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A Short Survey of Recent Advances in Graph and Subgraph Matching

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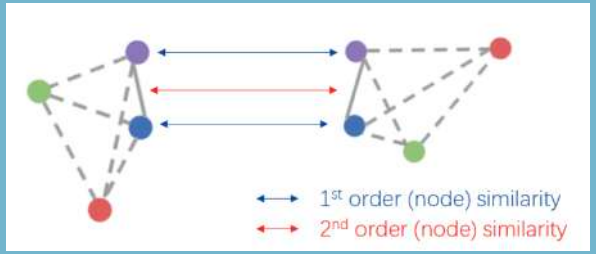
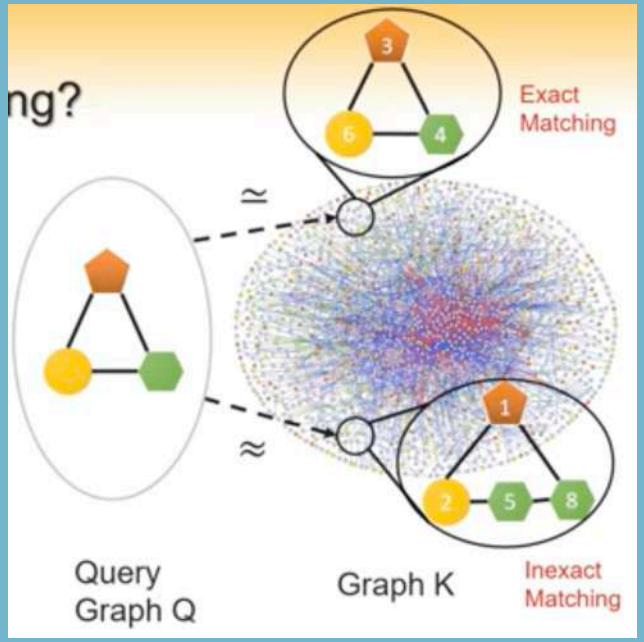
Learning Objectives





- GM: *Construct vertex corresponding, which maximize affinities*
  - *Object Function ← Lawler's QAP*
  - *Optimization Problem ← Maximize Affinity Score*
- SubGM: *Find all subgraphs in the database graph*
  - *Making Index ← Dataset Preprocessing*
  - *Query processing ← GM*
- Current Hotspots:
  - *Multi-graph Matching*
  - *Incremental GM*
  - *Deep Learning based GM/SubGM*
- Applications:
  - *Effective and Efficient SubGM for bio networks*
  - *Online Incremental Learning*

Background:

1. Subgraph Matching for (large) biological networks/graphs
2. Maximum Common Subgraphs (MCS)

Survey:

1. **Most** *(Inexact) Graph Matching*
2. **Few** *Subgraph Matching*

Graph Matching

Definitions

- Model vertex corresponding to maximize object function (e.g., affinity score, distance cost)
- Properties: isometric (等距), isomorphisms (同构), homeomorphisms (同胚)
- Two Steps:

1. Build vertex corresponding (Assignment Matrix) and object function
2. Optimize the Assignment Matrix to maximize/minimize object function

Measurements

- Which metrics we aim to optimize → Assignment Matrix
- How we define our object function → Lawler's QAP (Most commonly used affinity score)

Keywords

- Graph Matching, Subgraph Matching,
- Multi-graph Matching, Incremental Matching, Higher-order Graph Matching

