DATA STRUCTURE

SEMSTER - 2ND **ASSIGNMENT – 5** **COURSE - BSC – IT**

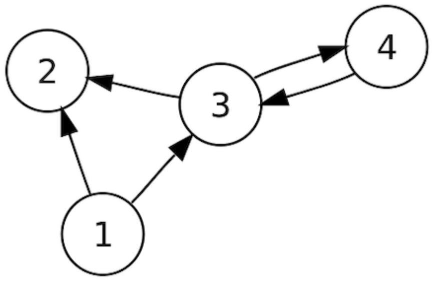
1. **What is graph?**

Ans - A graph is a collection of nodes, called vertices, and edges that connect pairs of vertices. Graphs are used to model relationships between objects and are fundamental in computer science, mathematics, and related fields

2. **Explain directed and undirected graph with an example for each**.

Ans – Directed Graph

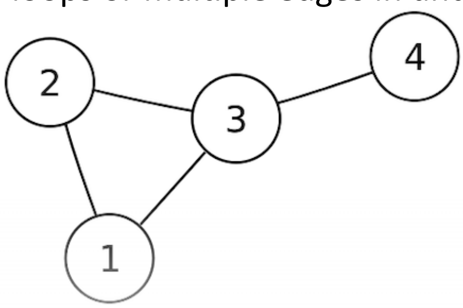
In directed graphs, the edges direct the path that must be taken to travel between connected nodes. The edges are typically represented as arrows.



Example of a directed graph

- **Undirected graph**

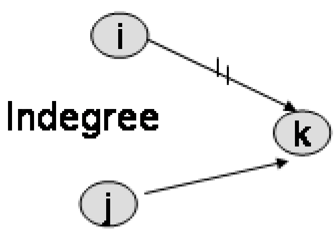
Undirected graphs do not show the direction which must be taken between nodes. Instead, travel between nodes is allowed along an edge in either direction. There are no loops or multiple edges in undirected graphs.



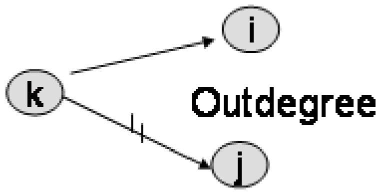
3. **Explain the following in reference to a graph: 1. Indegree 2. Outdegre**

Ans - Indegree:

The number of incoming edges to a vertex in a directed graph. It represents how many edges point to the vertex.

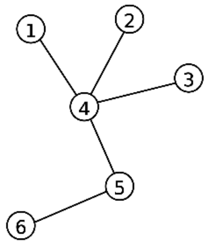


- **Outdegree:**
  The number of outgoing edges from a vertex in a directed graph. It represents how many edges originate from the vertex.



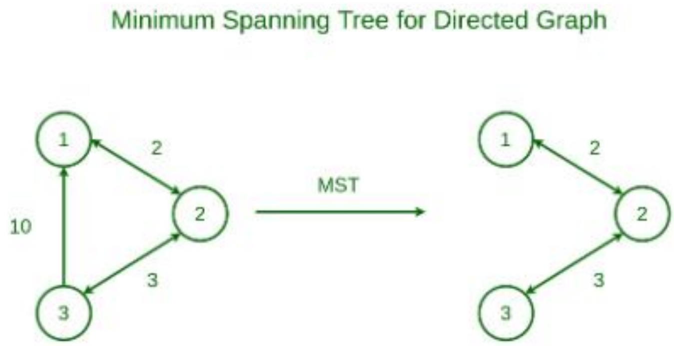
4. What is tree?

Ans - A tree is a special type of graph that is connected and acyclic (contains no cycles).



5. Explain minimum cost spanning tree

Ans - A Minimum Cost Spanning Tree (MST) of a graph is a subset of the edges that connects all the vertices together, without any cycles, and with the minimum possible total edge weight.

