

Team Reference Notes

v18.05
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*This is the **Team Reference Notes**. This material is just for Formulas and Theorems. If you are looking for some code, please download the **Team Reference Code** from GitHub at <https://github.com/ImperezCuba/TeamReferenceAlgorithms/tree/18.05>.*

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1. Graph

Cayley's Formula: There are n^{n-2} spanning trees of a complete graph with n labeled vertices. Example: UVa 10843 - Anne's game.

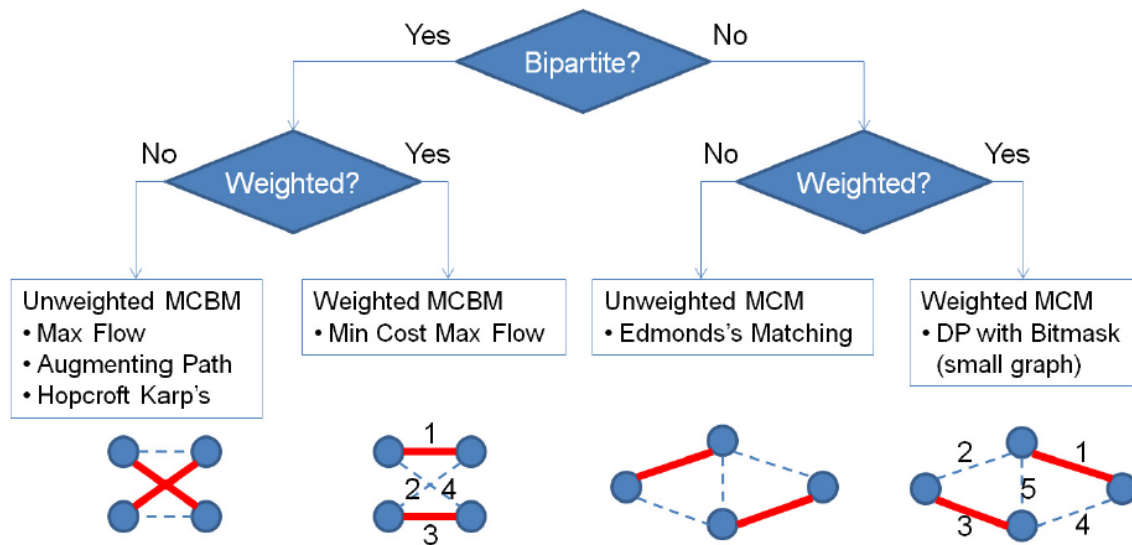
Erdős Gallai's Theorem gives a necessary and sufficient condition for a finite sequence of natural numbers to be the degree sequence of a simple graph. A sequence of nonnegative integers $d_1 \geq d_2 \geq \dots \geq d_n$ can be the degree sequence of a simple graph on n vertices if $\sum_{i=1}^n d_i$ is even and $\sum_{i=1}^k d_i \leq k \times (k-1) + \sum_{i=k+1}^n \min(d_i, k)$ holds for $1 \leq k \leq n$. Example : UVa 10720 - Graph Construction.

Euler's Formula for Planar Graph: $V - E + F = 2$, where F is the number of faces of the Planar Graph. Example: UVa 10178 - Count the Faces.

The **number of spanning tree** of a complete bipartite graph $K_{n,m}$ is $m^{n-1} \times n^{m-1}$. Example: UVa 11719 - Gridlands Airport.

Graph Matching: Select a subset of edges M of a graph $G(V,E)$ so that no two edges share. [1] page.349

Fig. 1: The Four Common Variants of Graph Matching in Programming Contests



the same vertex.

2. Combinatory

Derangement: A permutation of the elements of a set such that none of the elements appear in their original position. The number of derangements $\text{der}(n)$ can be computed as follow: $\text{der}(n) = (n - 1) \times (\text{der}(n - 1) + \text{der}(n - 2))$ where $\text{der}(0) = 1$ and $\text{der}(1) = 0$. A basic problem involving derangement is UVa 12024 - Hats (see Section 5.6).

3. Computational Geometry

Pick's Theorem: Let i be the number of integer points in the polygon, A be the area of the polygon, and b be the number of integer points on the boundary, then $A = i + \frac{b}{2} - 1$. Example: UVa 10088 - Trees on My Island.

4. Mathematic

Moser's Circle: Determine the number of pieces into which a circle is divided if n points on its circumference are joined by chords with no three internally concurrent. Solution: $C_4^n + C_2^n + 1$. Example: UVa 10213 - How Many Pieces of Land?

Bibliography

- [1] Competitive Programming 3, 2013, (Steven Halim, Felix Halim)
- [2] Análisis y diseño de algoritmos (Antonio Vallecillo - Univ. Málaga)