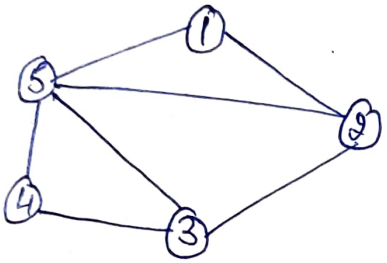
Graph Coloring Problem —

Let $G = (V, E)$ be a graph.

In graph coloring problem, we have to find out all the vertices of the given graph can be colored or not with the constraint that no two adjacent vertices have the same color.

For solving the graph coloring problem, we assume that graph is represented by its adjacency matrix.



Let $m = 3$

colors $= \{R, G, B\}$

one solution can be

R, G, R, G, B

or

The Graph coloring problem has two versions

1. m-coloring decision problem.
2. m-coloring optimization problem.

m-coloring decision Problem —

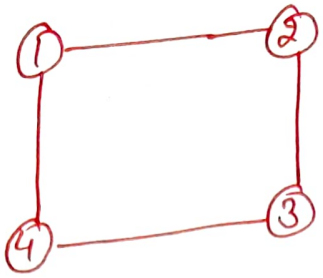
In this problem we have to check whether all the vertices of the graph can be colored with m-colors or not

m-coloring optimization Problem —

In this problem, we have to find out the minimum number of colors required to color all the vertices of the graph with the constraint that no two vertices have the same color.

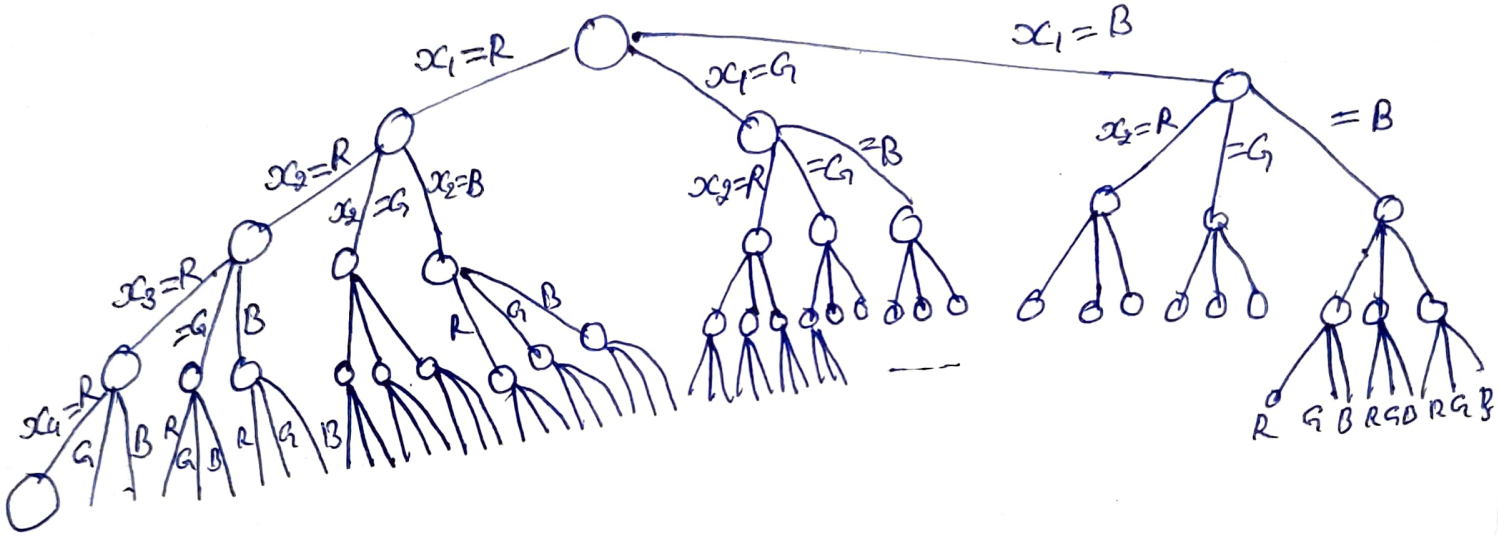
Also called chromatic number.

e.g



$m = 3$

colors $= \{R, G, B\}$



Total nodes generated $= 1 + 3 + 3 \times 3 + 3 \times 3 \times 3 + 3 \times 3 \times 3 \times 3$

$= 1 + 3 + 3^2 + 3^3 + 3^4$

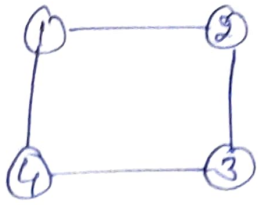
$= \frac{3^{4+1} - 1}{3 - 1} = \frac{3^{4+1} - 1}{2}$

$\simeq 3^{n+1}$

$= c^{n+1}$

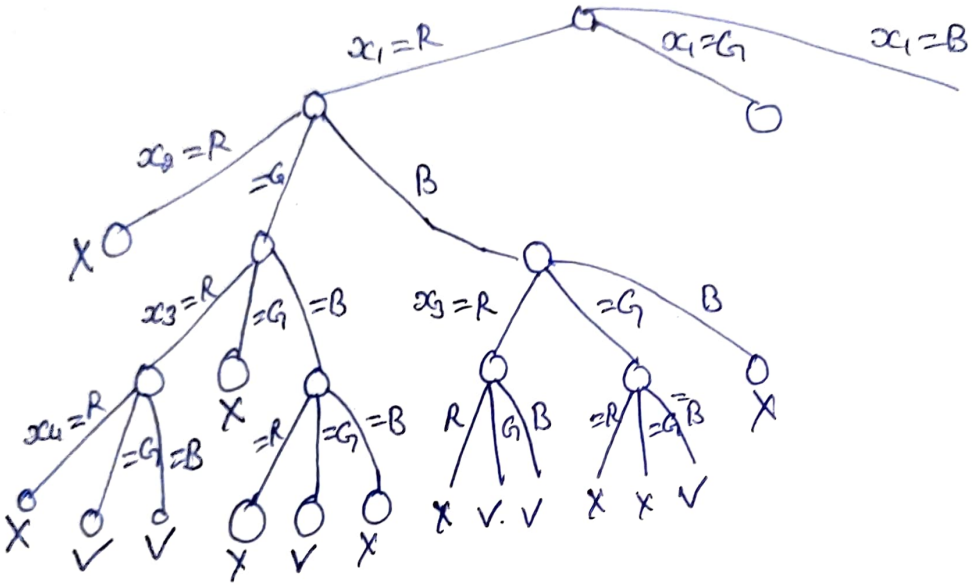
↑ exponential time complexity

Using Backtracking



$m = 3$

Red (R), Green (G), Blue (B)



Solutions

1	R	G	R	G
2	R	G	R	B
3	R	G	B	G
4	R	B	R	G.
	⋮			

Applications

- Data Mining
- Image Segmentation
- clustering
- Image capturing
- Networking
- Making schedule
- Sudoku
- Map coloring
- Pattern Matching.
- Design Seating Pla