CSE221 ALGORITHMS

Topic: Graph Traversal (DFS, BFS)

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Topic: Graph Traversal

→ different ways to traverse through vertices of graph

Graph Traversal

BFS

(Breadth first search)

DFS

(Depth first search)

BFS (Breadth first search):

Properties / Areas of application:

(i) Finds the shortest distance from a particular source vertex:

→ minimum কত গুলো step এ এক vertex হতে অন্য vertex এ যাওয়া যায়

যেমন:

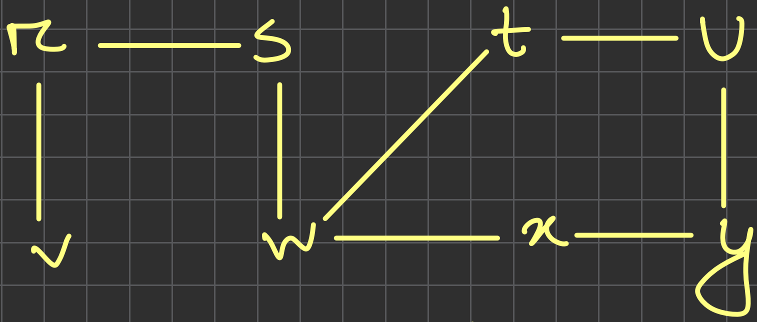


Fig: unweighted undirected graph

let's say we want to go from S to U. so we will prefer

✓ s → w → t → u

not s → w → x → y → u ✗

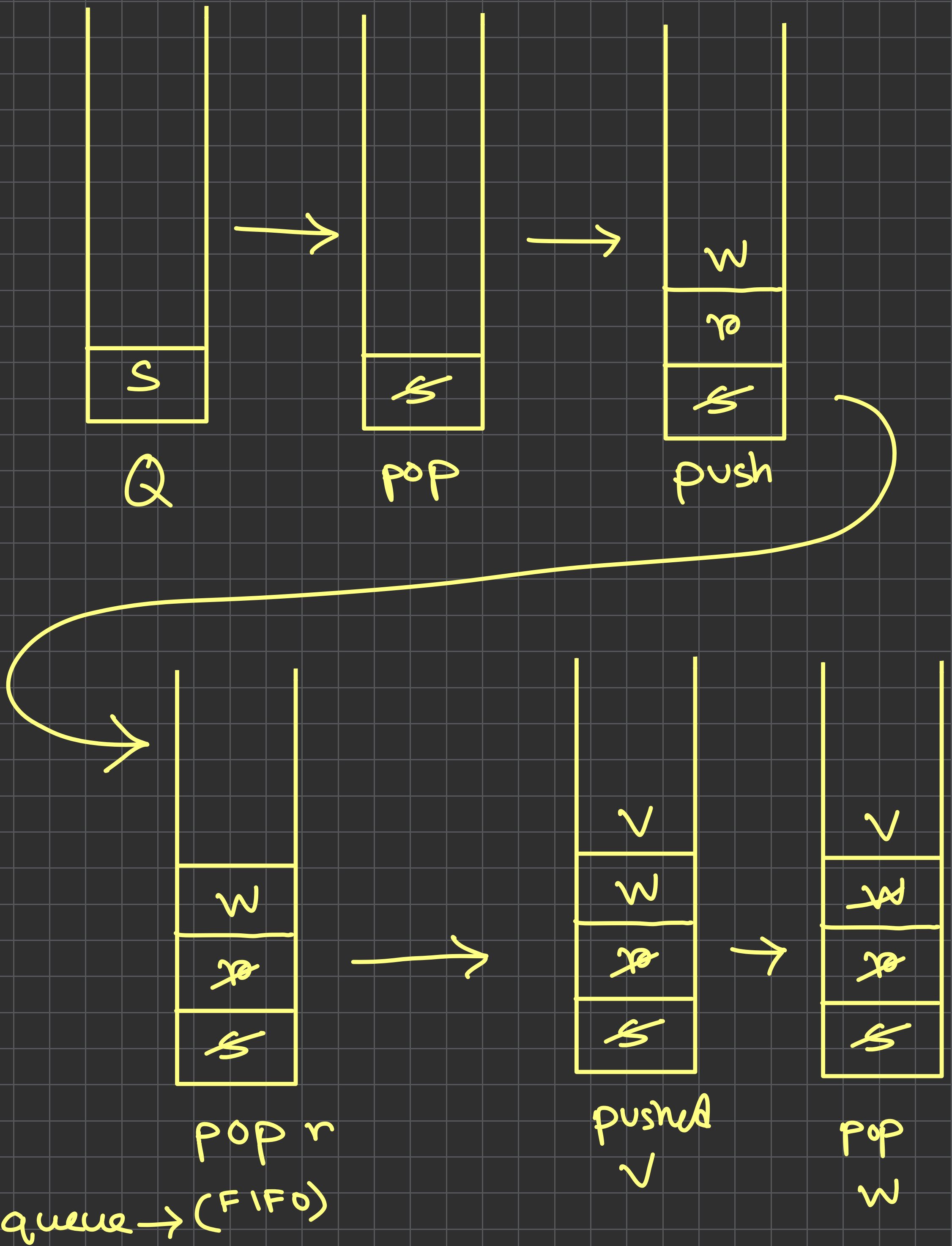
(ii) Bipartite Graph check:

