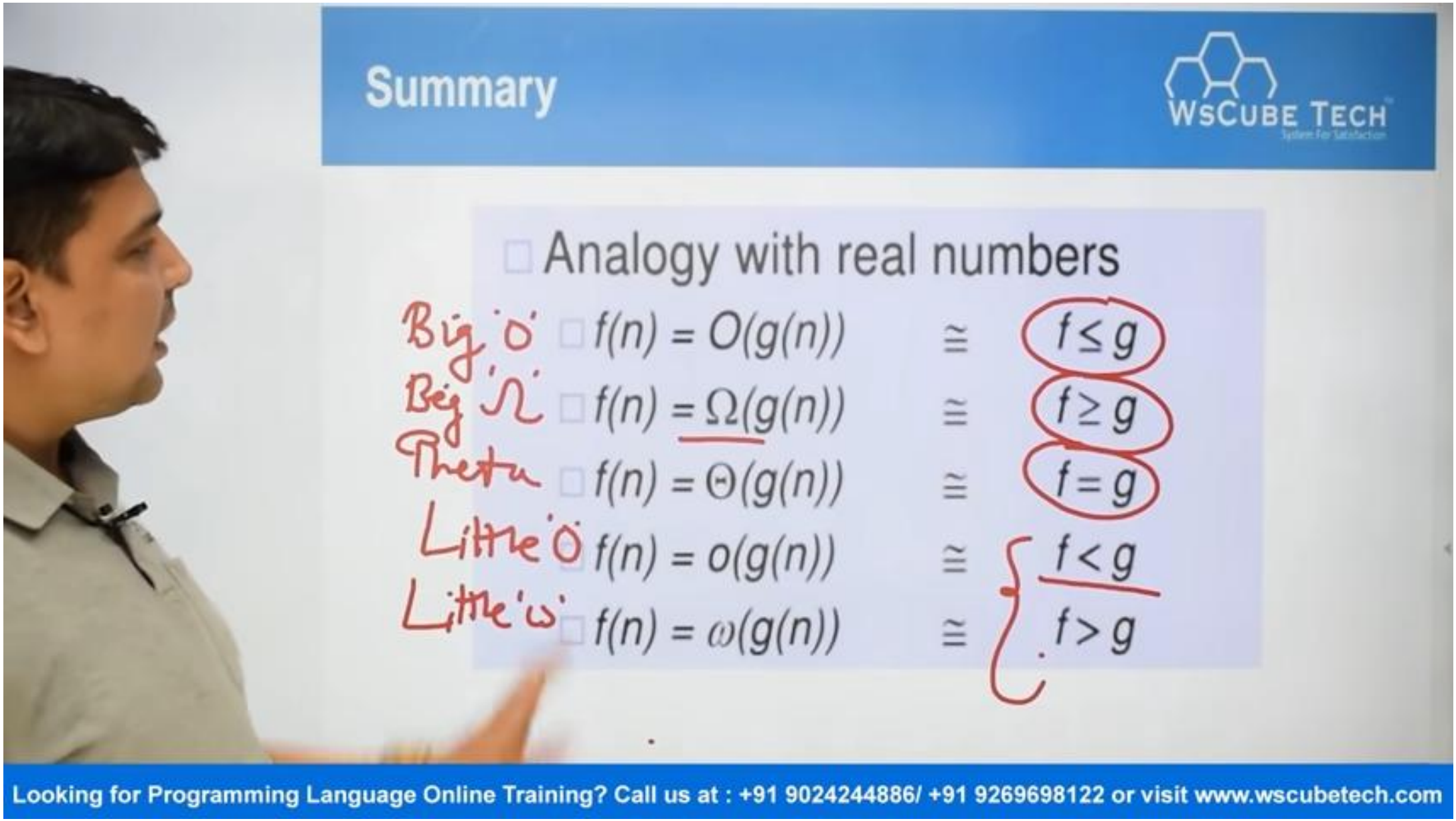

Data Structure & Algorithm

Array in DSA

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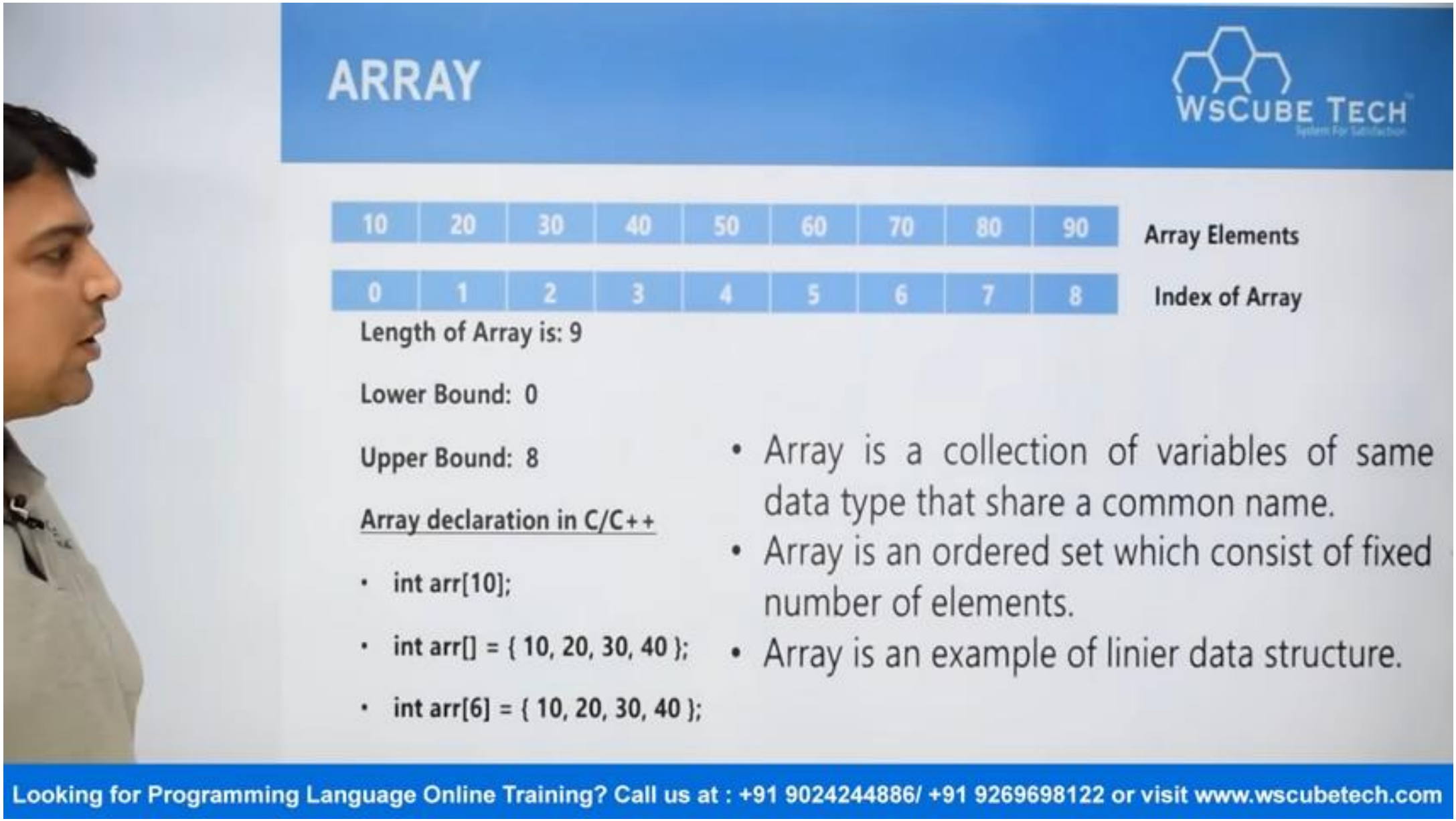

ARRAY

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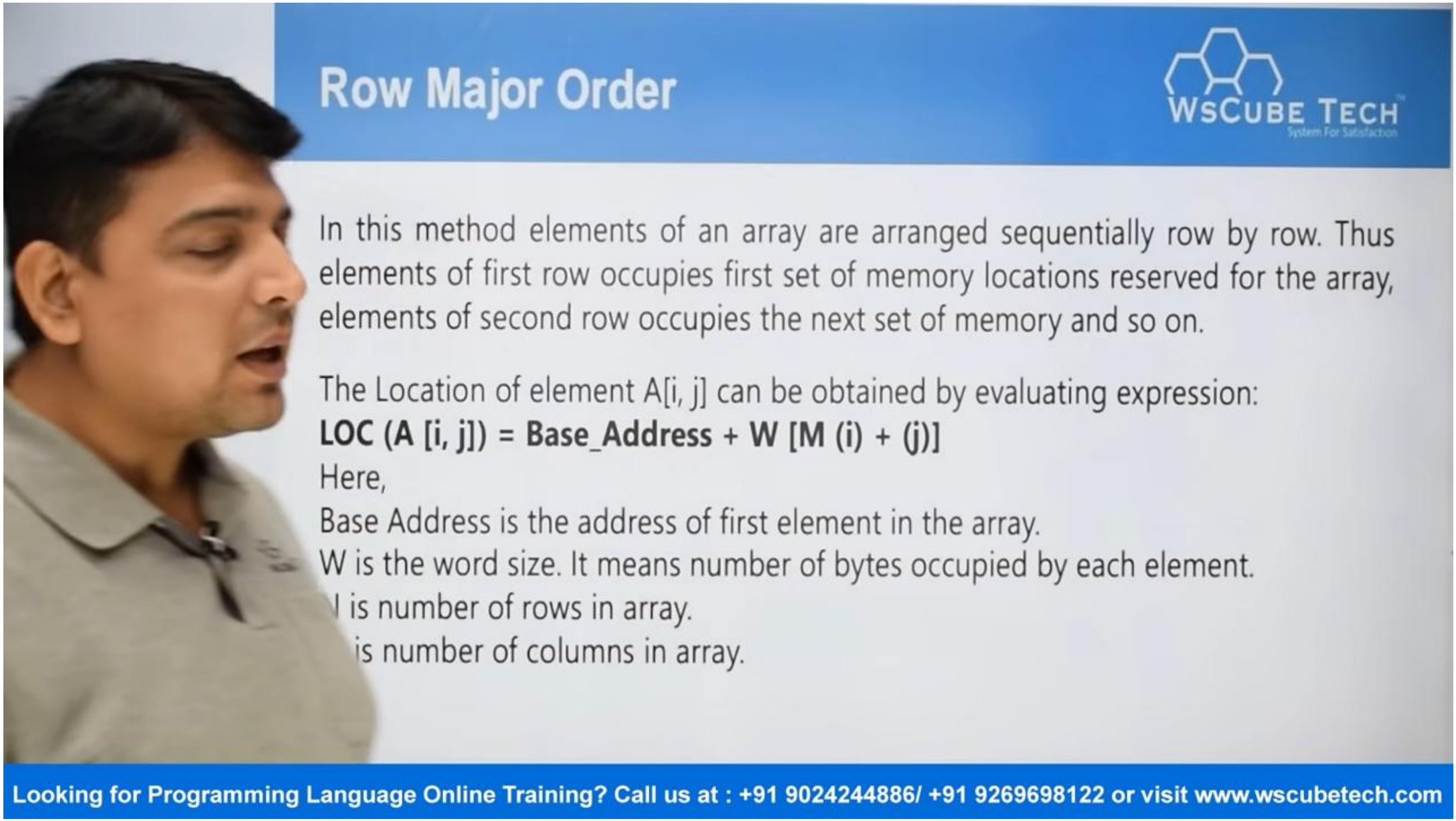
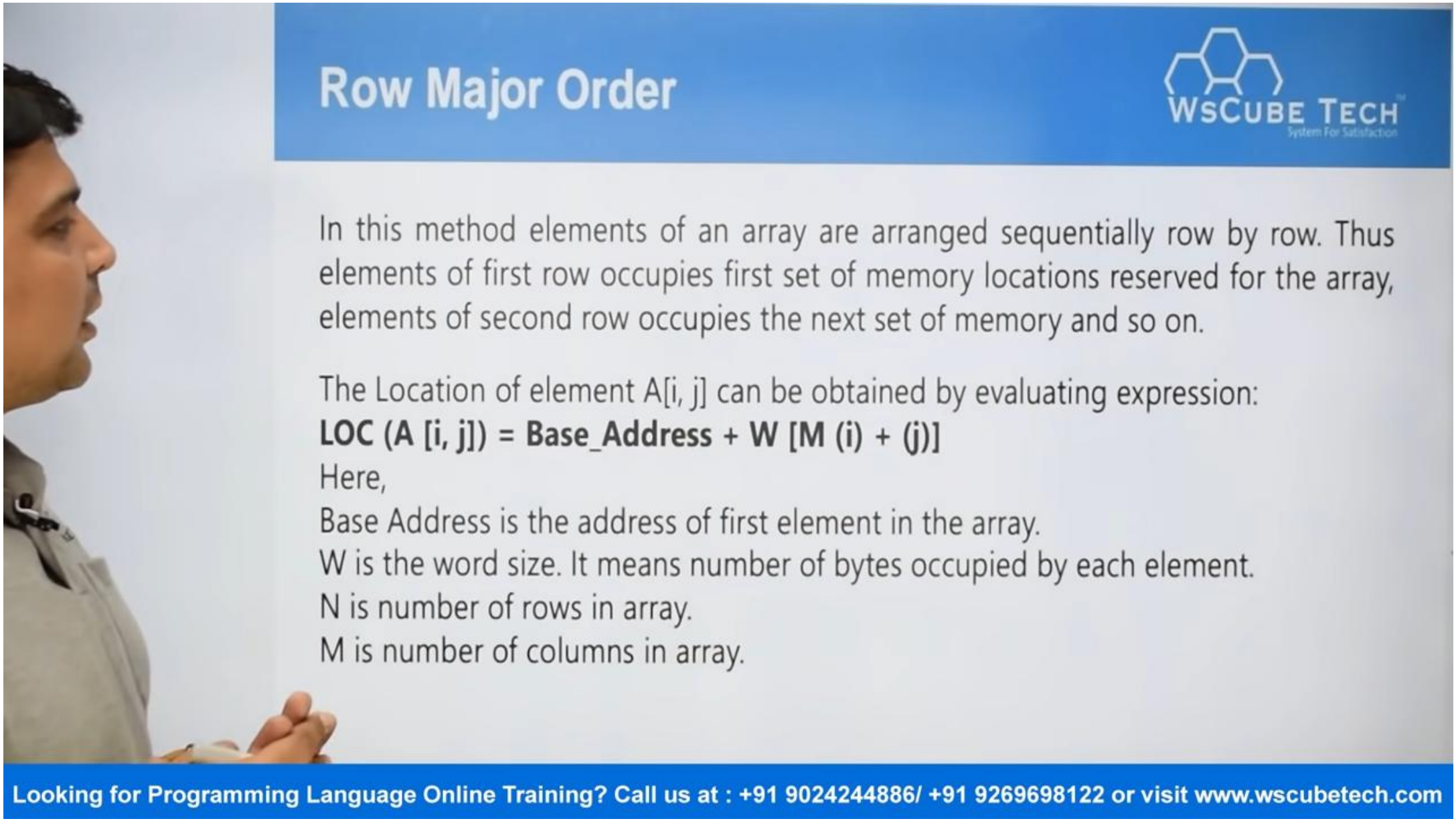
In One Dimensional Array location of element A[i] can be calculated using following equation:

LOC (A[i]) = Base_Address + W * (i)

Base_Address is the address of first element in the array.
W is the word size. It means number of bytes occupied by each element.





Example of Row Major Order

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11 Arr[0][0] 1000	**12** Arr[0][1] 1002	**13** Arr[0][2] 1004	**14** Arr[0][3] 1006
21 Arr[1][0] 1008	**22** Arr[1][1] 1010	**23** Arr[1][2] 1012	**24** Arr[1][3] 1014
31 Arr[2][0] 1016	**32** Arr[2][1] 1018	**33** Arr[2][2] 1020	**34** Arr[2][3] 1022

Suppose we want to calculate the address of element Arr[1, 2].

It can be calculated as follow:

Here,

Base Address = 1000, W= 2, M=4, N=3, i=1, j=2

LOC (A [i, j])=Base Address + W [M (i) + (j)]

LOC (A[1, 2])=1000 + 2 *[4*(1) + 2]

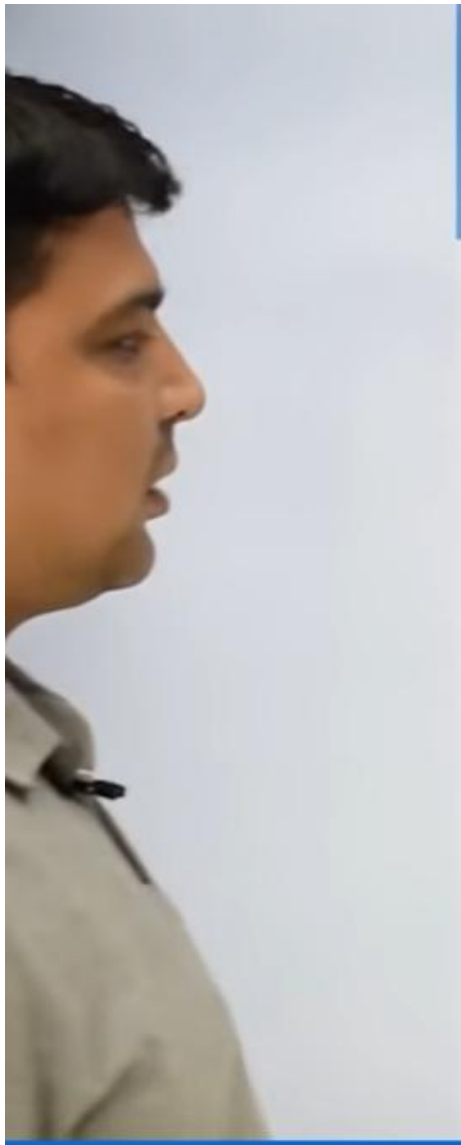
= 1000 + 2 * [4 + 2]

= 1000 + 2 * 6

= 1000 + 12

= **1012**

11	**12**	**13**	**14**	**21**	**22**	**23**	**24**	**31**	**32**	**33**	**34**



Column Major Order

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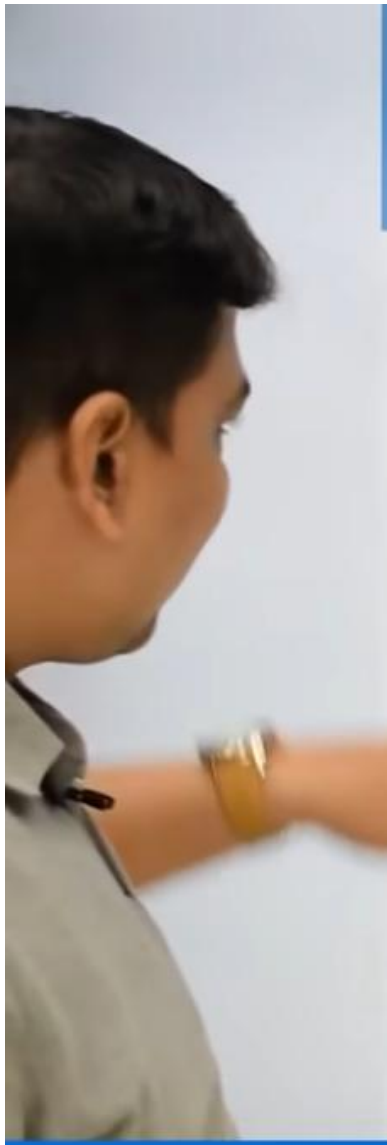
In this method elements of an array are arranged sequentially column by column. Thus elements of first column occupies first set of memory locations reserved for the array, elements of second column occupies the next set of memory and so on.

The Location of element A[i, j] can be obtained by evaluating expression:

LOC (A [i, j]) = Base_Address + W [N (j) + (i)]

Base_Address is the address of first element in the array.
W is the word size. It means number of bytes occupied by each element.
N is number of rows in array.
M is number of columns in array.

Example of Column Major Order



11 Arr[0][0] 1000	**12** Arr[0][1] 1006	**13** Arr[0][2] 1012	**14** Arr[0][3] 1018
21 Arr[1][0] 1002	**22** Arr[1][1] 1008	**23** Arr[1][2] 1014	**24** Arr[1][3] 1020
31 rr[2][0] 1004	**32** Arr[2][1] 1010	**33** Arr[2][2] 1016	**34** Arr[2][3] 1022

Suppose we want to calculate the address of element Arr[1, 2].

It can be calculated as follow:

Here,

Base Address = 1000, W= 2, M=4, N=3, i=1, j=2

LOC (A [i, j])=Base Address + W [N (j) + (i)]

LOC (A[1, 2])=1000 + 2 *[3*(2) + 1]

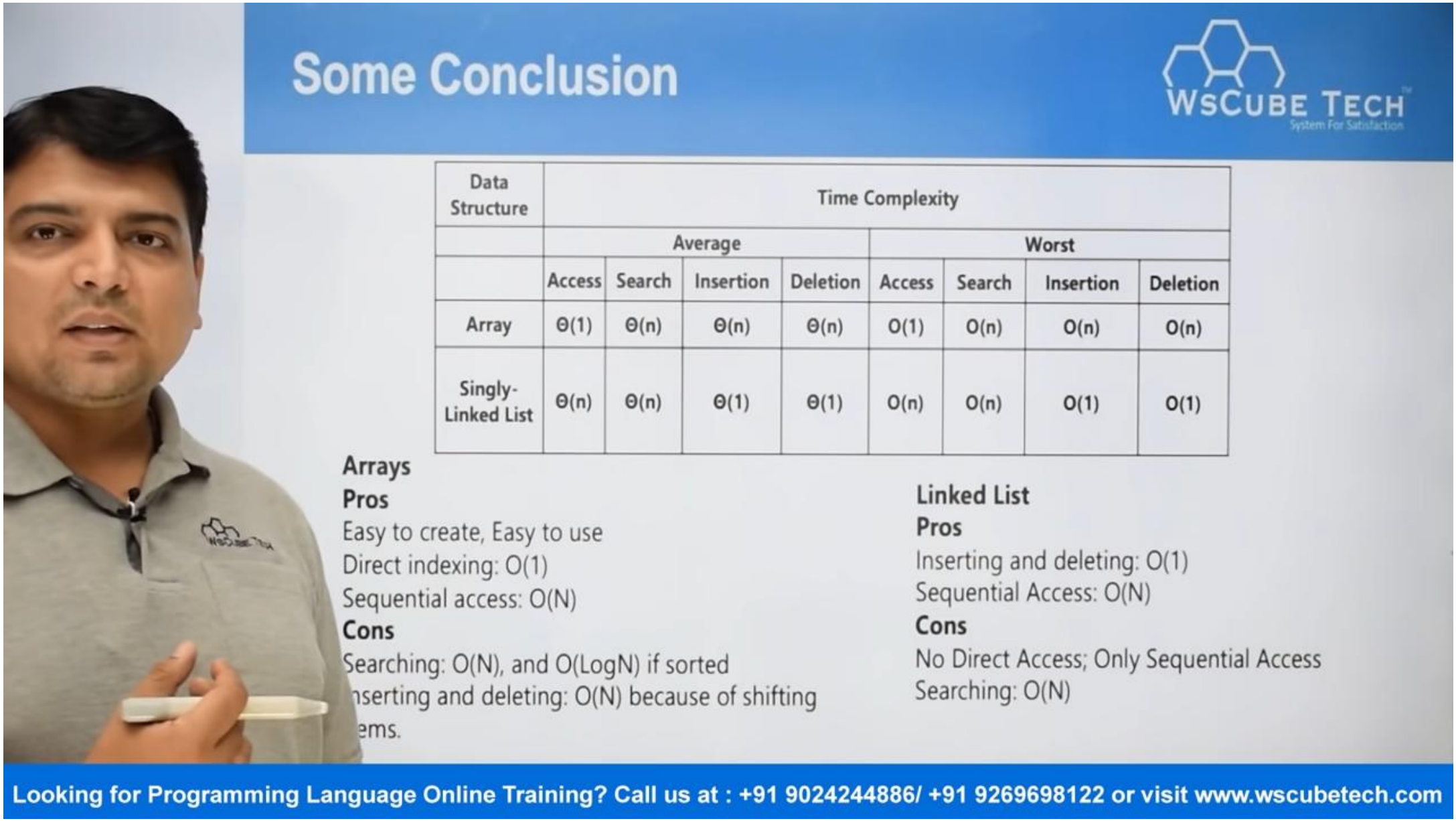
= 1000 + 2 * [6 + 1]

= 1000 + 2 * 7

= 1000 + 14

= **1014**

11	**21**	**31**	**12**	**22**	**32**	**13**	**23**	**33**	**14**	**24**	**34**



Data Structure	Time Complexity							
	Average				Worst			
	Access	Search	Insertion	Deletion	Access	Search	Insertion	Deletion
Array	Θ(1)	Θ(n)	Θ(n)	Θ(n)	O(1)	O(n)	O(n)	O(n)
Singly-Linked List	Θ(n)	Θ(n)	Θ(1)	Θ(1)	O(n)	O(n)	O(1)	O(1)

Data Structure & Algorithm

Concept of Stack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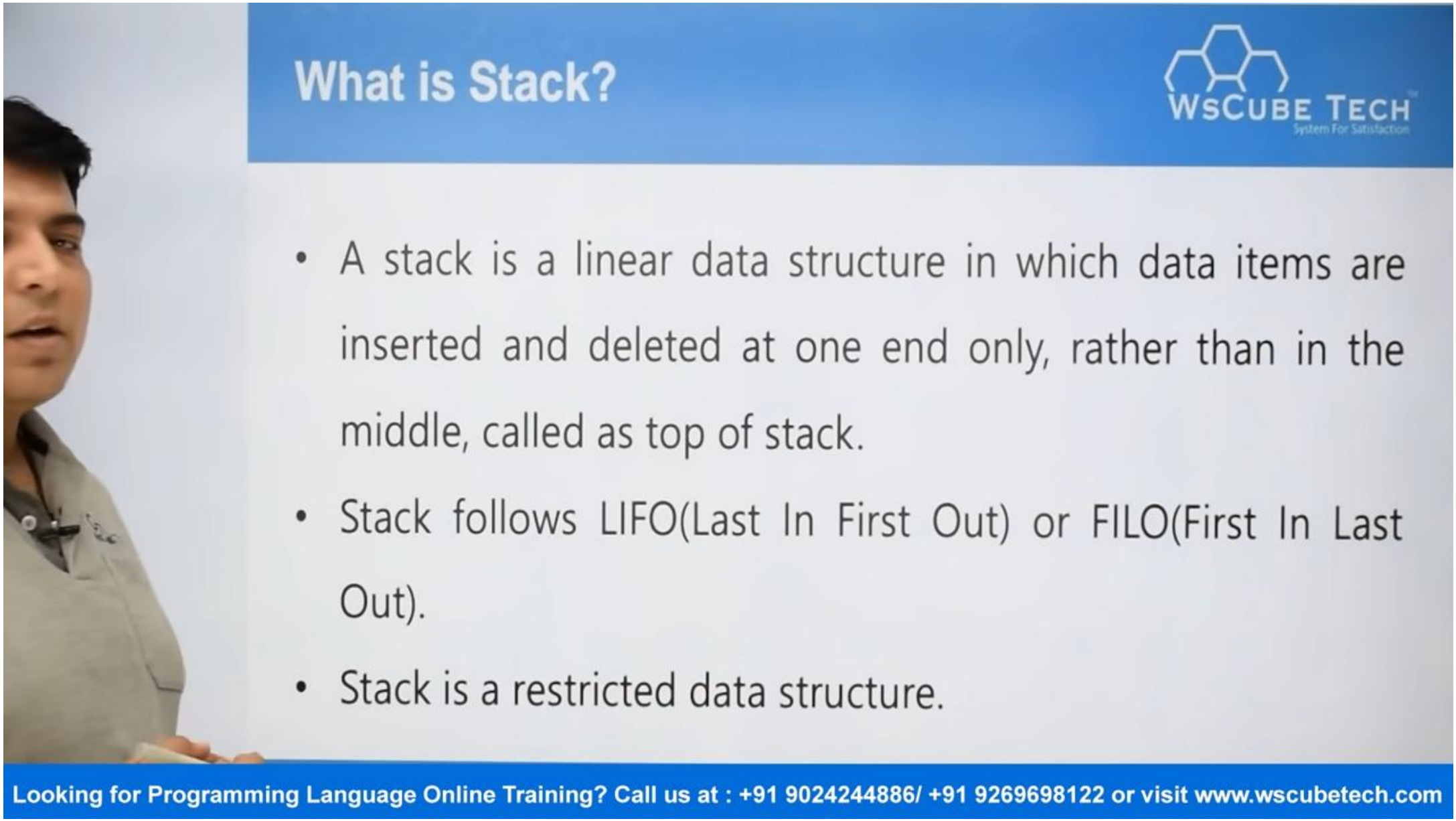
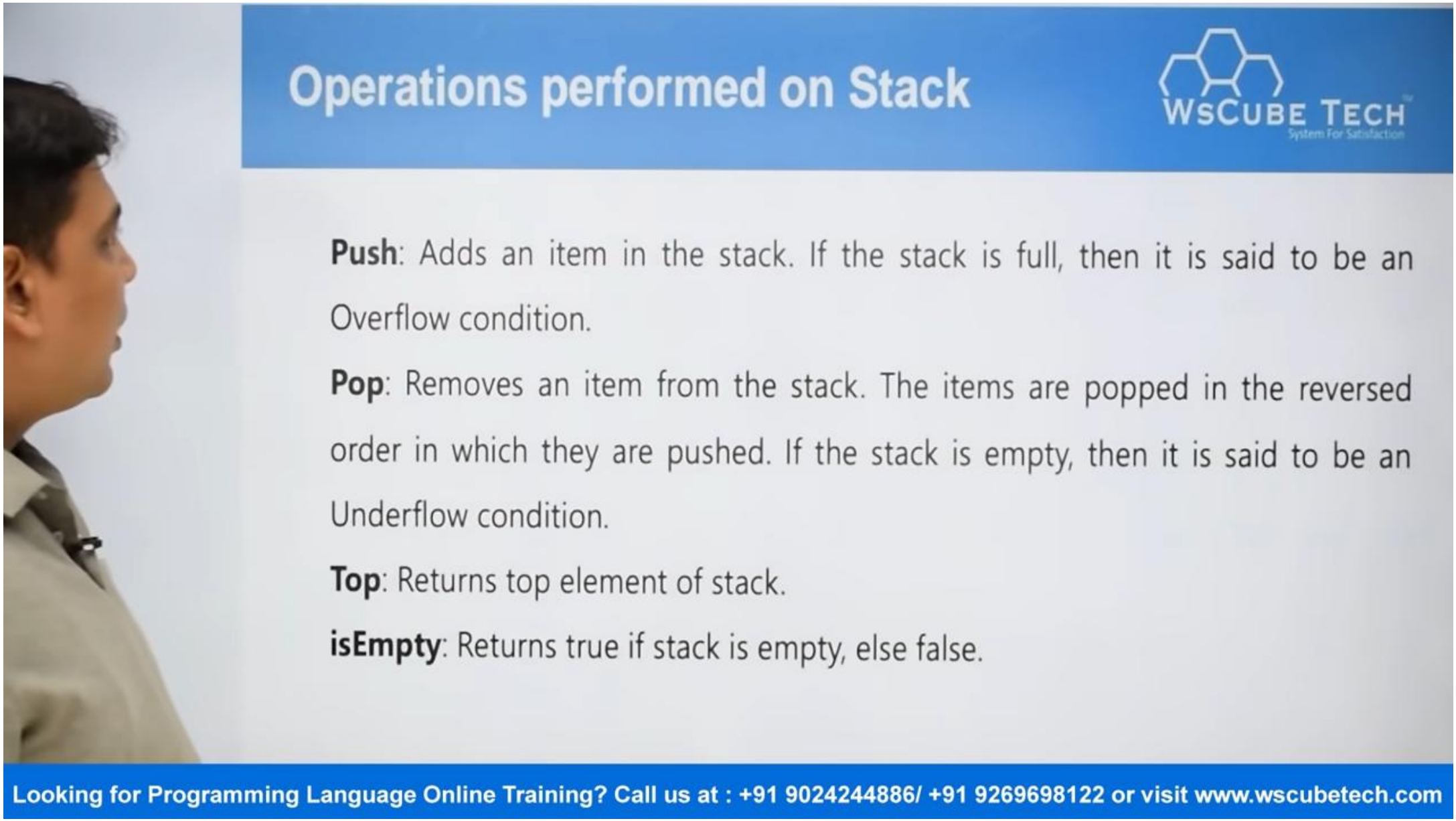
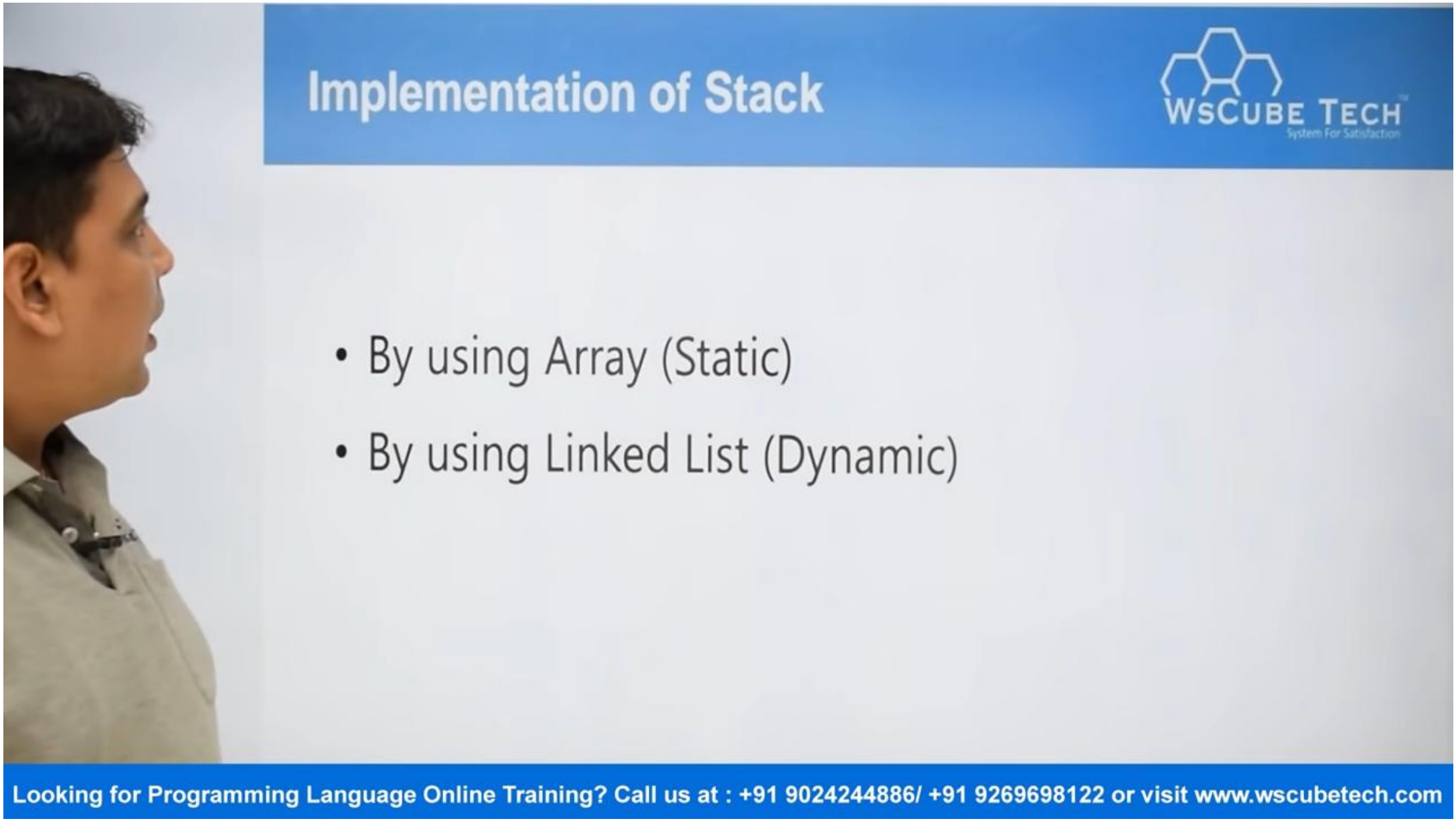
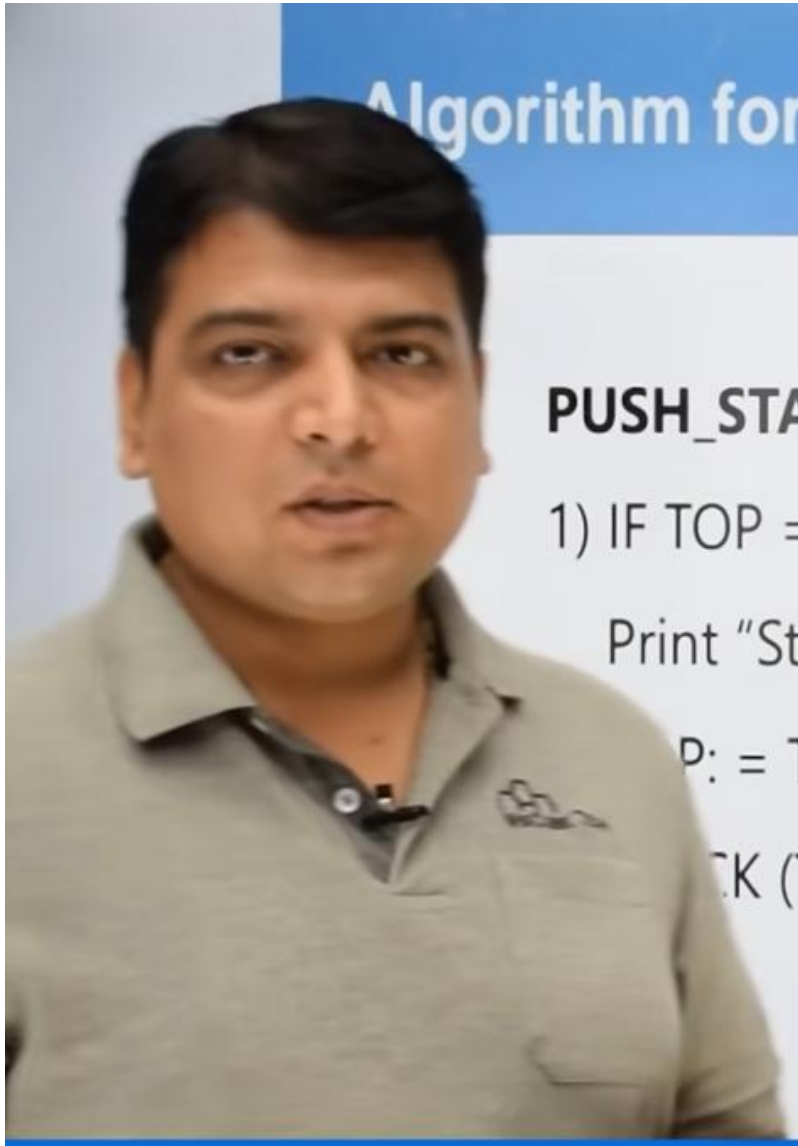






Algorithm for Push Operation



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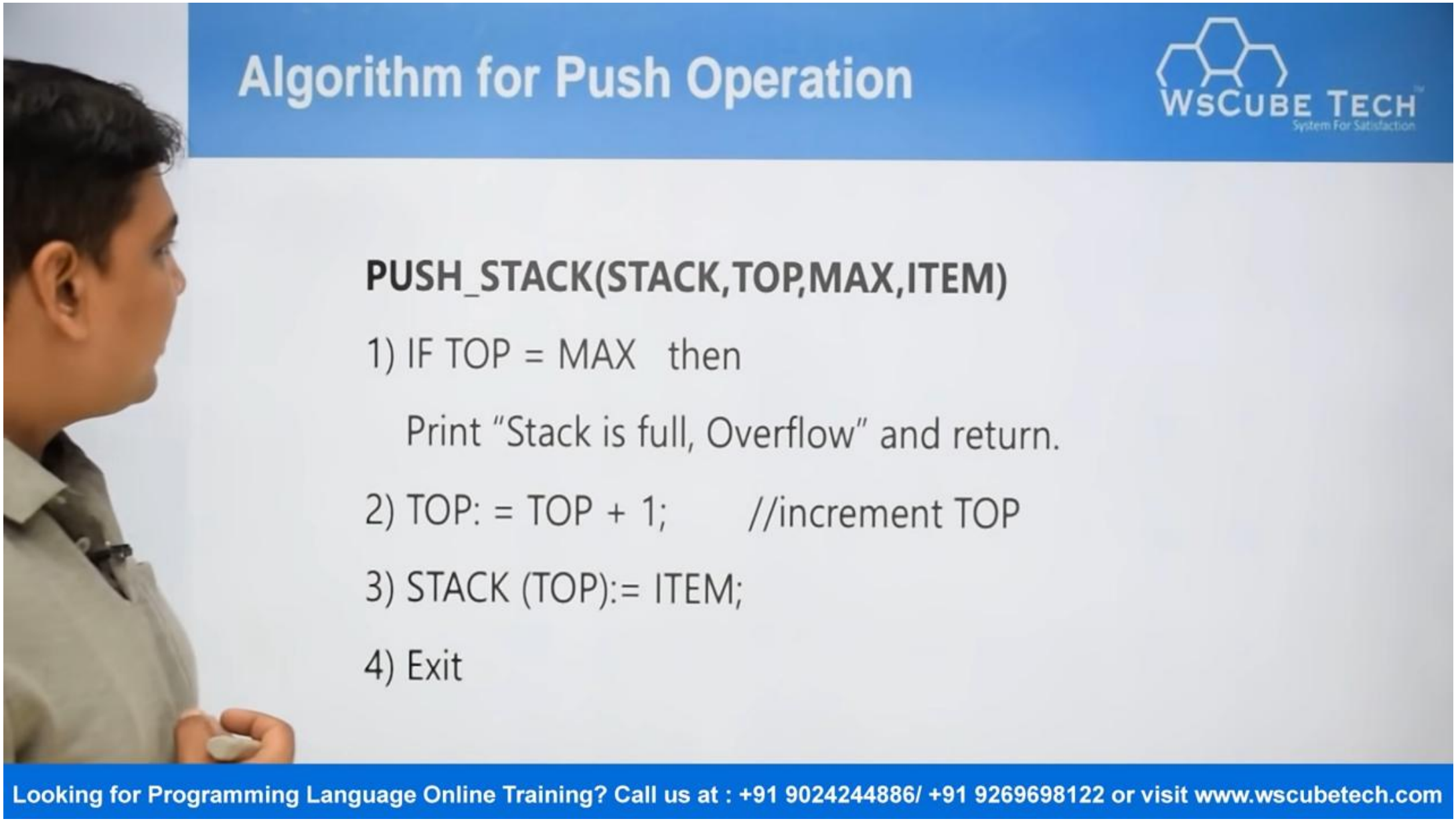
PUSH_STACK(STACK,TOP,MAX,ITEM)