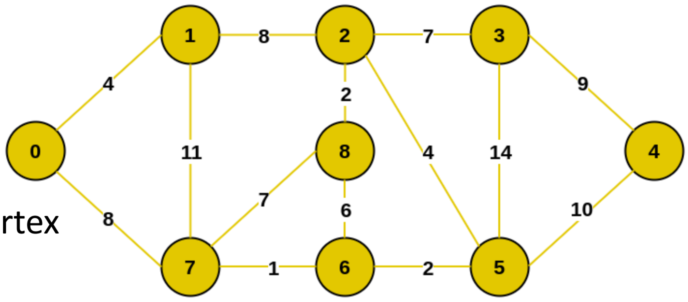


➢ **Properties of a Spanning Tree:**

- The spanning tree holds the below-mentioned principles:
- The spanning tree should not be disconnected, as in there should only be a single source of component, not more than that.
- The spanning tree should be acyclic, which means there would not be any cycle in the tree.
- The total cost (or weight) of the spanning tree is defined as the sum of the edge weights of all the edges of the spanning tree.
- There can be many possible spanning trees for a graph.

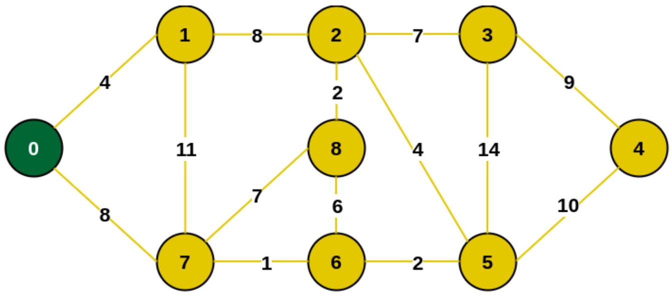
6. **Create a spanning tree using prim's algorithm for the following graph and write the minimum cost:**

Ans –



Example of a Graph

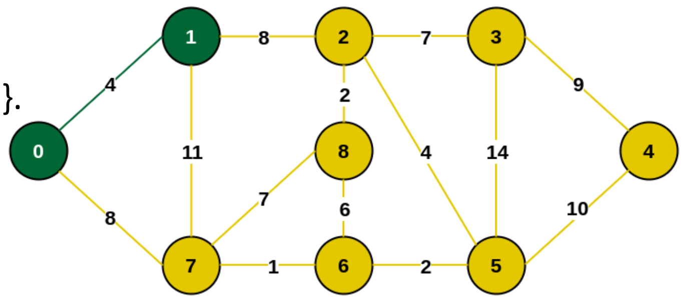
Step 1: Firstly, we select an arbitrary vertex that acts as the starting vertex of the Minimum Spanning Tree. Here we have selected vertex 0 as the starting vertex.



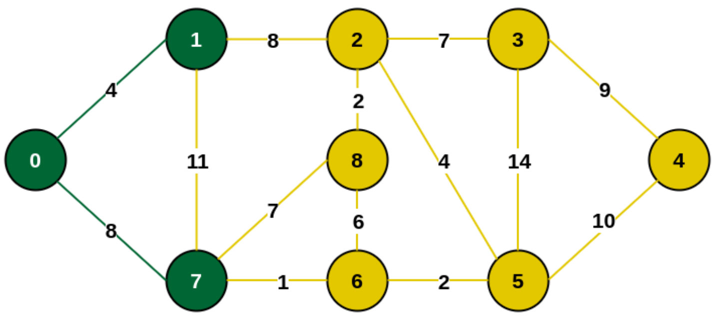
Select an arbitrary starting vertex. Here we have selected 0

Step 2: All the edges connecting the incomplete MST and other vertices are the edges {0, 1} and {0, 7}. Between these two the edge with minimum weight is {0, 1}. So, include the edge and vertex 1 in the MST.

Step 3: The edges connecting the incomplete MST to other vertices are {0, 7}, {1, 7} and {1, 2}. Among these edges the minimum weight is 8 which is of the edges {0, 7} and {1, 2}. Let us here include the edge {0, 7} and the vertex 7 in the MST. [We could have also included edge {1, 2} and vertex 2 in the MST].



Minimum weighted edge from MST to other vertices is 0-1 with weight 4



Minimum weighted edge from MST to other vertices is 0-7 with weight 8

Step 4: The edges that connect the incomplete MST with the fringe vertices are {1, 2}, {7, 6} and {7, 8}. Add the edge {7, 6} and the vertex 6 in the MST as it has the least weight (i.e., 1).