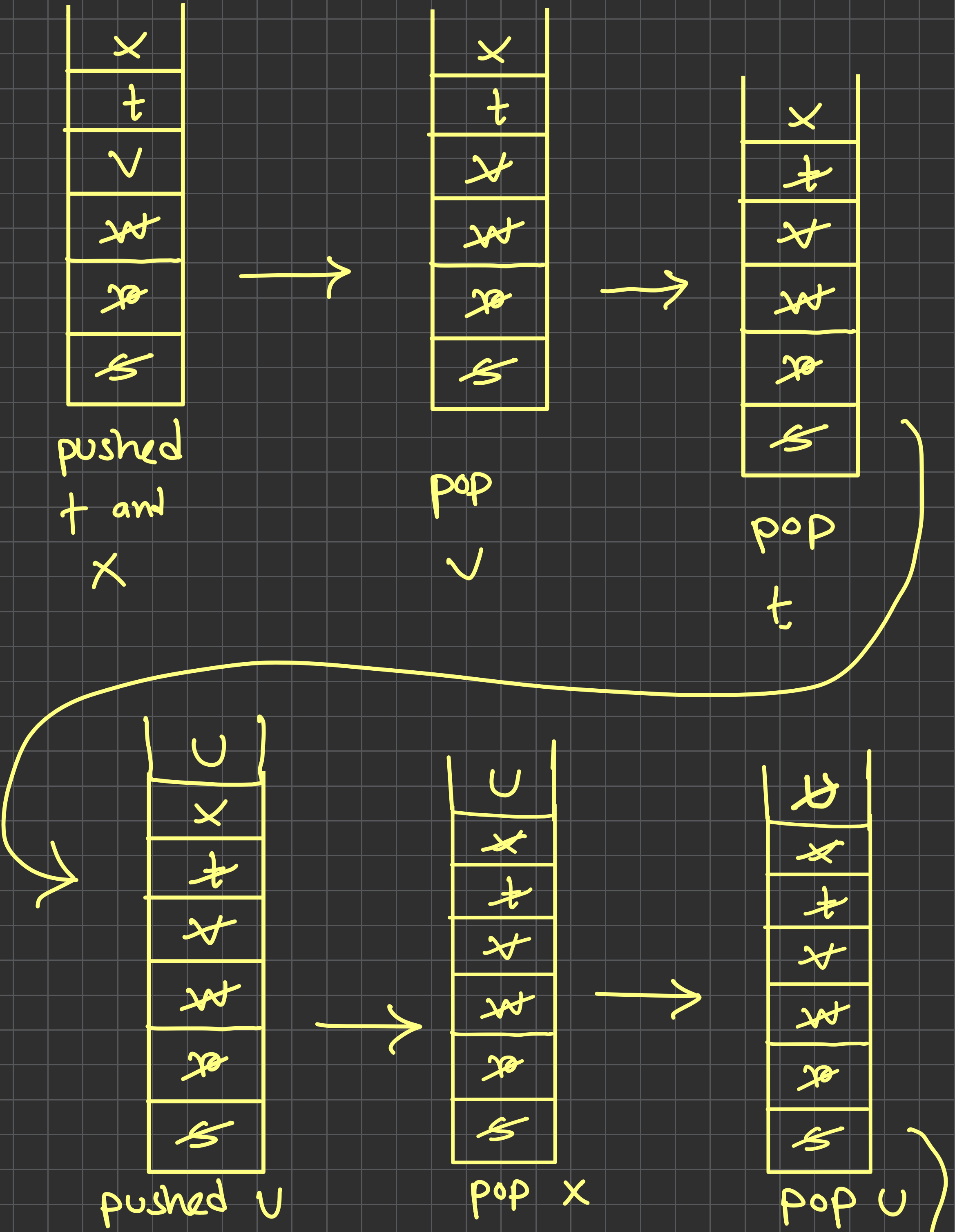
BFS uses Queue data structure.