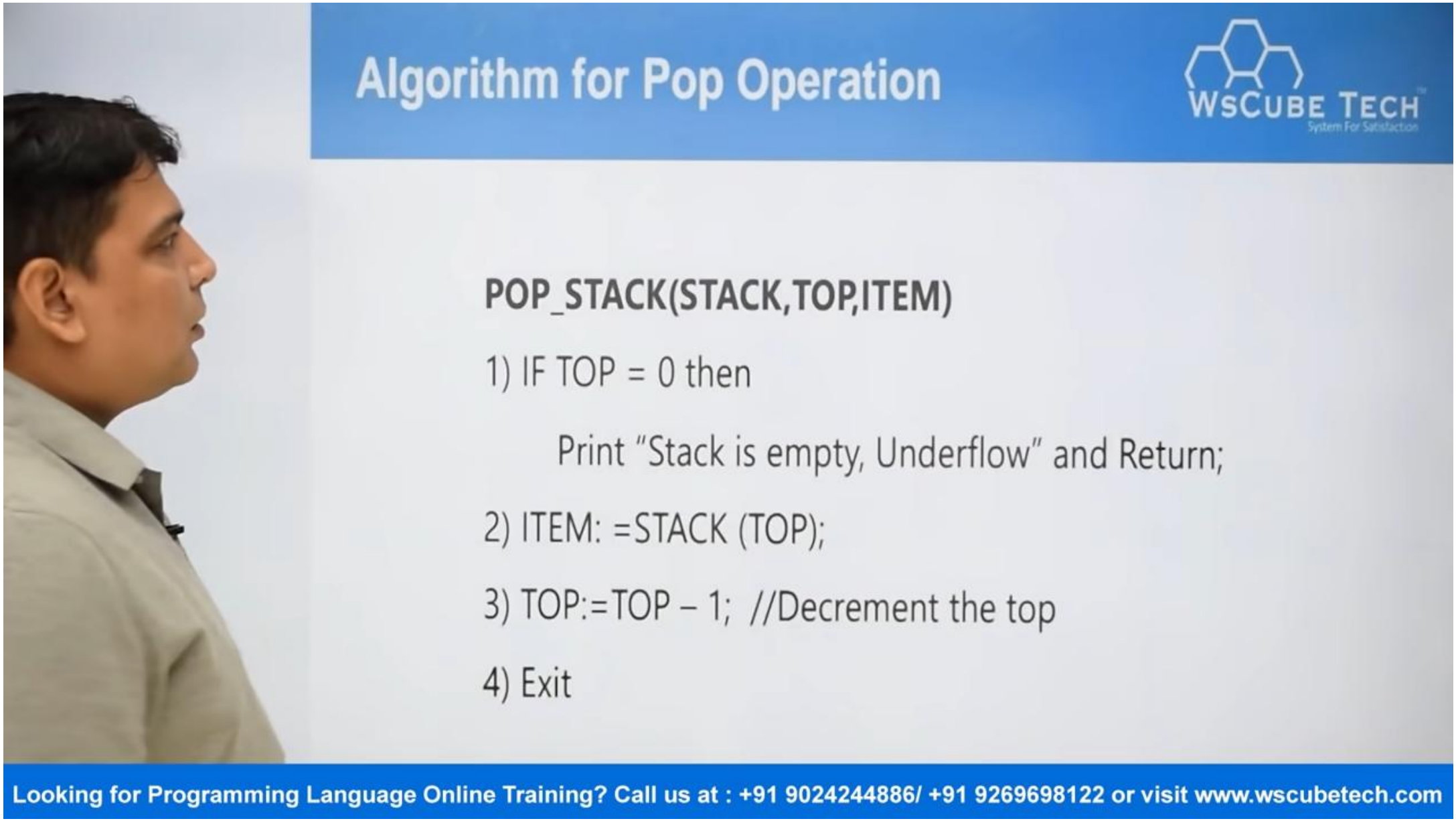
1) IF TOP = MAX then

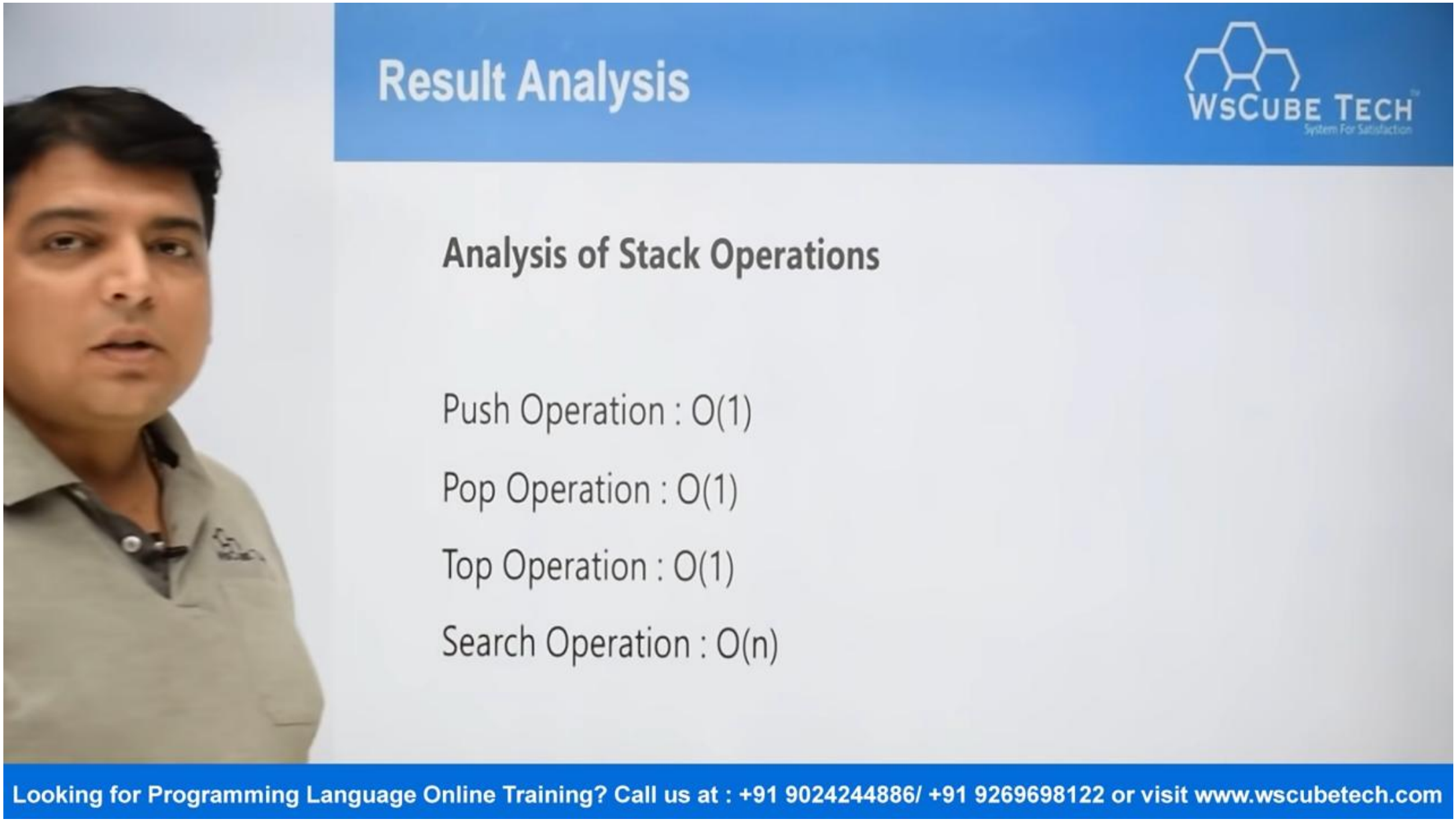
Print "Stack is full, Overflow" and return.

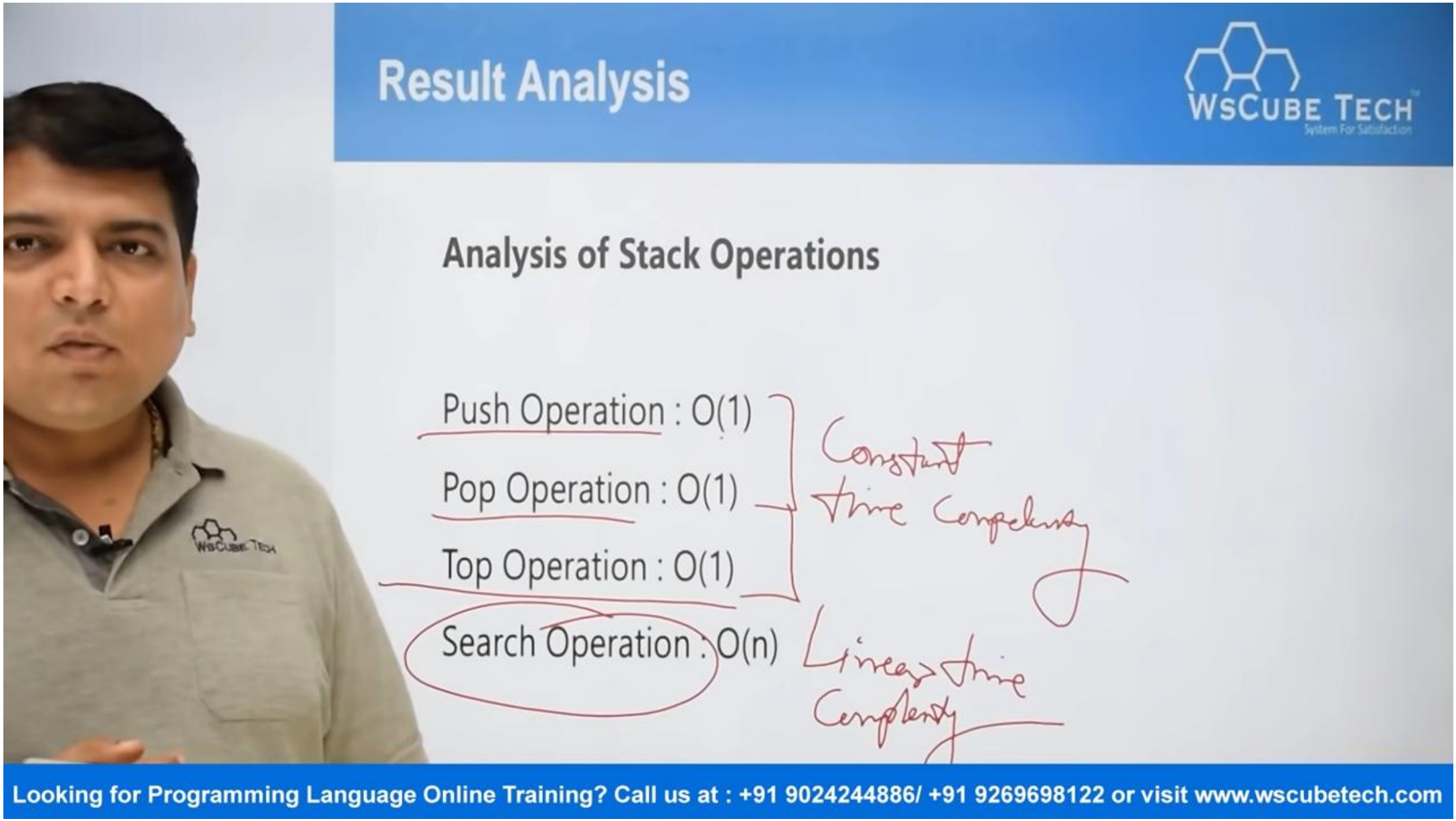
P: = TOP + 1; //increment TOP

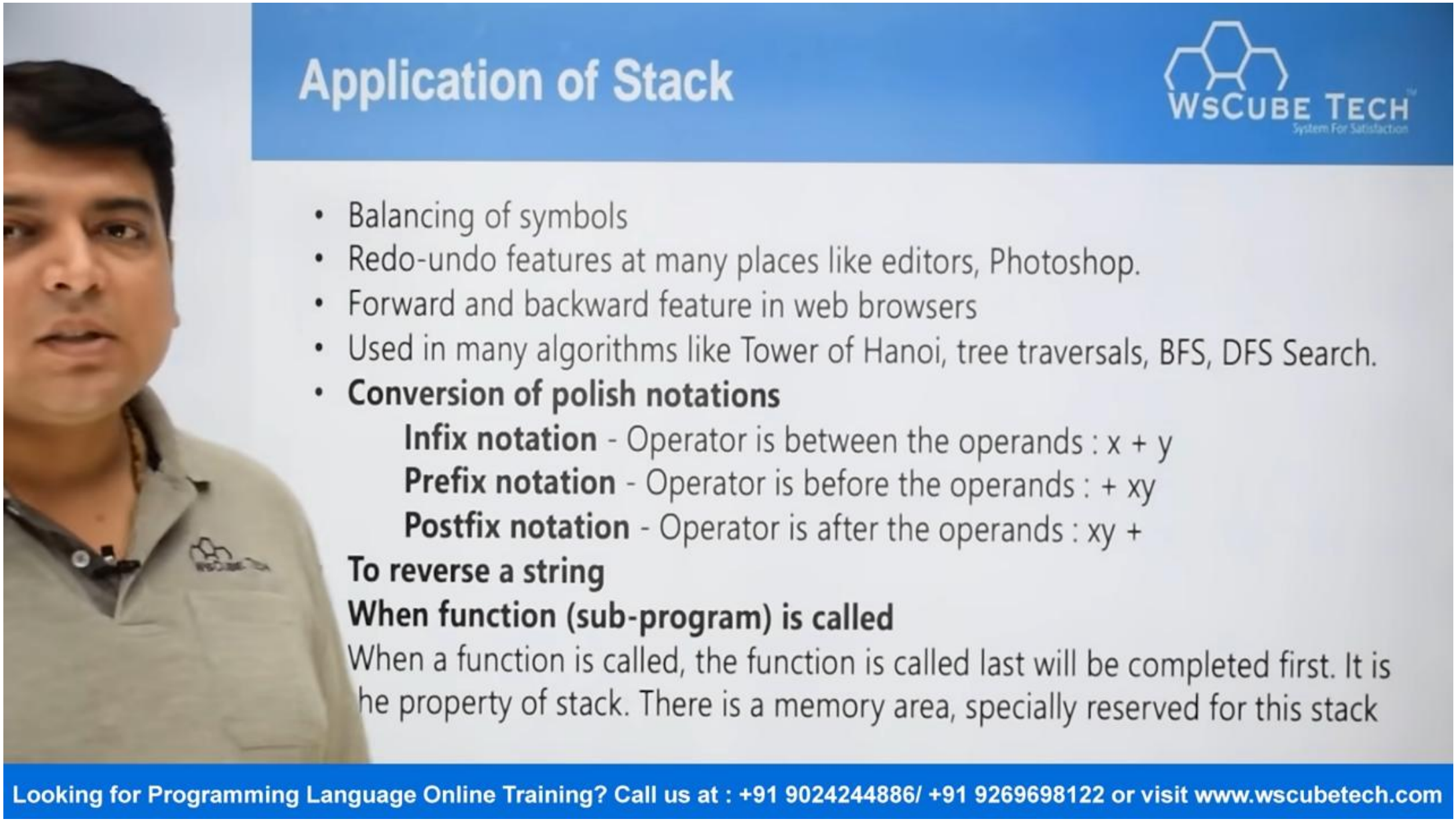
K (TOP):= ITEM;

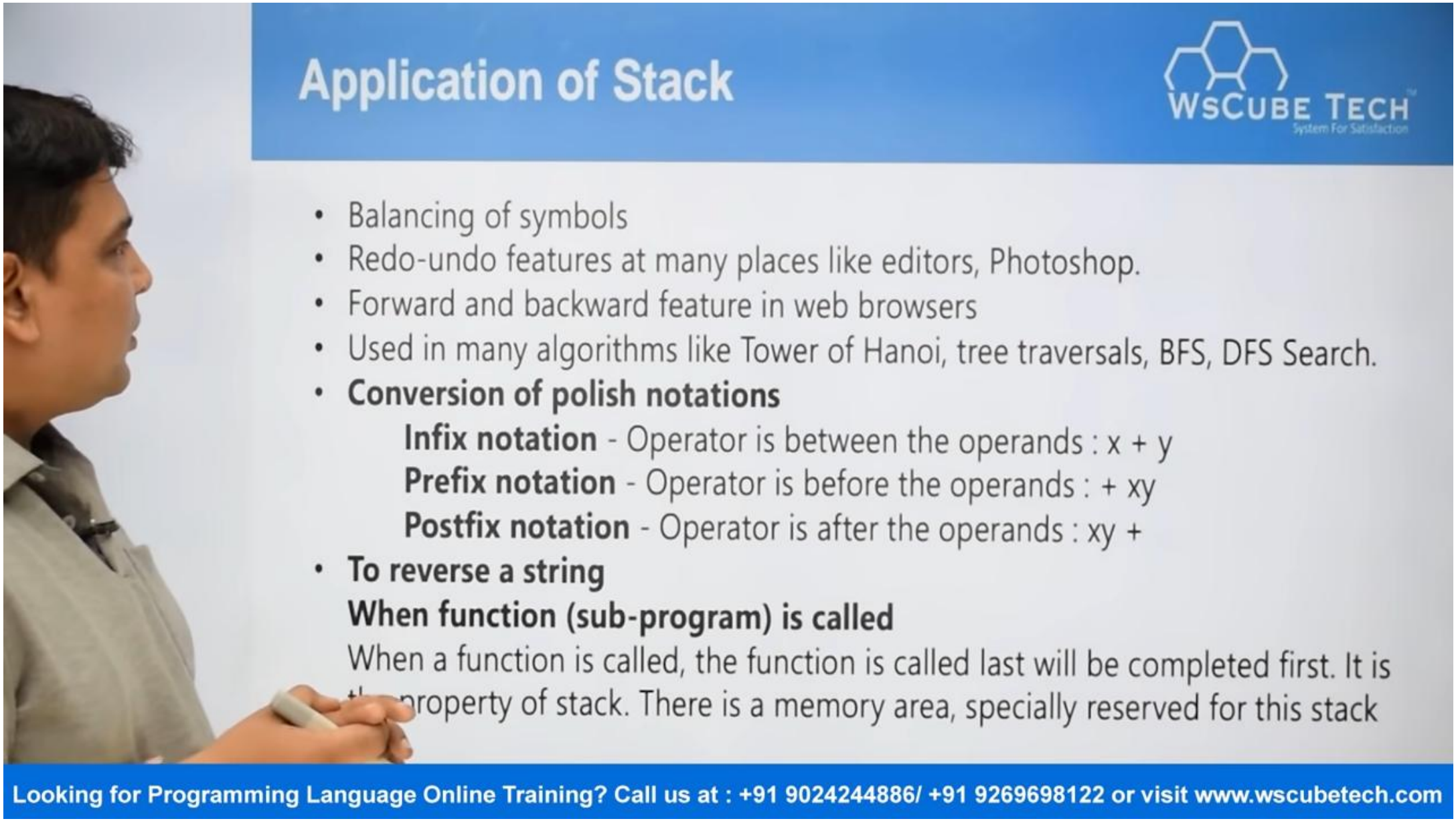












Data Structure & Algorithm

Tower of Hanoi

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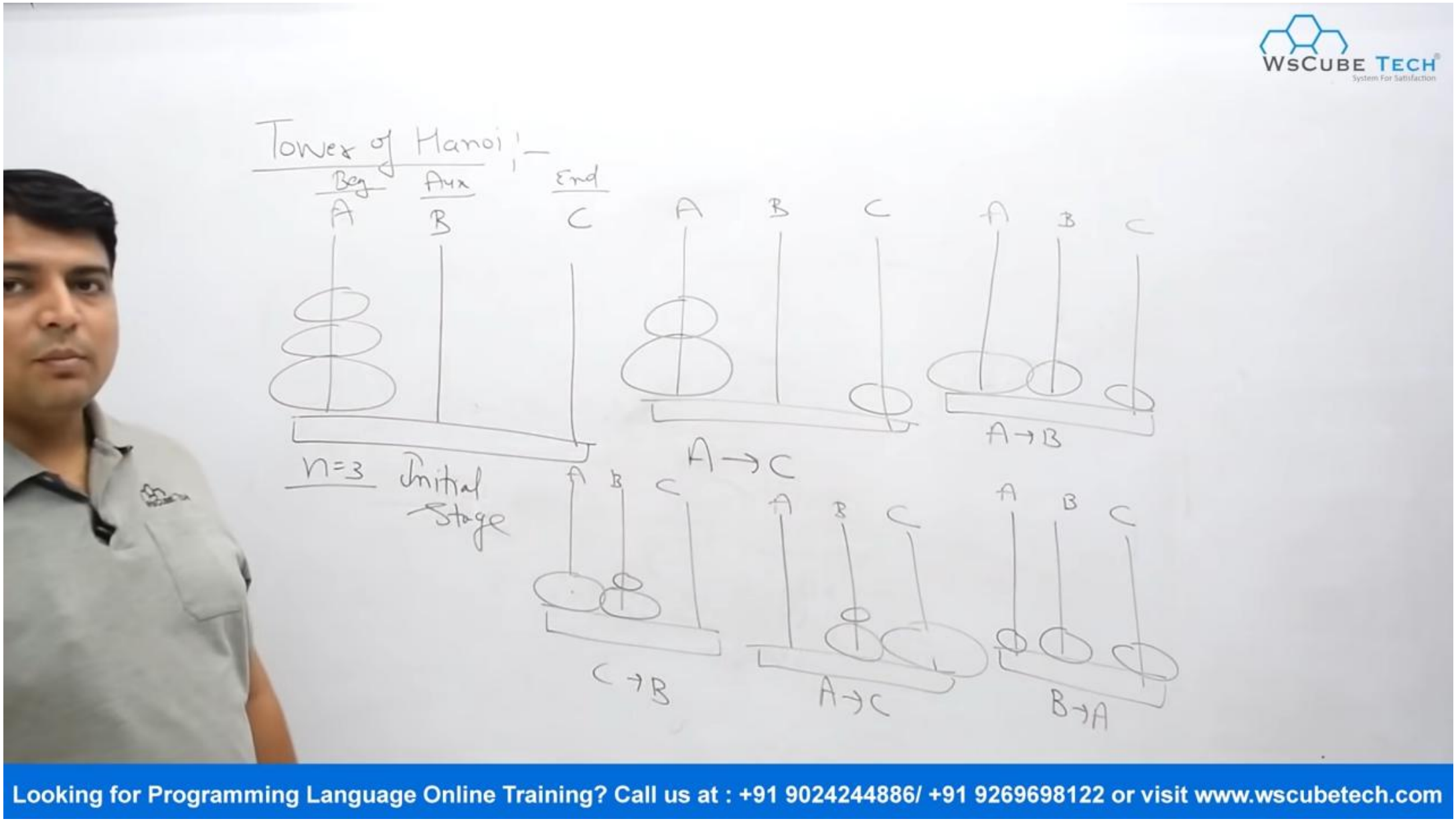


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A B C
B → C
A B C
A → B
A B C
A → C
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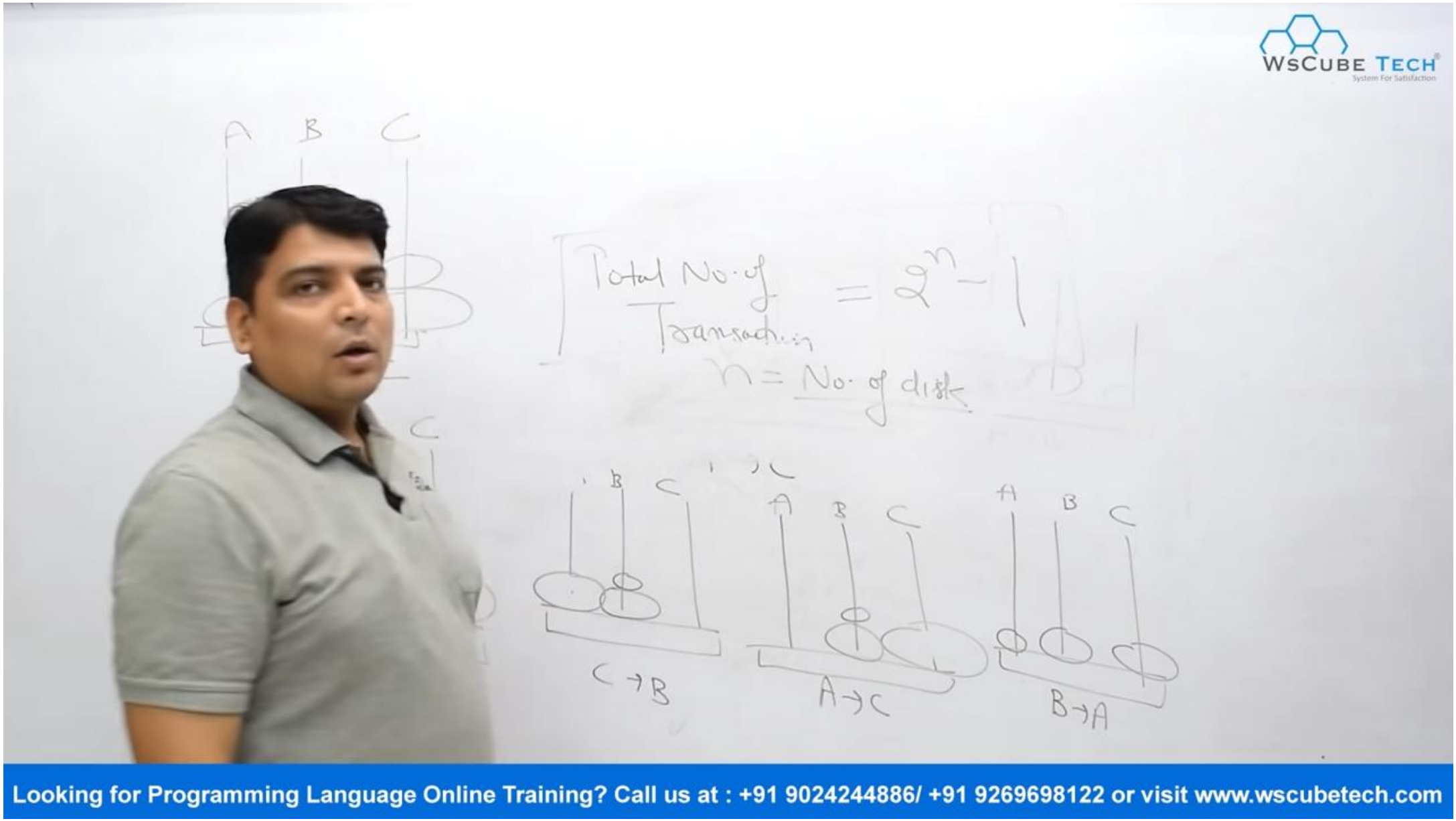
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A B C
Total No. of Transaction = $2^n - 1$
n = No. of disk
C → B
A → C
B → A
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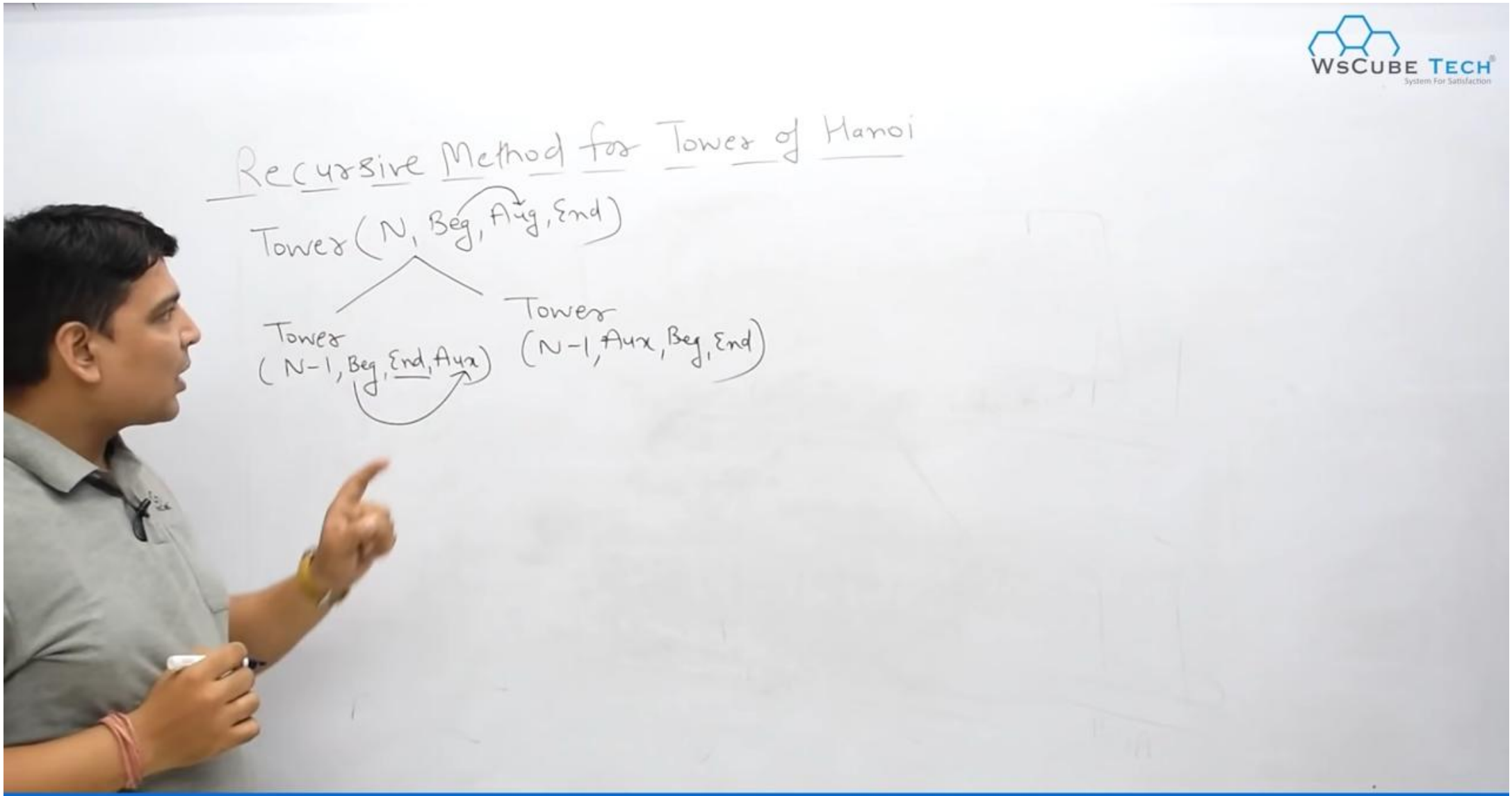
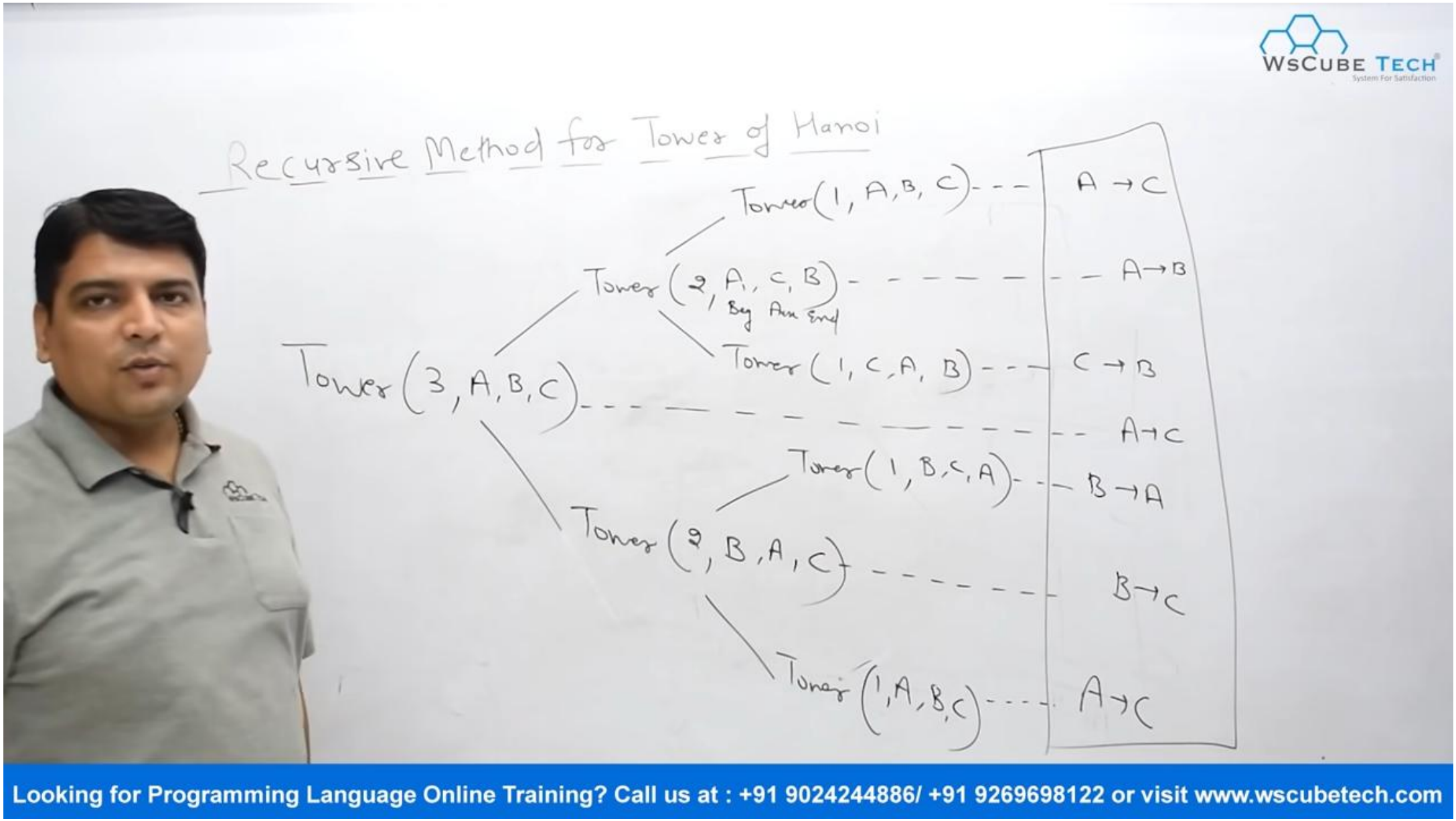
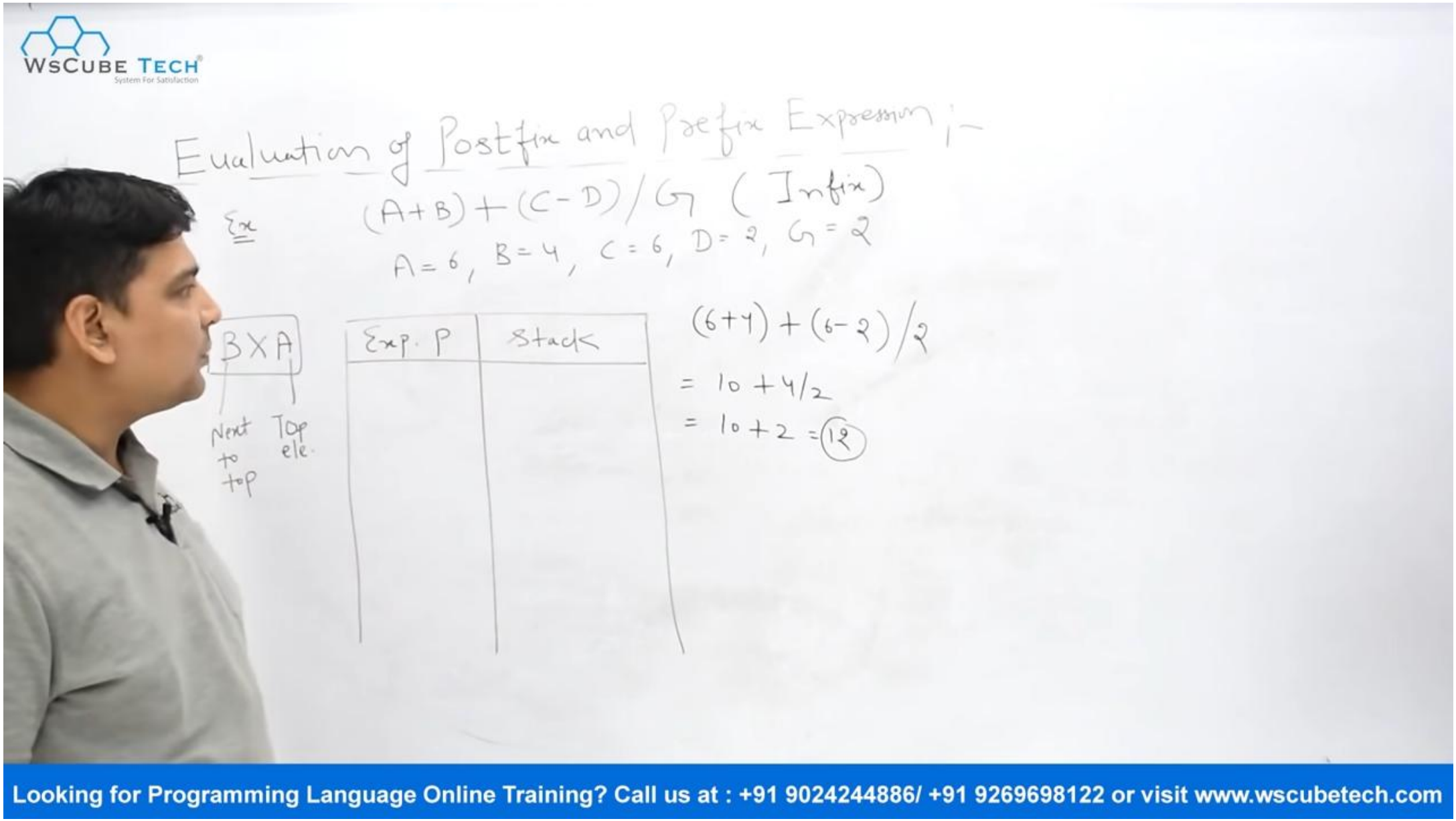
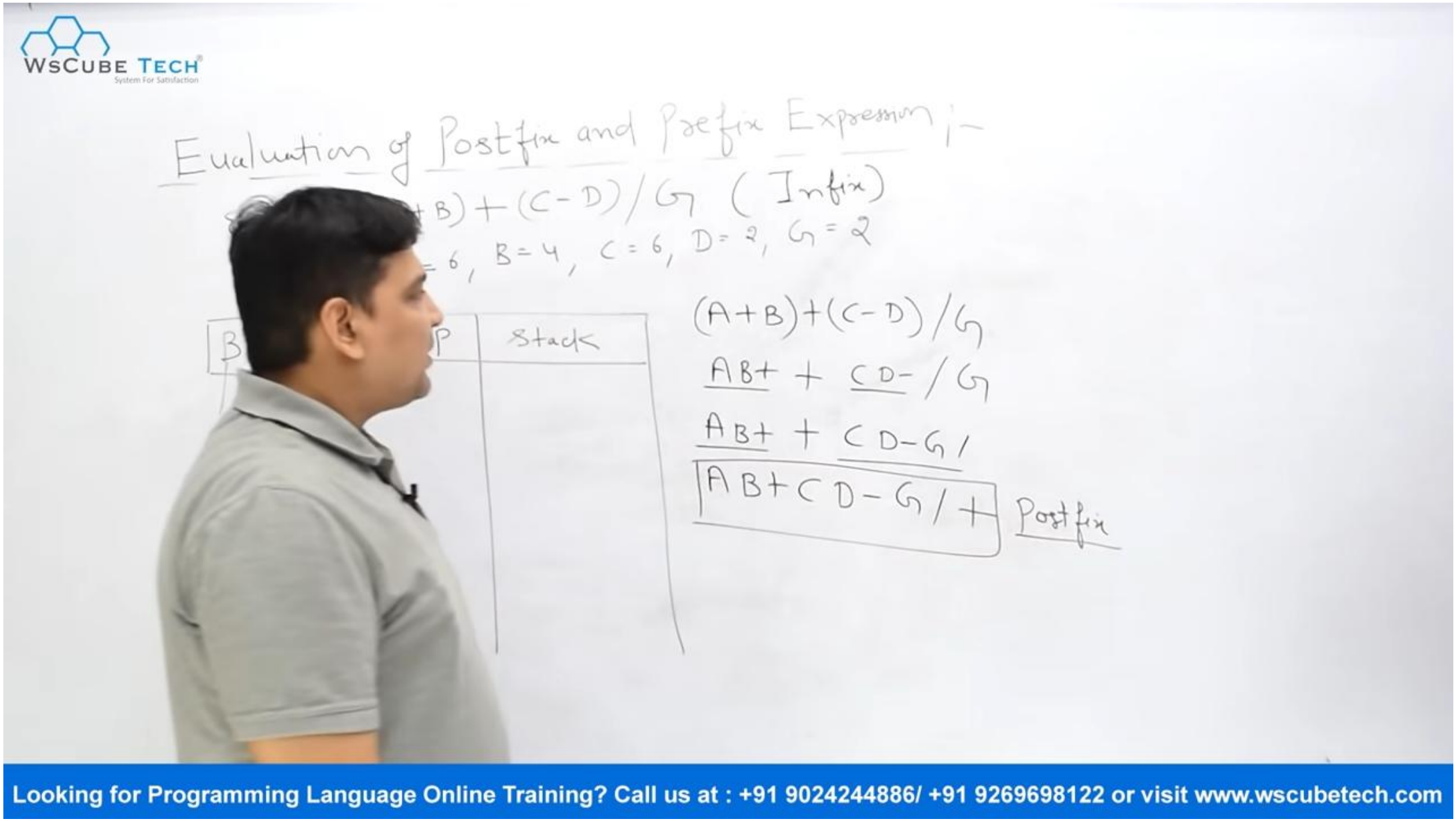


