Assignment-1

GATE Problems

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Question

The Chromatic Number of the following graph is

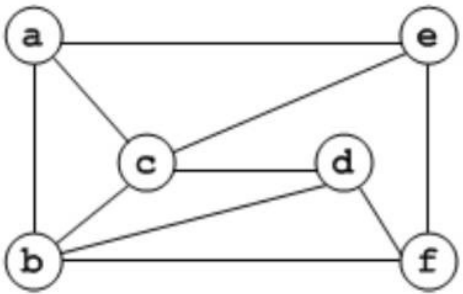

Figure: Question

Solution

The **chromatic number** of a graph is the smallest number of colors needed to color the vertices of the graph so that no two adjacent vertices share the same color.

Steps to Calculate Chromatic Number

1. We color first vertex with the first color.
2. For the remaining (V-1) vertices we do the following one by one:
3. We color the currently picked vertex with the lowest numbered color if the color has not been used to color any of its adjacent vertices.
4. If it has been used, then we choose the next least numbered color.
5. If all the previously used colors have been used, then we assign a new color to the currently picked vertex.

For given graph

We color first vertex with the first color.

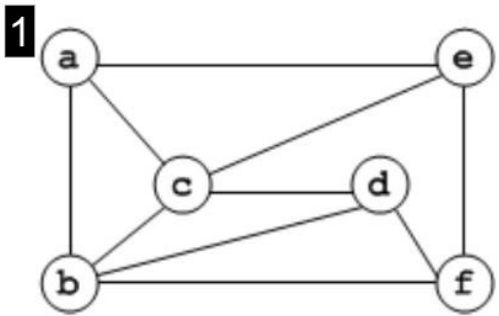

Figure: STEP 1

We assign color to the vertices which share an edge with the first vertex.

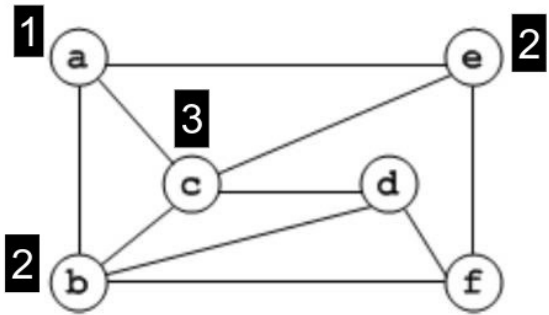

Figure: STEP 2

We assign color to the remaining vertices.

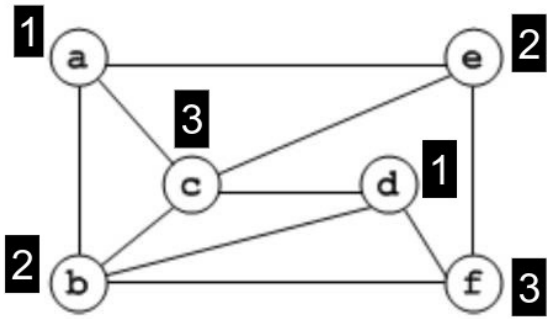

Figure: STEP 3

The number of colours used is 3. Hence the Chromatic Number is 3.

How to implement Graph as Adjacency List?

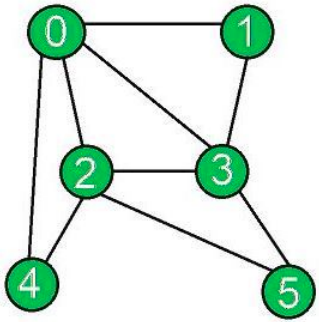

Figure: Graph

How to implement Graph as Adjacency Matrix?

This is the adjacency matrix for the graph

$$\begin{bmatrix} 0 & 1 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 \end{bmatrix}$$

How to implement Graph as Adjacency Matrix?

1. Let the number of vertices be N.
2. Create an N$\times$N matrix.
3. Let all the rows and columns be initialised as 0s.
4. Then for each edge between any 2 vertices we mark the respective row-column index as 1.
5. For example if vertices 1 and 2 have an edge between them we mark the cell of row 1, column 2 and cell of column 1, row 2 as 1 to show that an edge exists.

Code

1. We use an adjacency List to create the Graph.
2. The Code
3. Time Taken:0.000053s
4. We use an adjacency Matrix to create the Graph.
5. The Code
6. Time Taken:0.000073s