method:

so we start with the source vertex and push it in the queue.

```
push source vertex in Q
while Q is not empty:
(let the vertex be U) → pop vertex in Q
        push adjacent vertices of
        U in Q
```


S
Q
~~S~~
pop
W
~~r~~
~~S~~
push
W
~~r~~
~~S~~
pop r
V
W
~~r~~
~~S~~
pushed V
V
~~W~~
~~r~~
~~S~~
pop W
queue → (FIFO)



pushed t and x

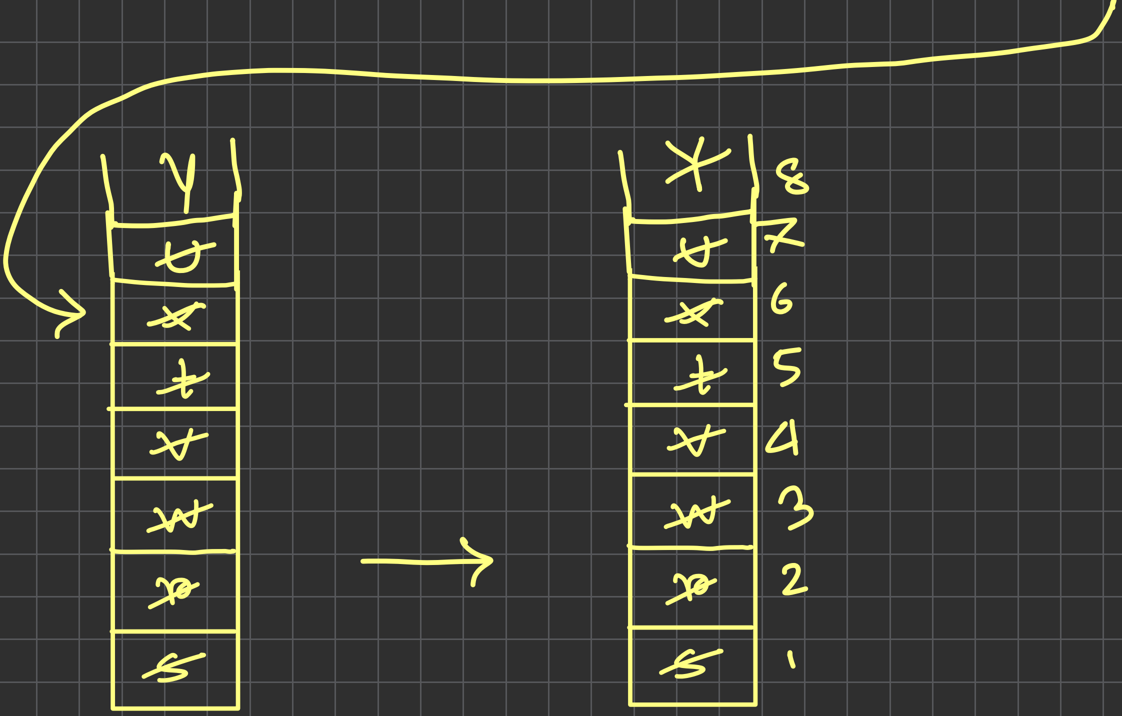
pop v

pop t

