

Bipartite Graphs

1. A graph is a collection of nodes (or vertices) and edges connecting these nodes.
2. Bipartite graphs are a special type of graph.

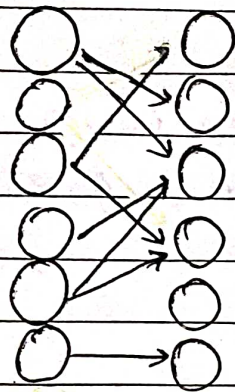
- A bipartite is a graph whose set of nodes can be divided into two sets A and B.
- All edges in the graph connect nodes from set A to nodes in set B.
- Bipartite graphs are used in various fields, like matching problems (assigning task to workers) and network modeling (like social networks or transportation systems).
- A map or graph is bipartite if and only if it doesn't contain any cycles of odd length.

Maximum Bipartite Matching :-

- Set of the edges chosen in such a way that no two edges share an endpoint.

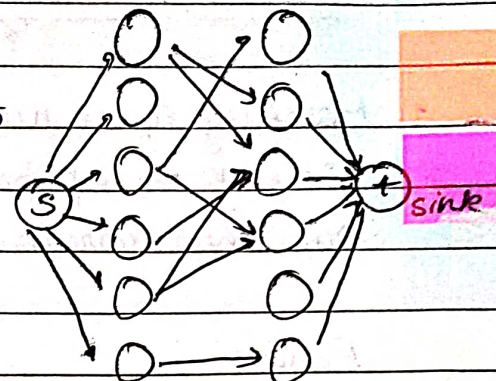
Real World Problem :-

There are M job applicants and N jobs. Each applicant has a subset of jobs that he/she is interested in. Each job opening can only accept one applicant and a job applicant can be appointed for only one job. Find an assignment of jobs to applicants in such a way that as many applicants as possible get jobs.



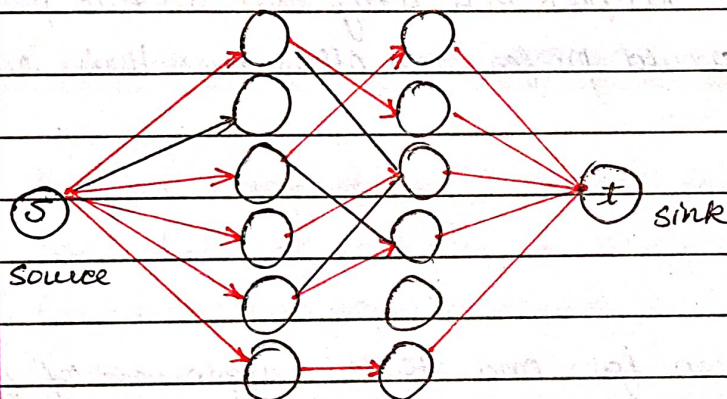
Applicants Jobs

Convert it into
flow network \rightarrow
source



applicants Jobs

Building a flow network :-



Time Complexity :-

$$O(V * F)$$

Stable Marriage Problem :-

1. Matching equal number of men and women in such a way that there are no unpaired individuals who both prefer each other over their current partners.

Easy :-

- Imagine there are an equal number of men and women, and each person has their own list of preferences about who they'd like to be with.
- The goal is to create couples in a way that no two people who are not together would prefer each other over their current partners.

Advantages :-

1. Fairness :- It ensures a fair and stable assignment of partners, minimizing dissatisfaction among individuals.
2. Optimality :- Optimal matching that maximizes the overall satisfaction.

Limitations :-

1. Gender Imbalance :- Equal no. of men and women not possible always.
2. Incomplete Information :- The SMP assumes that individuals have complete and accurate knowledge of their preferences, which may not lead to be the case in real world.

Time Complexity :- $O(n^2)$
↳ no. of men or women.