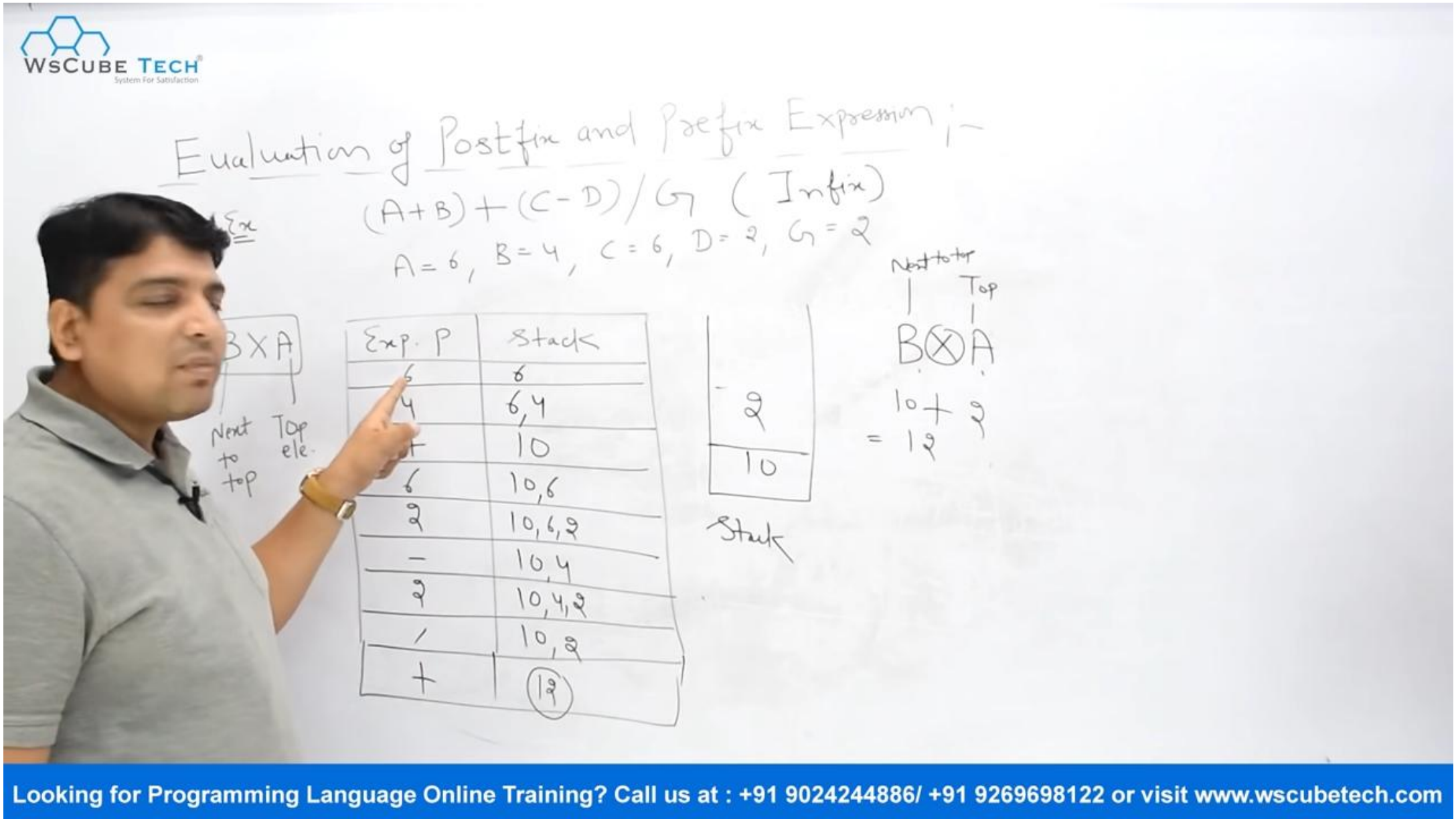


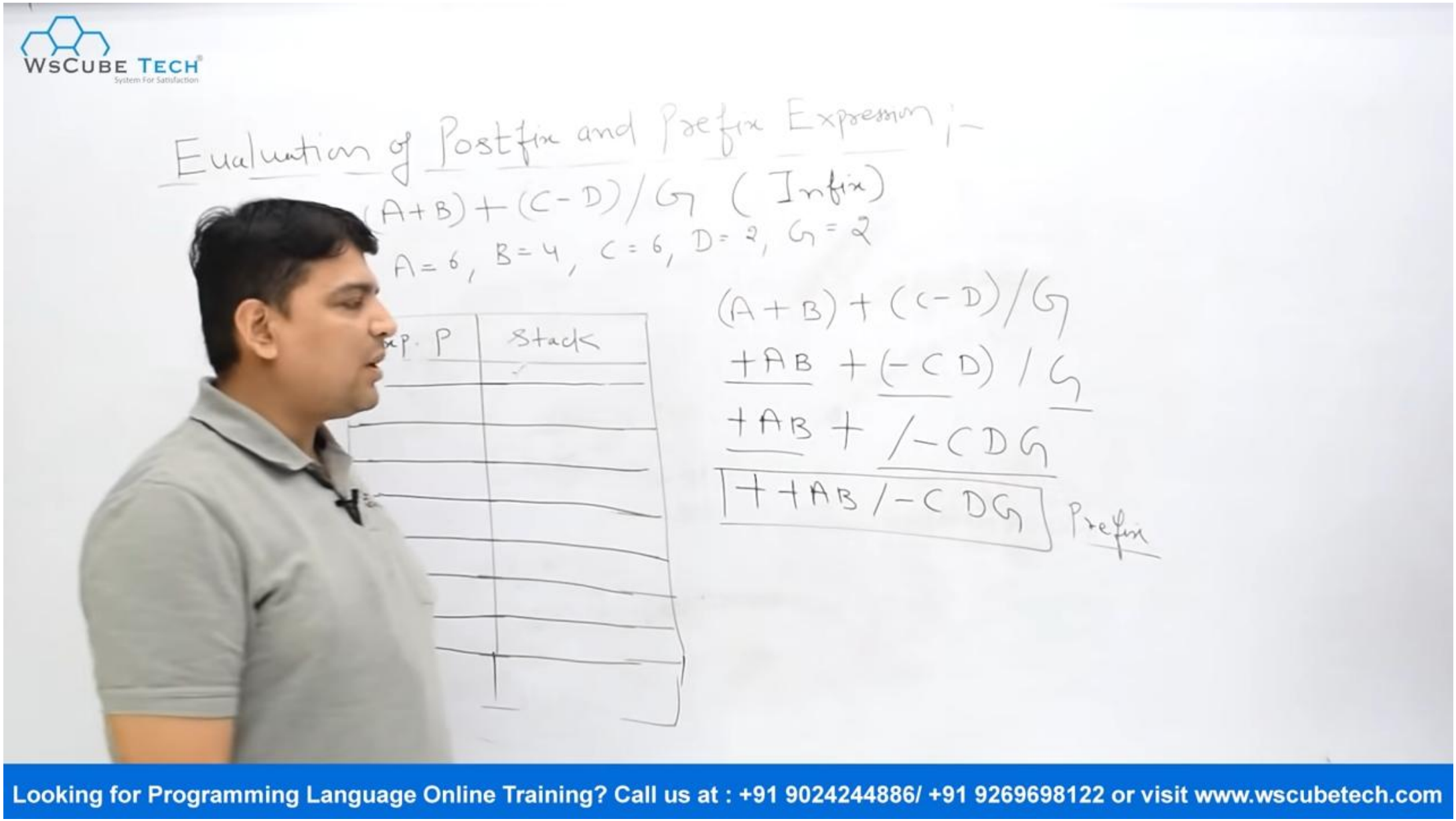
Data Structure & Algorithm

Evaluation of Postfix & Infix Expression









Evaluation of Postfix and Prefix Expression :-

(A+B)+(C-D)/G (Infix)

A=6, B=4, C=6, D=2, G=2

Ex

Exp. P	Stack
2	2
2	2,2
6	2,2,6
-	2,4
/	2
4	2,4
6	2,4,6
+	2,10
+	

top Next

B ⊗ A

6 + 4

= 10

Data Structure & Algorithm

Infix to Postfix Conversion

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Converting Infix Expression into Postfix Expression

1) ((A-B)*D) $ ((E+F)/G)
2) A+(B*C+(D/E$F)/G)/M

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Converting Infix Expression into Postfix Expression

1) ((A-B)*D)$((E+F)/G)

2) A+(B*C+(D/E$F)/G)/M

((A-B)*D)$((E+F)/G)

((AB-)*D)$((EF+)/G)

(AB-D*)$(EF+G/)

AB-D*EF+G/$ Postfix

$ ↑	R→L
/, *	L→R
+, -	L→R

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Converting Infix Expression into Postfix Expression

1) ((A-B)*D)$((E+F)/G)

2) A+(B*C+(D/E$F)/G)/M

((A-B)*D)$((E+F)/G)

((-AB)*D)$((+EF)/G)

*-ABD$/+EFG

$*-ABD/+EFG

Prefix Exp

$ ↑	R→L
/, *	L→R
+, -	L→R

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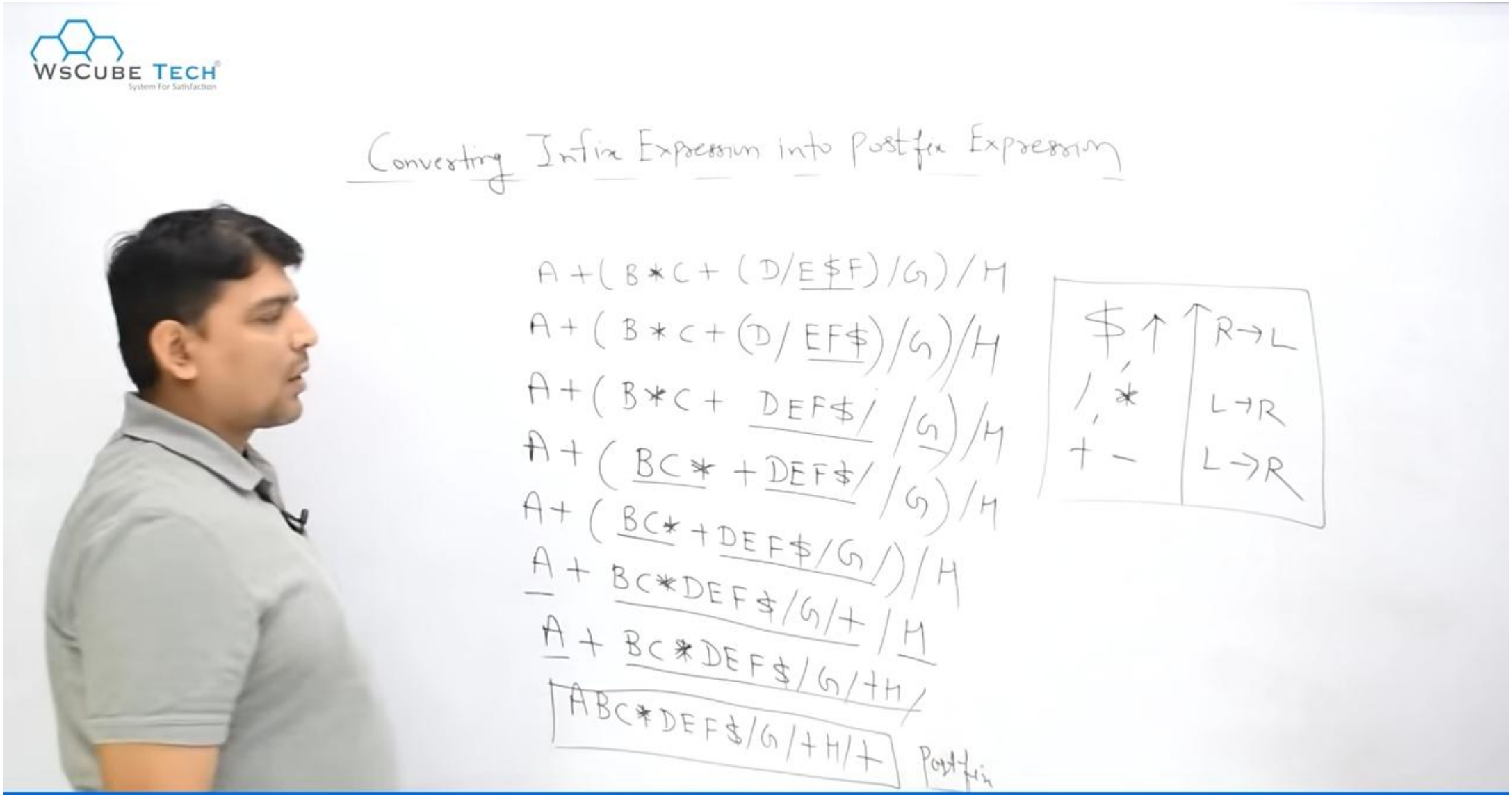
Converting Infix Expression into Postfix Expression



Data Structure & Algorithm

Infix to PostfixExpression

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Converting Infix Expression into Postfix Expression (Stack Concept)

Ex: (A - B$D) / E+F -G

Exp S	Stack	Exp P
	(	
(	((	

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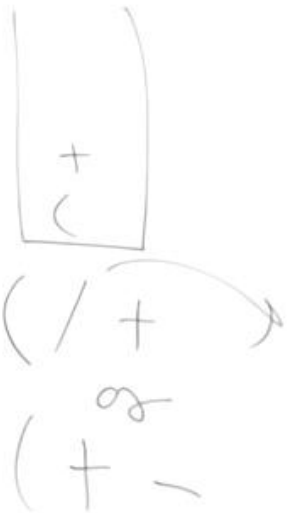
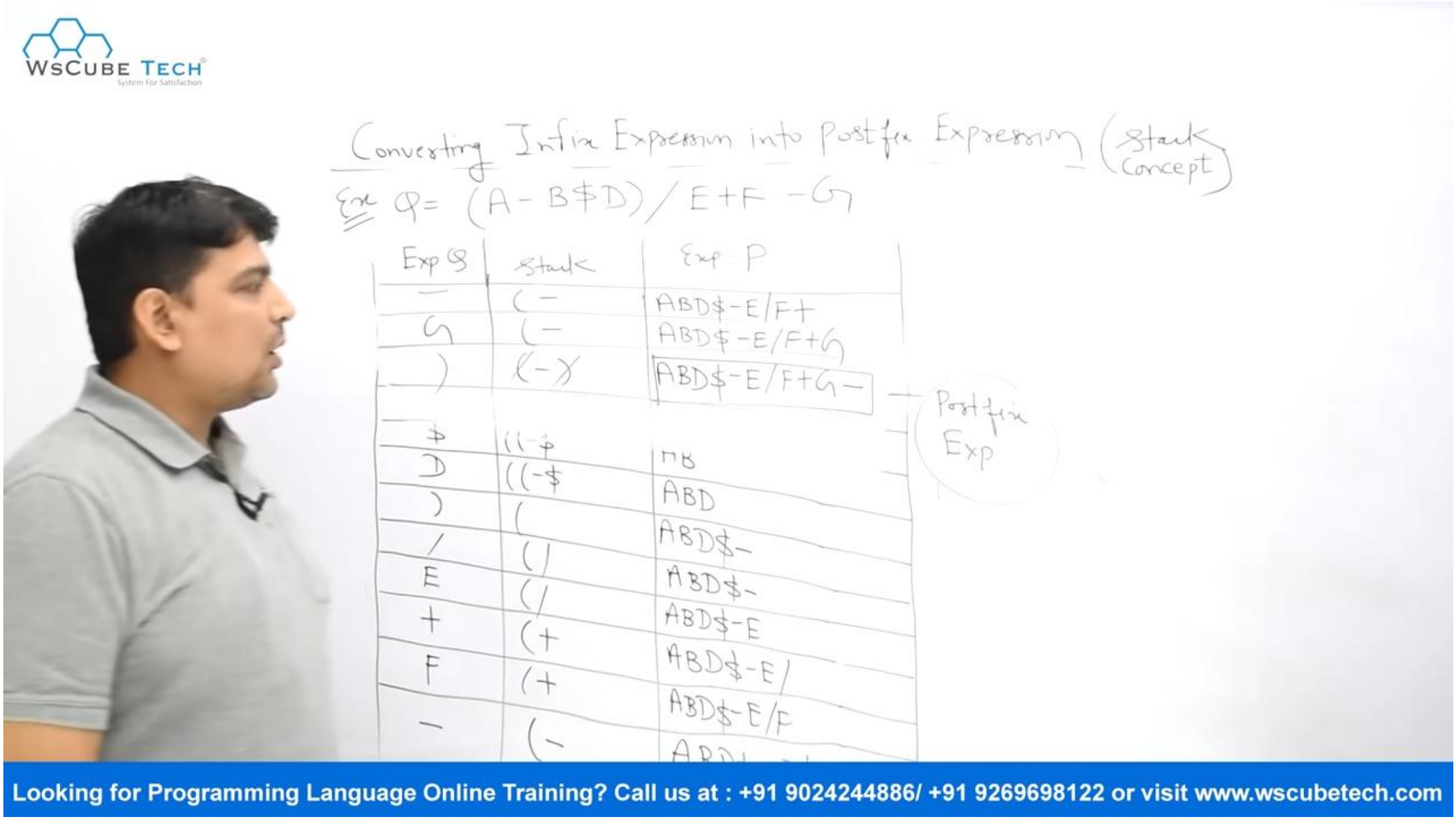
Converting Infix Expression into Postfix Expression (Stack Concept)

Ex Q = (A - B$D) / E + F - G

Exp Q	stack	Exp P
	(	
(	((	
A	((	A
-	((-	A
B	((-	AB
$	((-$	AB
D	((-$	ABD
)	(	ABD$-
/	(/	ABD$-
E	(/	ABD$-E
+	(+	ABD$-E/
F	(+	ABD$-E/F
-	(-	





Data Structure & Algorithm

Queue in DSA

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Queue :-

- → Linear Data Structure
- → Restricted DS
- → Based on FIFO Concept
- → Rear and front two pointers for insertion and deletion purpose

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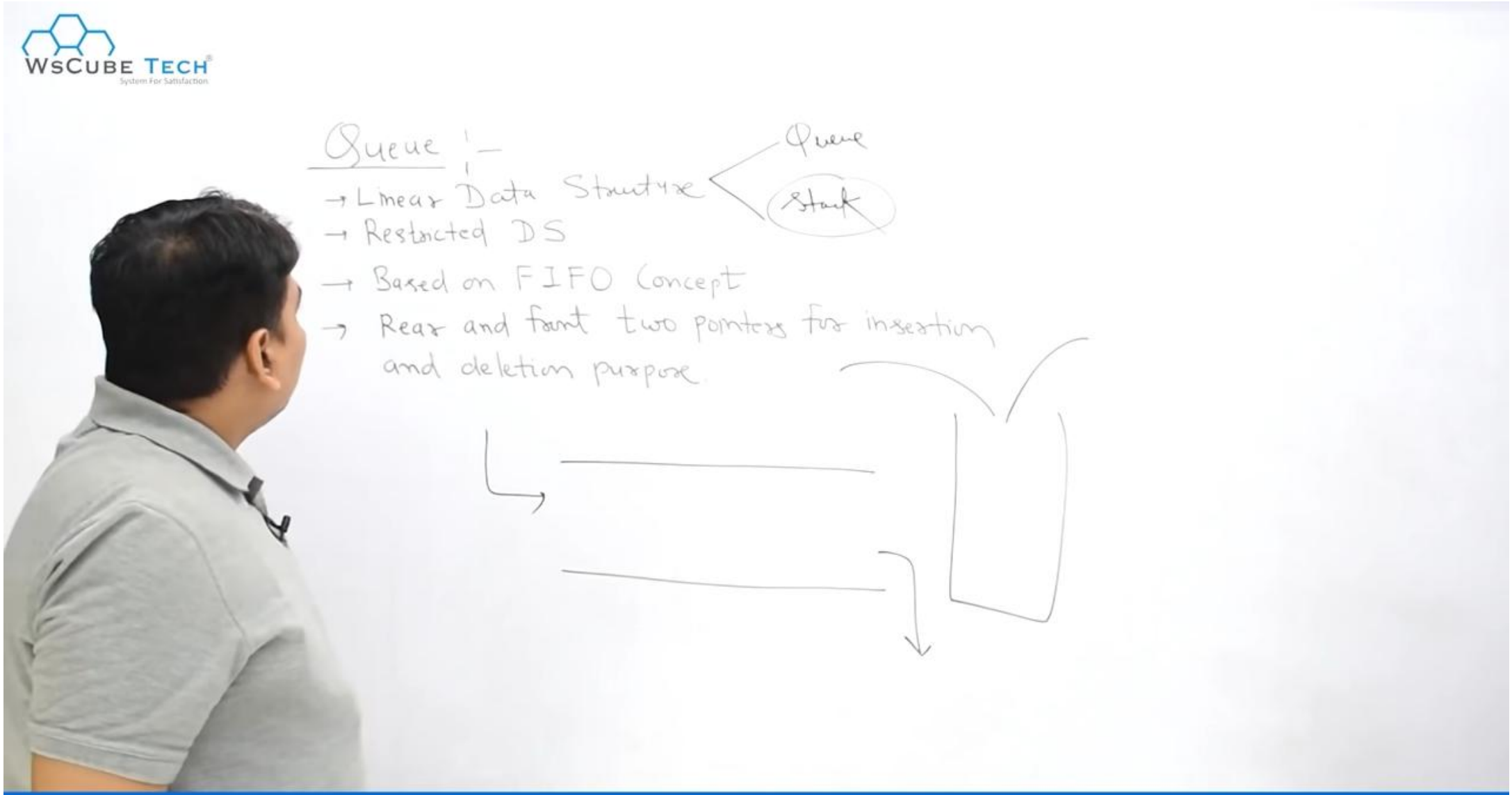
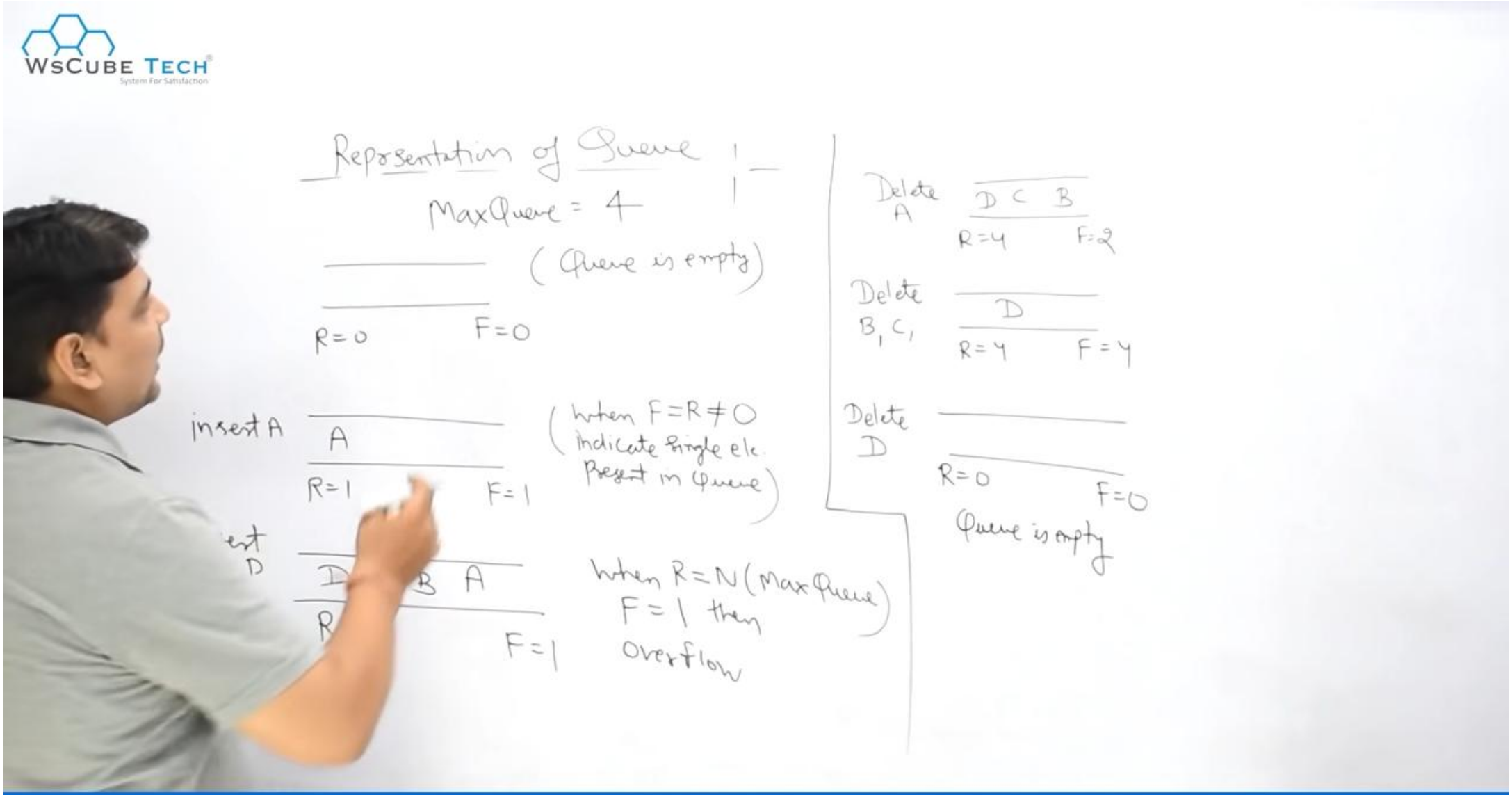
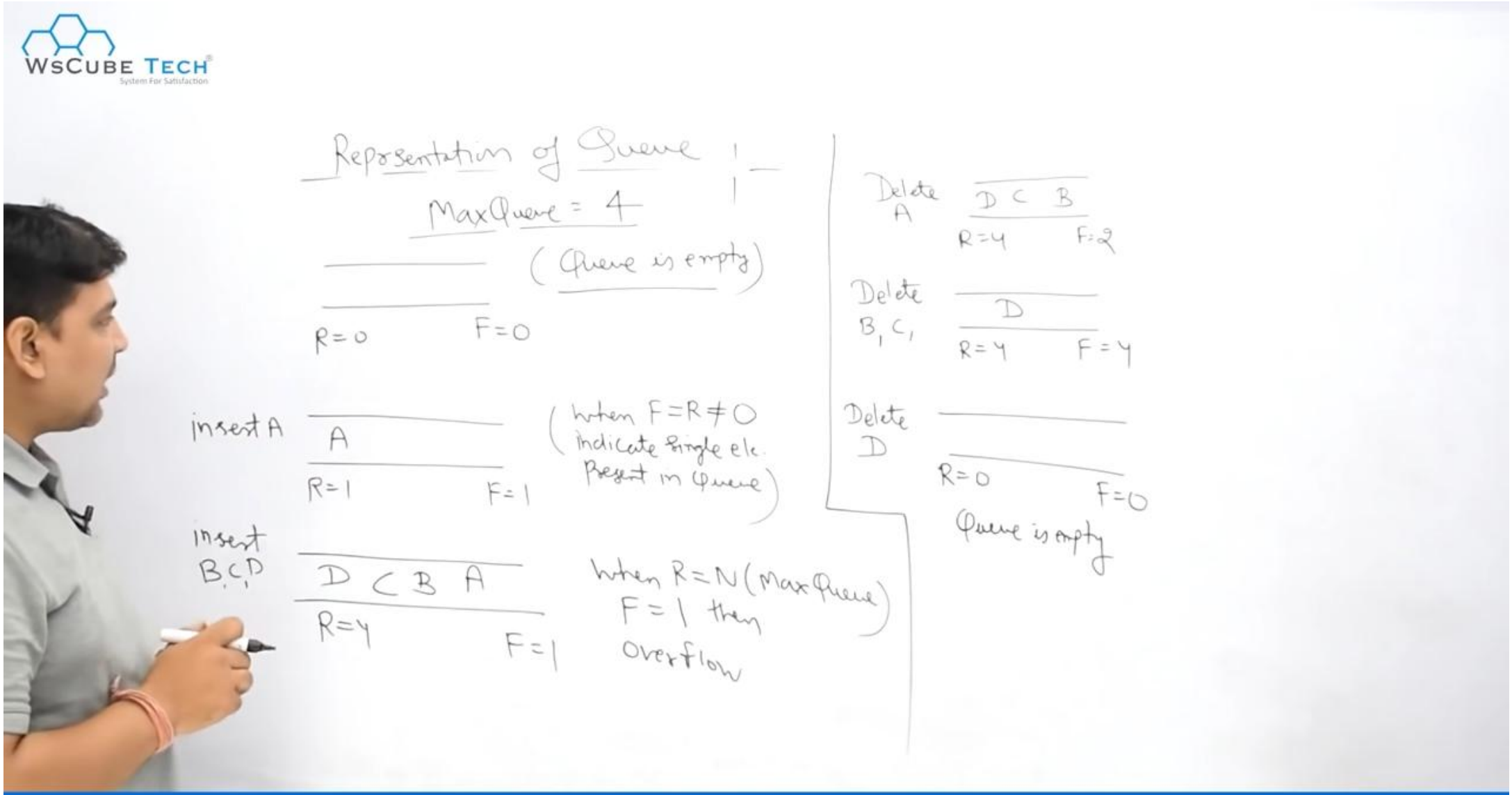
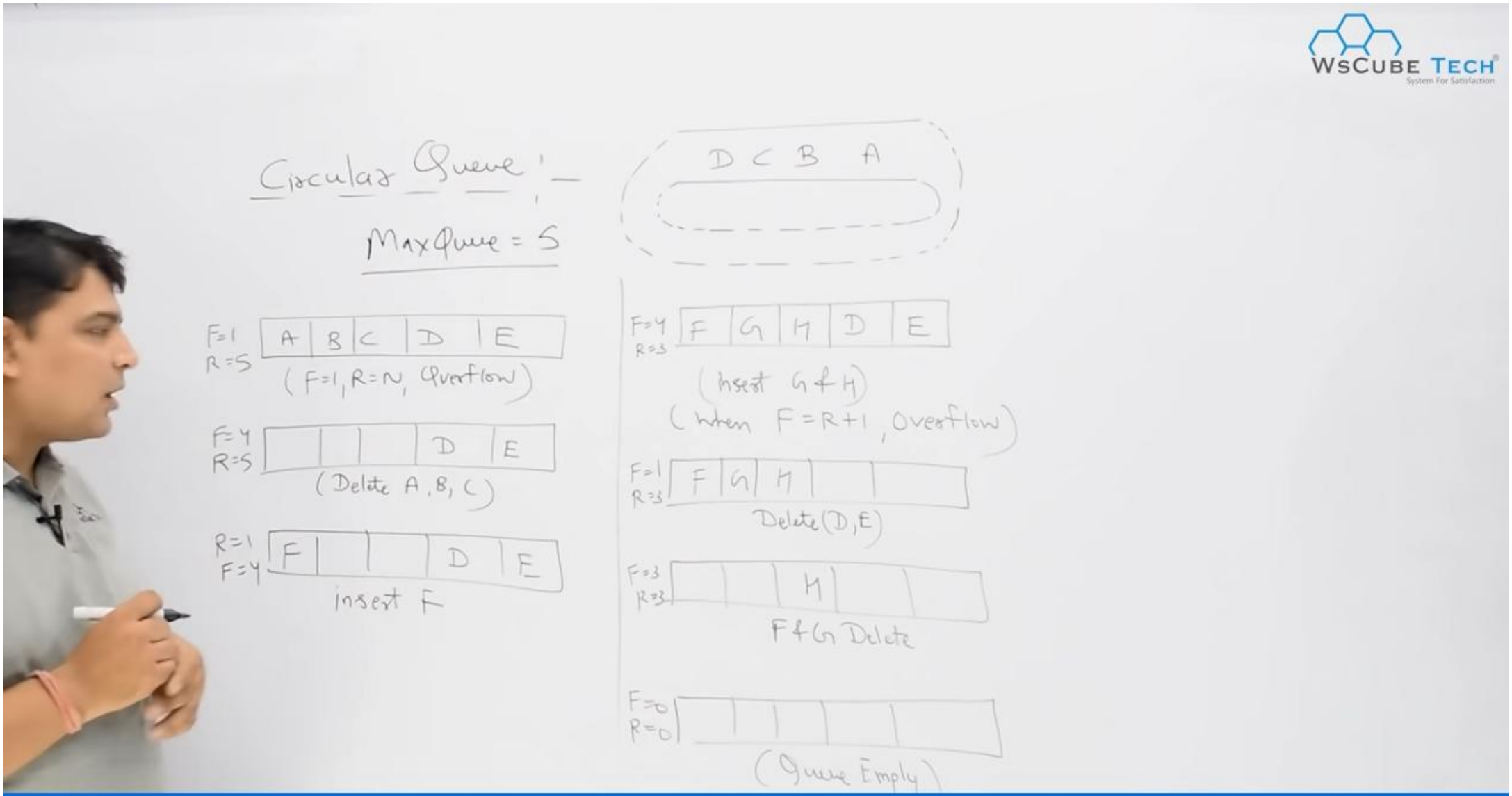






Data Structure & Algorithm

Circular Queue



Circular Queue Algorithm :-

Insertion

CQI(Queue, N, F, R, item)

1) if F=1, R=N or
   F=R+1, Overflow & Return
2) if F=Null
   Set F=1, R=1
   else if R=N then
   Set R=1
   else R=R+1
3) Set Queue[R]=item
4) Return

Deletion

CQD(Queue, N, F, R, item)

1) if F=Null, write Underflow & Return
2) set item = Queue[F]
3) if F=R≠Null
   set F=R=Null
   else if F=N set F=1
   else F=F+1
4) Return

Data Structure & Algorithm

Linked List in DSA

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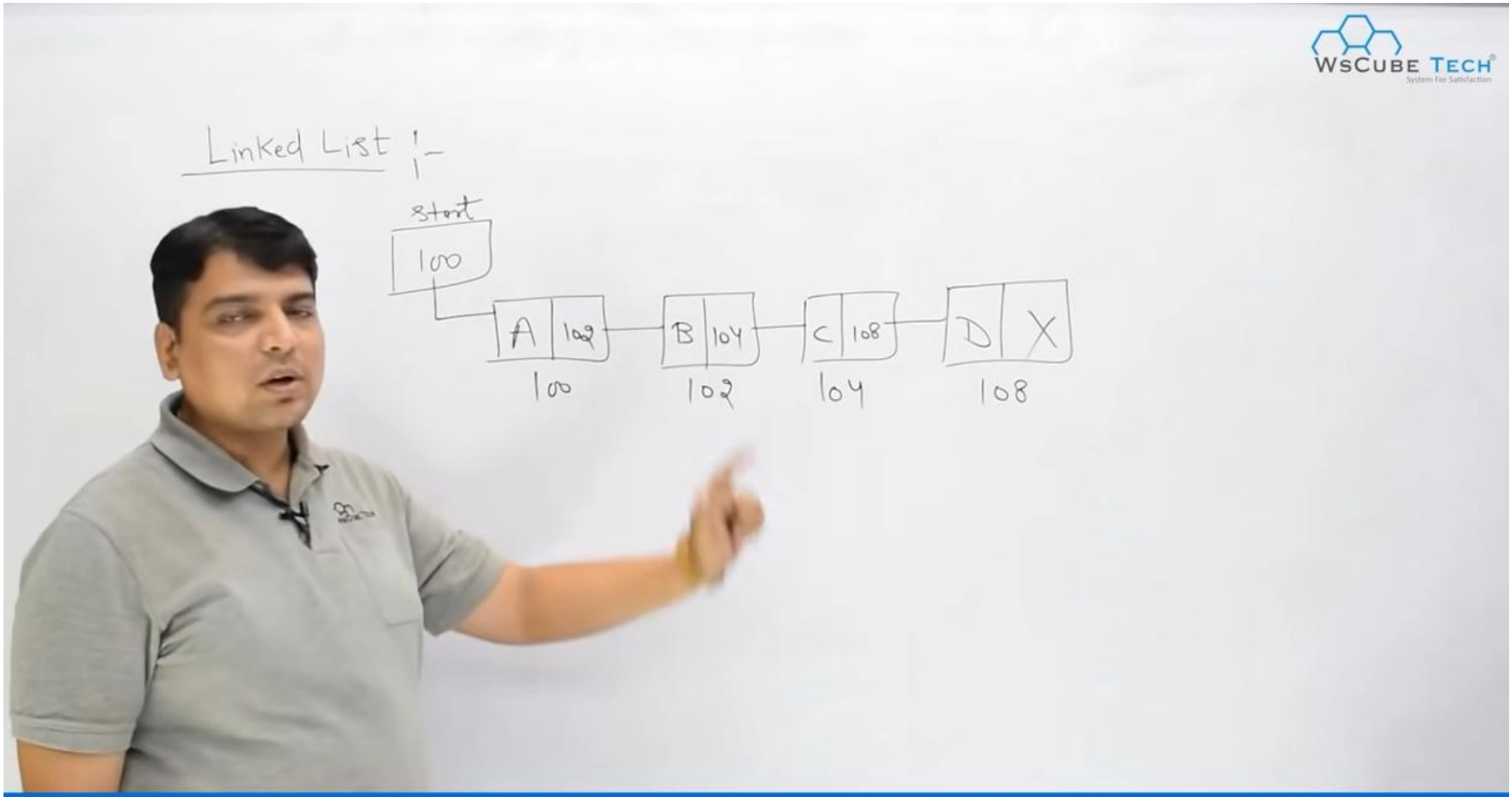
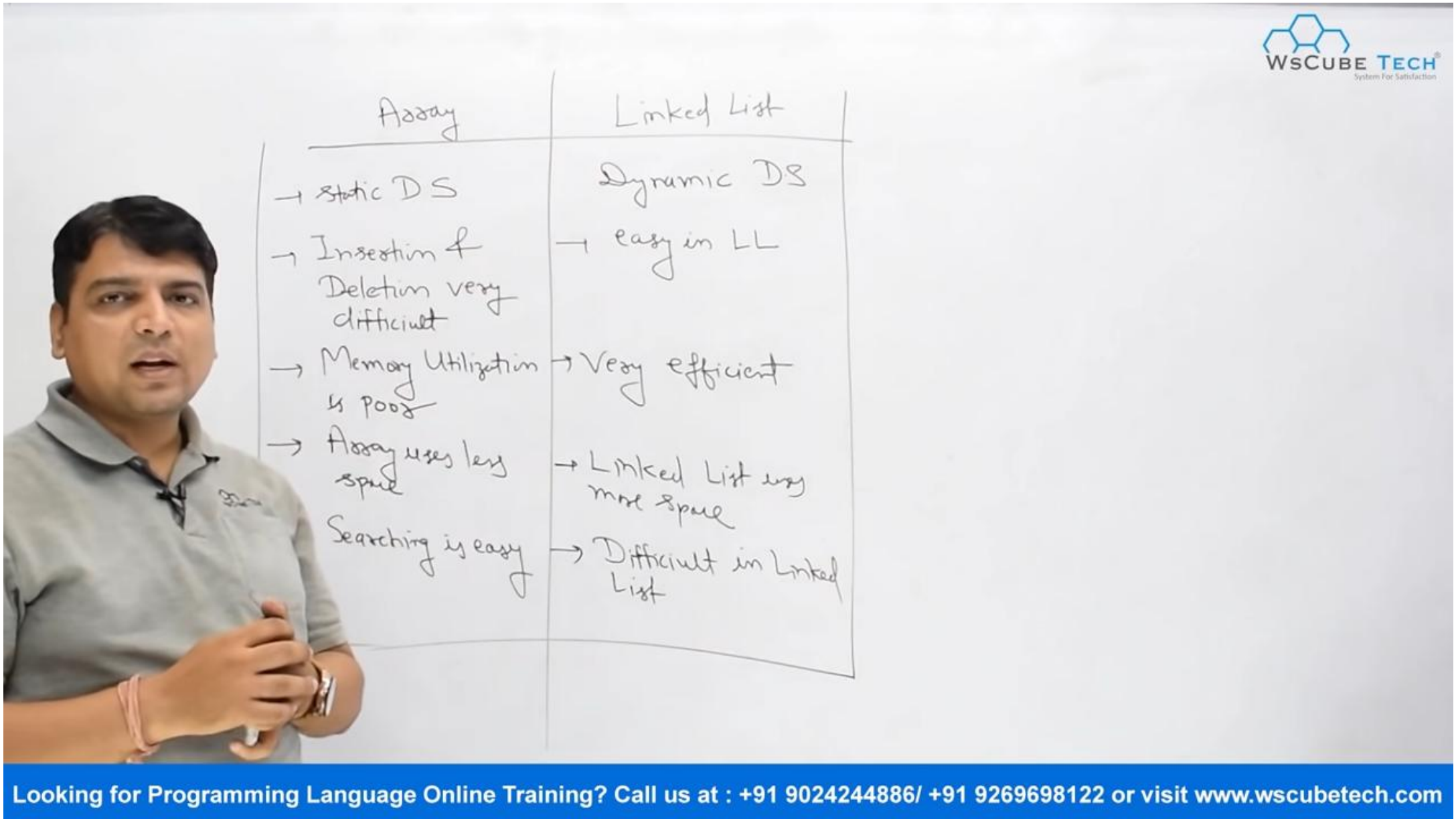
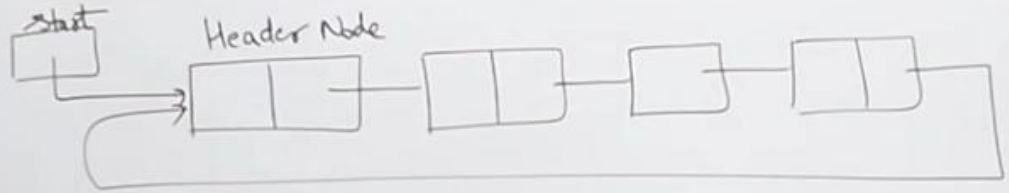