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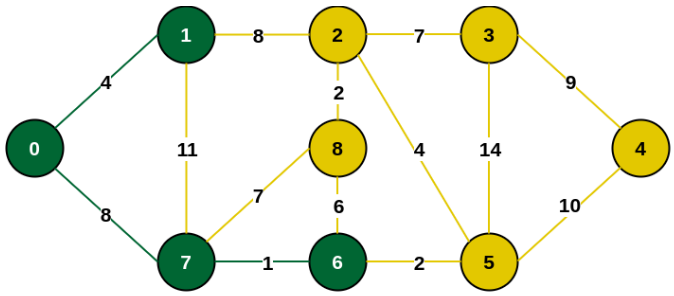
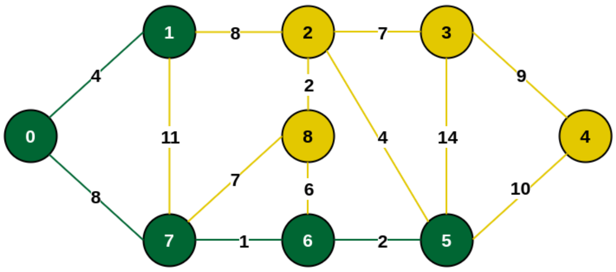
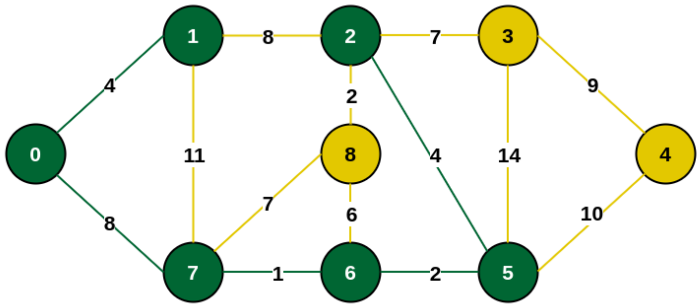


Minimum weighted edge from MST to other vertices is 7-6 with weight 1



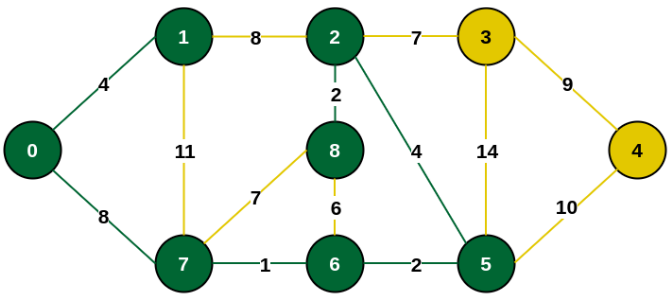
Minimum weighted edge from MST to other vertices is 6-5 with weight 2

Step 5: The connecting edges now are {7, 8}, {1, 2}, {6, 8} and {6, 5}. Include edge {6, 5} and vertex 5 in the MST as the edge has the minimum weight (i.e., 2) among them.



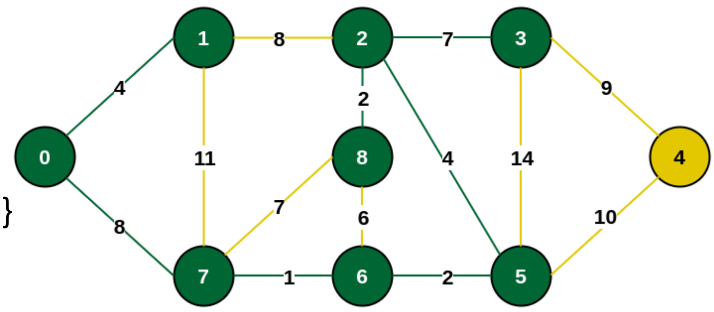
Minimum weighted edge from MST to other vertices is 5-2 with weight 4

Step 6: Among the current connecting edges, the edge {5, 2} has the minimum weight. So, include that edge and the vertex 2 in the MST.



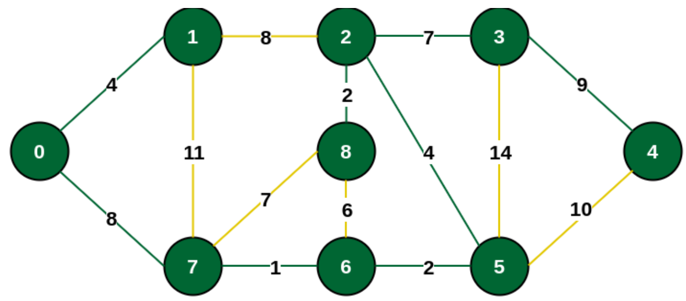
Minimum weighted edge from MST to other vertices is 2-8 with weight 2

Step 7: The connecting edges between the incomplete MST and the other edges are {2, 8}, {2, 3}, {5, 3} and {5, 4}. The edge with minimum weight is edge {2, 8} which has weight 2. So, include this edge and the vertex 8 in the MST.