Usage Scenarios

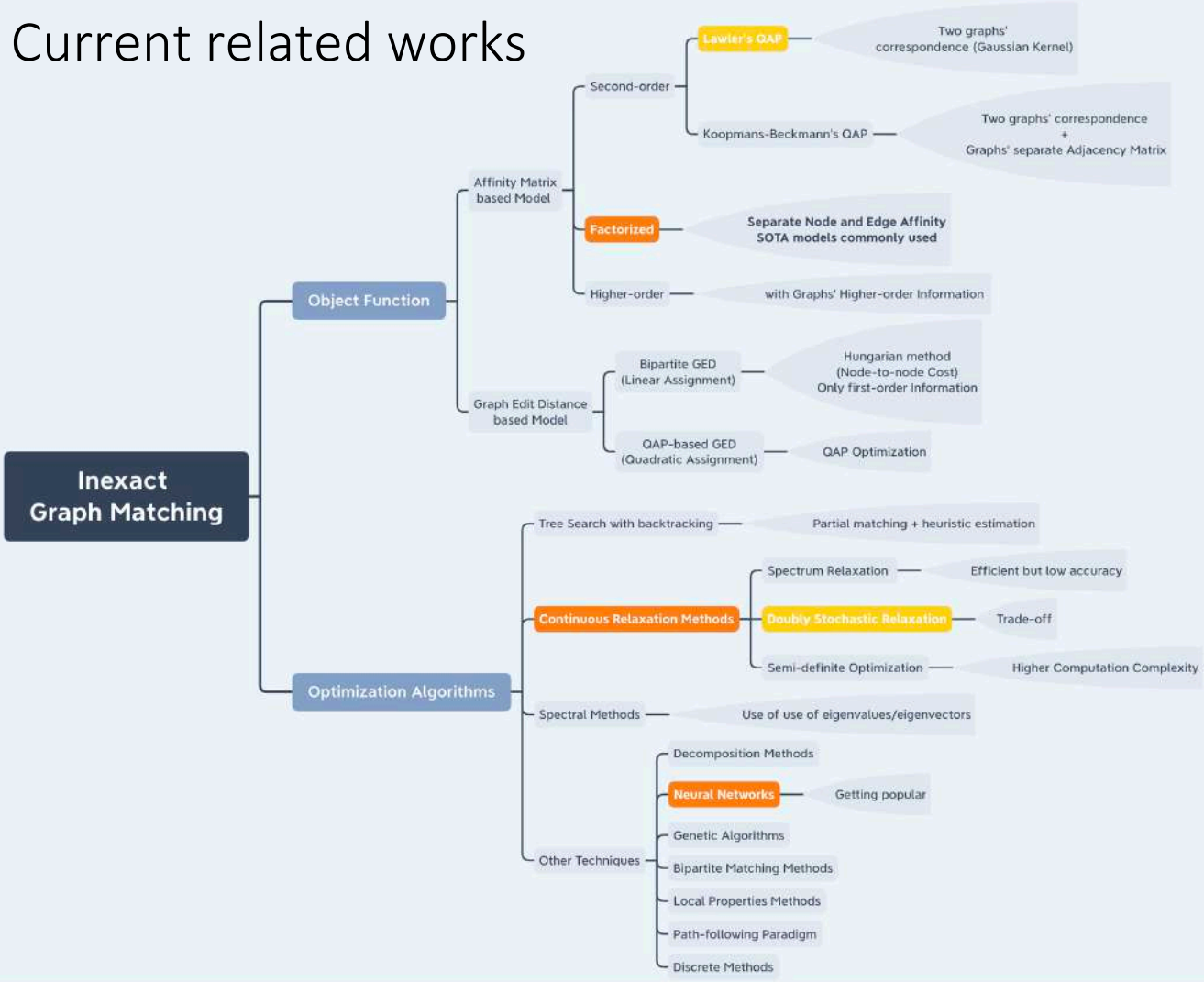
Graphs/Subgraphs Matching to (Multiple/Large) Domain Database Graphs

- Subgraphs → (Large, >10^3 vertexes) domain Knowledge Graphs
- **Physical Science** (Chemistry, Fluid Dynamics, Astronomy, structural mechanics, and ecosystem modeling)
- **Life Science** (Biological Networks, protein-protein interaction networks, gene regulatory networks, metabolic networks, brain connectivity from alignment-free functional magnetic resonance imaging (fMRI) data)