Data Structure & Algorithm

Circular Linked List

Circular Linked List :-



Advantages

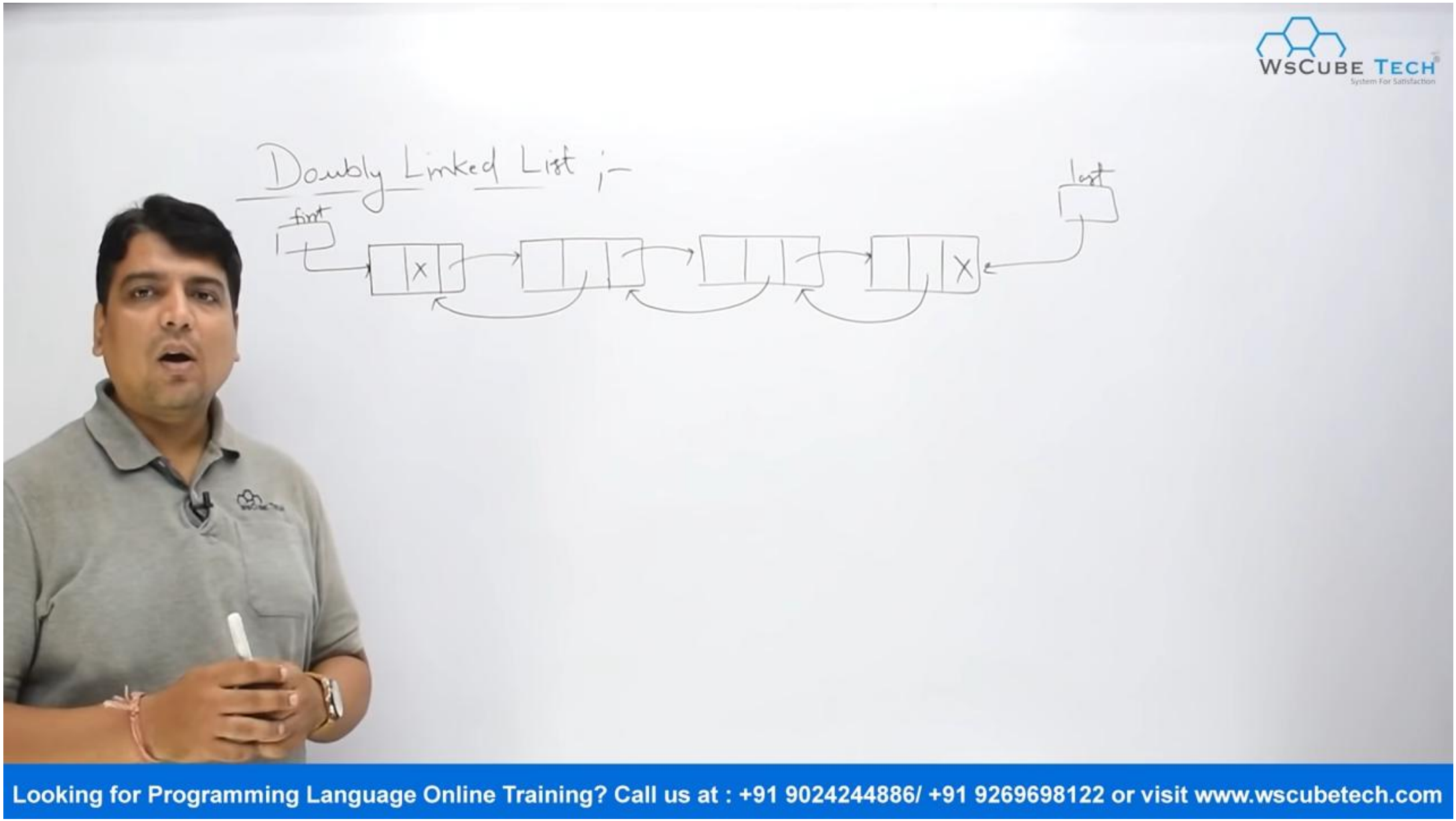
- We can go to any Node
- Save the time to go first to last Node
- All Node Contains Valid Address

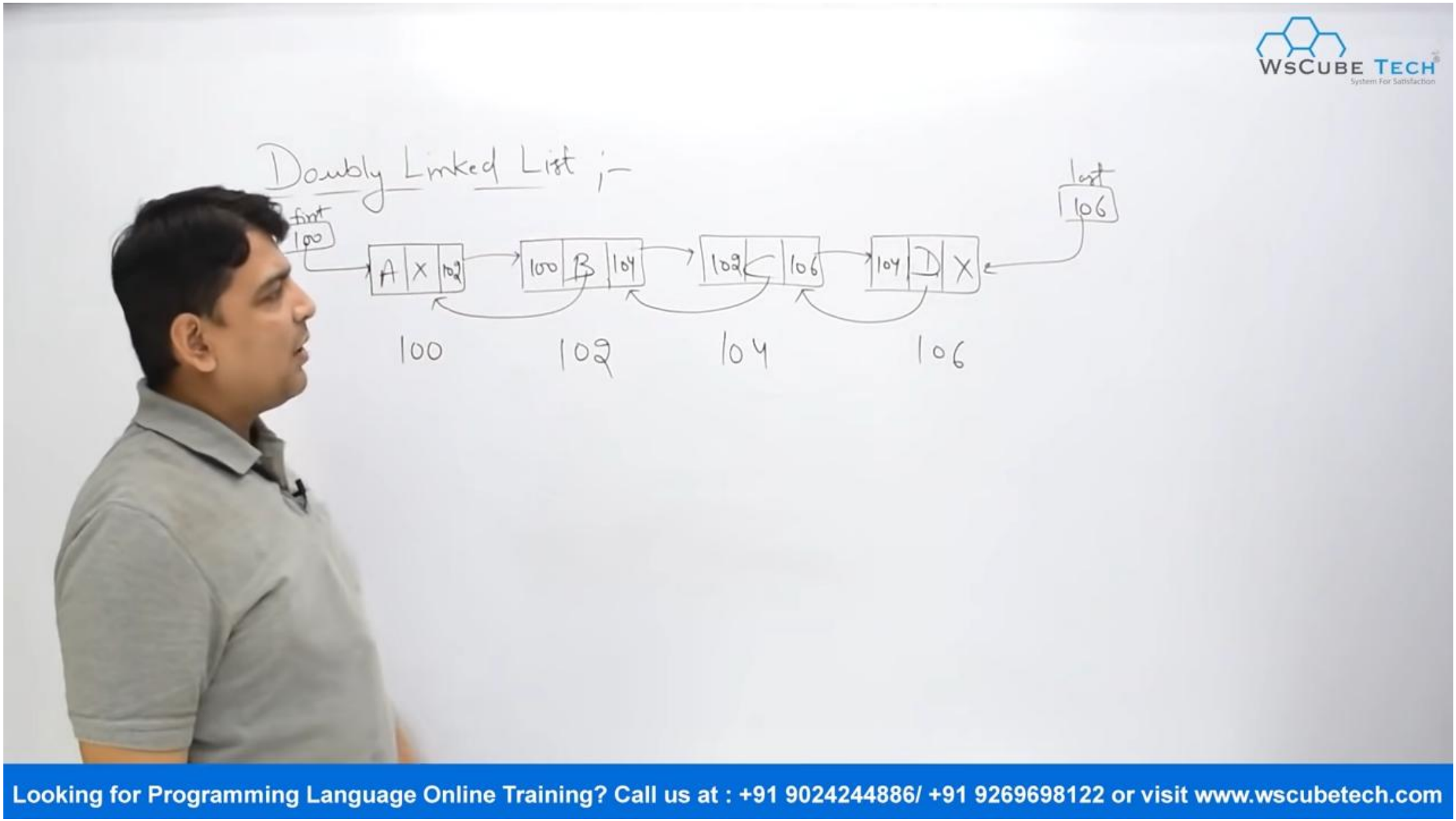
Disadvantages

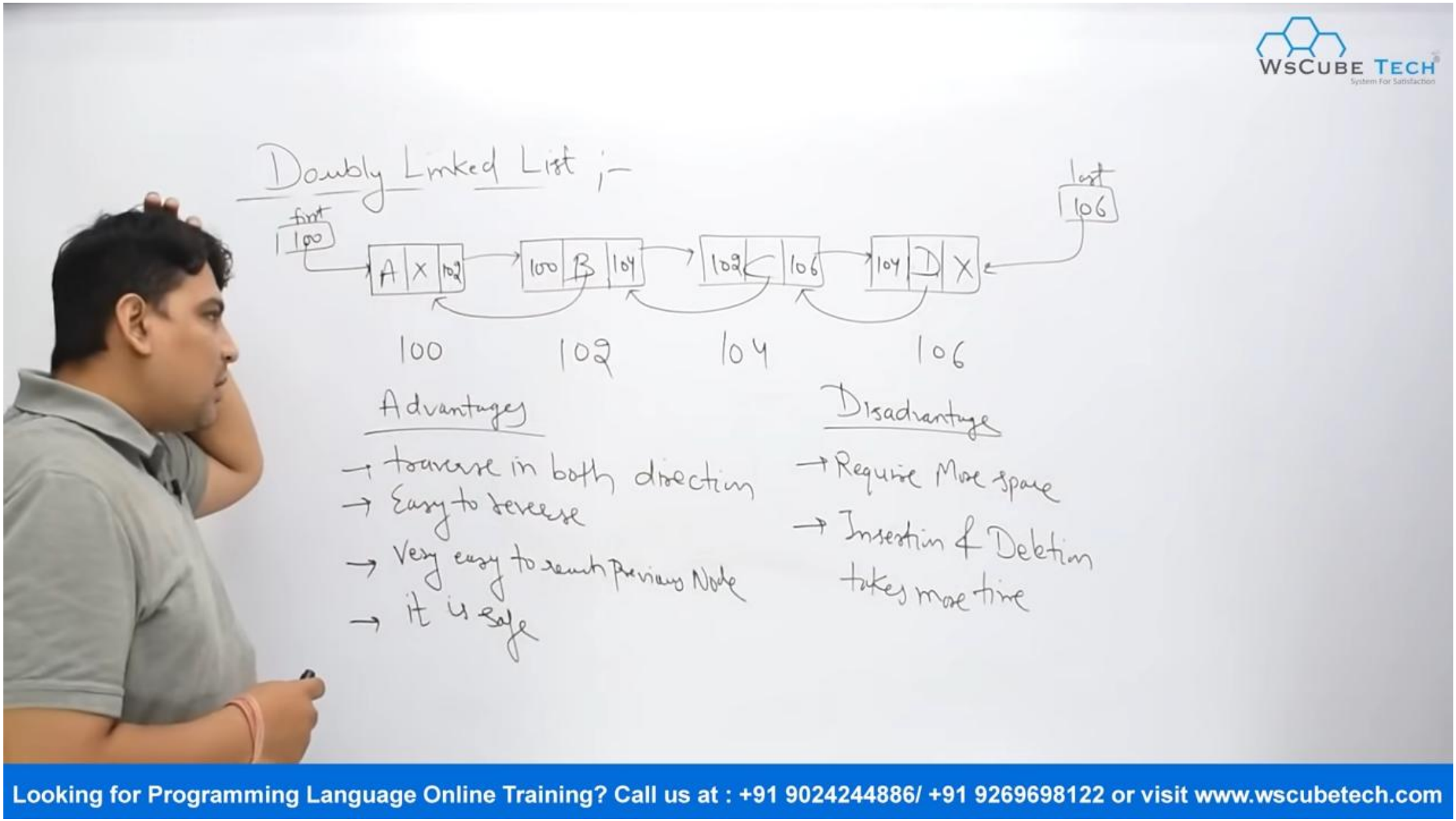
- Not easy to Reverse
- May go to infinite loop

Data Structure & Algorithm

Doubly Linked List







Data Structure & Algorithm

Tree in DSA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What is Tree Data Structure?

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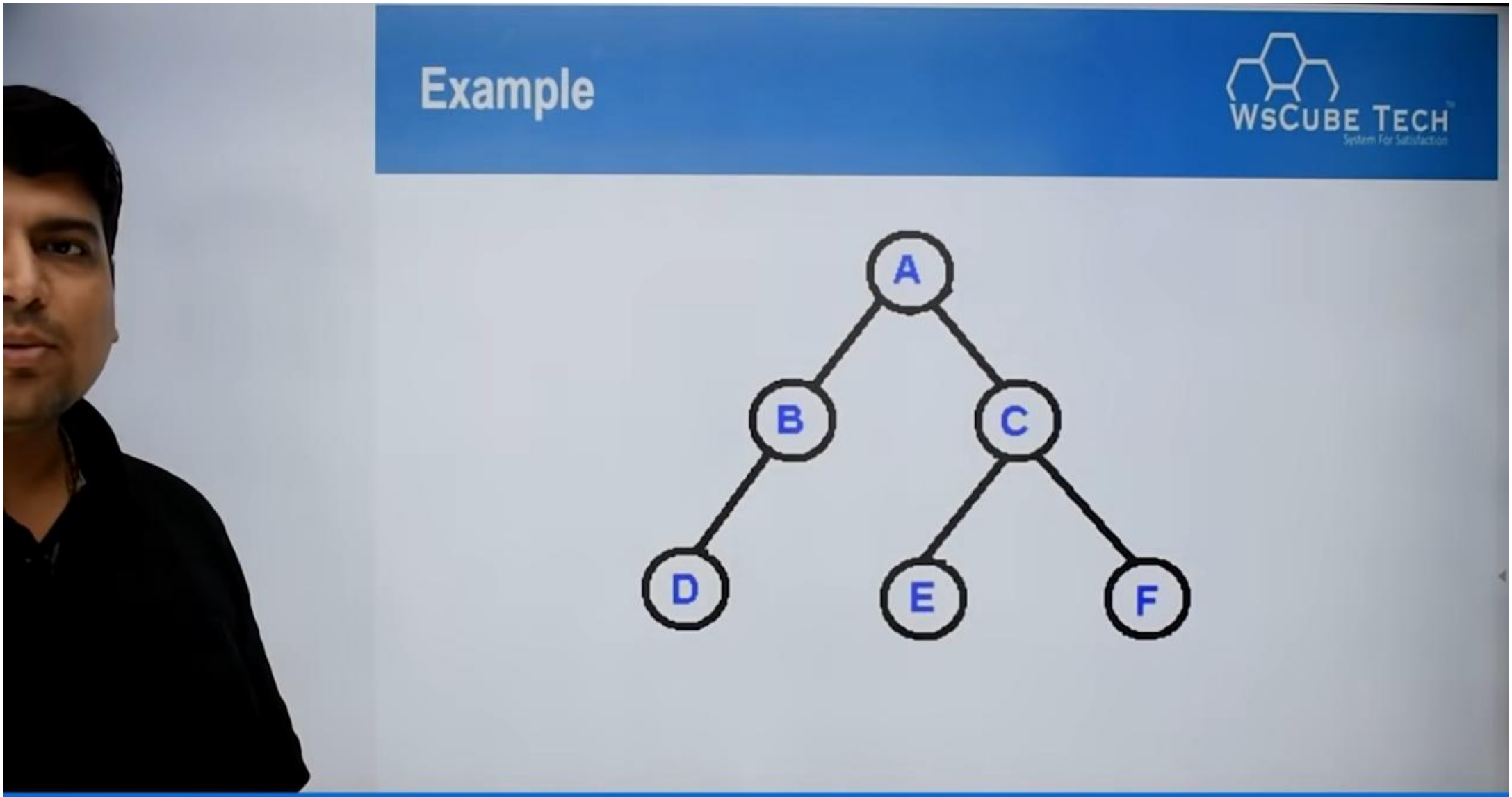
- Tree is a hierarchical data structure and follow parent child relationship.
- It is a non-linear data structure.
- A tree is a collection of elements called nodes. Each node contains some value or element.
- The node at the top of the tree is called **root** or the origin of tree.
- It represents the nodes connected by edges.



Tree Terminology

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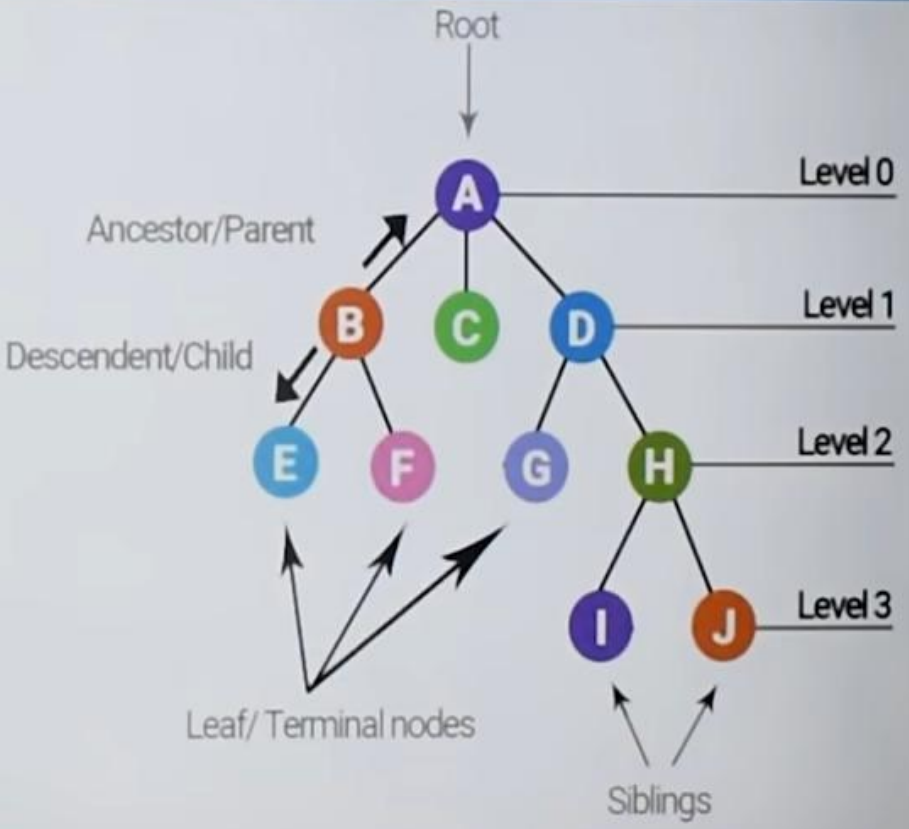
- **Root**: Root is a special node in a tree. The entire tree is referenced through it. It does not have a parent.
- **Parent Node**: Parent node is an immediate predecessor of a node.
- **Child Node**: All immediate successors of a node are its children.
- **Siblings**: Nodes with the same parent are called Siblings.
- **Path**: Path is a number of successive edges from source node to destination node.



Tree Terminology Continued...

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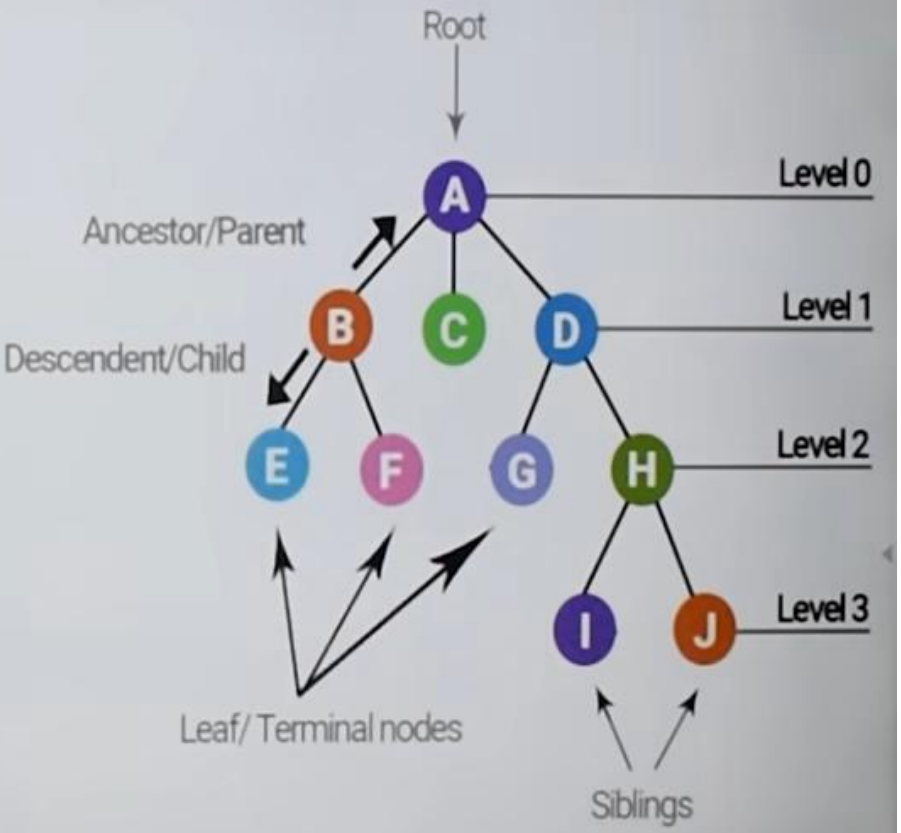
- **Edge:** Edge is a connection between one node to another. It is a line between two nodes or a node and a leaf.
- **Leaf**: The node which does not have any child node is called the leaf node. Leaf nodes are also called as external nodes or terminal nodes.
- **Levels**: Level of a node represents the generation of a node. If the root node is at level 0, then its next child node is at level 1, its grandchild is at level 2, and so on.



Tree Terminology Continued...

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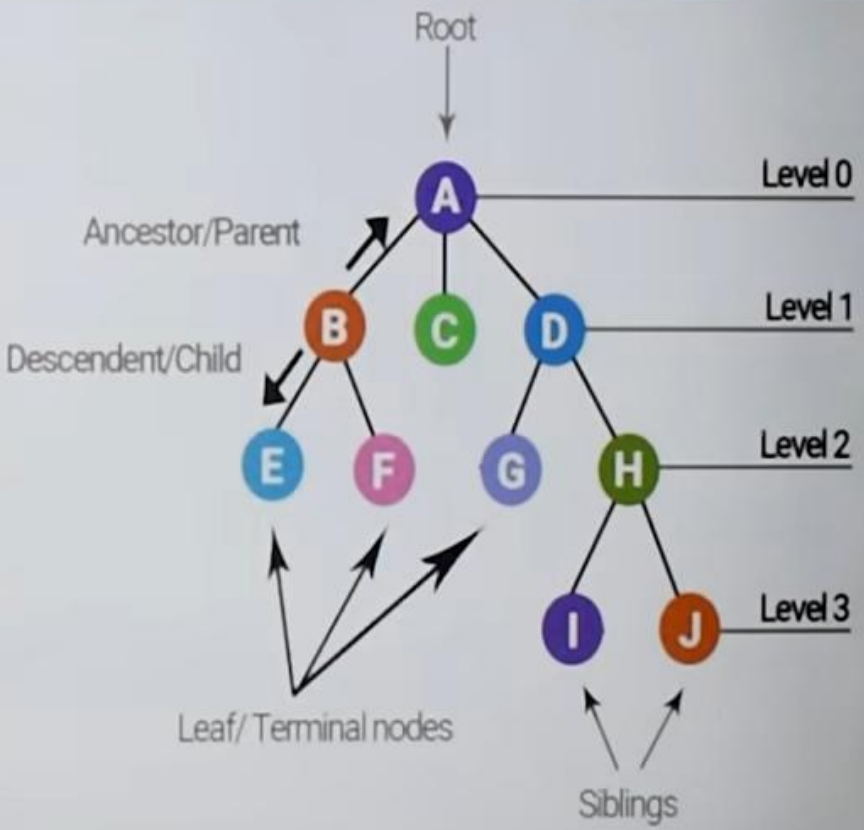
- **Degree of Node**: Degree of a node represents a number of children of a node.
- **Degree of a Tree** is the maximum degree of a node in the tree.
- **Internal Node:**
  - The node which has at least one child is called as an internal node
  - Internal nodes are also called as non-terminal nodes
  - Every non-leaf node is an internal n



Tree Terminology Continued...

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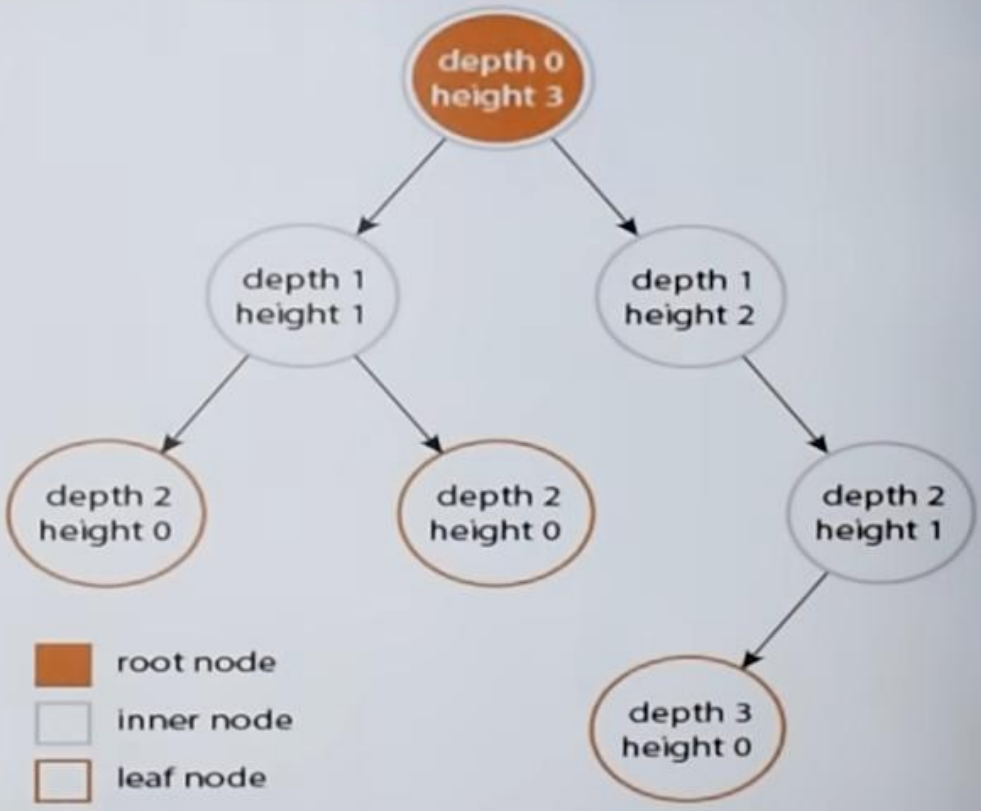
The depth of a node is the number of edges from the node to the tree's root node.
A root node will have a depth of 0. Note that the depth of the root is 0.

The height of a node is the number of edges on the longest path from the node to a leaf.
A leaf node will have a height of 0. The height of a tree would be the height of its root node.



Data Structure & Algorithm

Binary Tree in DSA

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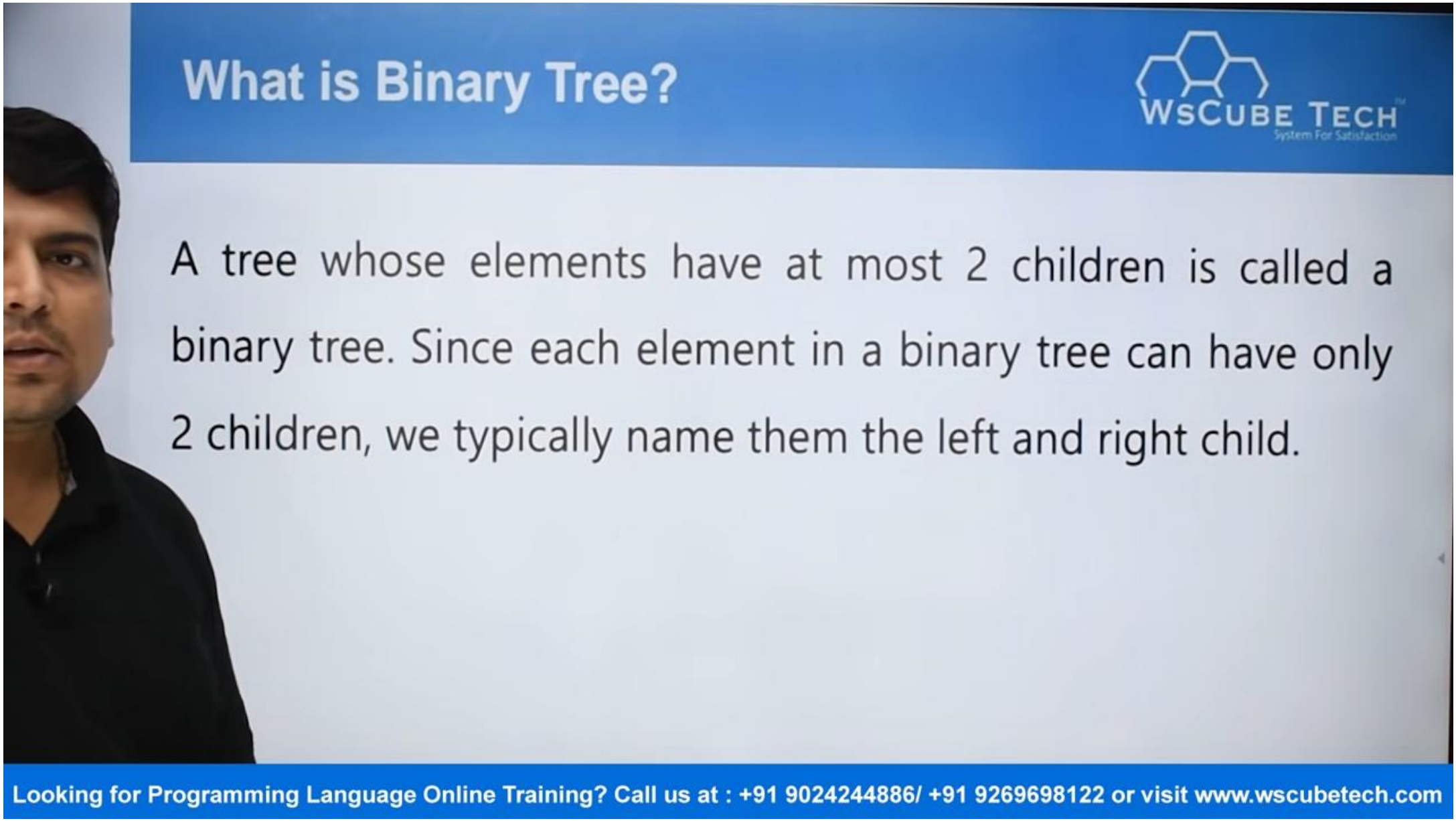
What is Binary Tree?
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A tree whose elements have at most 2 children is called a binary tree. Since each element in a binary tree can have only 2 children, we typically name them the left and right child.
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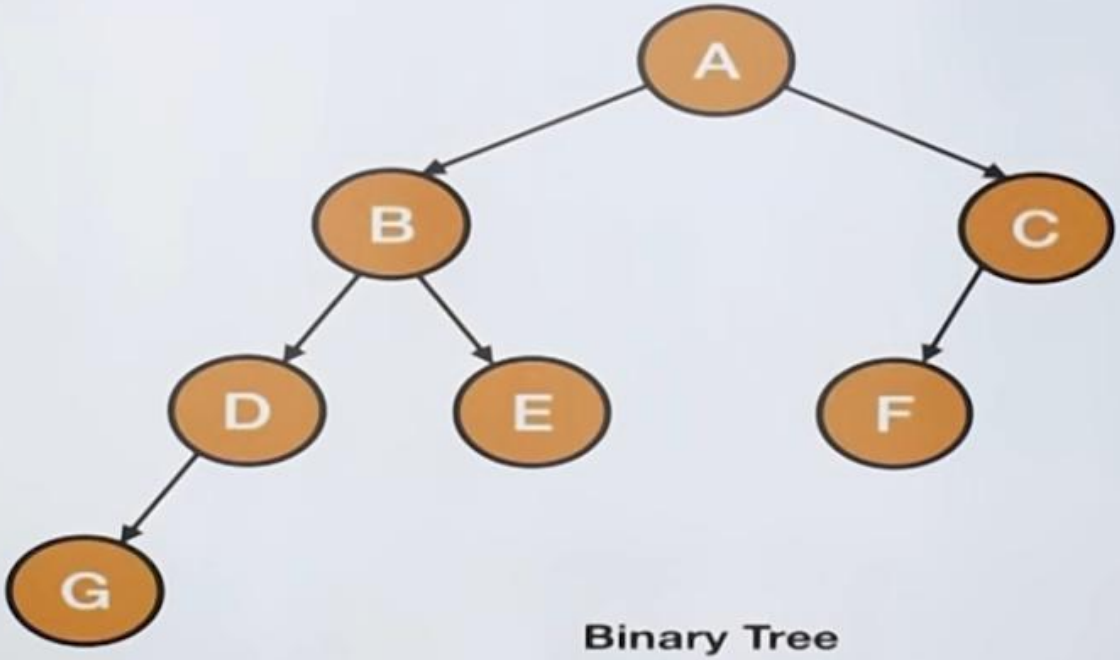
Example of Binary Tree



Binary Tree

Full or Strictly Binary Tree

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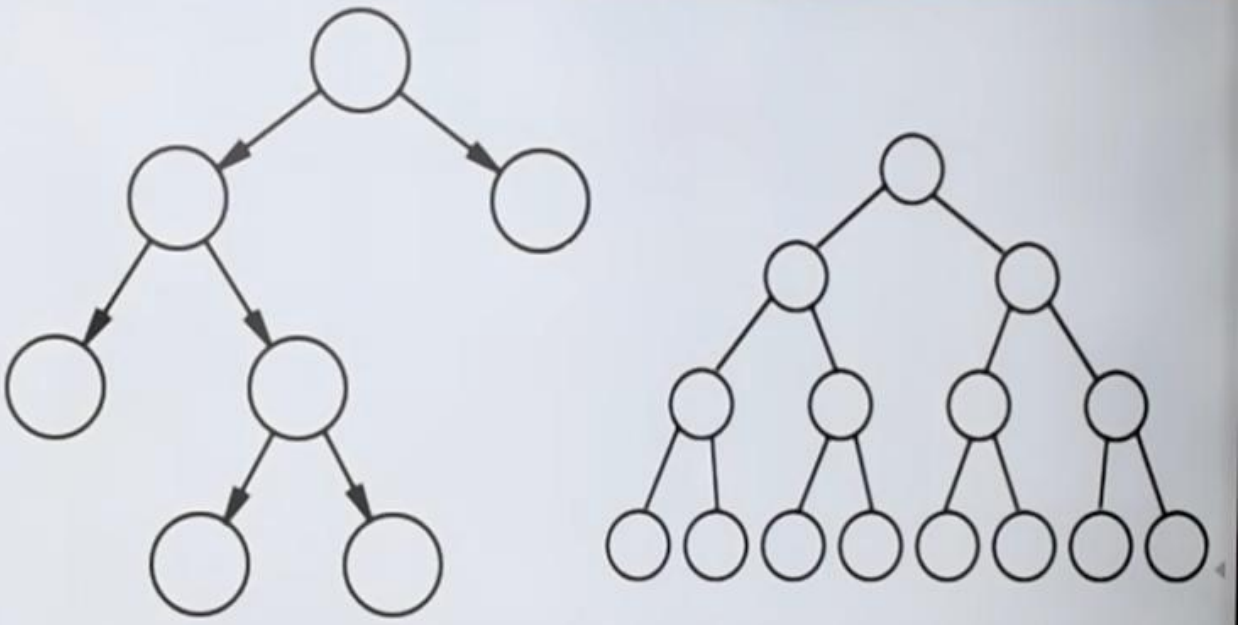
- A binary tree in which every node has either 0 or 2 children is called as a Full binary tree.
- Full binary tree is also called as Strictly binary tree.



Complete Binary Tree

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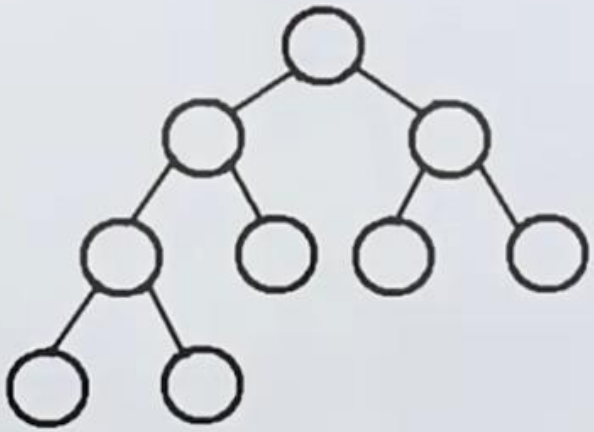
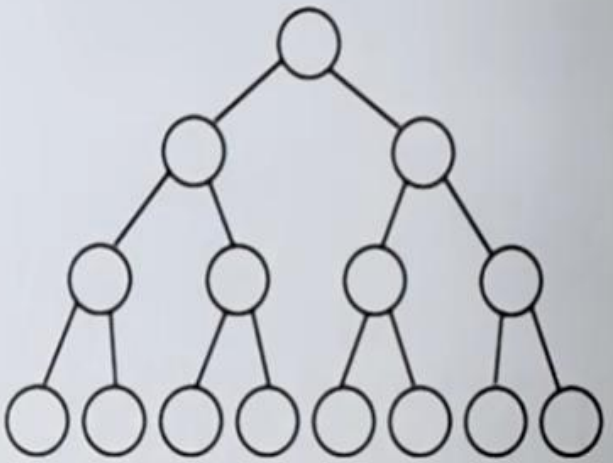
A Binary Tree is complete Binary Tree if all levels are completely filled except possibly the last level and the last level has all keys as left as possible





Perfect Binary Tree

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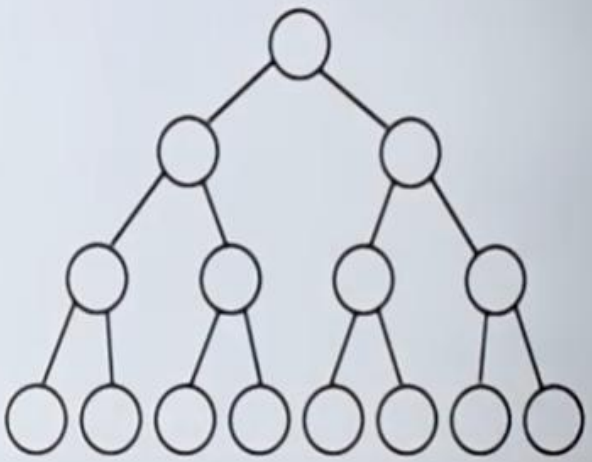
Perfect Binary Tree A Binary tree is Perfect Binary Tree in which all internal nodes have two children and all leaves are at the same level.



Almost Complete Binary Tree

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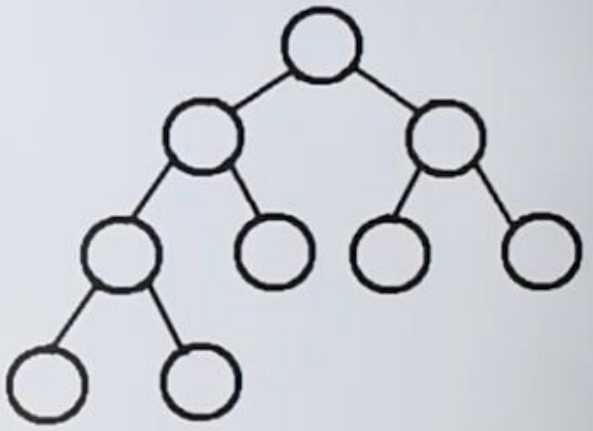
All leafs at lowest and next to lowest levels only. All except the lowest level is full. No gaps except at the end of a level. A perfectly balanced tree with leaves at the last level all in the leftmost position.