pushed u

pop x

pop u

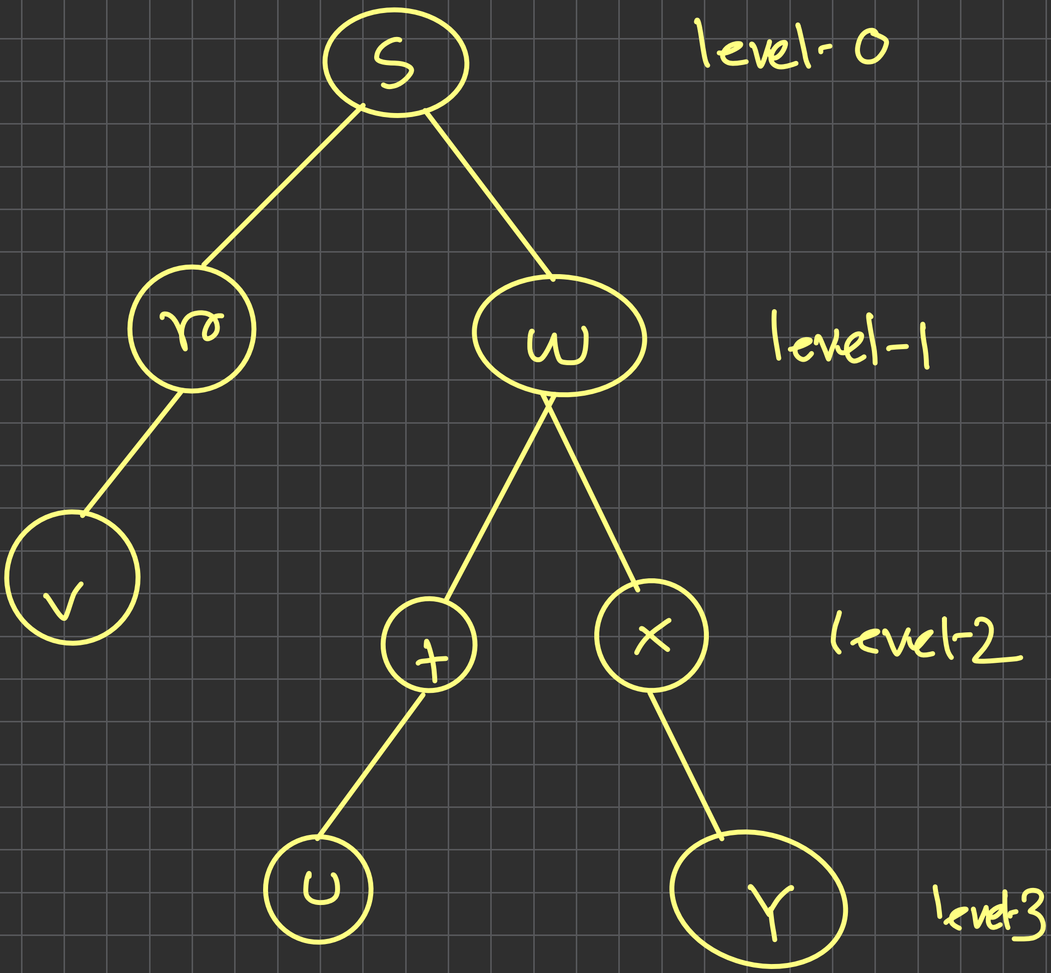


pushed y

pop y

from the queue we make a tree.

BFS Trees



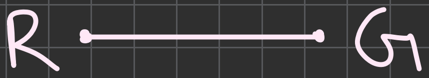
# ~~minimum cost~~ minimum distance

এ path/route উপরের tree থেকে পাওয়া যায়।

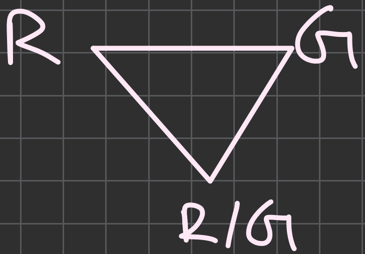
ii Bipartite Graph Check:

~ is a graph that can be colored with only 2 colors where no 2 adjacent vertex has same color.