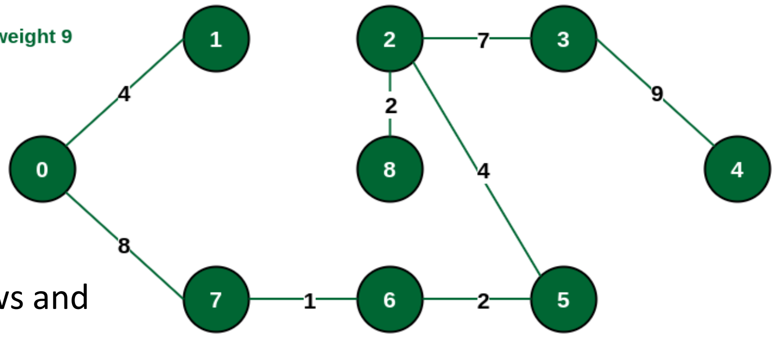
Minimum weighted edge from MST to other vertices is 2-3 with weight 7

Step 8: See here that the edges {7, 8} and {2, 3} both have same weight which are minimum. But 7 is already part of MST. So, we will consider the edge {2, 3} and include that edge and vertex 3 in the MST.



Step 9: Only the vertex 4 remains to be included. The minimum weighted edge from the incomplete MST to 4 is {3, 4}.

Minimum weighted edge from MST to other vertices is 3-4 with weight 9



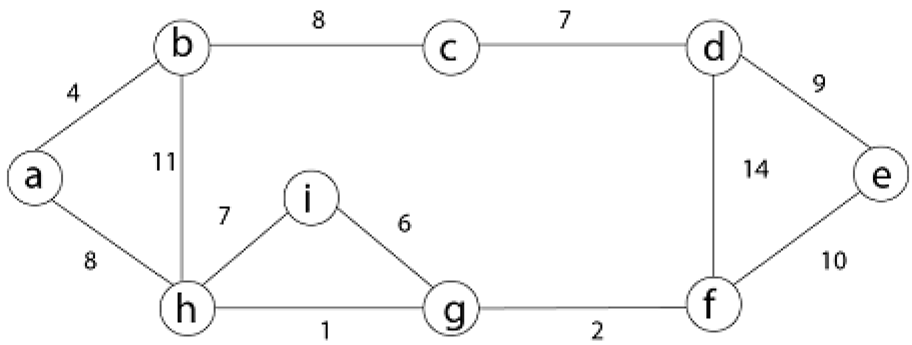
The final structure of MST

The final structure of the MST is as follows and the weight of the edges of the MST is

(4 + 8 + 1 + 2 + 4 + 2 + 7 + 9) = 37.

7. Create a spanning tree using Kruskal's algorithm for the following graph and write the minimum cost

Ans - For Example: Find the Minimum Spanning Tree of the following graph using Kruskal's algorithm.



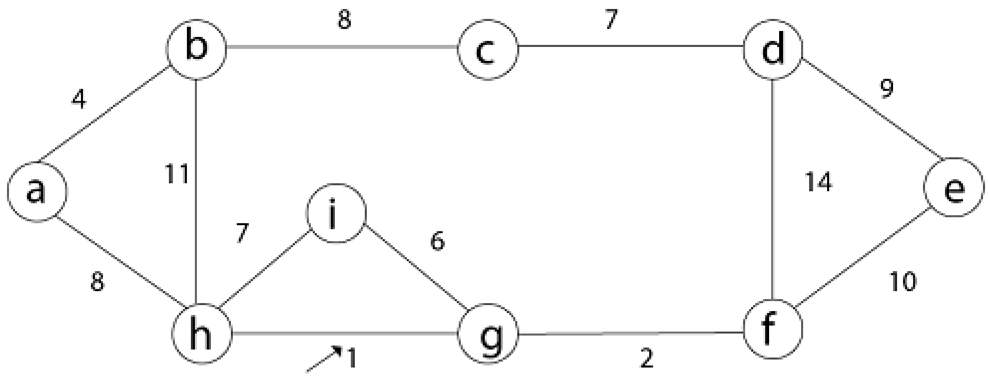
Solution: First, we initialize the set A to the empty set and create |v| trees, one containing each vertex with MAKE-SET procedure. Then sort the edges in E into order by non-decreasing weight.