Data Structure & Algorithm

Representation of Binary Tree

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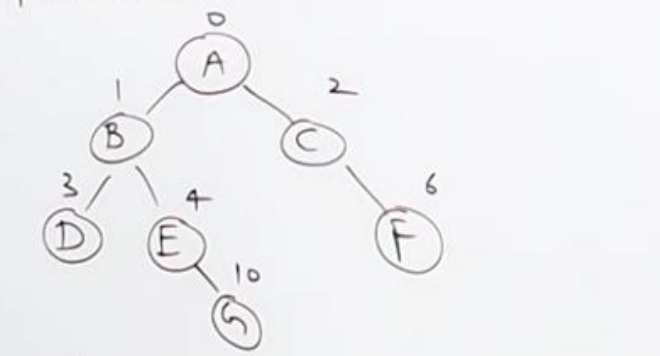
Representation of Binary Tree :-

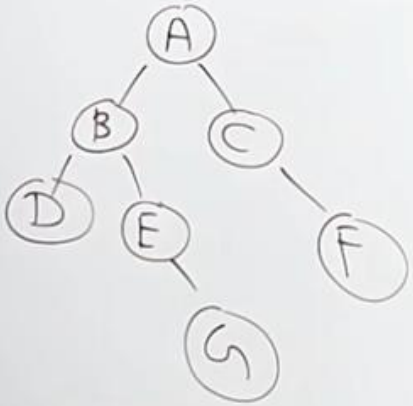
- Sequential Representation or Array Representation
- Linked List Representation

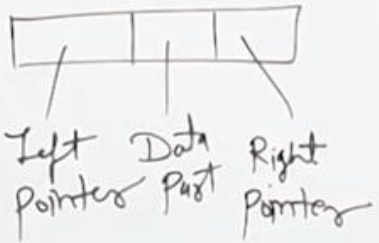


Representation of Binary Tree :-

→ Sequential Representation or Array Representation

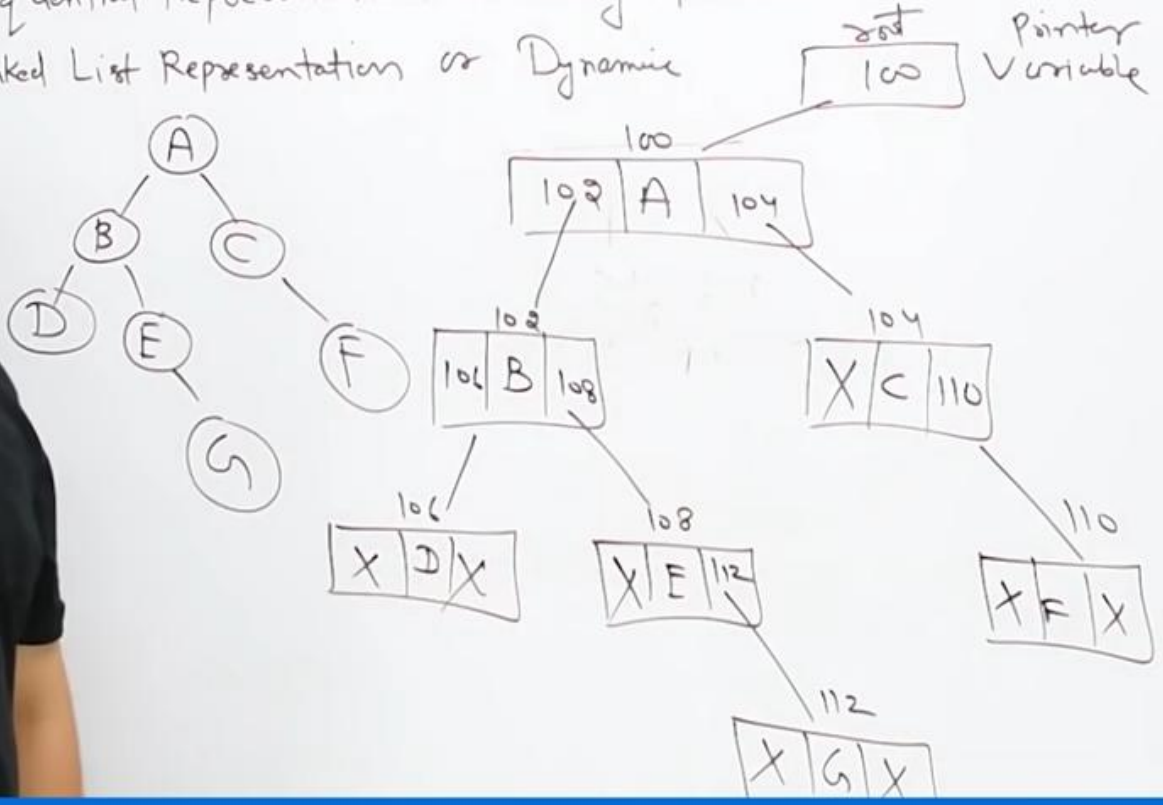
→ Linked List Representation or Dynamic ..





Representation of Binary Tree :-

- Sequential Representation or Array Representation
- Linked List Representation or Dynamic

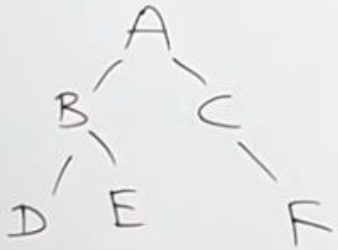


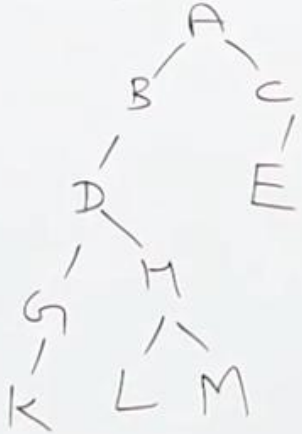
Data Structure & Algorithm

PreOrder Traversals of Binary Tree

Traversing of Binary Tree :-

→ Preorder (Root, Left Sub tree, Right Sub tree)
→ Inorder (left Sub tree, Root, Right Sub tree)
→ Postorder (left Sub tree, Right Sub tree, Root)





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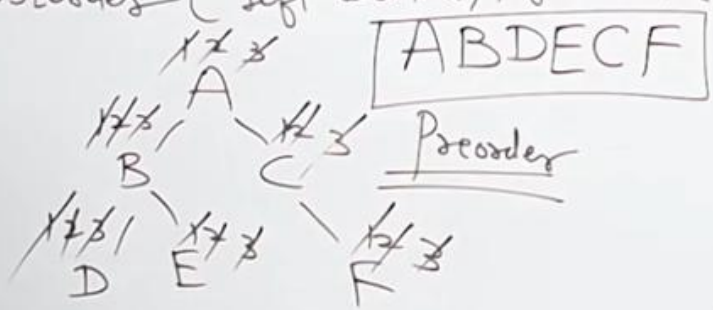
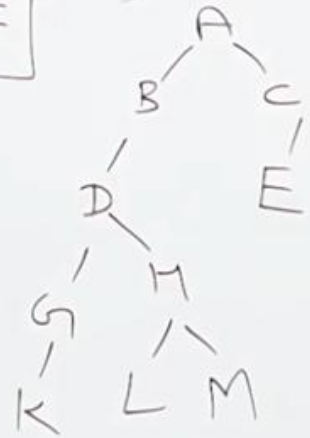
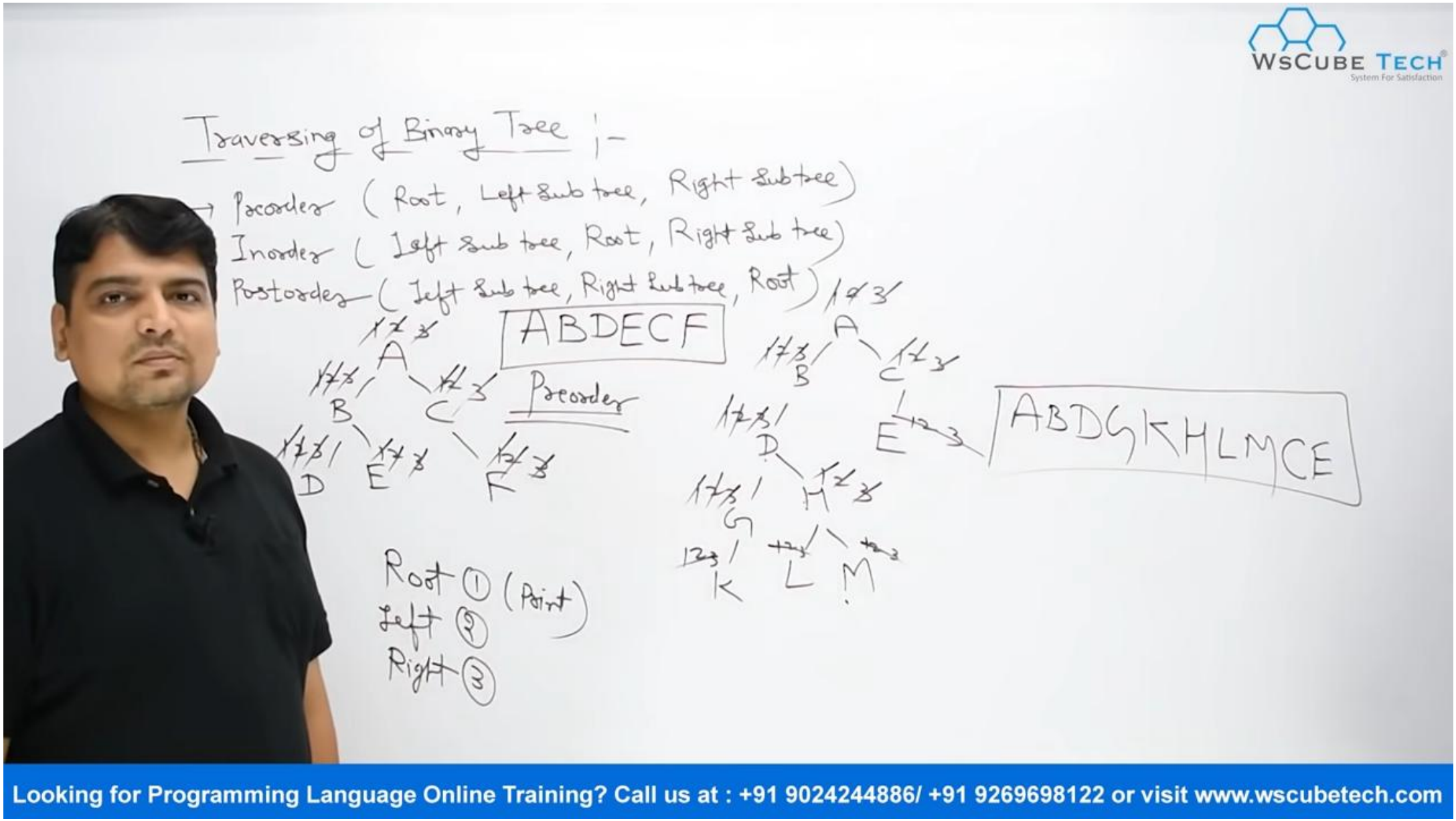


ABDECF

Preorder

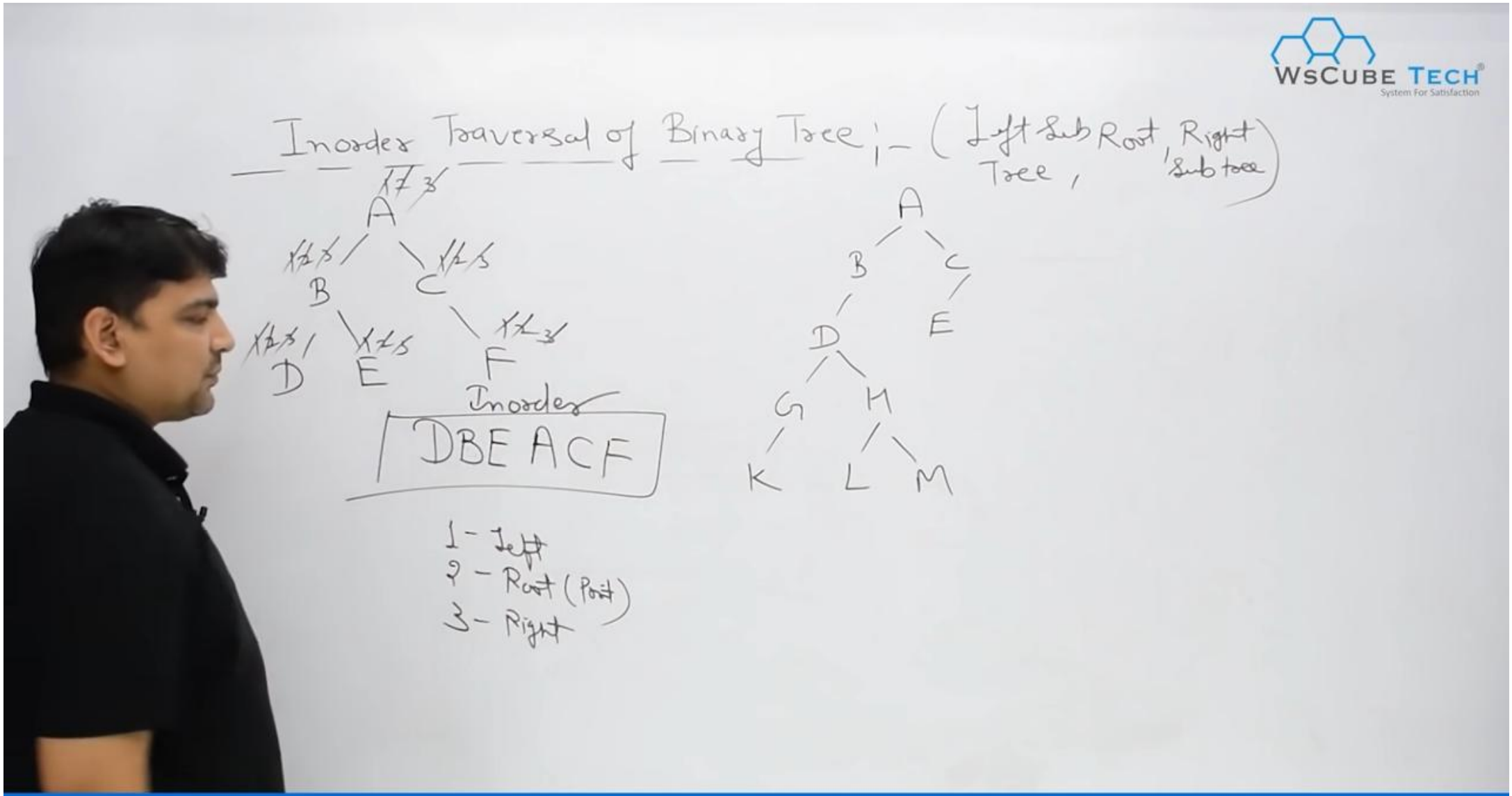


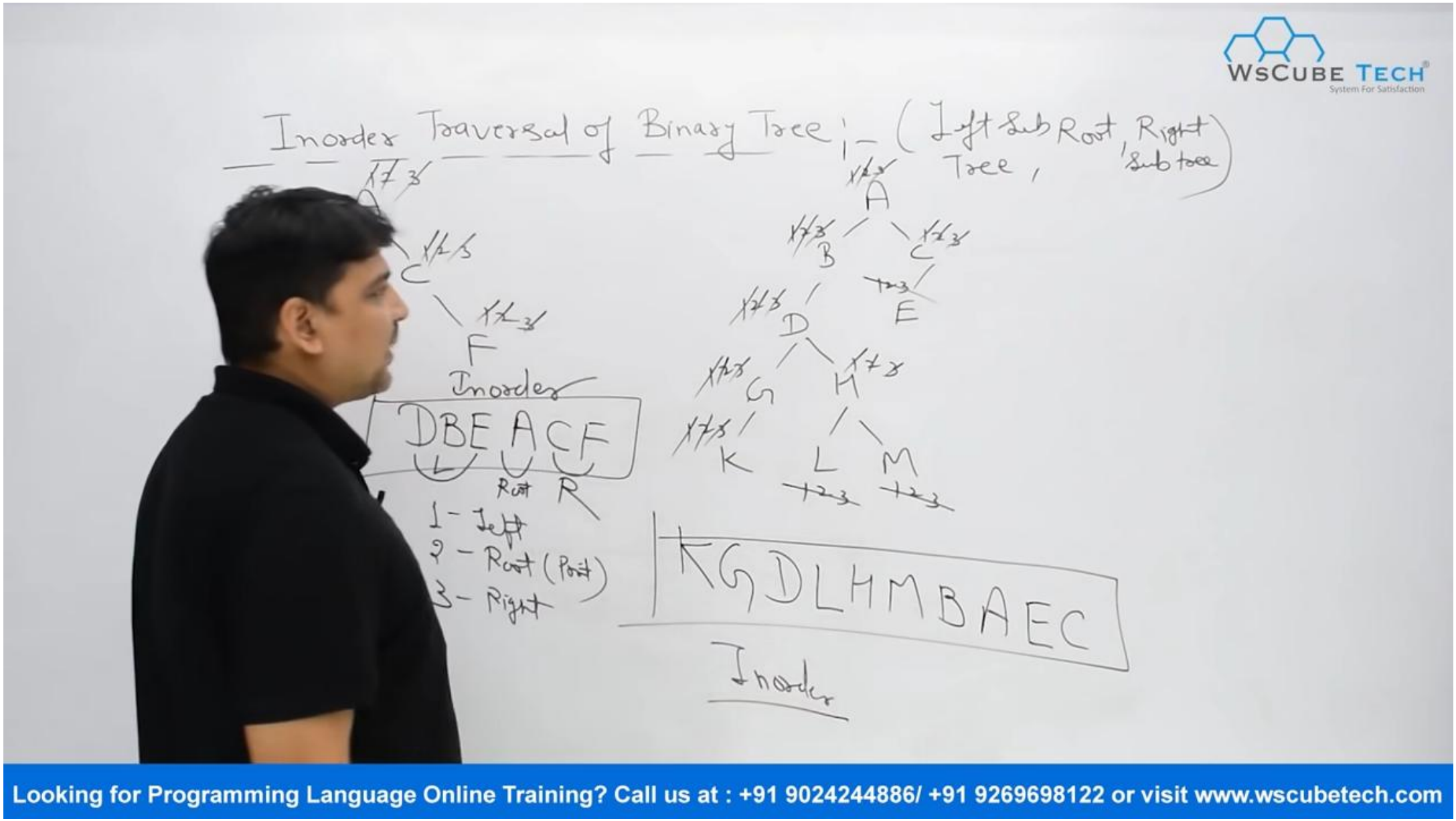
Root ① (Print)
Left ②
Right ③



Data Structure & Algorithm

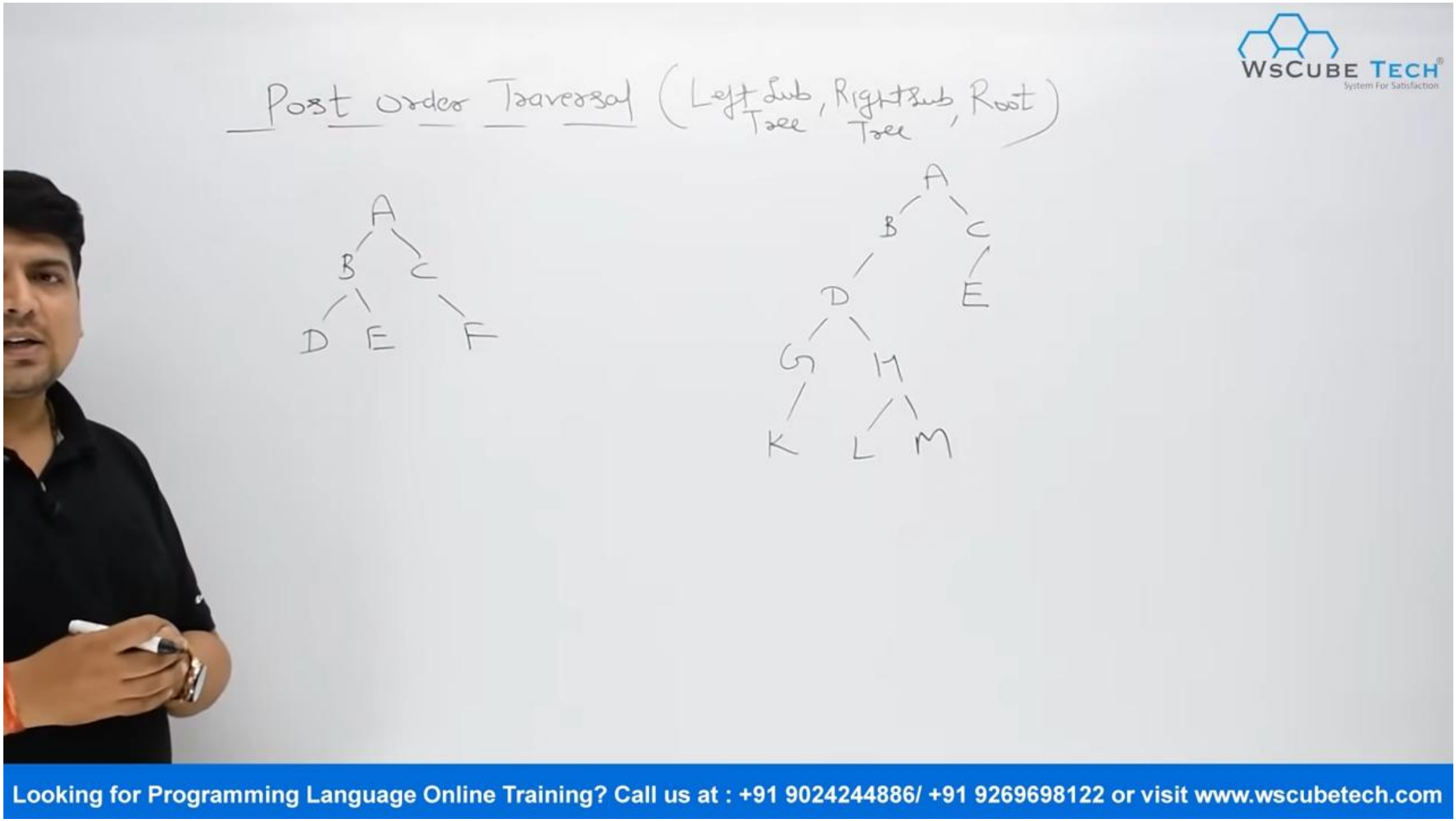
Inorder Traversal

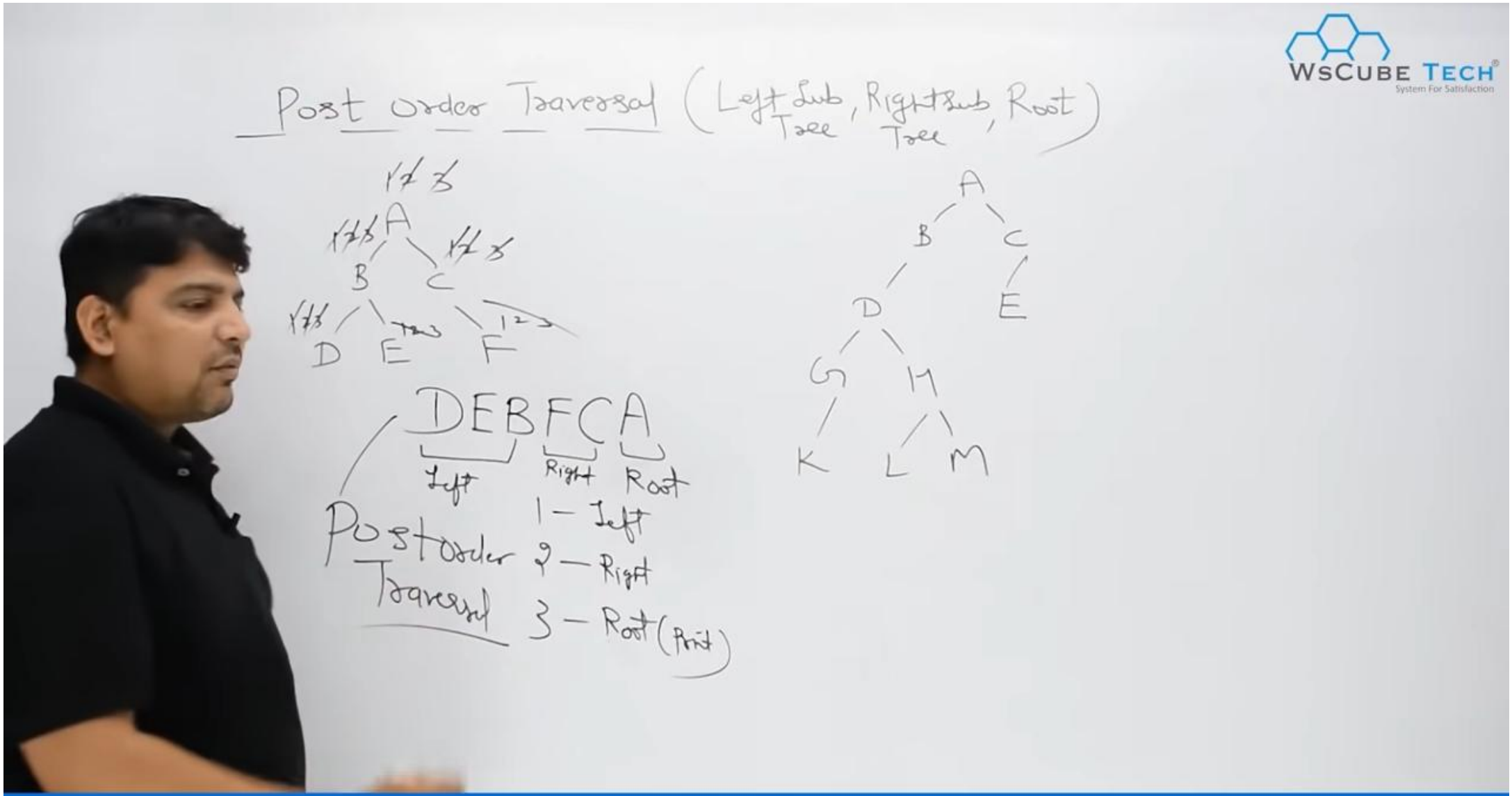


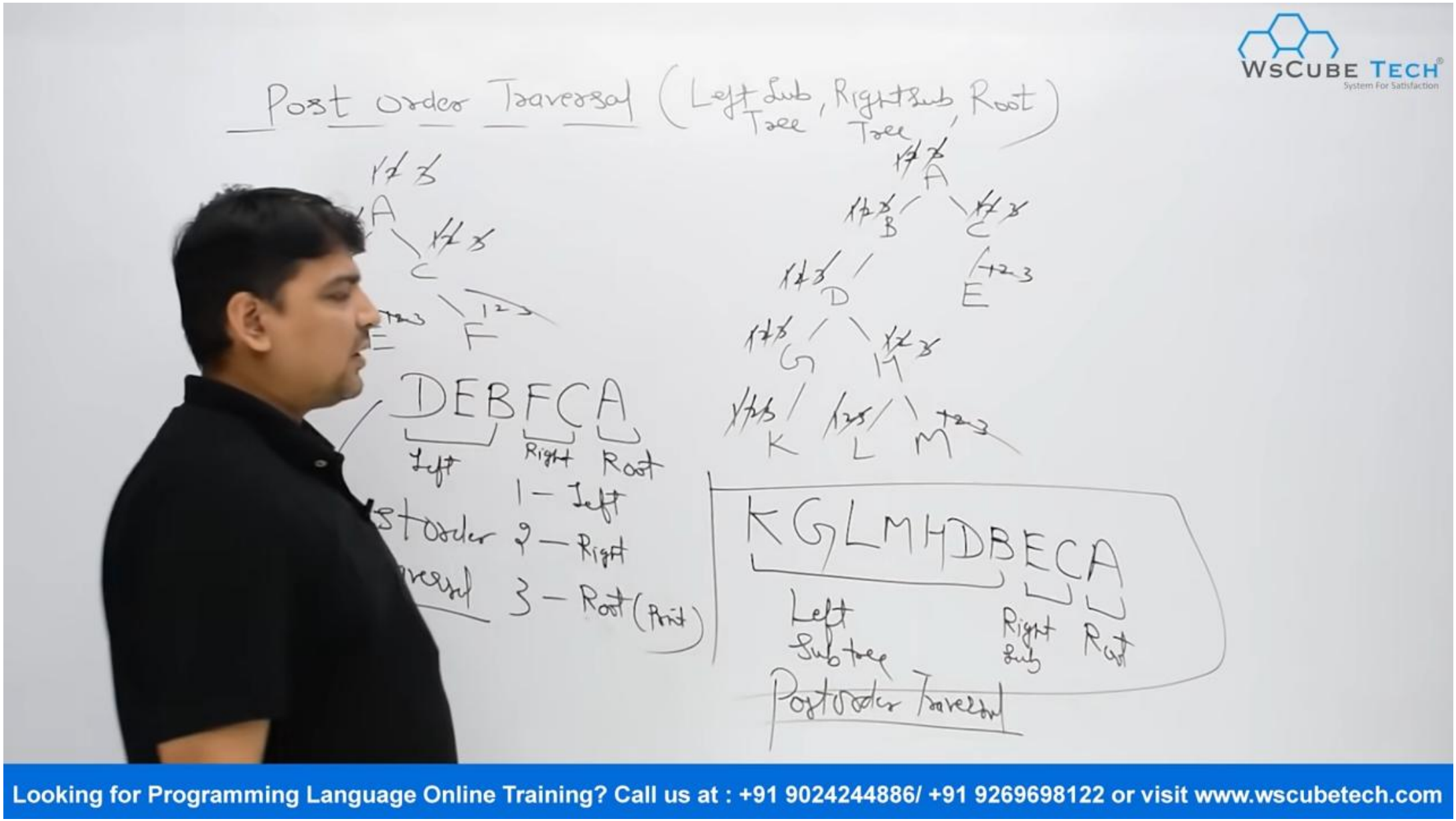


Data Structure & Algorithm

Post Order Traversal of Binary Tree







Data Structure & Algorithm

Binary Search Tree

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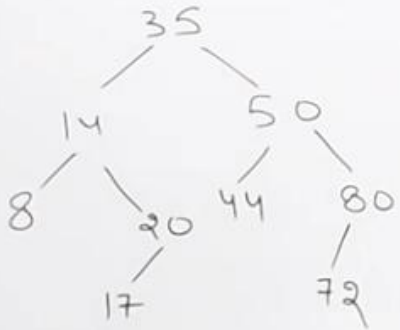
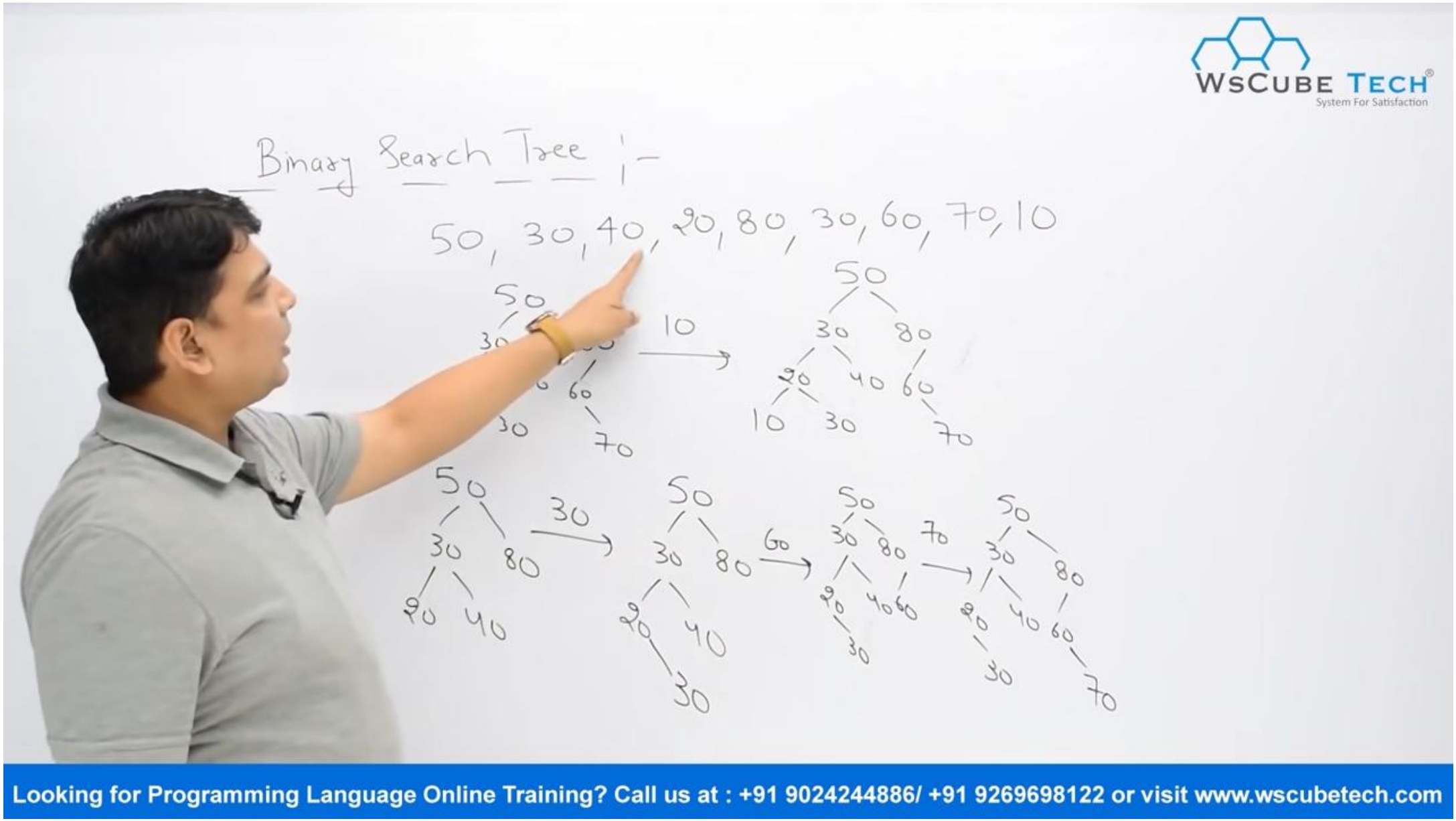
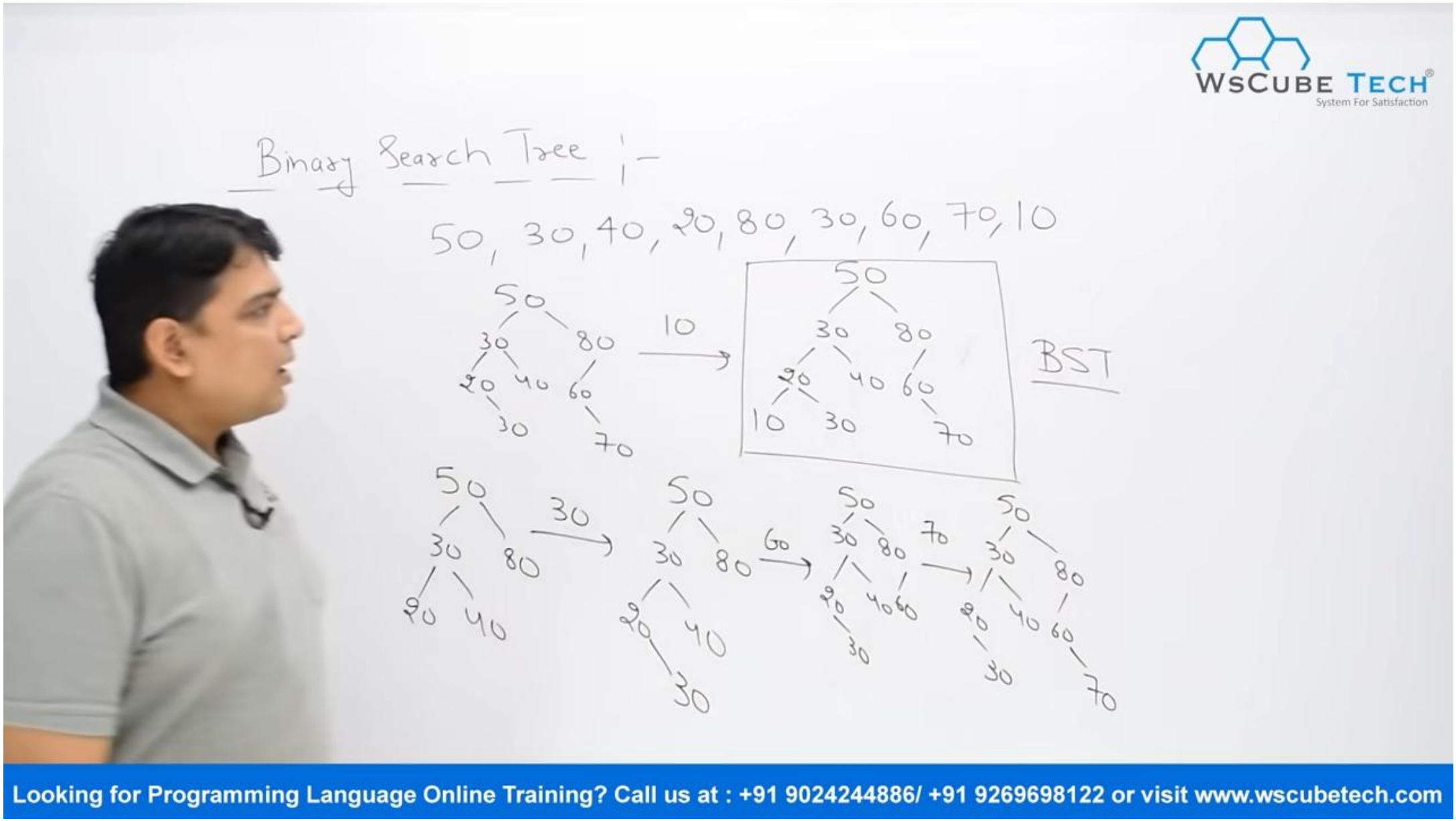
Binary Search Tree :-



Left ≤ Data < Right

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Binary Search Tree :-
50, 30, 40, 20, 80, 30, 60, 70, 10
10
BST
30
60
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Data Structure & Algorithm

Deletion into Binary Search Tree

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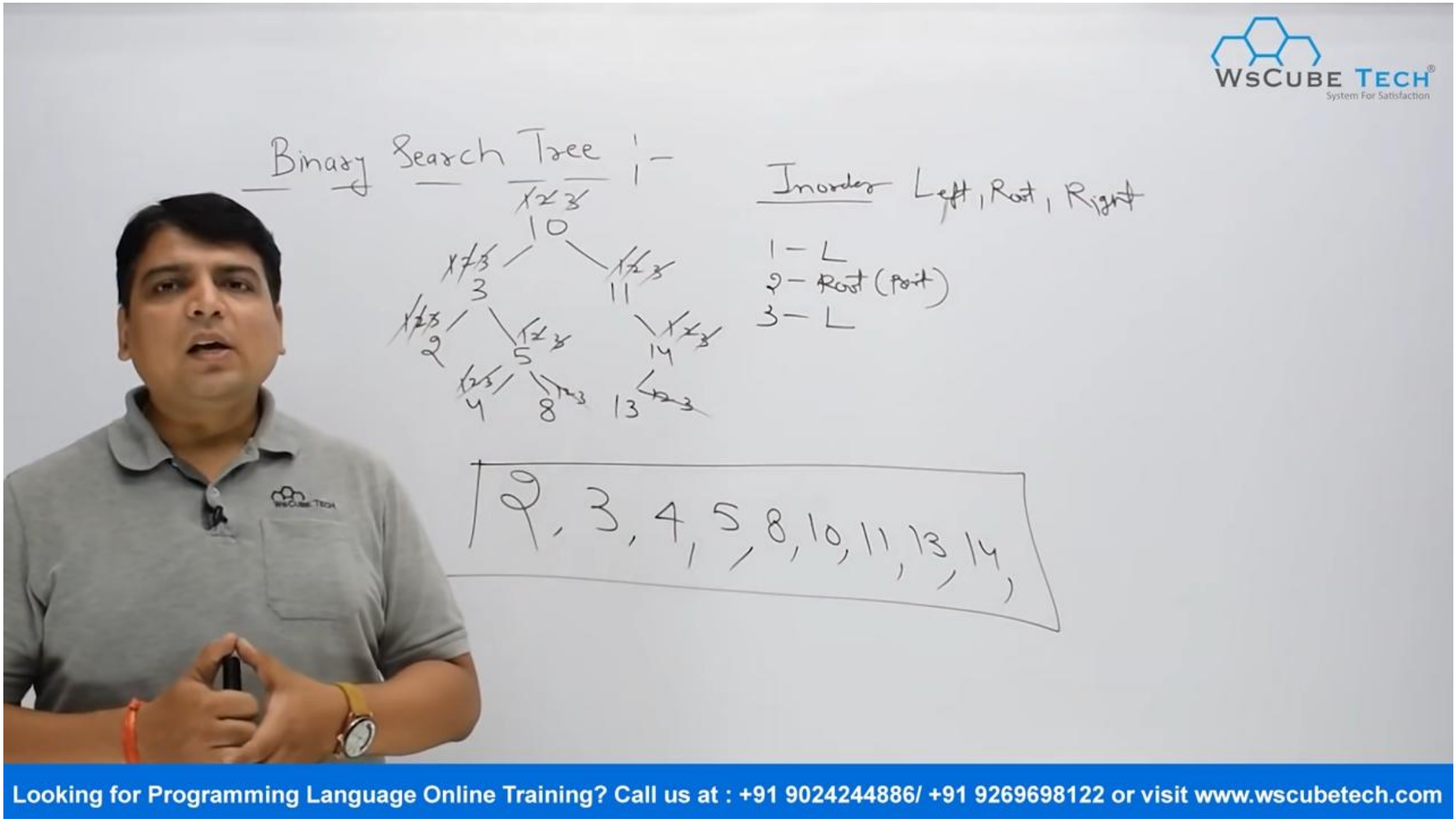