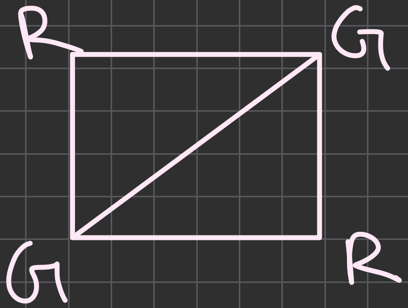
let R=red
G=green



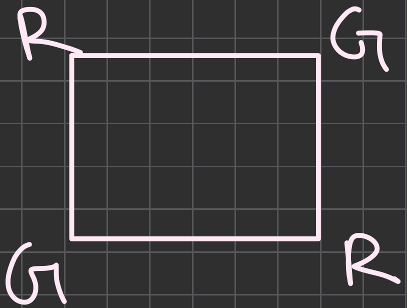
is bipartite



→ not bipartite



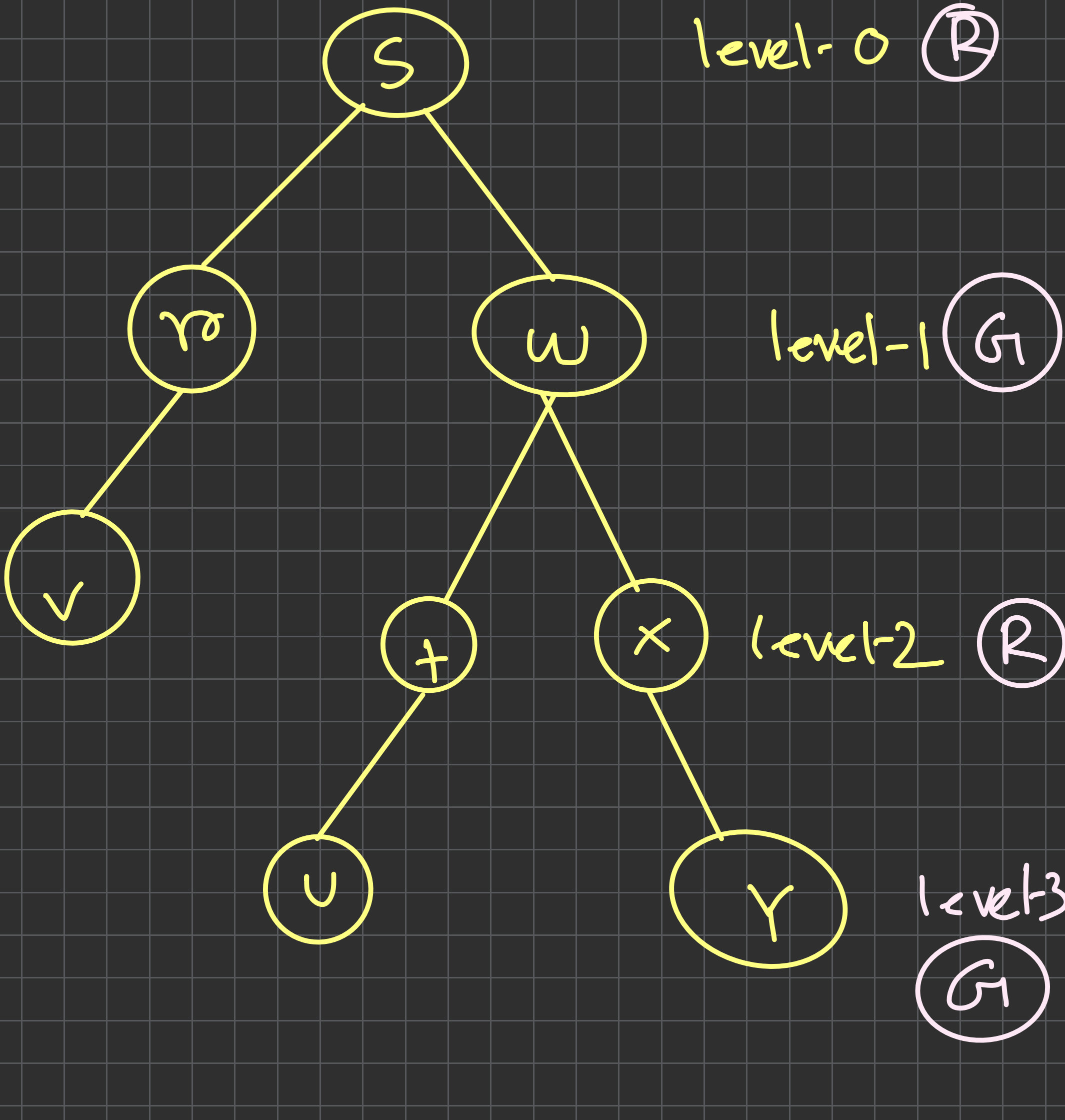
→ not bipartite



→ bipartite

# For a graph to be bipartite graph, there cannot be odd number of cycles.

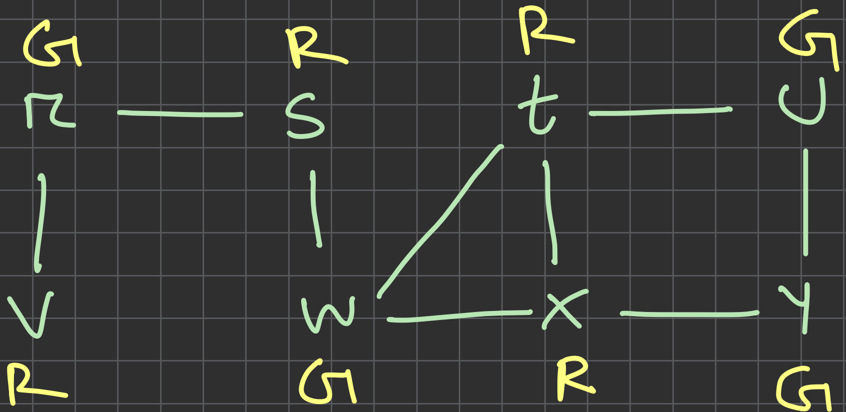
Tree হতে color assign করতেছি।



NB: every vertex in same level

will be given same color.

now from the color mentioned tree we give color names to the given graph.



not a bipartite graph

Question type: With how many minimum number of colors, can you color all the countries in the map in such a way that no two পাশাপাশি countries are given same color?

