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Week 11: Solving Maximum Matching Problem

1. Describe the difference between original Ford-Fulkerson algorithm and Edmonds-Karp algorithm in general flow network and in bipartite matching.

Both algorithms can be exactly the same, however Ford-Fulkerson doesn't have a defined way to find the augmented paths, while Edmonds-Karp uses a Breadth first search to find the shortest path with available capacity

2. Brief about blossom algorithm.

Blossom algorithms also uses breadth first found augmented paths which to form pairings. When a new longer augmented path is found then the pairings are updated. The blossom algorithm encounters a "blossom" which is an odd cycle of alternating edges. The blossom is contracted into a single super vertex and the augmented path is found using this blossom.

3. Suppose edges between V_s and V_t are weighted, please design an algorithm for finding maximum matching with minimum cost.

Given V_s has n elements and V_t m elements.

Create $n \times m$ matrix

Fill the cells with the weights of the edges

Subtract the minimum weight in a line to all the elements in that line

Subtract the minimum weight in a column to all the elements in that column

Count the number X of lines and columns that contain 0

If $X < \min(n, m)$

Take the lowest number from the lines and column that don't contain 0

Subtract it to all the elements not part of a column or line with 0

Add it to all the elements part of a column or line with 0

Repeat until $X = \min(n, m)$

4. Please compare time complexity between original flow algorithm and your modified version in Question 3.

The maximum flow algorithm using Edmonds-Karp has a time complexity of $O(V^2 \cdot E)$

The algorithm in Question 3 has complexity $O(n^2 \cdot m^2)$ but it returns the minimum cost while the other just the first pairing encountered.