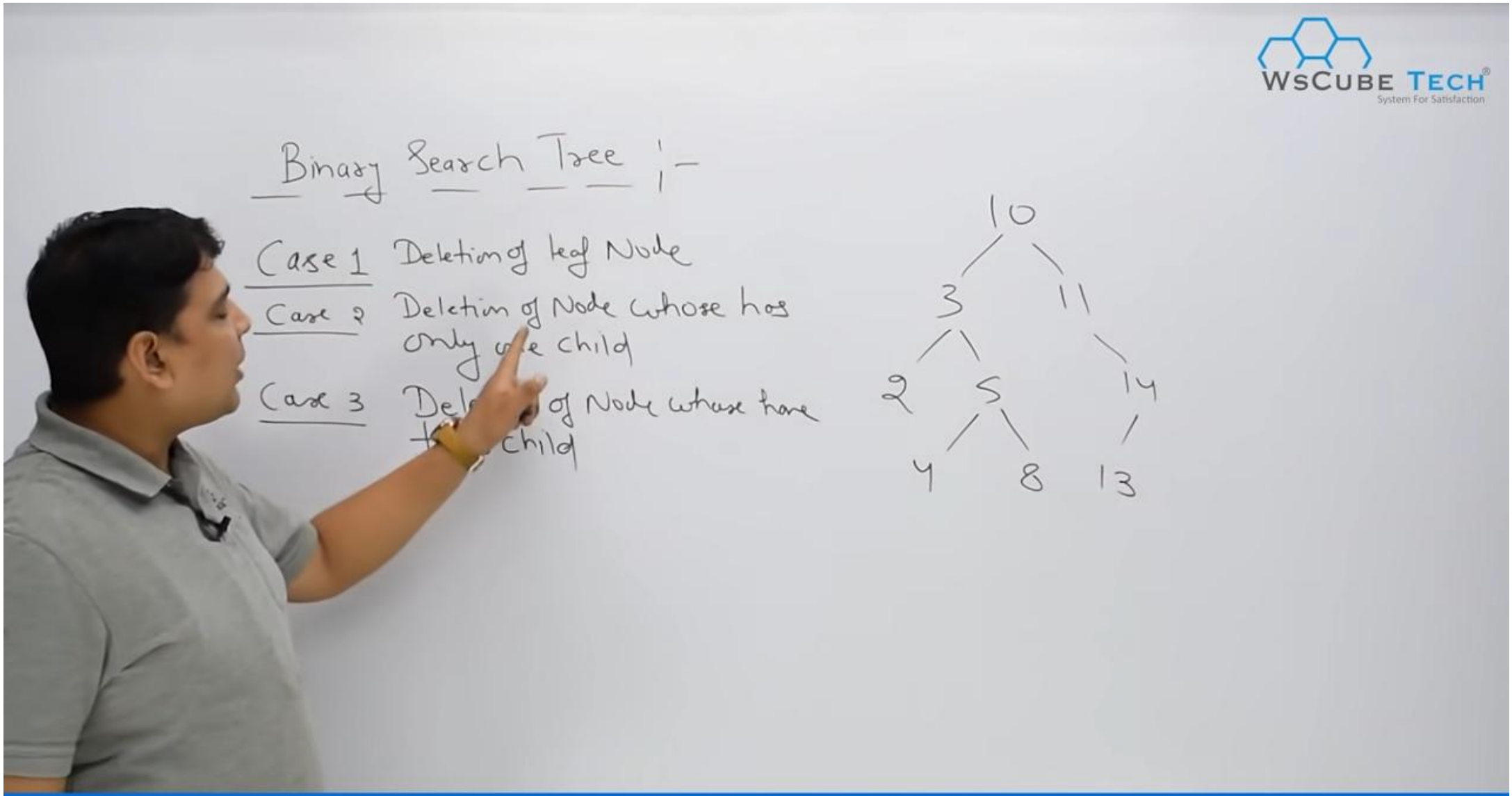

Data Structure & Algorithm

AVL Tree in DSA

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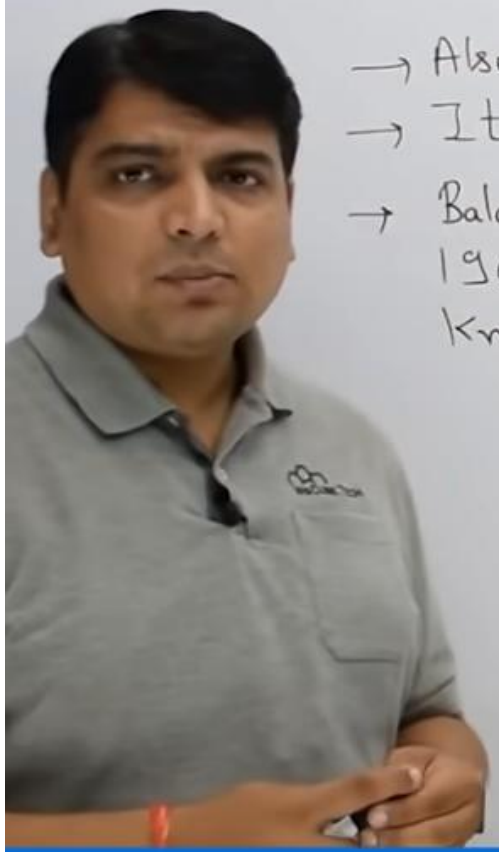
Introduction to AVL Tree :-

- → Also called as height balance Tree
- → It is binary Search Tree
- → Balance Tree's Concept was introduced in 1962 by Adelson-Velski-Landis known as AVL Tree.

$$\text{Balance factor} = h(T^L) - h(T^R)$$



Introduction to AVL Tree :-

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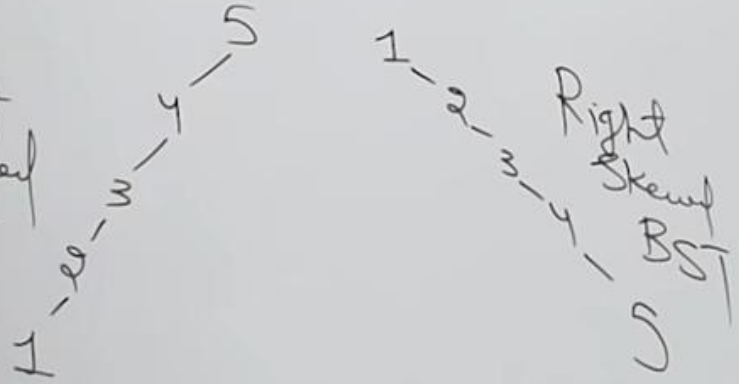

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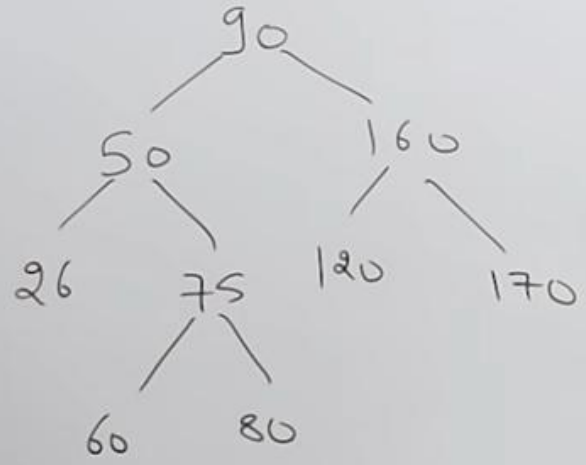
Introduction to AVL Tree :-

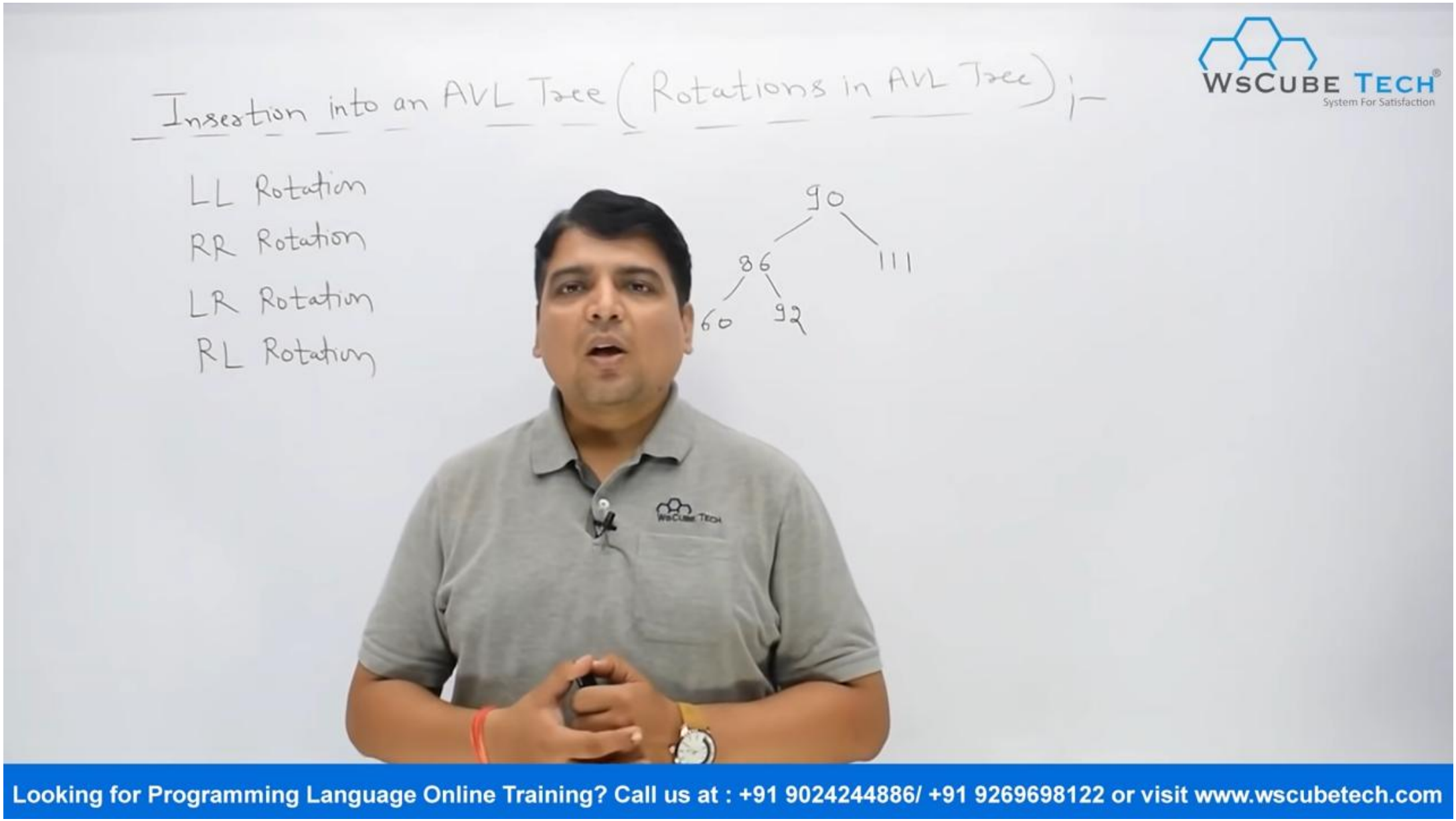


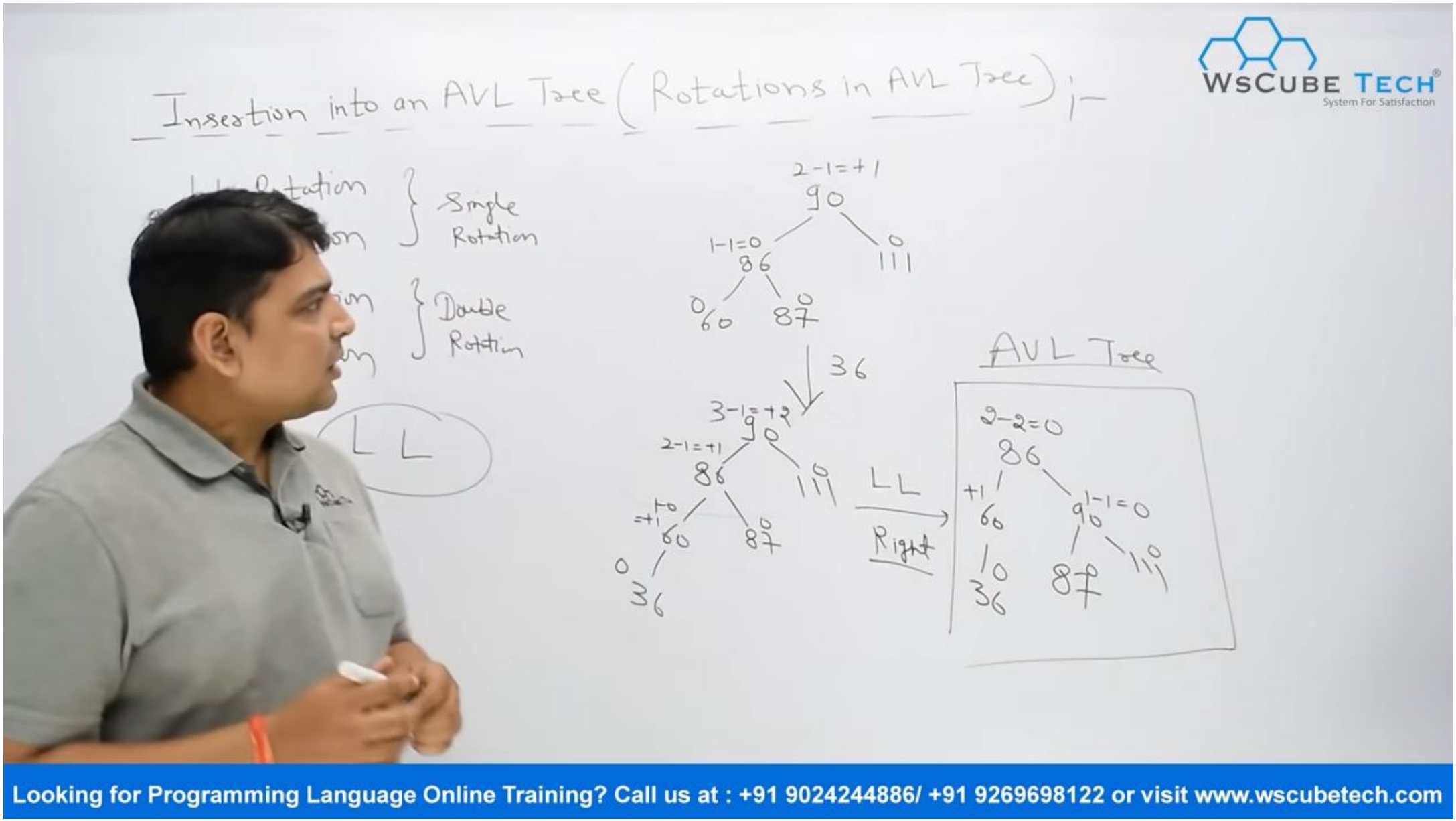
Balance Factor = $h(T^L) - h(T^R)$

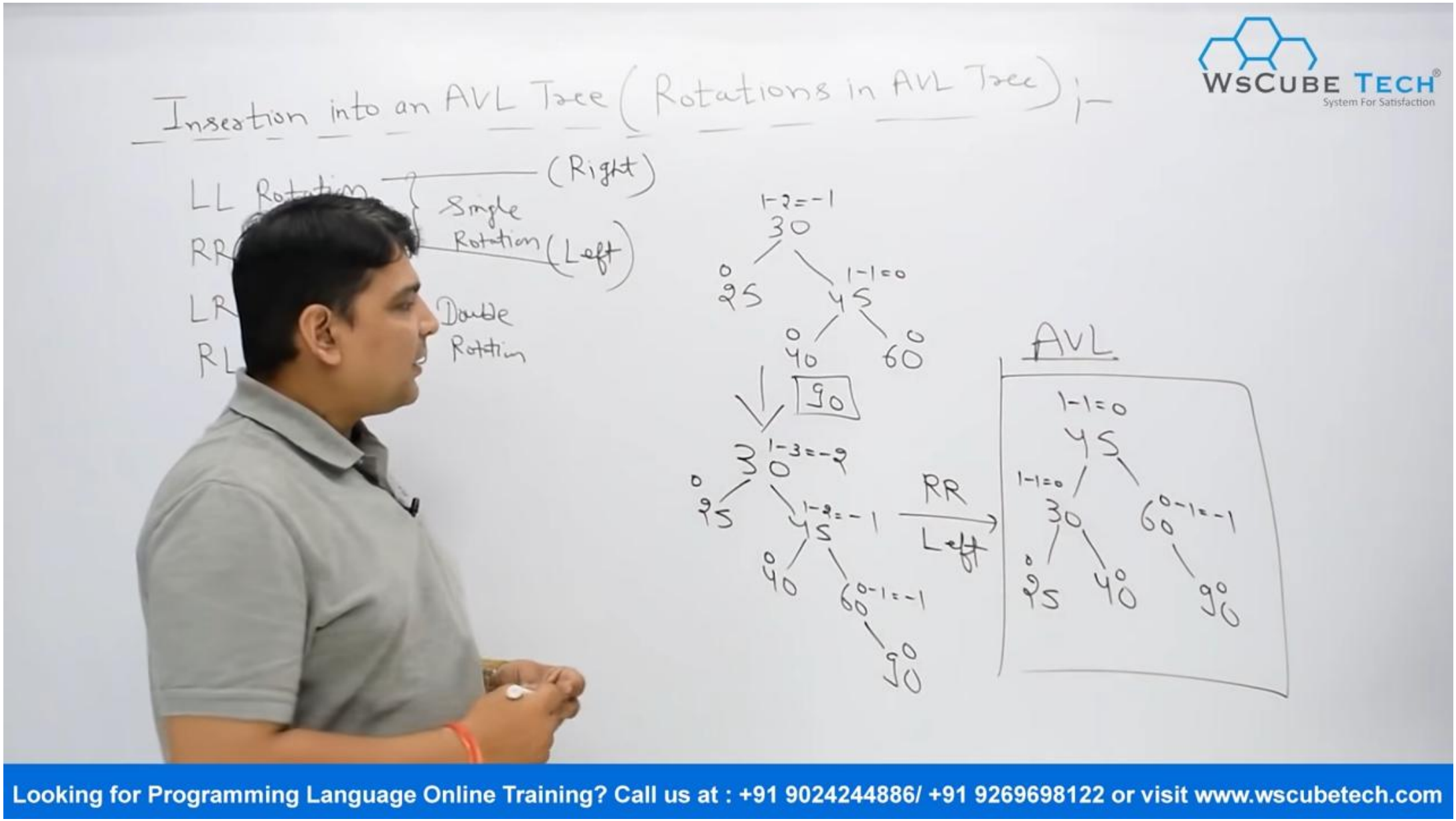
0, +1, -1

Data Structure & Algorithm

AVL Tree Insertion





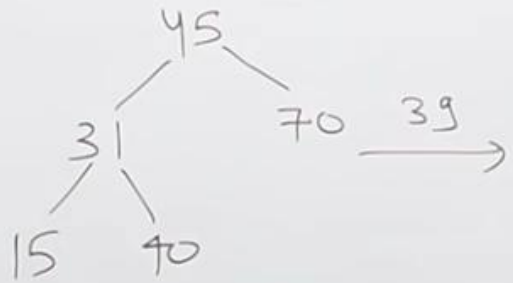


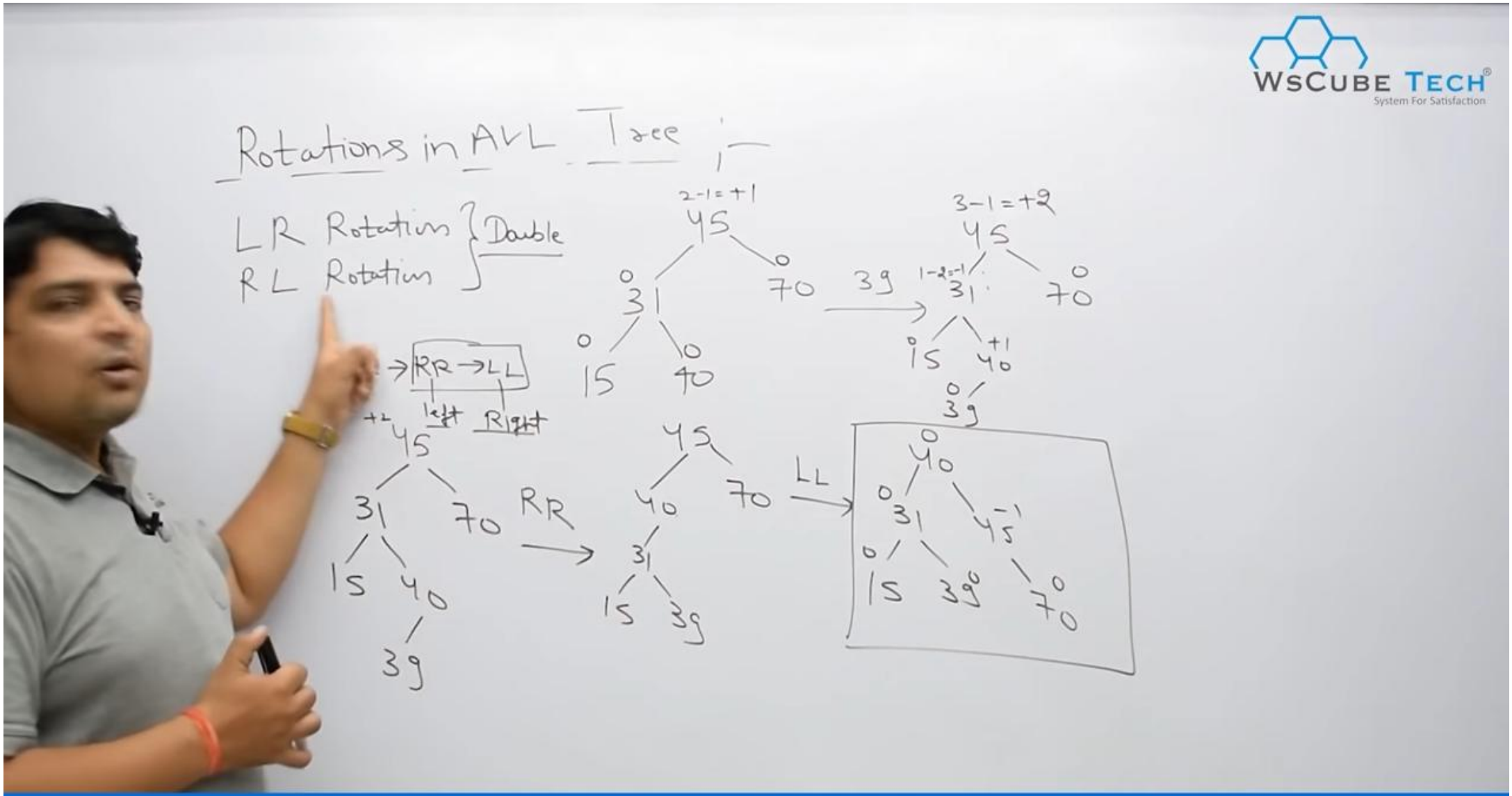
Data Structure & Algorithm

AVL Tree Rotation

Rotations in AVL Tree :-

LR Rotation } Double
RL Rotation }

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Rotations in AVL Tree :-
LR Rotation
RL Rotation
Double
RR → LL
Left
Right
RR
LL
39
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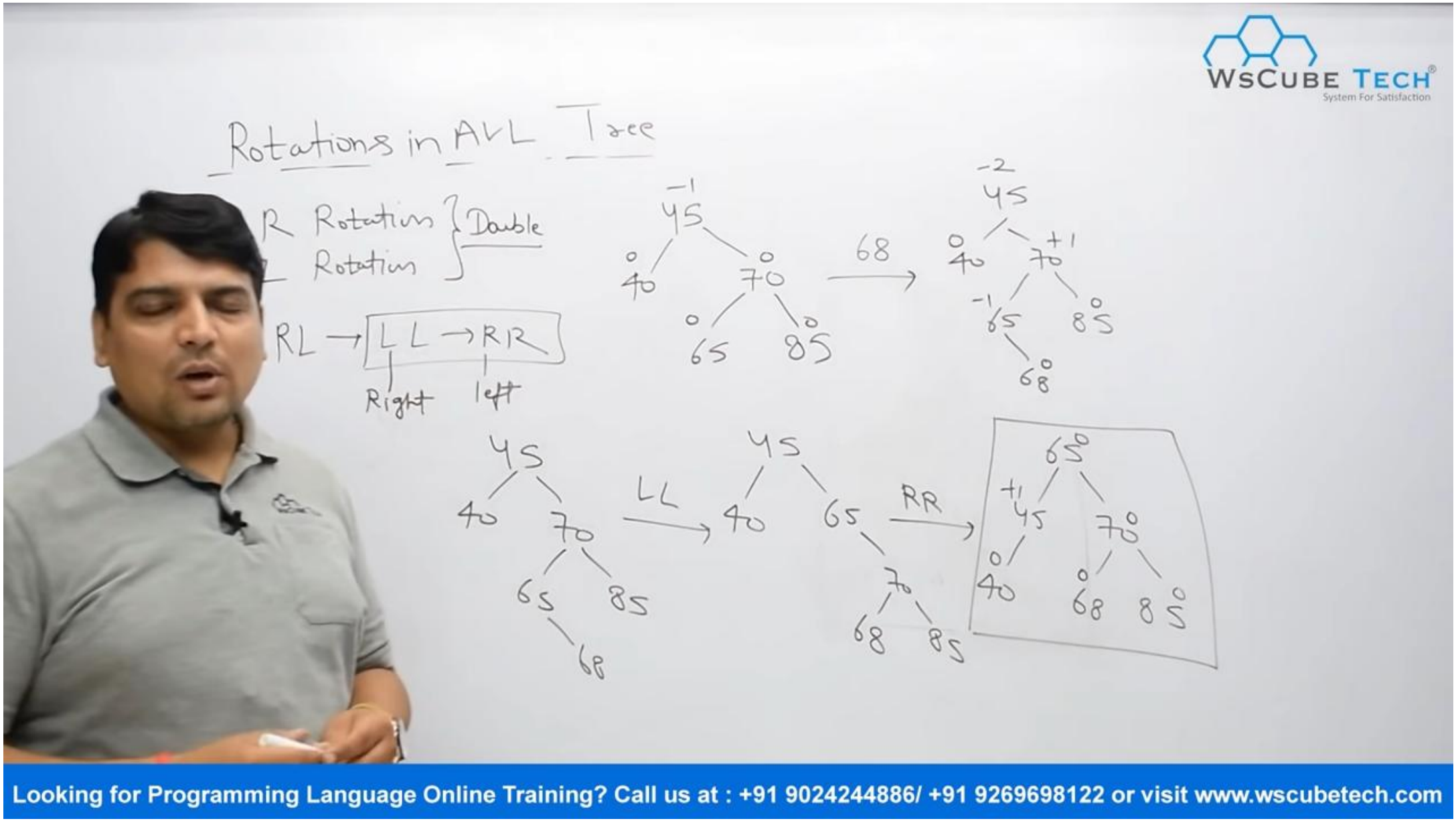
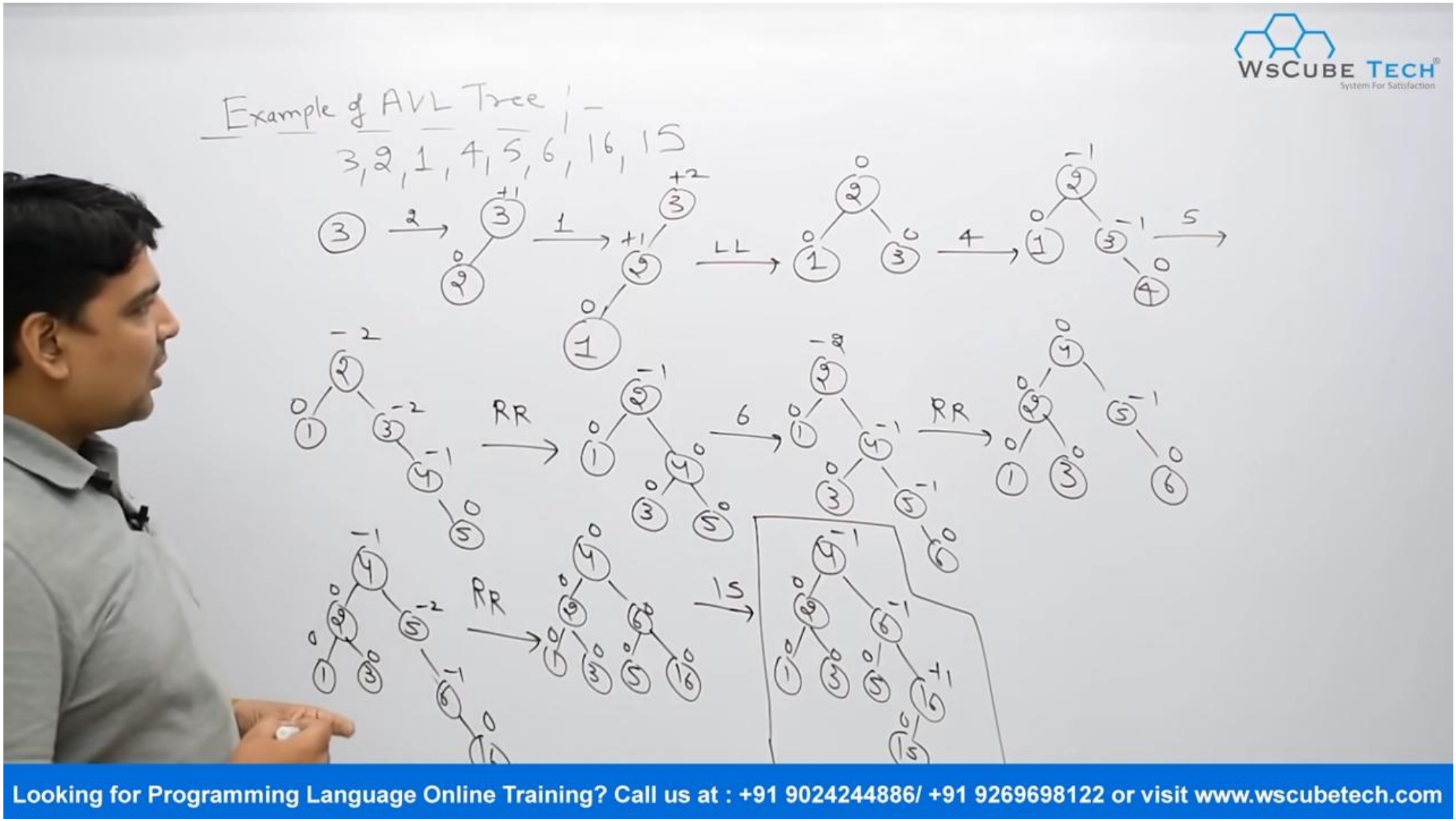


Data Structure & Algorithm

AVL Tree Example

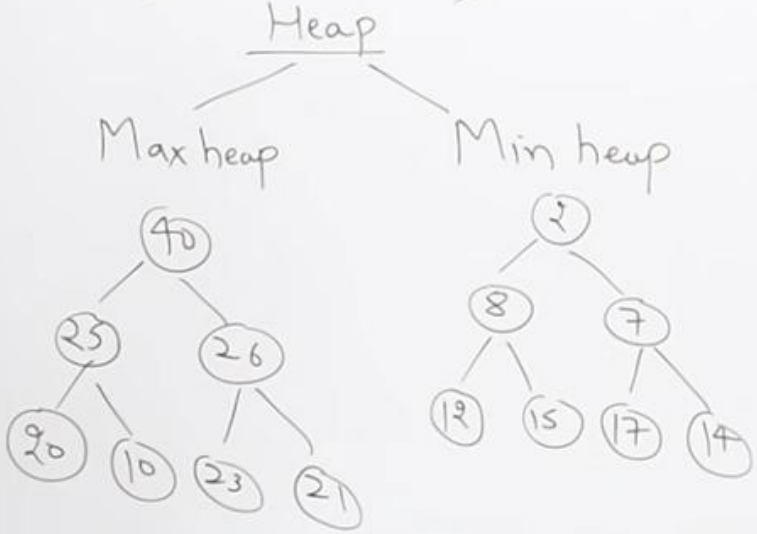


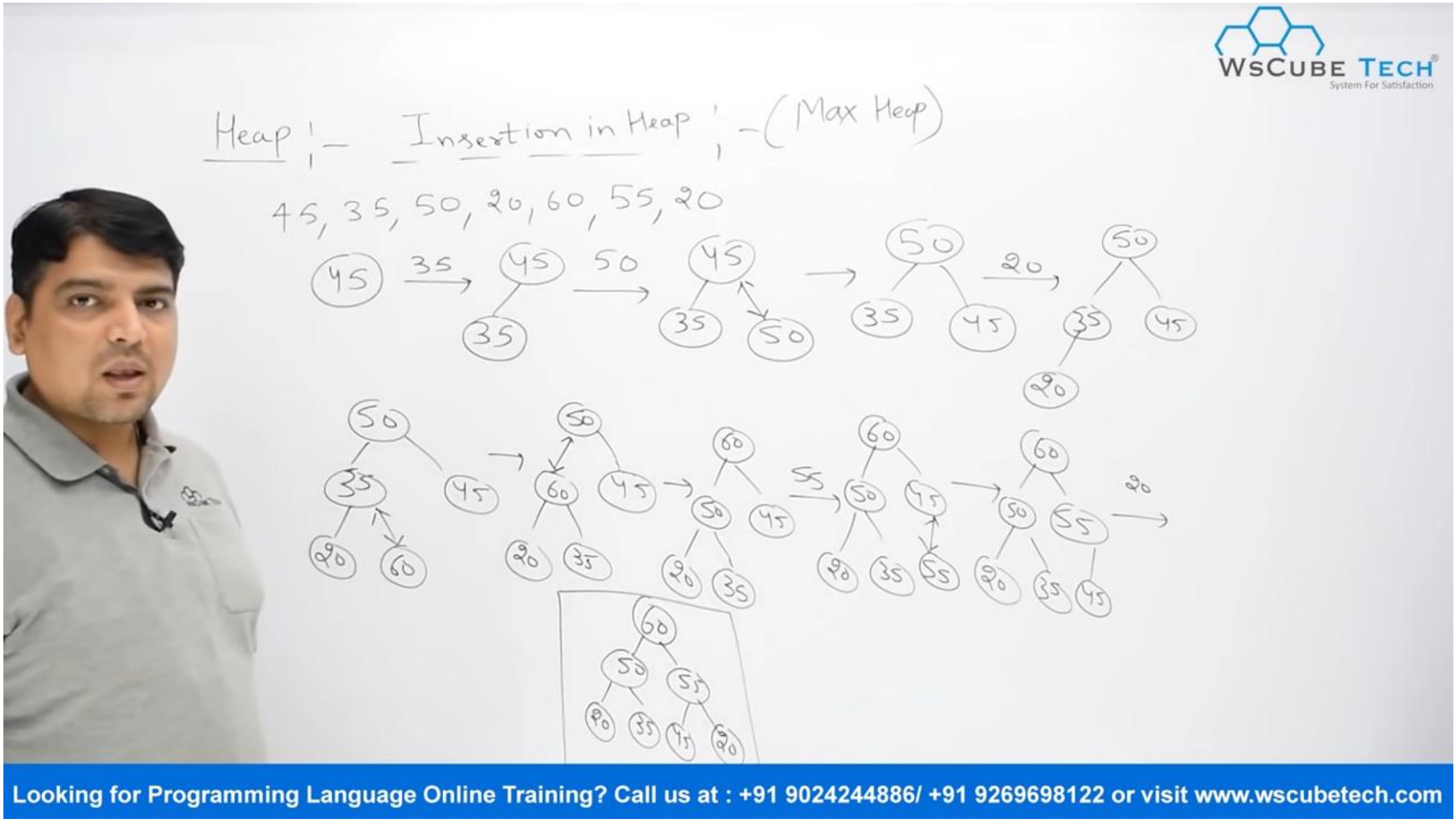
Data Structure & Algorithm

Insertion in Heap Tree

Heap :- It is a Complete Binary Tree

→ The value at Node N is greather than or equal to the value at each of the children of N (Max Heap)

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Heap :- Insertion in Heap :- (Max Heap)
45, 35, 50, 20, 60, 55, 20
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Data Structure & Algorithm

Deletion in Heap Tree

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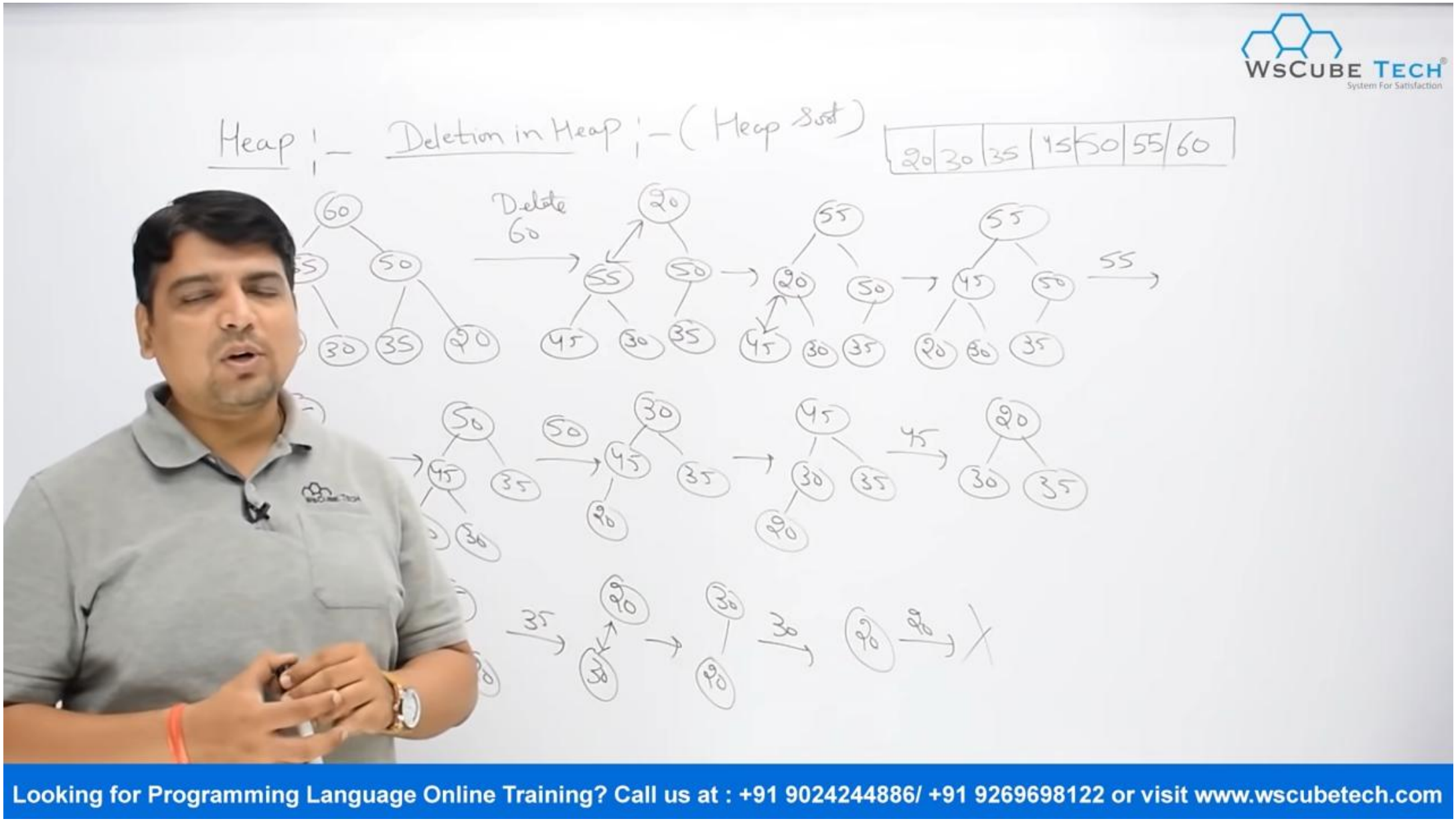
Heap :- Deletion in Heap :-

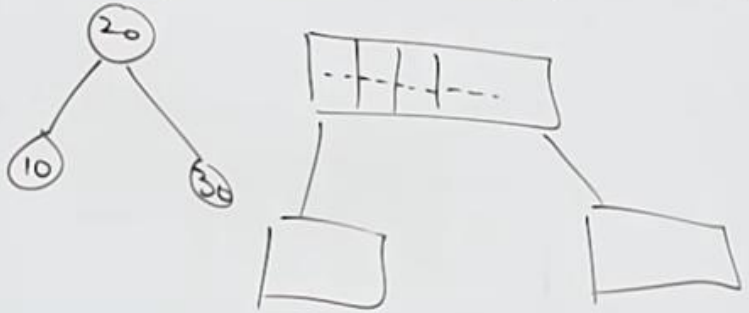


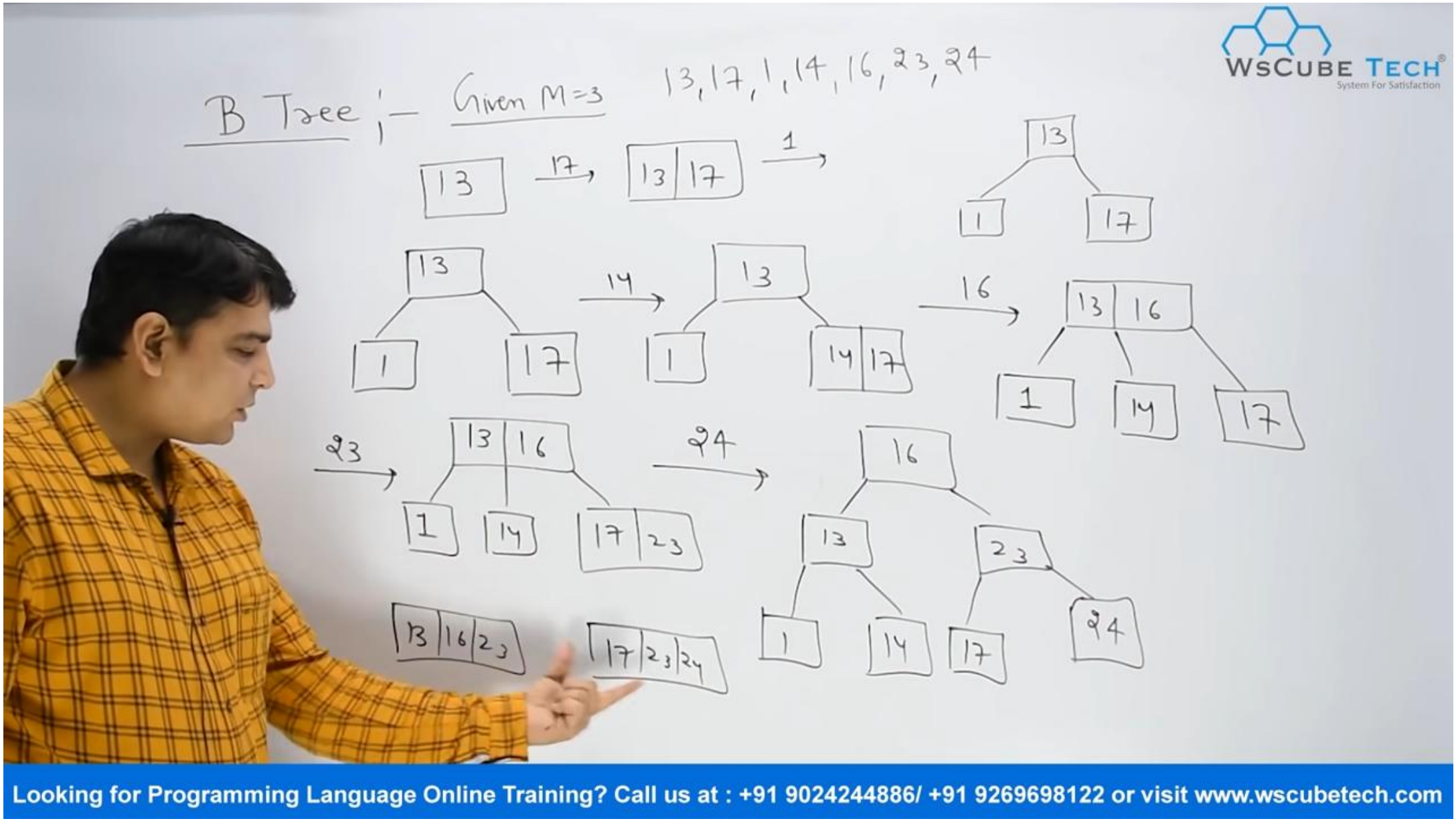
Data Structure & Algorithm

B Tree Insertion

B Tree :- B-Tree is a self-balanced Search Tree in which every node contains multiple keys (values) and has more than two children. (M-order)

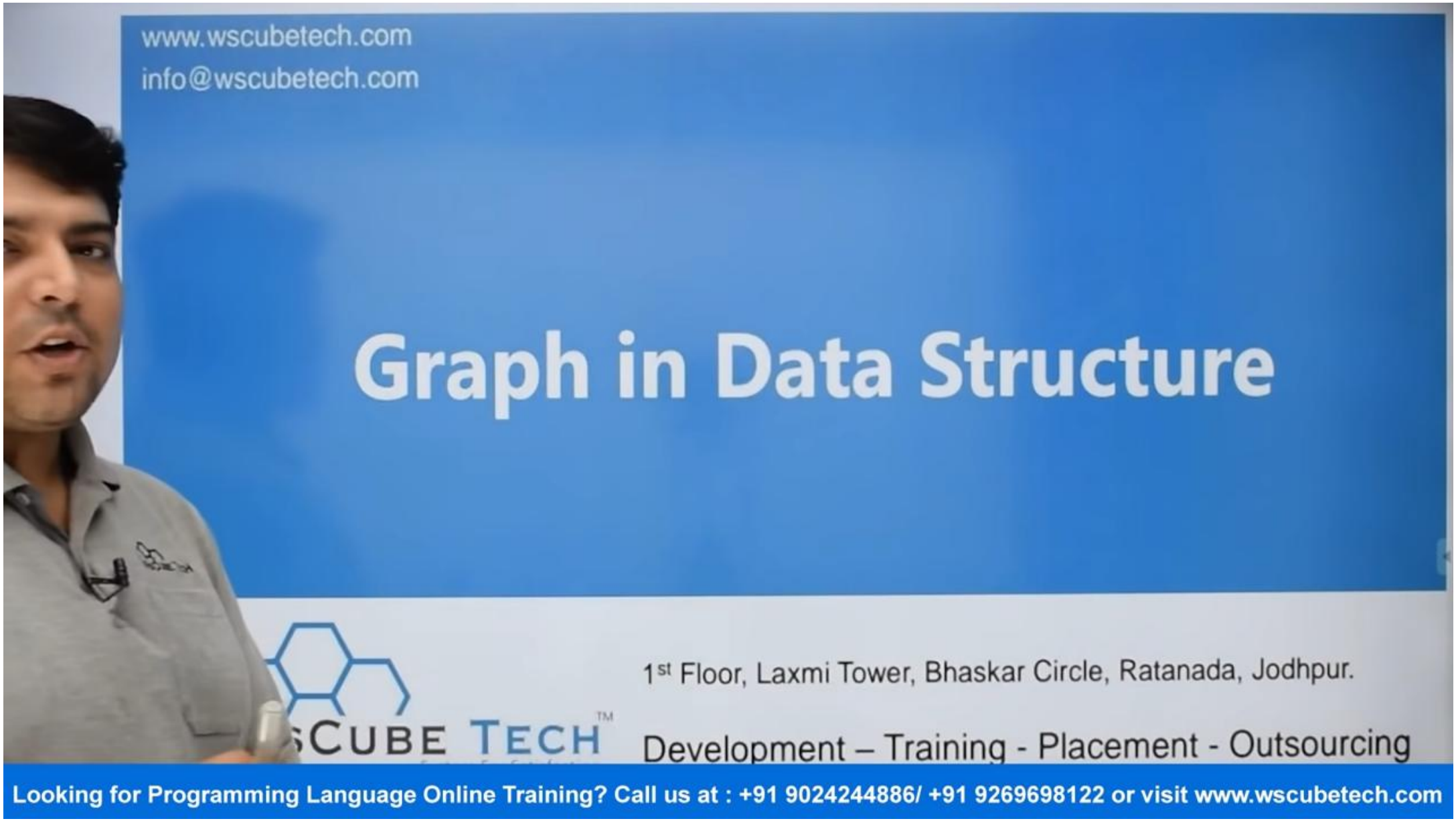
- → All Nodes (leaf) are at same level.
- → All nodes except root node have at least $\lceil m/2 \rceil - 1$ keys and max. m-1 keys.
- → No Node Contain more than (M-1) values
- → Keys are arranged in defined order within the Nodes.