Ans: 4 colors

#application maps a country color করা।

DFS

→ Depth first search

Properties of DFS :

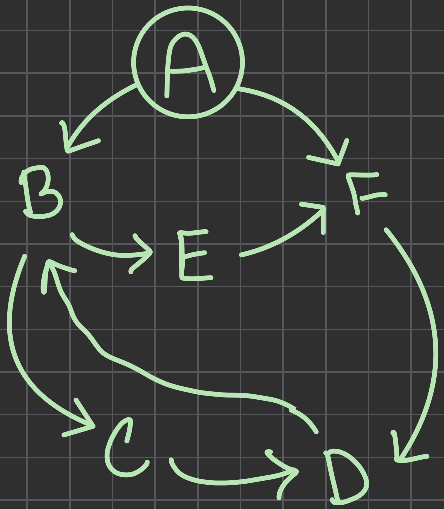
i) start / finish time

ii) Edge classification

iii) Cycle detection

Start / Finish time

lets say we start with the following



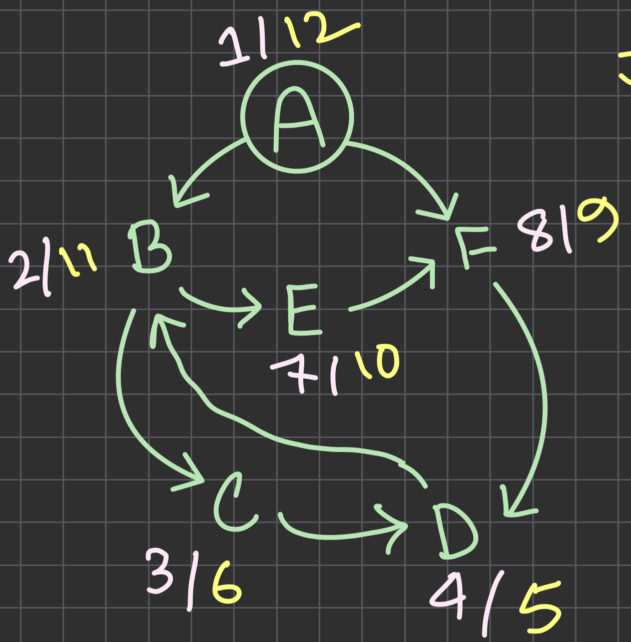
→ we start with the root

→ there is no specific rule for, যদি একটা vertex থেকে multiple vertex এ যাওয়া যায় তাহলে next কোন vertex এ যাবে তার জন্য

→ (alphabetical order এ) vertex to vertex travel করো until there is no next vertex that already hasn't been visited. Travel এর time ও serially order mention করতে করতে যাবো, those will be regarded as start time