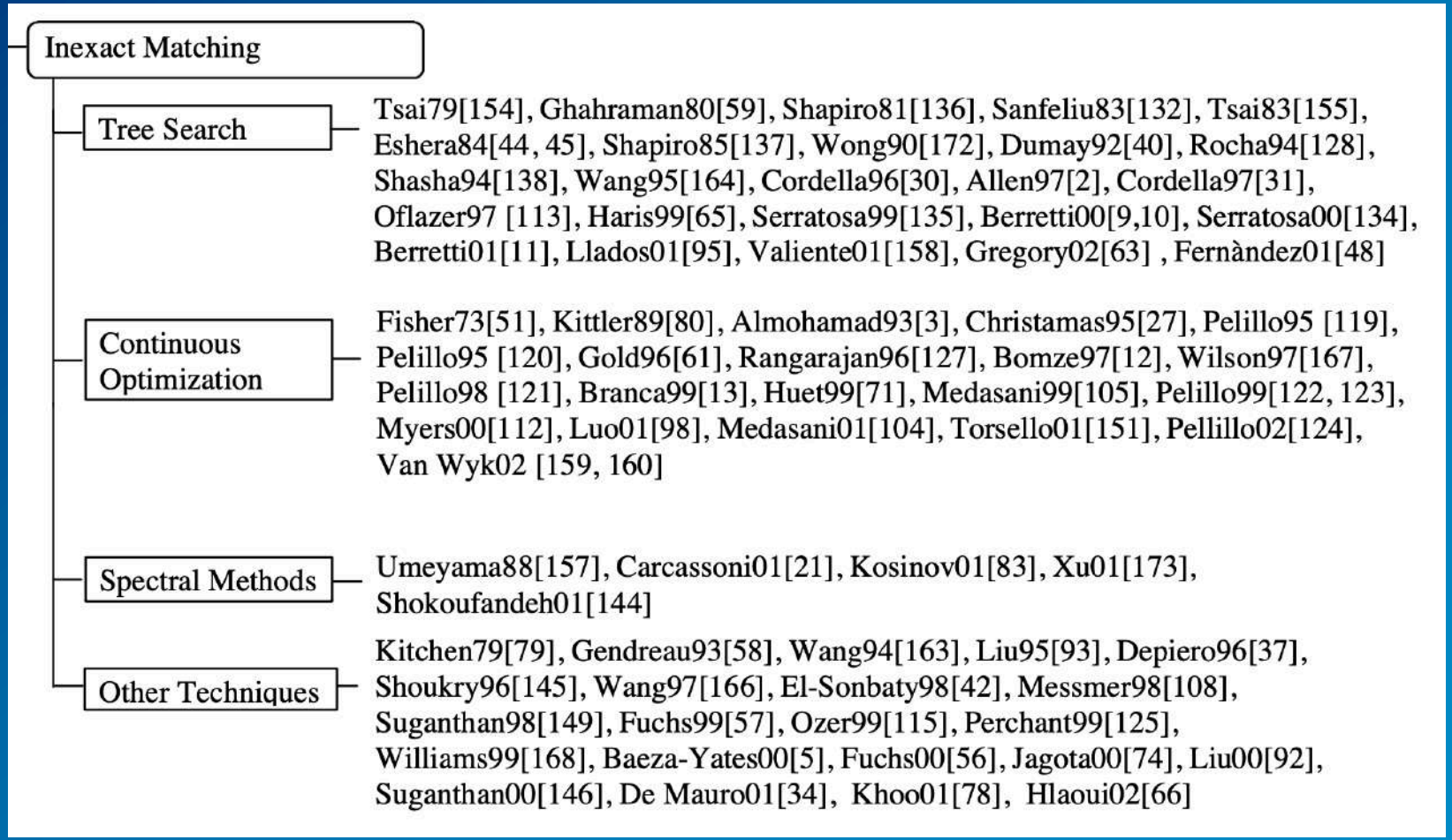
Computer Science Scenarios ← A lot of scenarios

- **Combinatorics** ← Quadratic Assignment Problem (QAP) ← Graph Matching
- **Pattern Recognition**, **Multimedia**, **Computer Vision**
- Image registration, understanding, extrapolation and recognition, object recognition and tracking, scene understanding and parsing, weak-perspective 3-D reconstruction, action recognition, robotics, video surveillance and person re-identification.