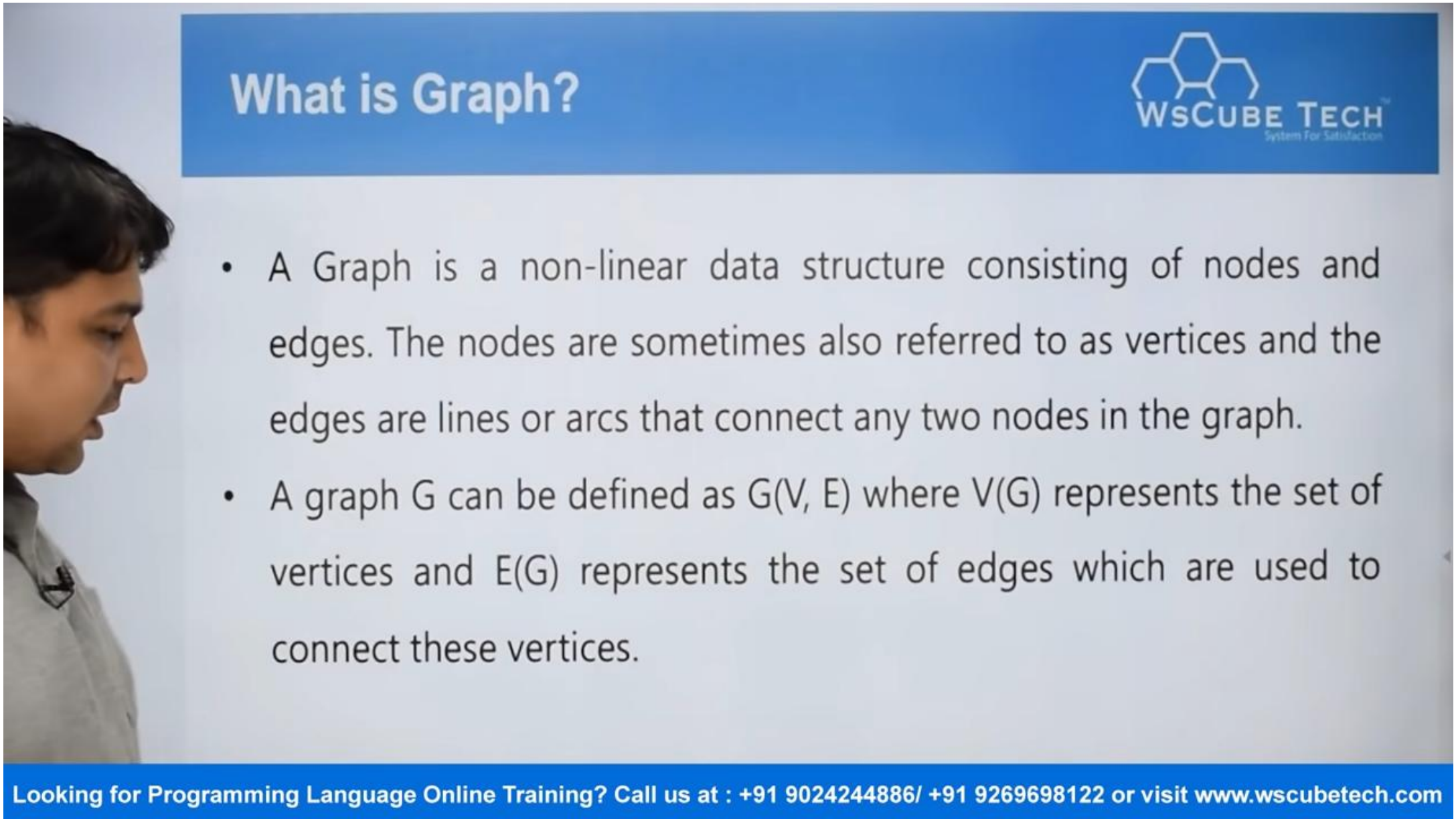


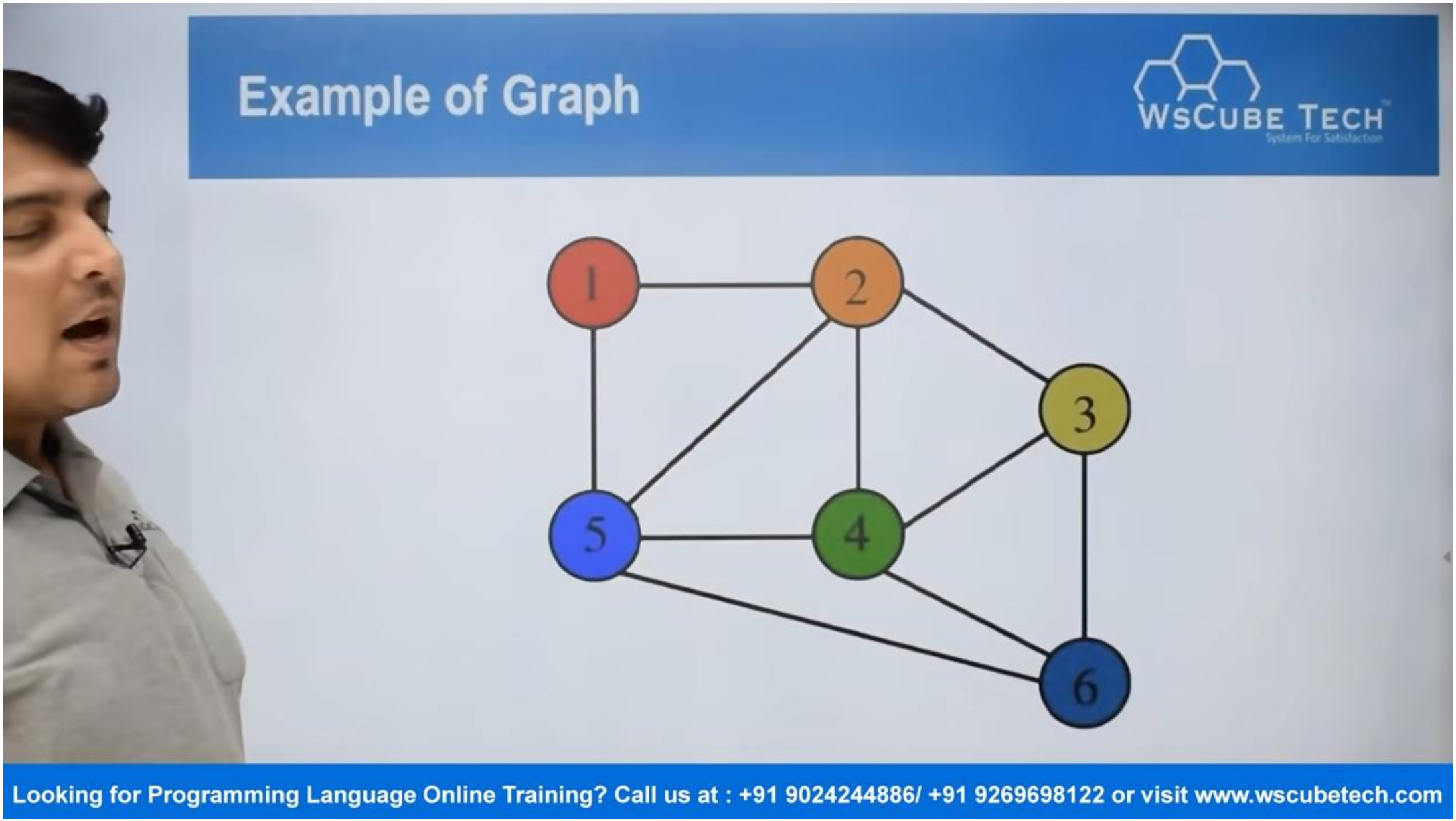


Data Structure & Algorithm

Introduction to Graph






Example of Graph
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1
2
3
4
5
6
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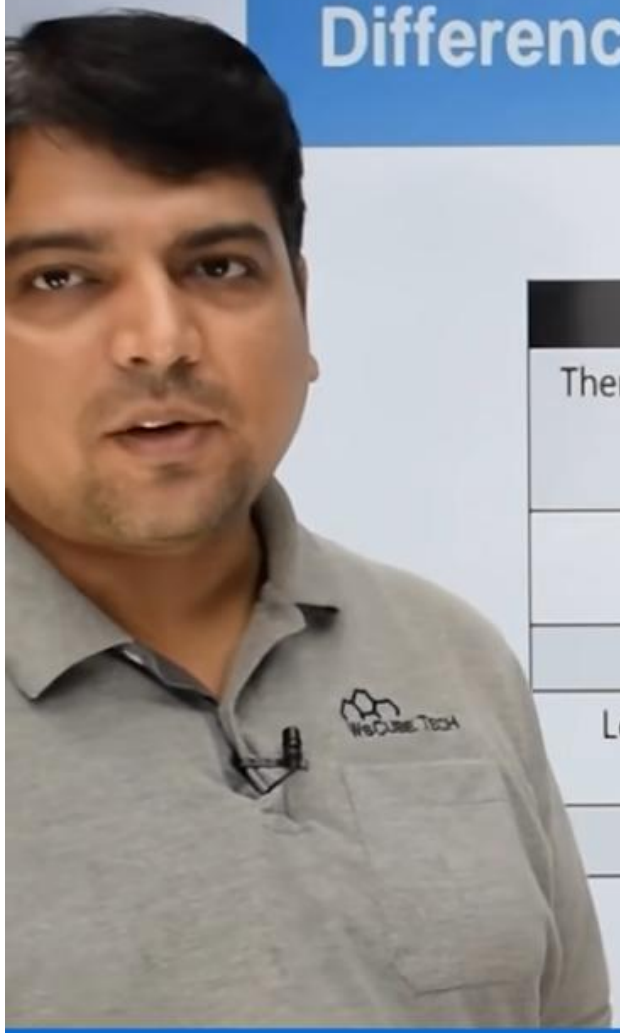
Difference between Tree and Graph



TREE	GRPAH
There is a unique node called root in trees.	All nodes called as root in graph.
There will not be any cycle.	A cycle can be formed.
All trees are graphs.	all graphs are not trees.
Less in complexity compared to graphs.	High complexity than trees due to loops.
Hierarchical	Network

Graph Terminology

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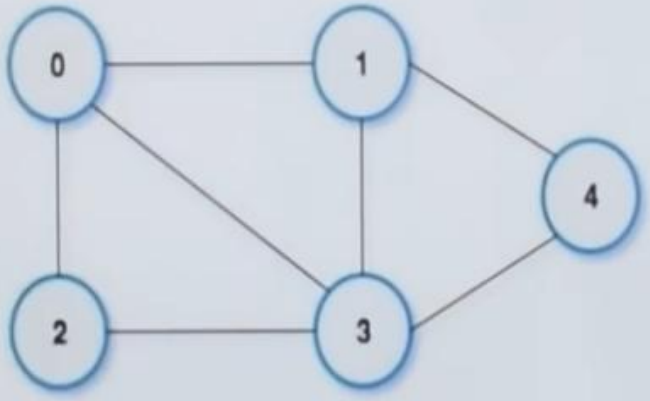
- **Undirected Graph:** A graph with only undirected edges is said to be undirected graph.
- **Directed Graph:** A graph with only directed edges is said to be directed graph.



Graph Terminology

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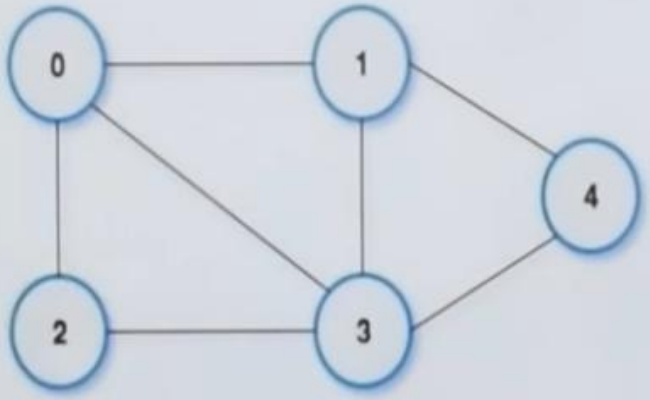

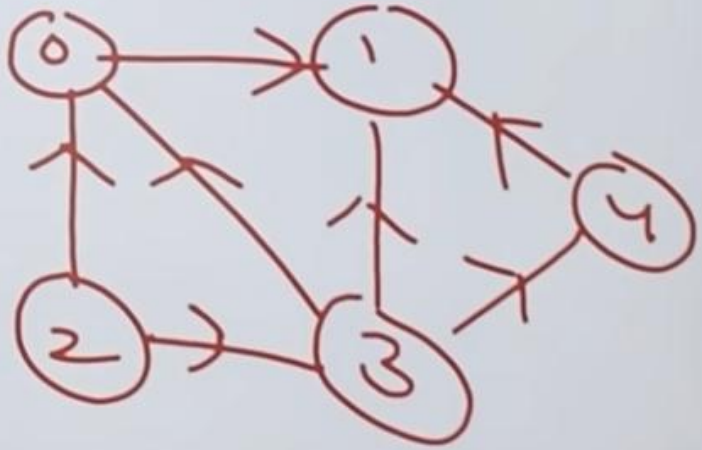

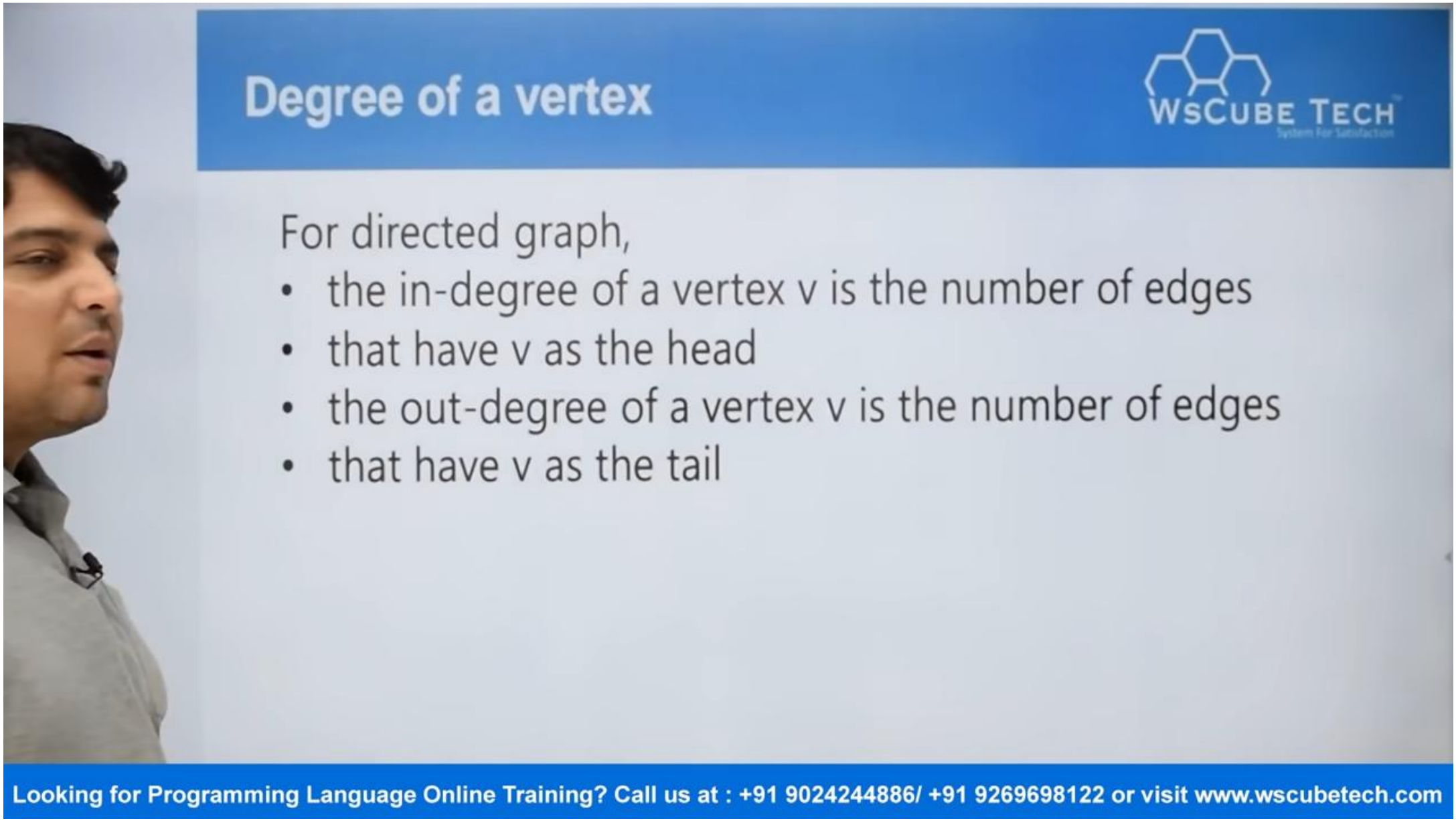

Degree of a vertex

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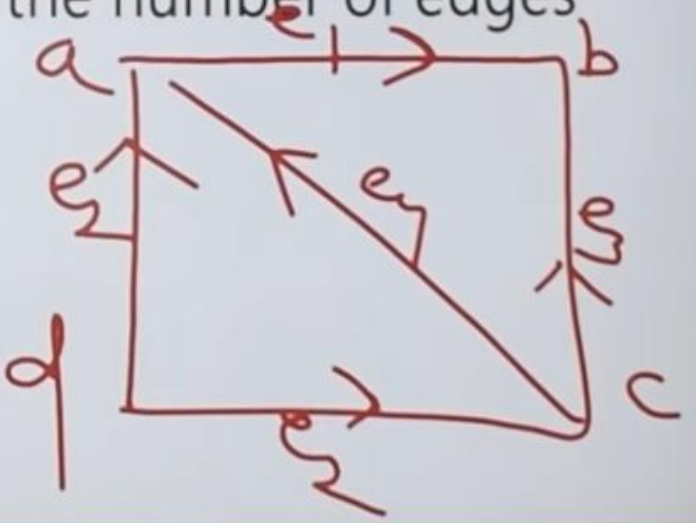
For directed graph,

- the in-degree of a vertex v is the number of edges
- that have v as the head
- the out-degree of a vertex v is the number of edges
- that have v as the tail

deg−(a) = 2

deg+(a) = 1



Simple Graph

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A graph with no loops and no parallel edges is called a simple graph.

Cycle Graph

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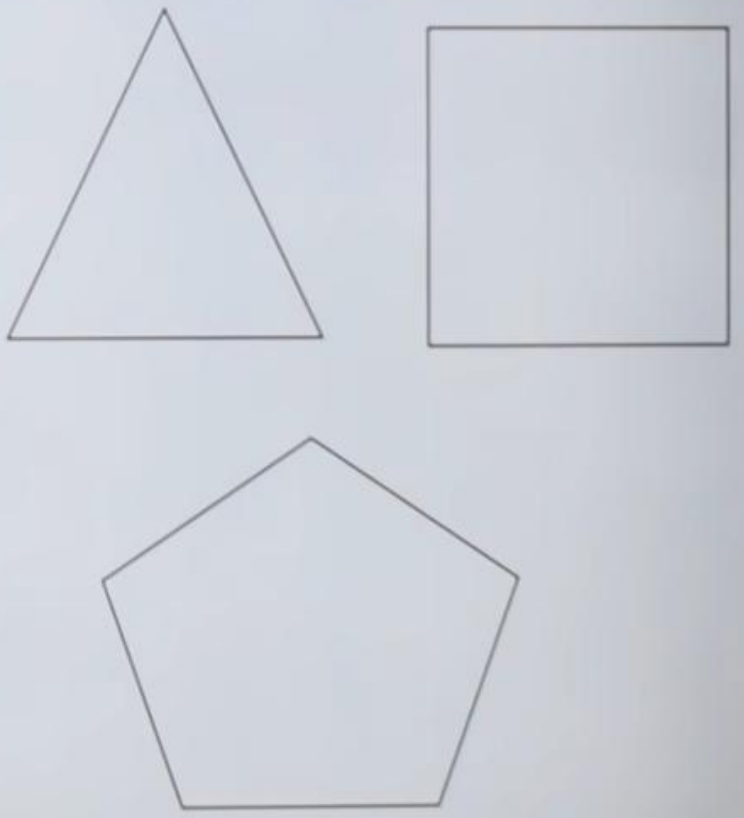
A simple graph with 'n' vertices (n >= 3) and 'n' edges is called a cycle graph if all its edges form a cycle of length 'n'.
If the degree of each vertex in the graph is two, then it is called a Cycle Graph. It is denoted by Cn.



Complete Graph

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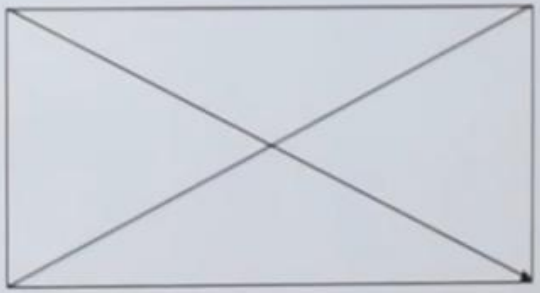
A vertex is connected to all other vertices in a graph, then it is called a complete graph.



Complete Graph

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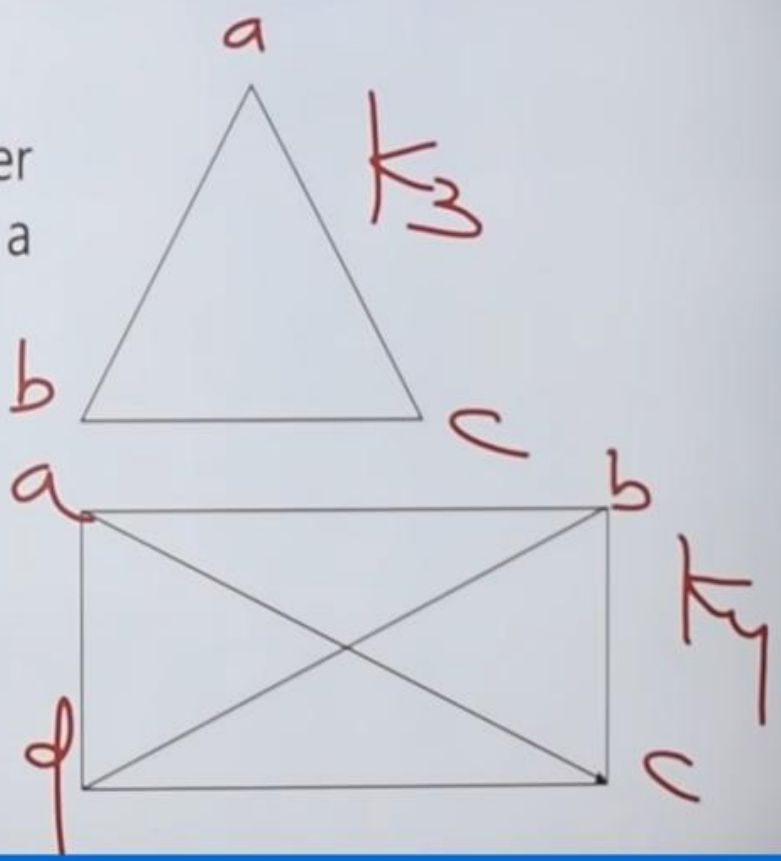
K_8 K_{10}

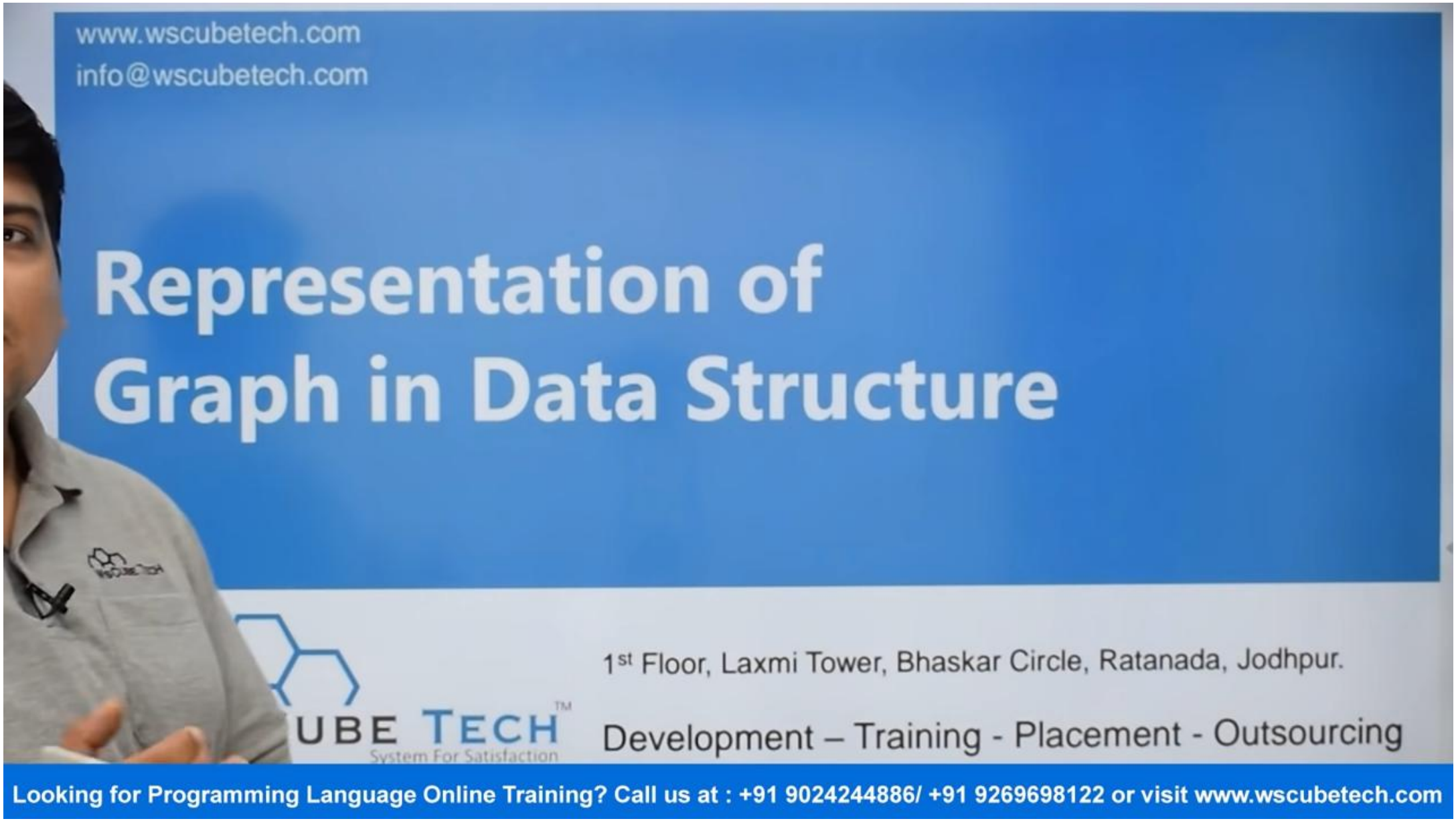
A vertex is connected to all other vertices in a graph, then it is called a complete graph.

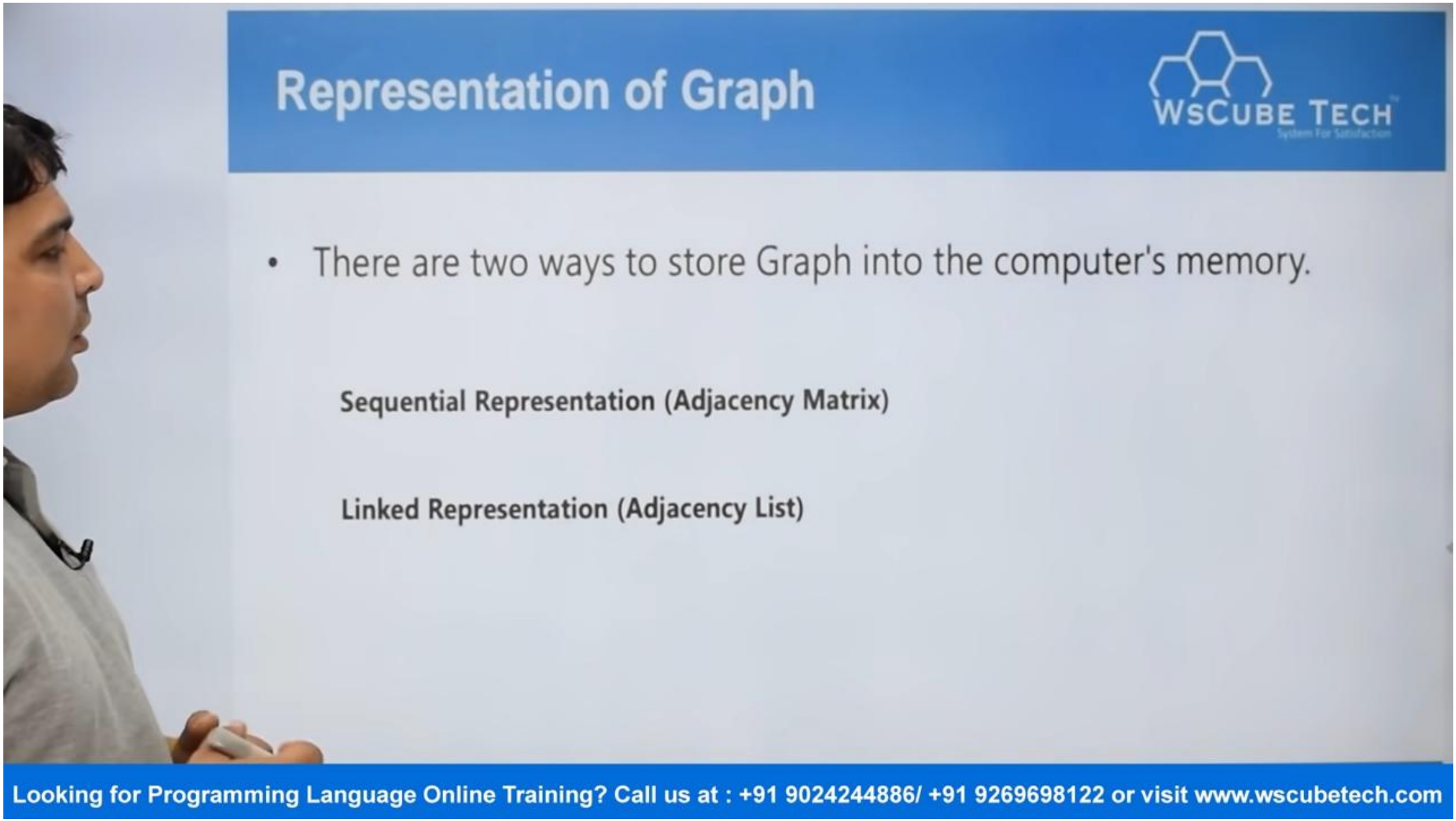
$$K_n = \frac{n(n-1)}{2}$$



Data Structure & Algorithm

Representation of Graph





Sequential Representation

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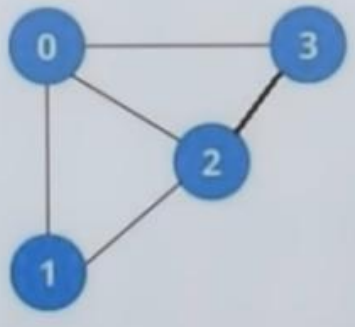
An adjacency matrix is 2D array of V x V vertices. Each row and column represent a vertex. If the value of any element a[i][j] is 1, it represents that there is an edge connecting vertex i and vertex j.



	0	1	2	3
0	0	1	1	1
1	1	0	1	0
2	1	1	0	1
3	1	0	1	0

Sequential Representation

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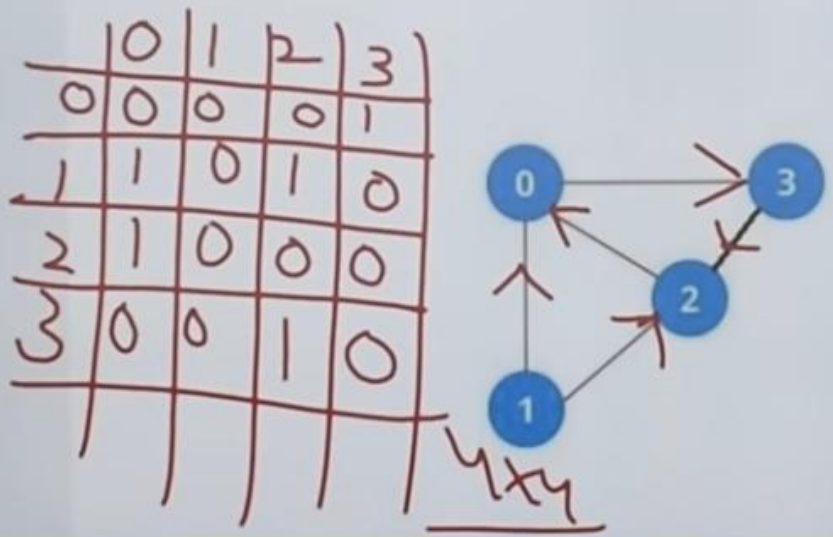
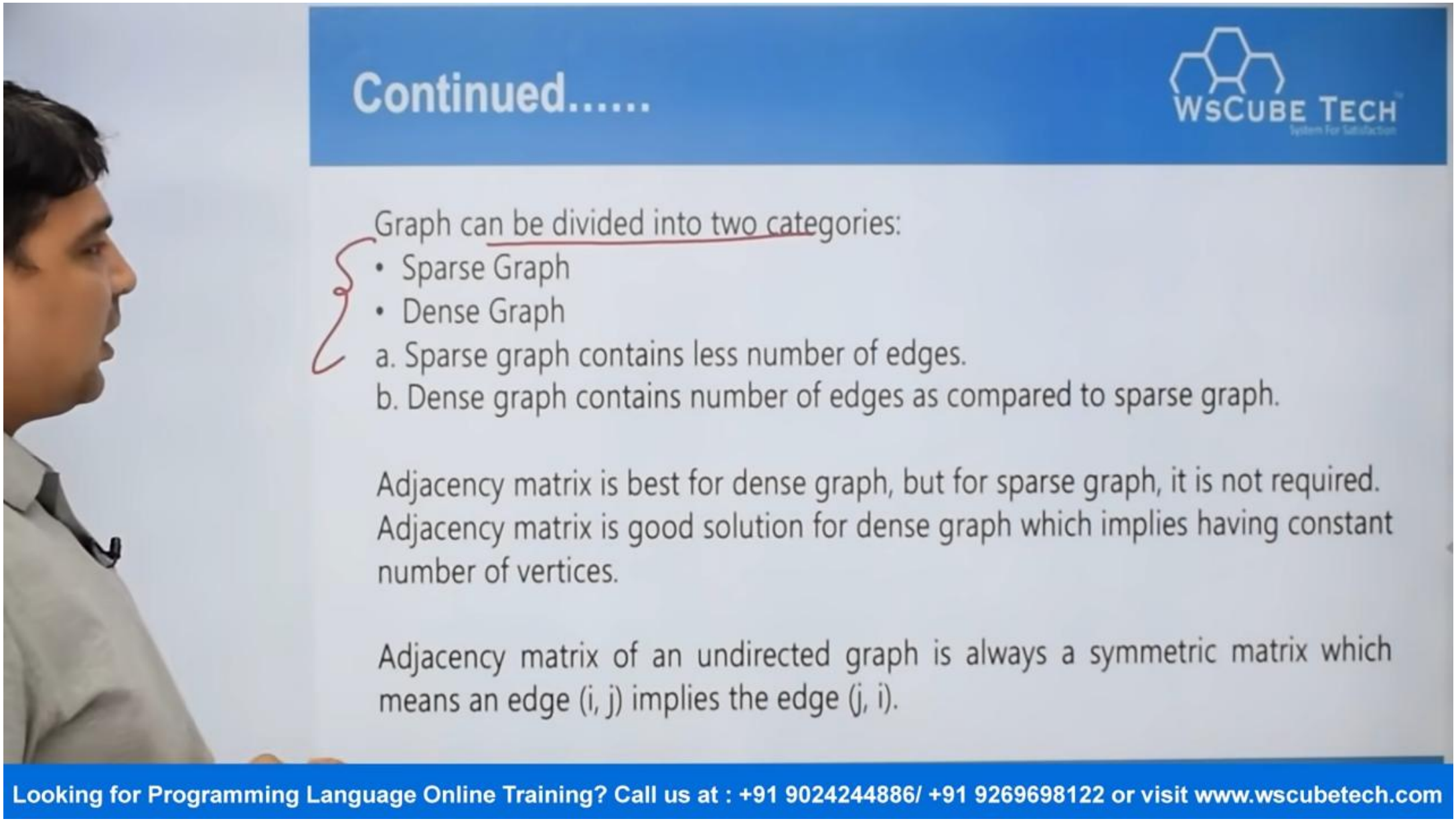
An adjacency matrix is 2D array of V x V vertices. Each row and column represent a vertex. If the value of any element a[i][j] is 1, it represents that there is an edge connecting vertex i and vertex j.