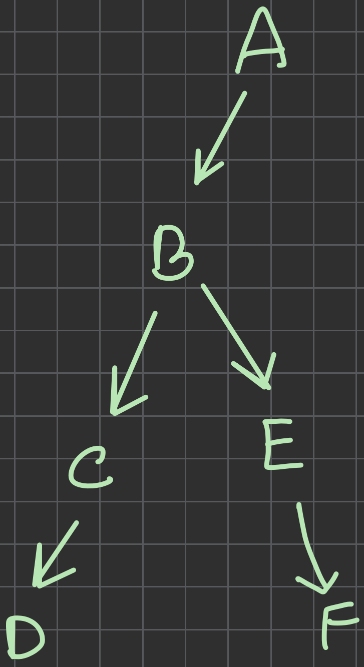
→ when there is no unvisited vertex thats connected, come back to itself. and thats the end time for that vertex.

so



start time
finish time

Given graph থেকে DFS tree বানানো যায়,



Edge Classification

There are 4 types of edges.

(i) Tree edge

(ii) Forward edge

(iii) Backward edge

(iv) Cross edge

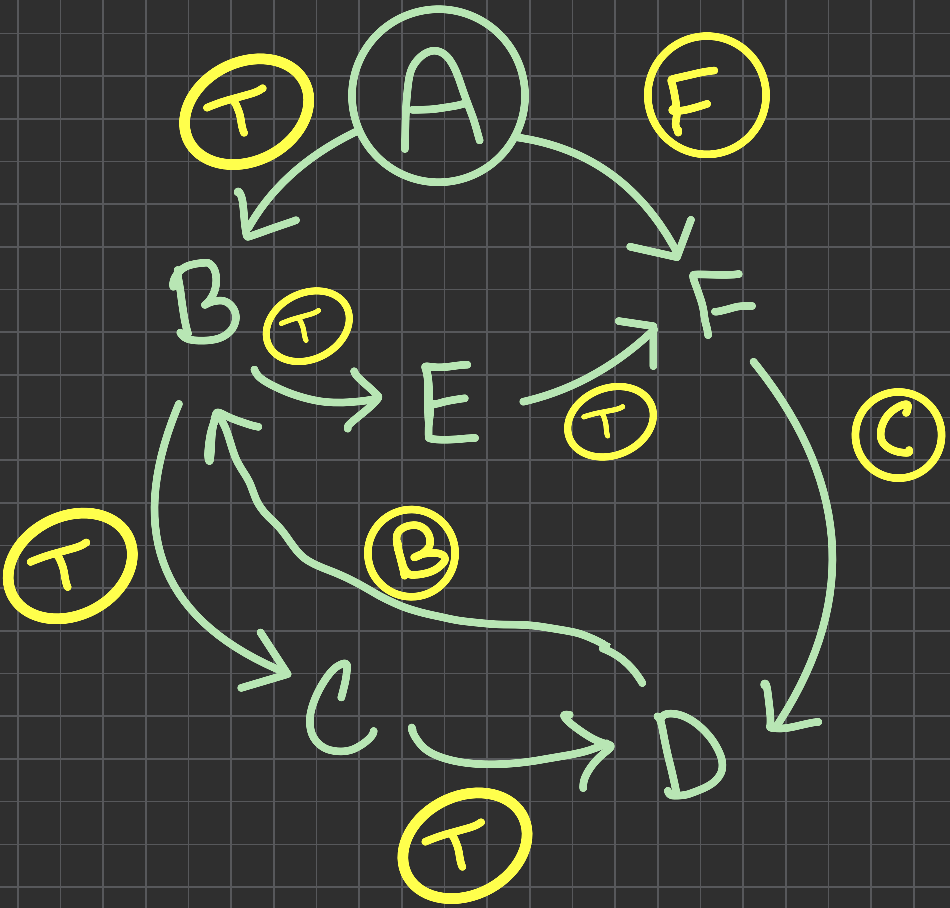
(i) Tree Edge

DFS tree তে যেসব edge আছে শুধু তারাই tree edge হবে (DFS tree edge).

কারণ, not all the vertices in the graph will appear in DFS tree.

And while naming edges, always start with tree edge.

One edge cannot be of two edge types at the same time.



(ii) Forward Edge $(\underbrace{\text{Parent} \rightarrow \text{child}})$

এই relation বোঝানোর জন্য DFS tree দেখতে হবে।

(iii) Backward edge (child → parent)

↳ এই type এর edge যেখানে থাকে, সেখানে cycle create হয়।

(iv) Cross edge (no direct relationship)