There are 9 vertices and 12 edges. So, MST formed (9-1) = 8 edges

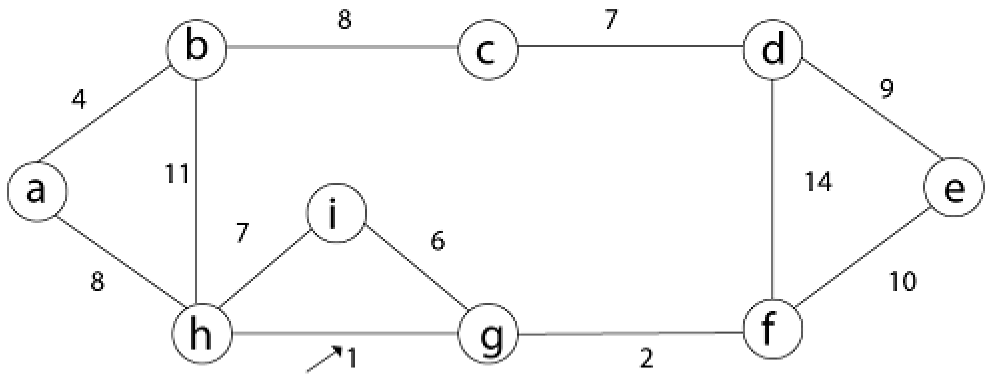
Weight	Source	Destination
1	h	g
2	g	f
4	a	b
6	i	g
7	h	i
7	c	d
8	b	c
8	a	h
9	d	e
10	e	f
11	b	h
14	d	f

Now, check for each edge (u, v) whether the endpoints u and v belong to the same tree. If they do then the edge (u, v) cannot be supplementary. Otherwise, the two vertices belong to different trees, and the edge (u, v) is added to A, and the vertices in two trees are merged in by union procedure.

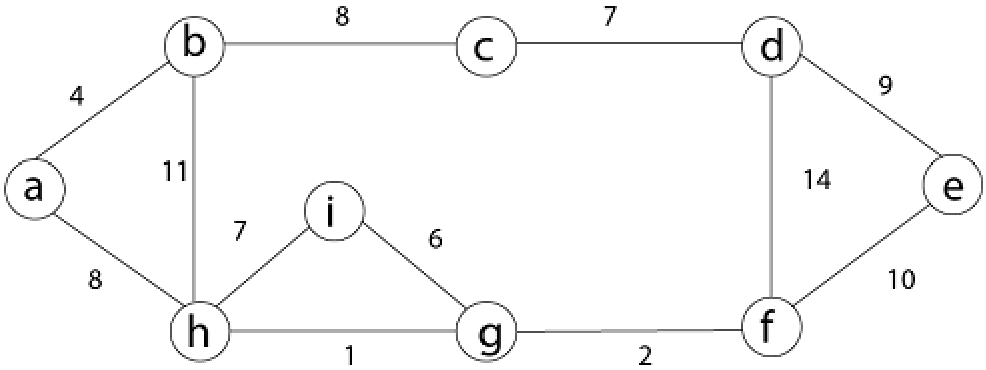
Step1: So, first take (h, g) edge



Step 2: then (g, f) edge.

