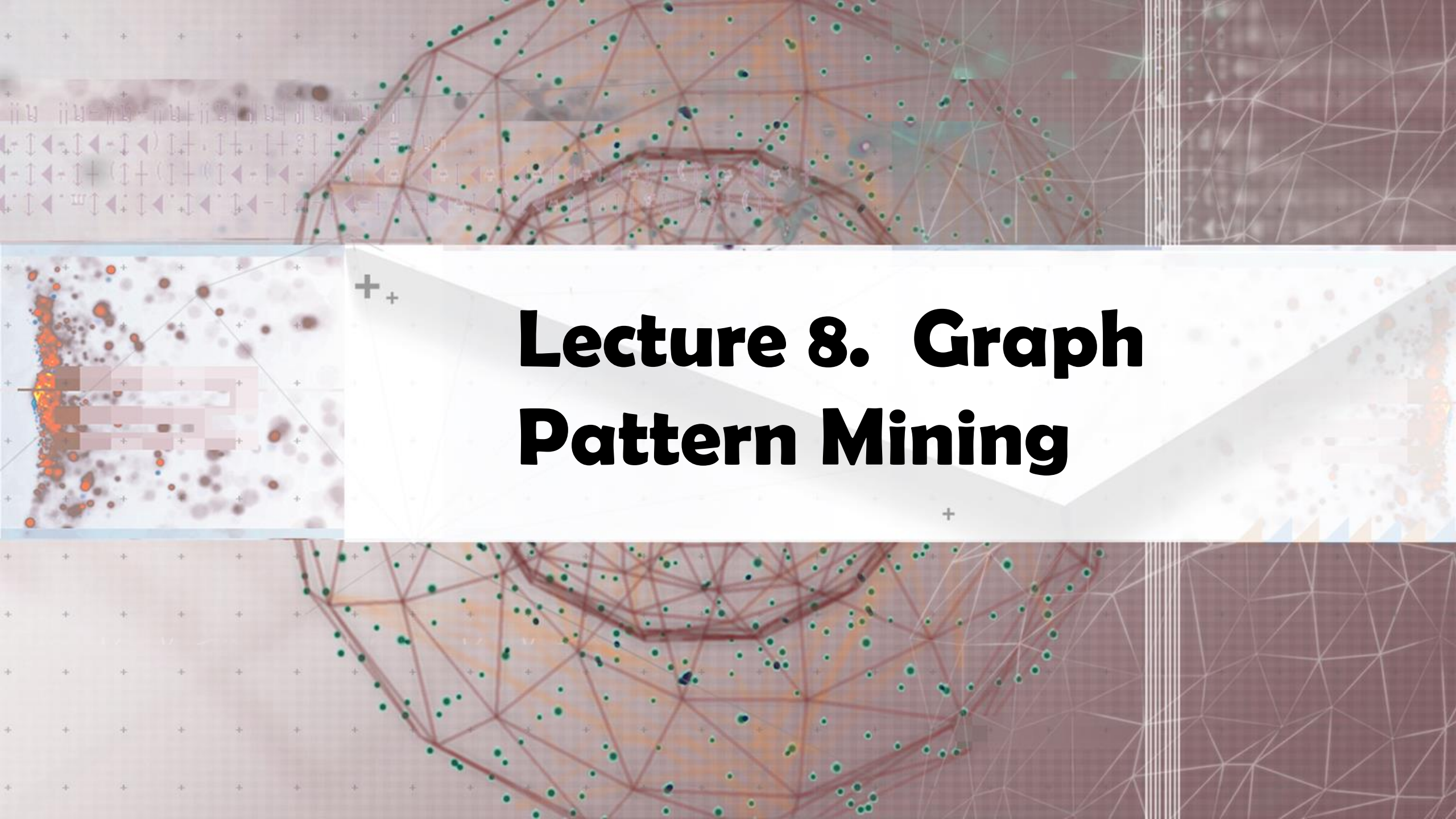

Lecture 8. Graph Pattern Mining

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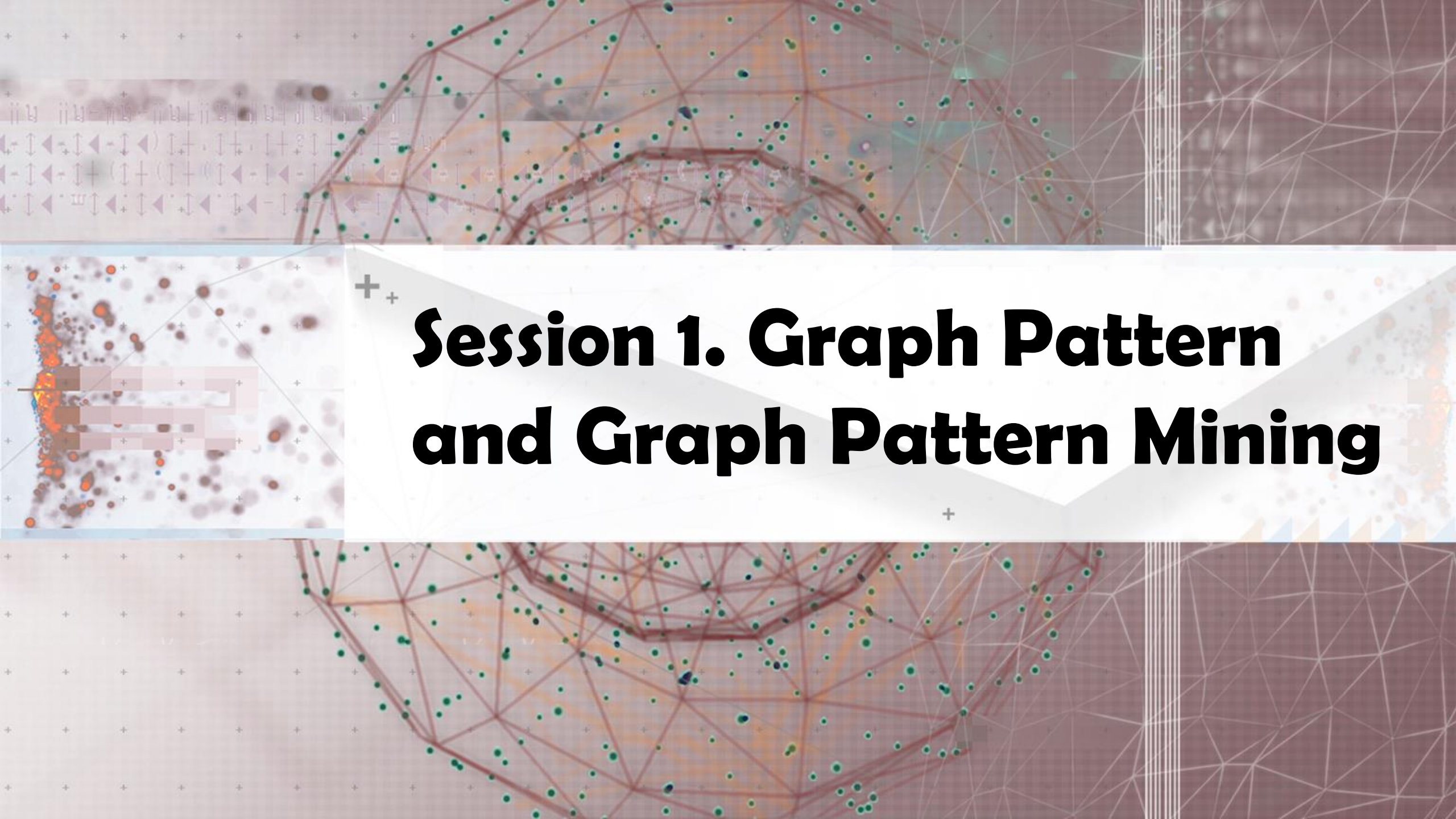
- Graph Pattern and Graph Pattern Mining
- Apriori-Based Graph Pattern Mining Methods
- gSpan: A Pattern-Growth-Based Method
- CloseGraph: Mining Closed Graph Patterns
- Graph Pattern Mining Application: Graph Indexing
- Mining Top-K Large Structural Patterns in a Massive Network