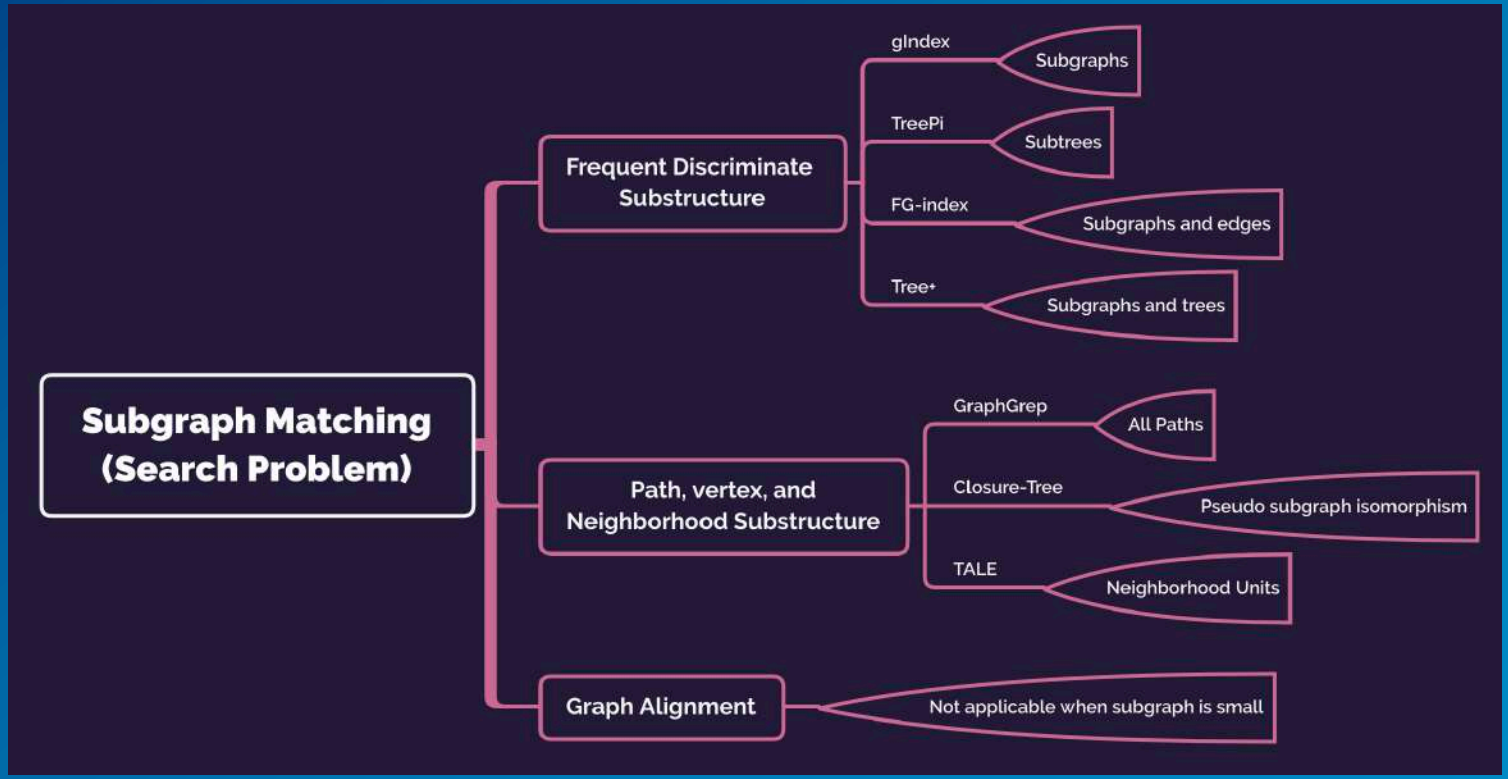
Current related works



Current related works



Current related works



Summary

Year	Author	Institution	Title	Scenario	Metrics	Model	Result
2016	Junchi Yan (严骏驰)	上海交大	A Short Survey of Recent Advances in Graph Matching	Multiple	-	-	-
2018 2015	Junchi Yan (严骏驰)	上海交大	(中文期刊) 计算机视觉中图匹配研究进展: 从二图匹配迈向多图匹配 (博士论文) 图匹配问题的研究和算法设计	Multiple	-	-	-
2004	Donatello Conte, Pasquale Foggia, and et al.	萨勒诺大学	Thirty Years Of Graph Matching In Pattern Recognition	Multiple	-	-	-
2018	Andrei Zanfir and Cristian Sminchisescu	隆德大学	Deep Learning of Graph Matching	Multiple, Computer Vision in particular	PCK: Percentage of Correct Keypoints PCK@10 pixels, PCK@0.05, PCK@0.1	Neural Network (CNNs)	MPI-Sintel: PCK@10 pixels: 92.6% CUB: PCK@0.05: 0.86 PASCAL VOC keypoints: PCK@0.1 (class average): 40.6
2009	Shijie Zhang, Shirong Li, and Jiong Yang	凯斯西储大学	GADDI: Distance Index based Subgraph Matching in Biological Networks	Biological Networks	Accuracy, Precision, Recall, Query Time	Distance Index based method	-

To do

- Continue to survey *subgraph matching*, especially those methods for biological networks
- Try to reproduce “Deep Learning of Graph Matching” and apply the algorithm into biological networks (graph matching)
  - See whether the method is suitable for *subgraph matching*
- Get engaged with knowledge graph and corresponding tasks.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