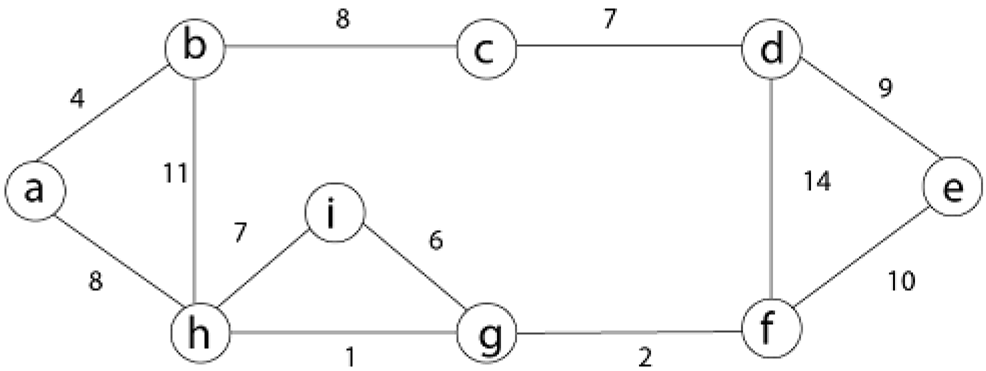


Step 3: then (a, b) and (i, g) edges are considered, and the forest becomes



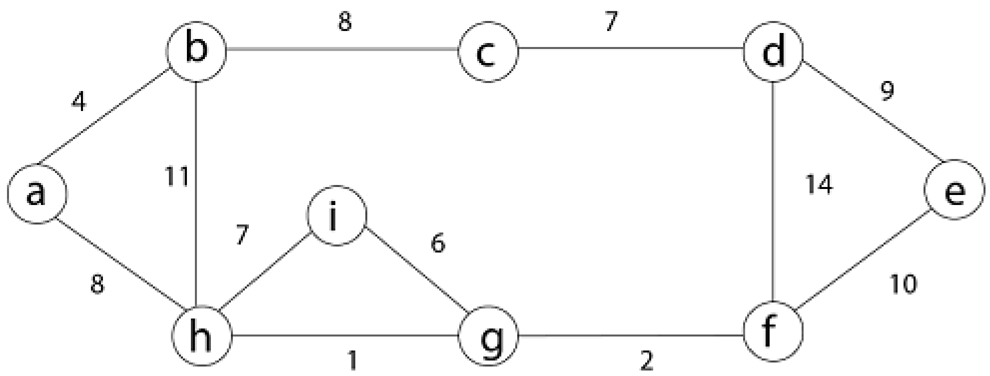
Step 4: Now, edge (h, i). Both h and i vertices are in the same set. Thus, it creates a cycle. So, this edge is discarded.

Then edge (c, d), (b, c), (a, h), (d, e), (e, f) are considered, and the forest becomes.



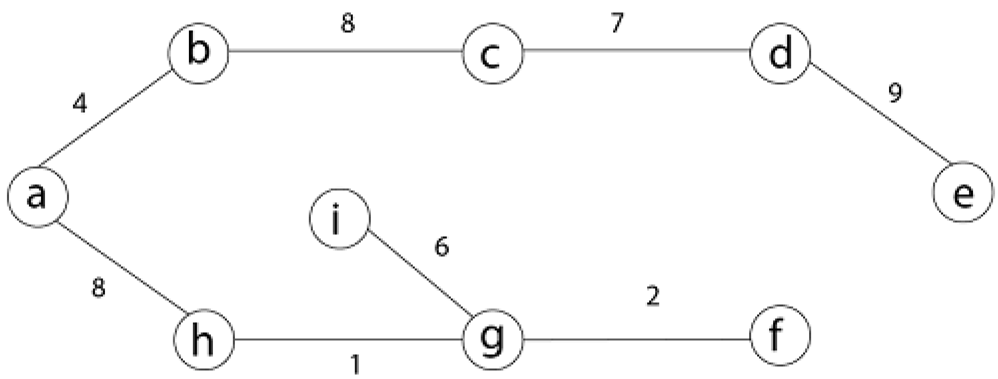
Step 5: In (e, f) edge both endpoints e and f exist in the same tree so discarded this edge. Then (b, h) edge, it also creates a cycle.

Step 6: After that edge (d, f) and the final spanning tree is shown as in dark lines



Step 7: This step will be required Minimum Spanning Tree because it contains all the 9 vertices and (9 - 1) = 8 edges

1. e → f, b → h, d → f [cycle will be formed]



Disclaimer: **Answers are based on available data and calculations. We strive for accuracy but cannot guarantee it. Users should verify information independently. We are not responsible for any errors or outcomes.**

THANK YOU, CREATED BY SAURABH

All THE BEST

कुणीही कसं दिसावं यापेक्षा कसं असावं याला महत्त्व आहे. ते शक्य नसेल तर कमीत जास्तीत जास्त कसं नसावं यालातरी नक्कीच महत्त्व आहे