Thanks to Xifeng Yan@UCSB and Feida Zhu@SMU.SG for their contributions

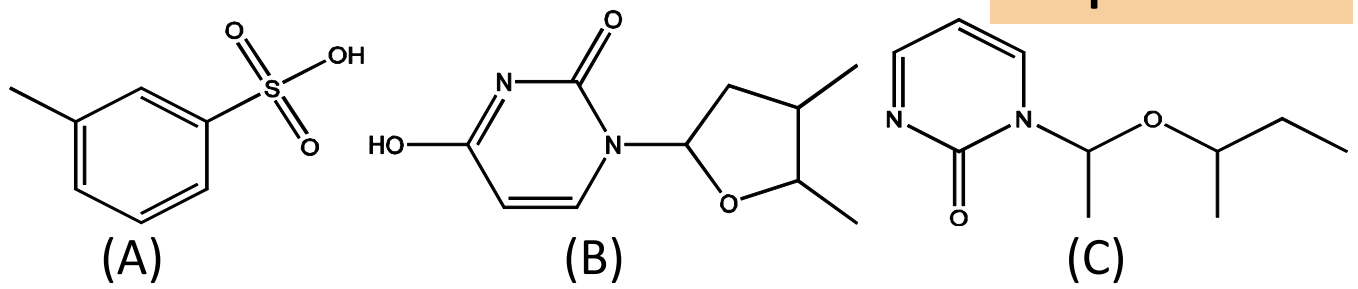


Session 1. Graph Pattern and Graph Pattern Mining

Frequent (Sub)Graph Patterns

- Given a labeled graph dataset D = {G_1, G_2, …, G_n), the supporting graph set of a subgraph *g* is D_g = {G_i | $g \subseteq G_i$, $G_i \in D$}.
  - support(*g*) = $|D_g|/|D|$
- A (sub)graph *g* is ***frequent*** if *support*(*g*) ≥ *min_sup*
- Ex.: Chemical structures
- Alternative:
  - Mining frequent subgraph patterns from a single large graph or network

Graph Dataset

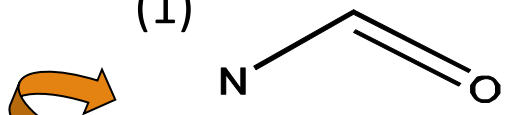


(A) (B) (C)

min_sup = 2

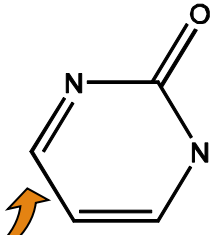
Frequent Graph Patterns

(1)



support = 67%

(2)



Applications of Graph Pattern Mining

- Bioinformatics
  - Gene networks, protein interactions, metabolic pathways
- Chem-informatics: Mining chemical compound structures
- Social networks, web communities, tweets, …
- Cell phone networks, computer networks, …
- Web graphs, XML structures, semantic Web, information networks
- Software engineering: program execution flow analysis
- Building blocks for graph classification, clustering, compression, comparison, and correlation analysis
- Graph indexing and graph similarity search

Graph Pattern Mining Algorithms: Different Methodologies

- Generation of candidate subgraphs
  - Apriori vs. pattern growth (e.g., FSG vs. gSpan)
- Search order
  - Breadth vs. depth
- Elimination of duplicate subgraphs
  - Passive vs. active (e.g., gSpan (Yan&Han'02))
- Support calculation
  - Store embeddings (e.g., GASTON (Nijssen&Kok'04, FFSM (Huan, et al.'03), MoFa (Borgelt and Berthold ICDM'02))
- Order of pattern discovery
  - Path → tree → graph (e.g., GASTON (Nijssen&Kok'04)