	0	1	2	3
0	0	1	1	1
1	1	0	1	0
2	1	1	0	1
3	1	0	1	0



Linked Representation

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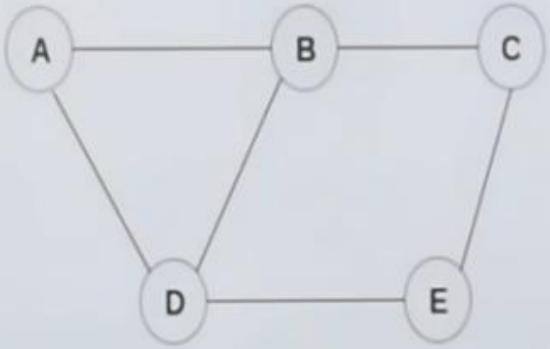
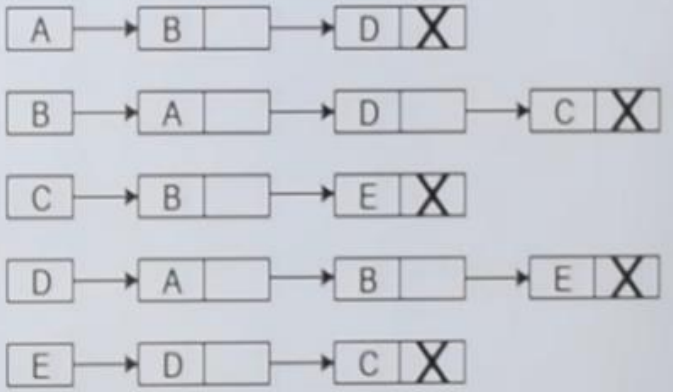
An adjacency list is maintained for each node present in the graph which stores the node value and a pointer to the next adjacent node to the respective node.



Undirected Graph



Adjacency List

Continued.....

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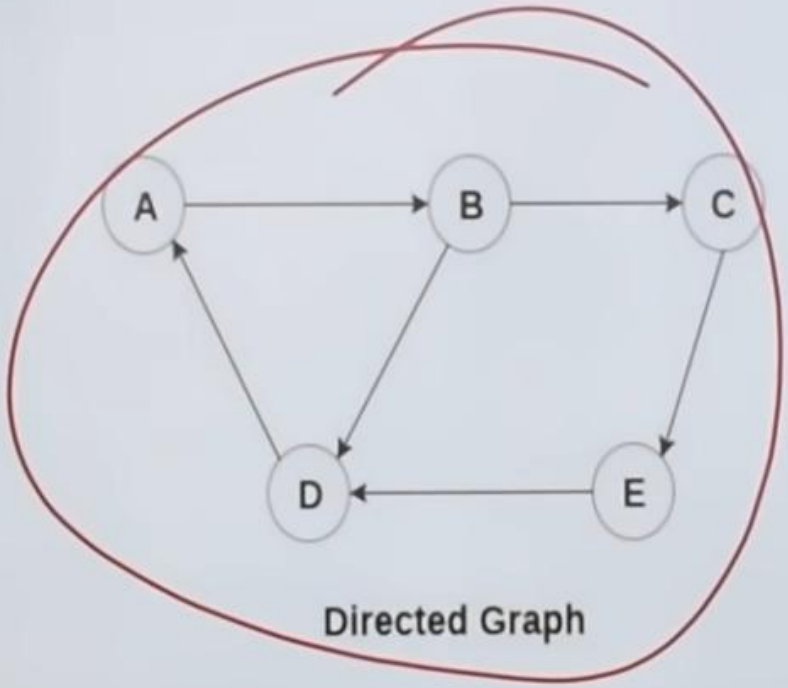
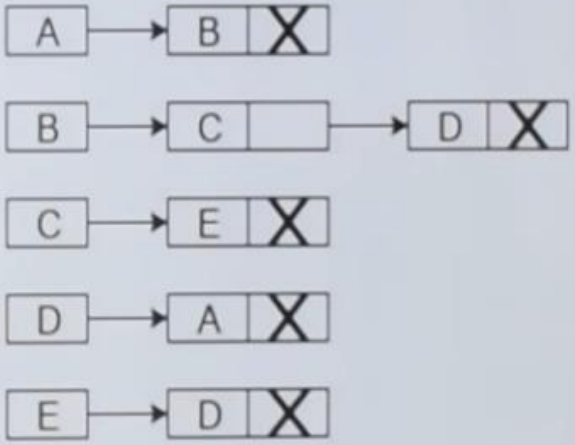


Directed Graph



Adjacency List

Continued.....

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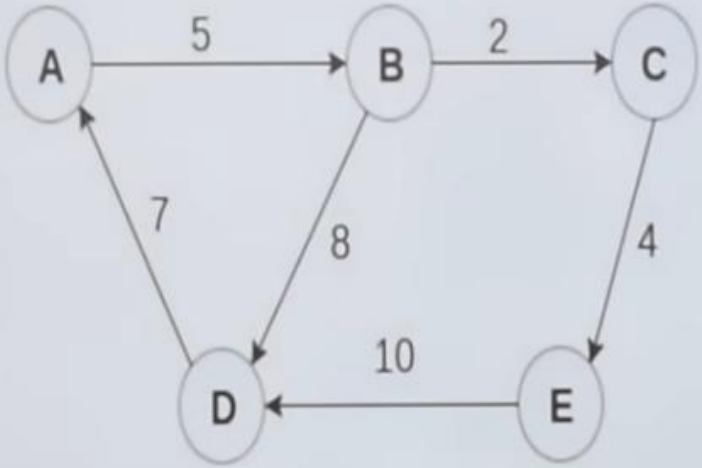
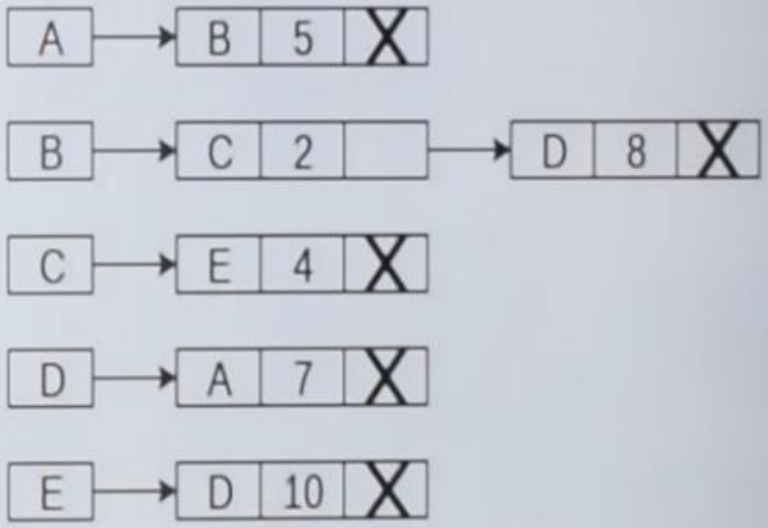


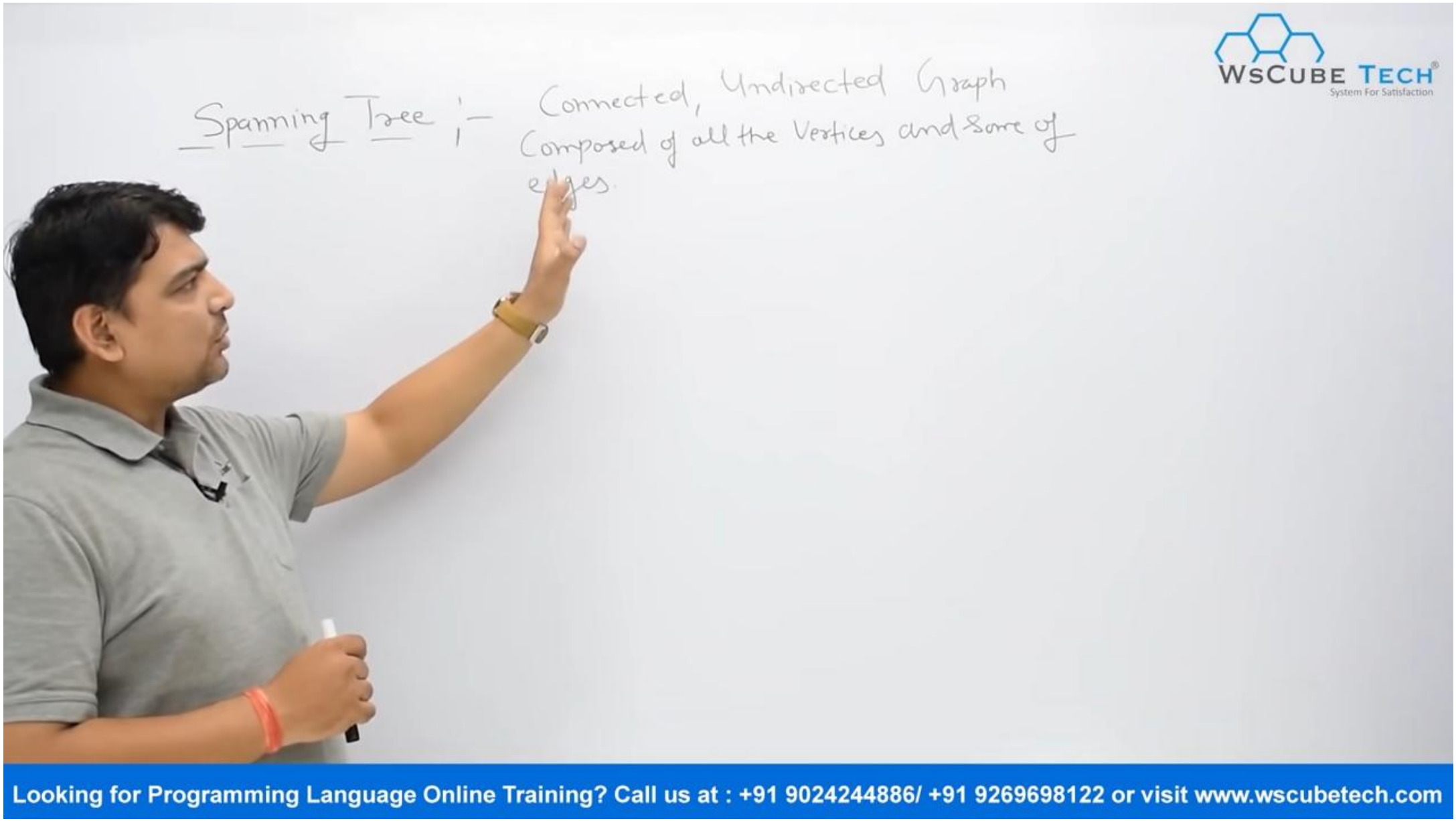
Weighted Directed Graph



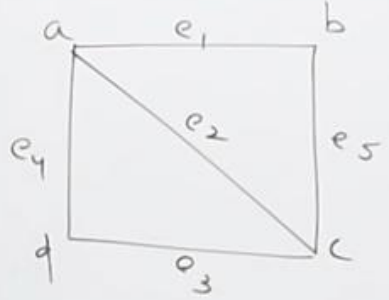
Adjacency List

Data Structure & Algorithm

Spanning Tree

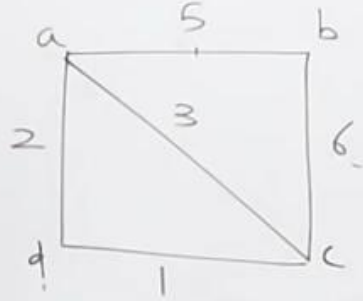


Spanning Tree :- Connected, Undirected Graph Composed of all the Vertices and Some of edges.



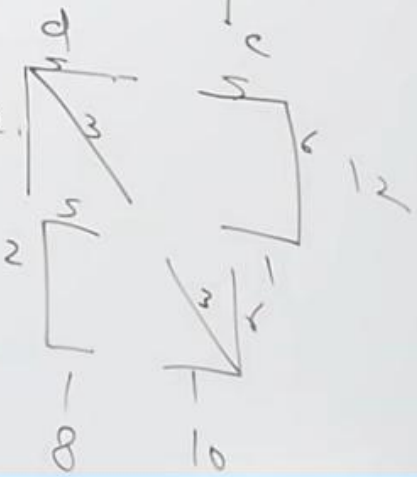
for n vertices, to construct the Spanning Tree, we Required n vertices and (n-1) edges

Spanning Tree :- Connected, Undirected Graph Composed of all the Vertices and Some of edges.



n = 4 | (n-1) = (3)

for n vertices, to constitute the Spanning Tree, we Required 102.
n vertices and (n-1) edges
No loop or cycle Exist.



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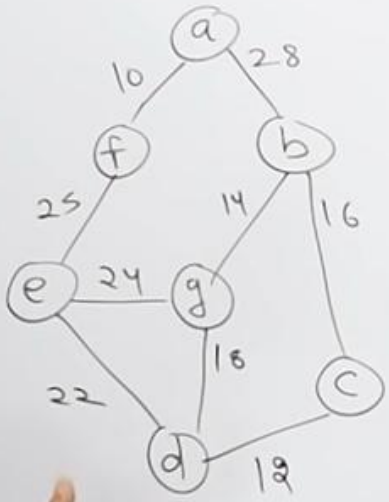
Spanning Tree :- Kruskal's Algorithms



10	12	14	16	18	22	24	25	28
(a,f)	(c,d)	(b,g)	(b,c)	(d,g)	(d,e)	(e,g)	(e,f)	(a,b)

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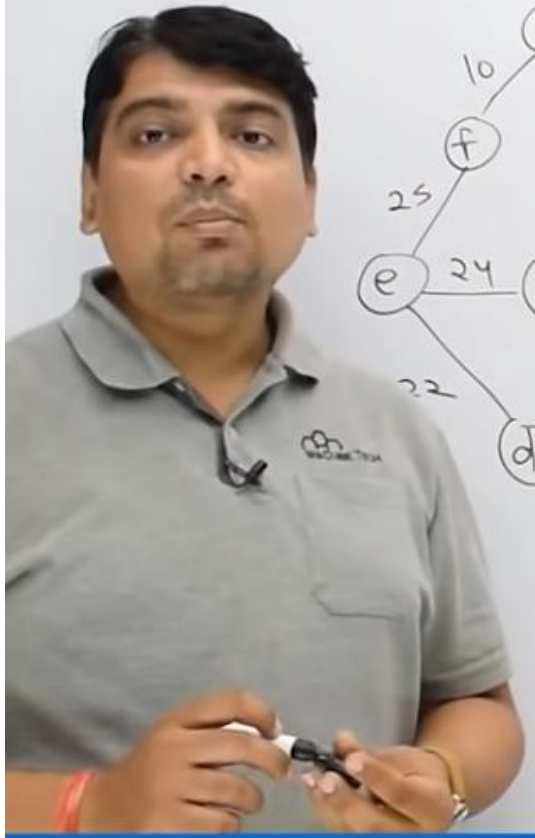
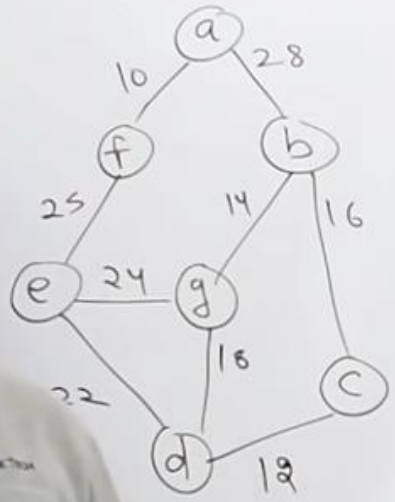
Spanning Tree :- Kruskal's Algorithms

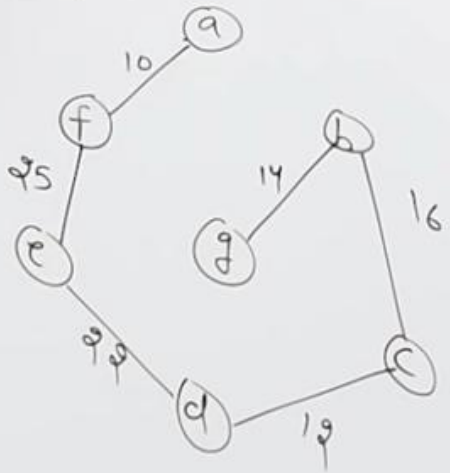




n = 7

(n-1) = 6

✓	✓	✓	✓	X	✓	X	✓	
10	12	14	16	18	22	24	25	28
(a,f)	(c,d)	(b,g)	(b,c)	(d,g)	(d,e)	(e,g)	(e,f)	(a,b)



Data Structure & Algorithm

Prim's Algorithm

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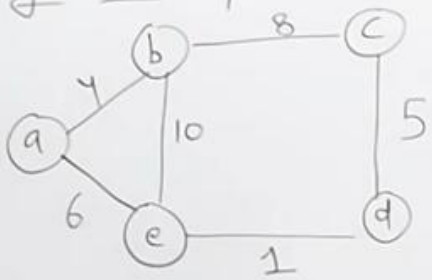
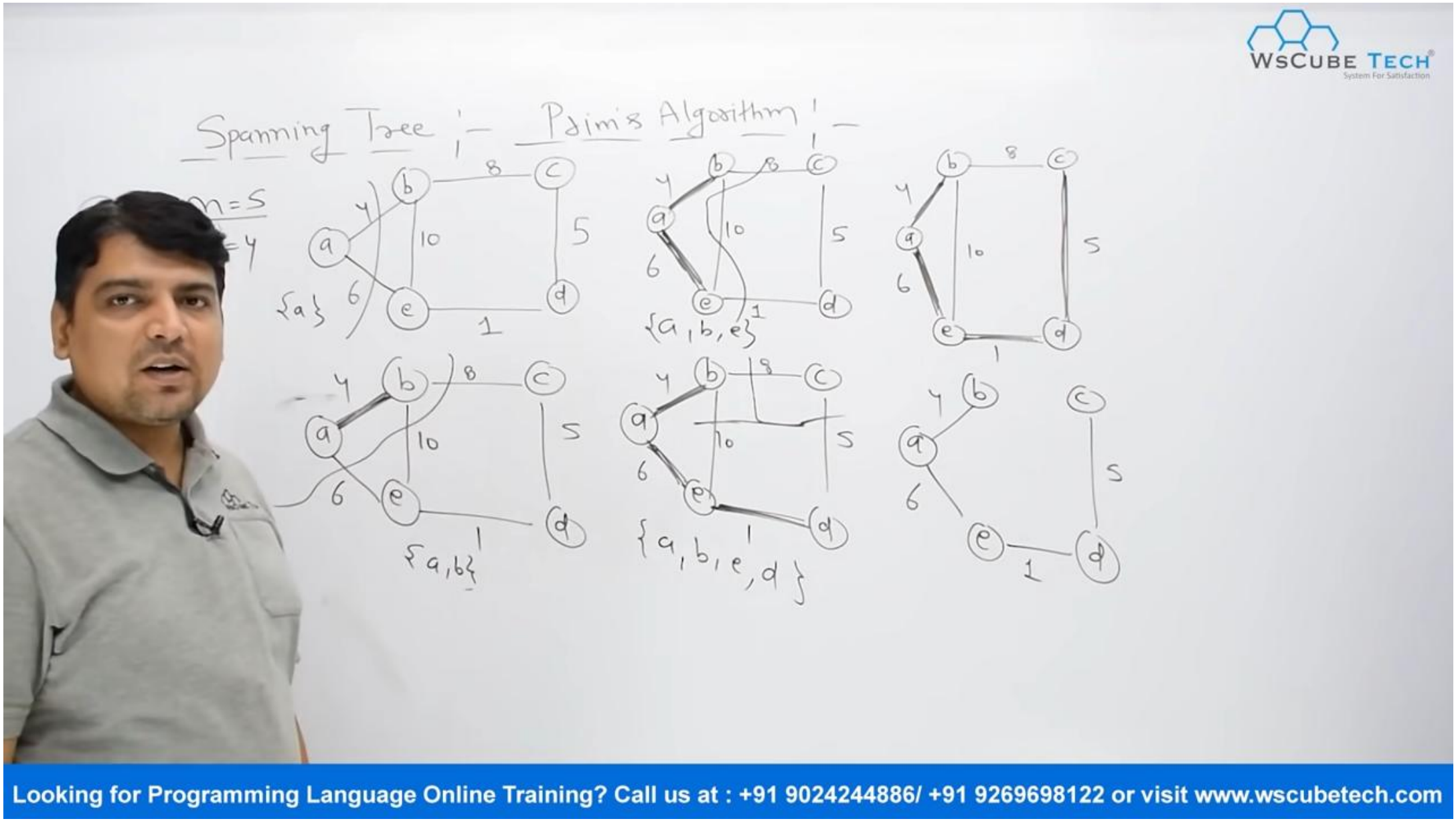
Spanning Tree :- Prim's Algorithm :-

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Spanning Tree :- Prim's Algorithm :-
{a}
{a, b, e}
{a, b}
{a, b, e, d}
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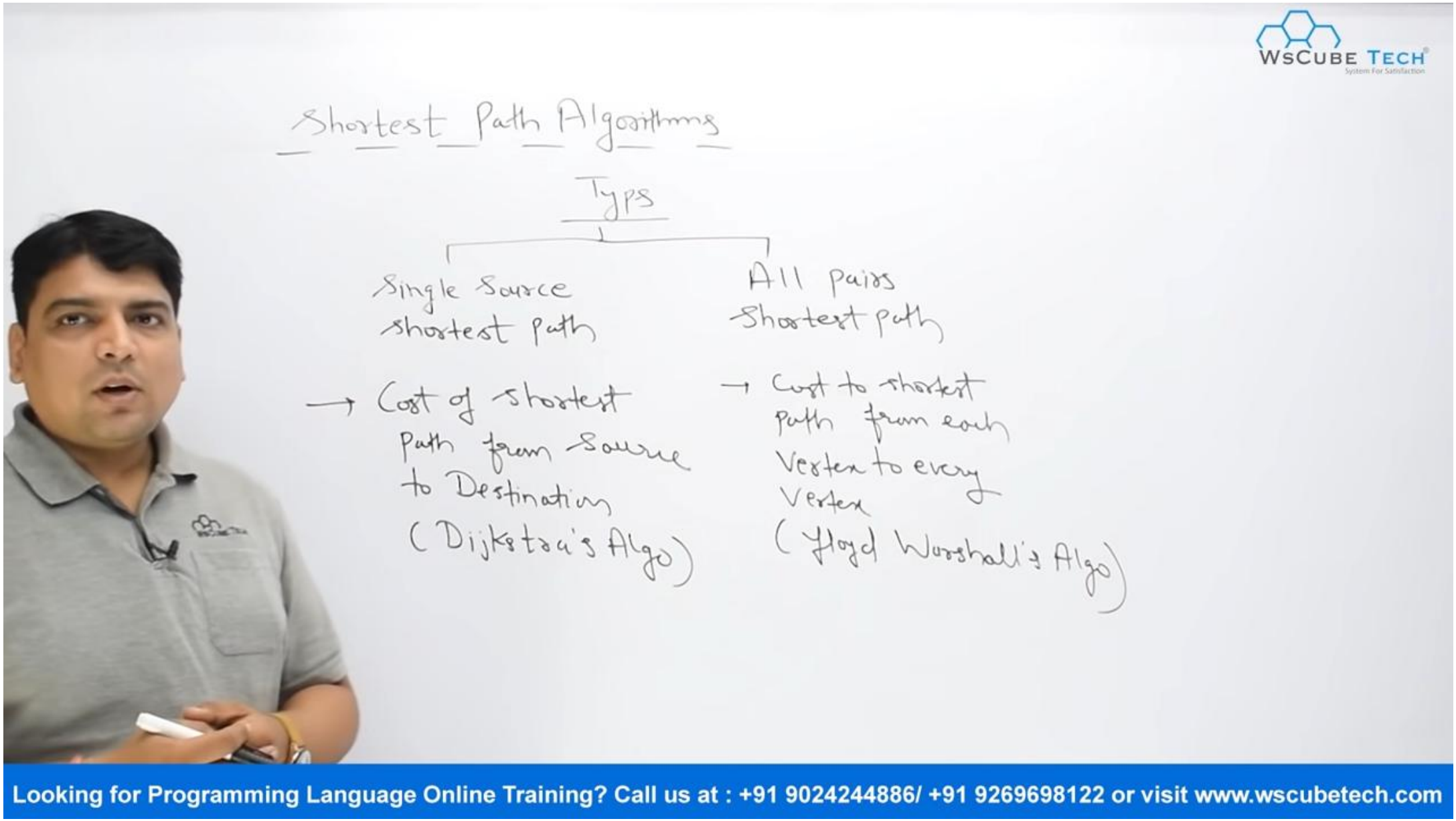
Data Structure & Algorithm

Shortest Path Algorithms in DSA



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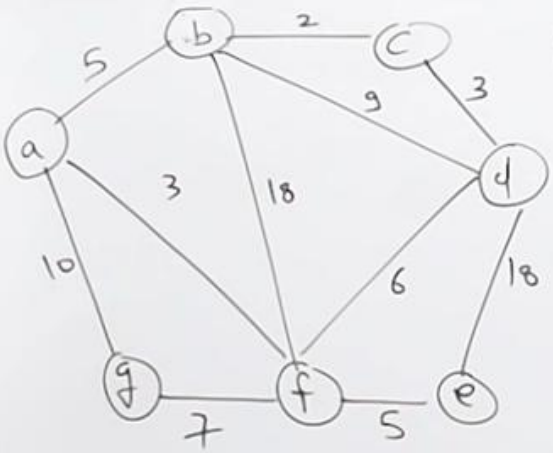
Single Source Shortest Path Algorithm !—(Dijkstra's)



	a	b	c	d	e	f	g
{a}	0	∞	∞	∞	∞	∞	∞

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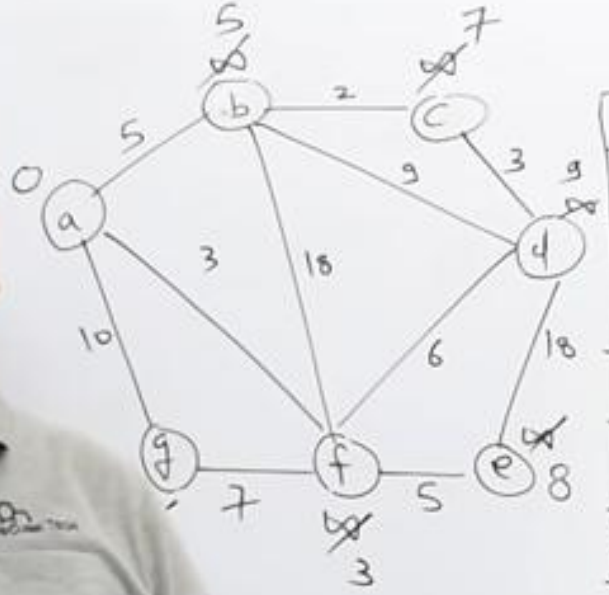
Single Source Shortest Path Algorithm !—(Dijkstra's)



	a	b	c	d	e	f	g
{a}	0	∞	∞	∞	∞	∞	∞
{a,f}	0	5	∞	∞	∞	3	10
{a,f,b}	0	5	∞	9	8	3	10
{a,f,b,c}	0	5	7	9	8	3	10
{a,f,b,c,e}	0	5	7	9	8	3	10
{a,f,b,c,e,d}	0	5	7	9	8	3	10
{a,f,b,c,e,d,g}	0	5	7	9	8	3	10
	0	5	7	9	8	3	10

Data Structure & Algorithm

Graph Traversal Algorithm

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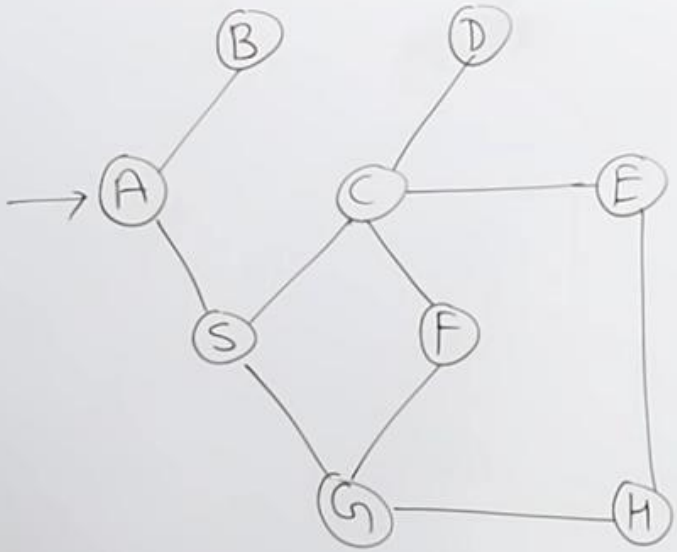
Graph Traversal Algorithms :- Breadth First Search (BFS)



Queue

Output

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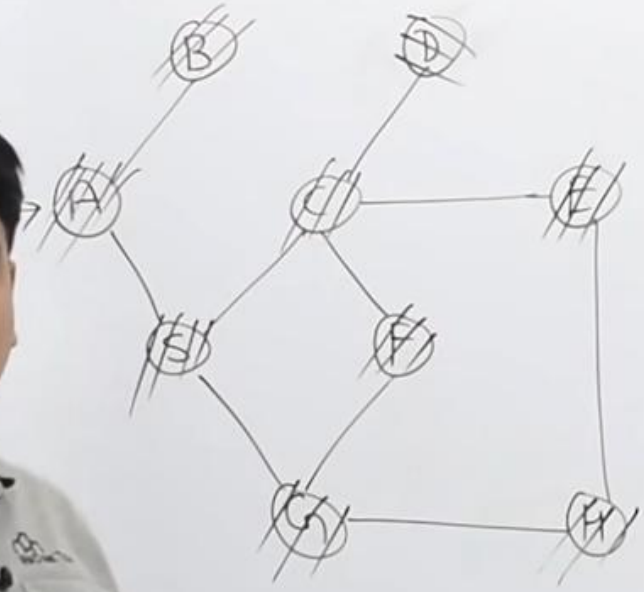
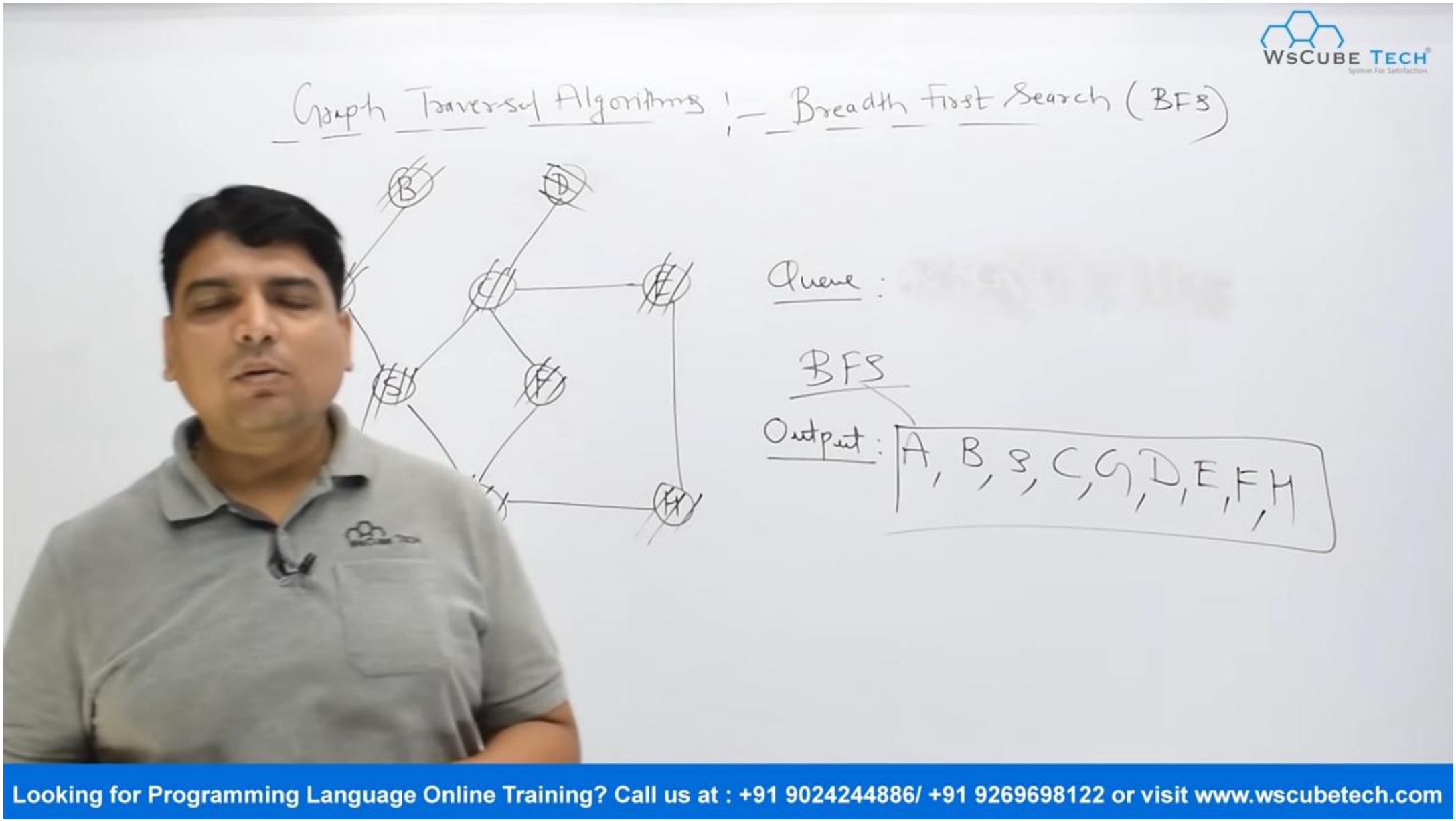
Graph Traversal Algorithms :- Breadth First Search (BFS)



Queue :

Output : A, B, S, C, G, D, E, F, H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Graph Traversal Algorithms :- Breadth First Search (BFS)
Queue :
BFS
Output : A, B, S, C, G, D, E, F, H
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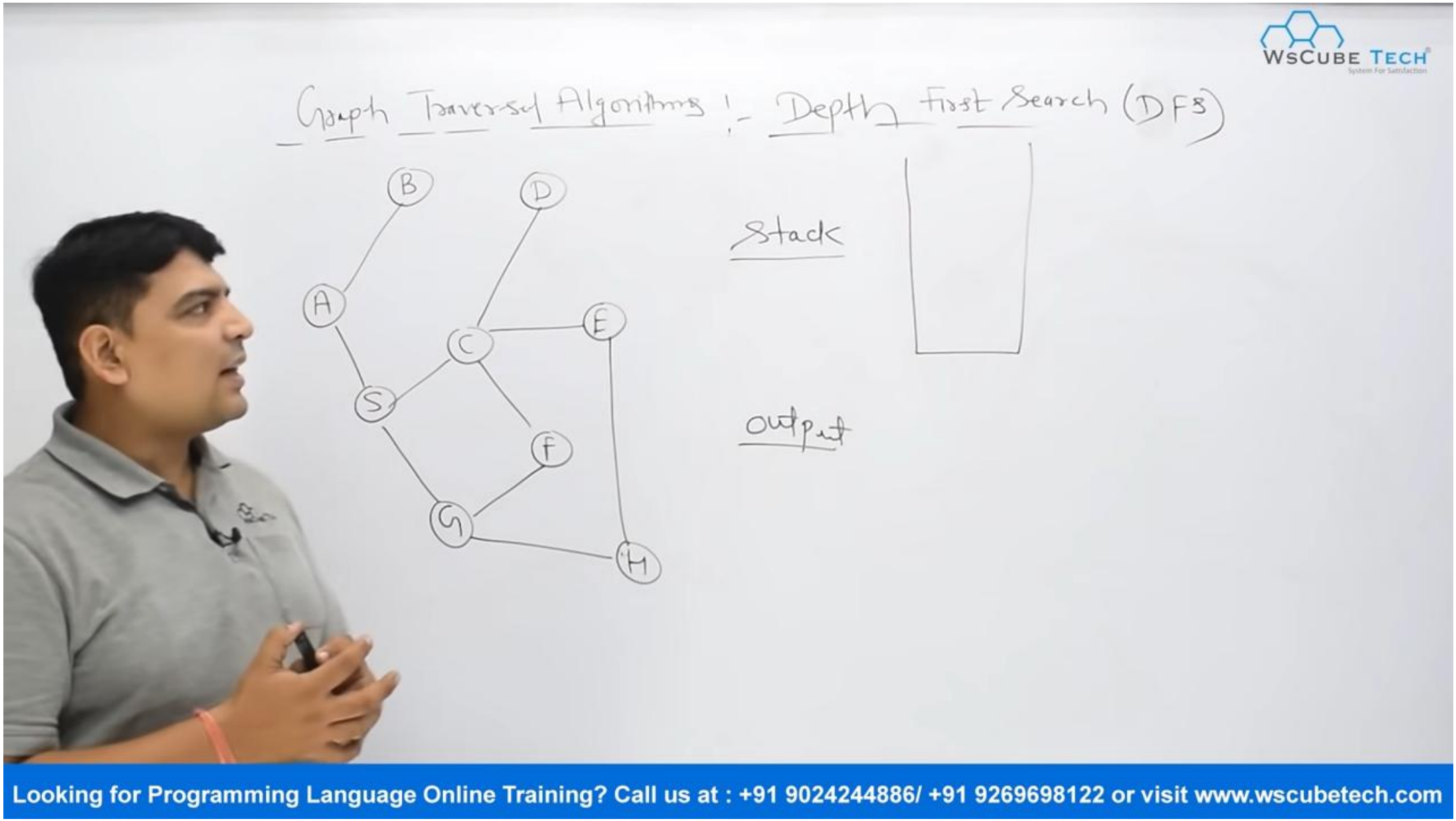
Data Structure & Algorithm

Graph Traversal - Depth Fisrt Search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System For Satisfaction
Graph Traversal Algorithms :- Depth First Search (DFS)
B
D
A
E
C
S
F
G
H
Stack
output
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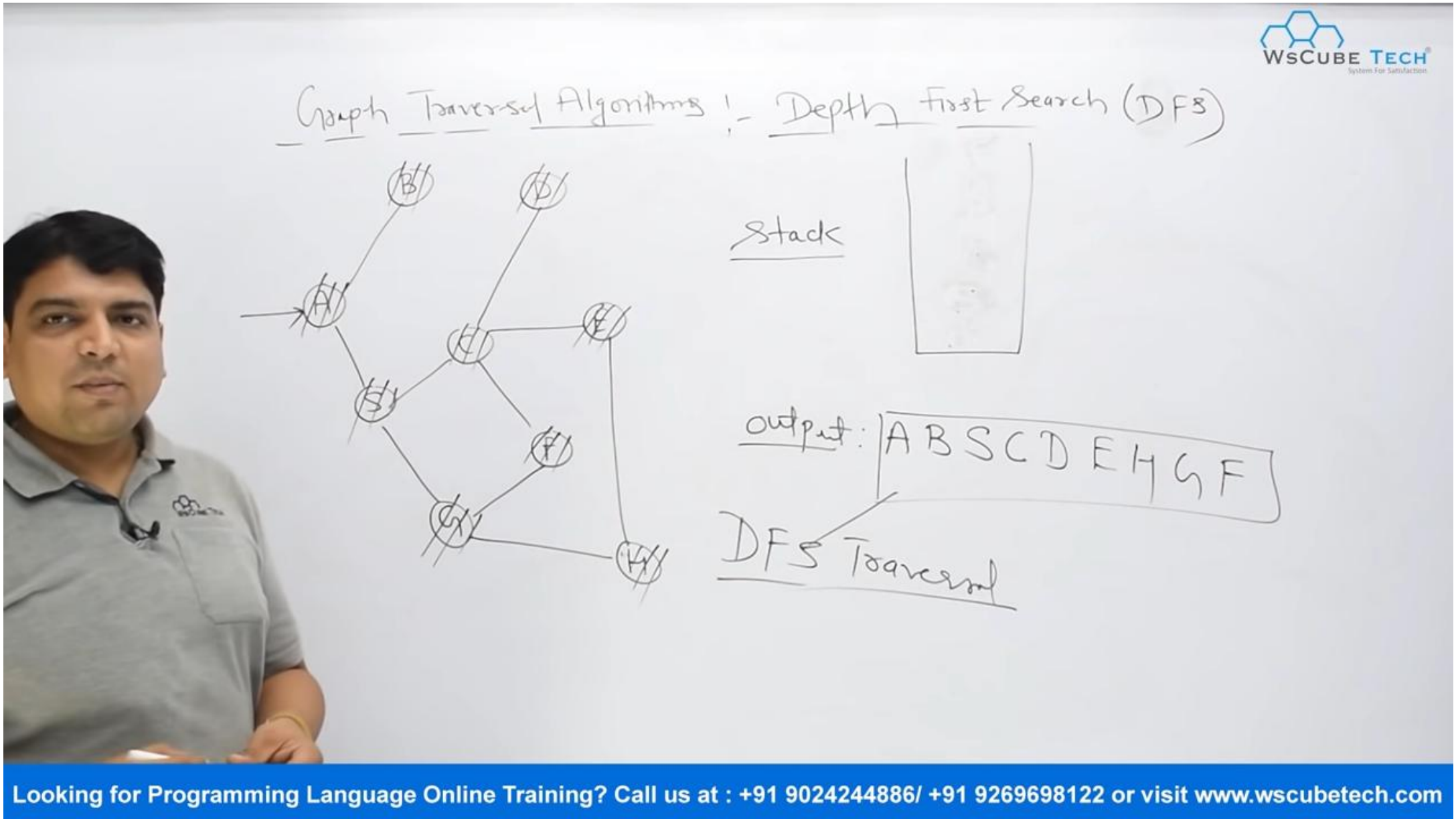
WsCube Tech
System For Satisfaction
Graph Traversal Algorithms :- Depth First Search (DFS)
Stack
output : A B S C D E H G F
DFS Traversal
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