CS 58004: Graph Mining

Subject: CS Faculty: Faculty of Engineering and Natural Sciences
SU Credit: 3 , ECTS Credit: 10.00 / 10.00 ECTS
Instructor(s): Kubilay Atasu
Language of Instruction: English
Level of Course: Graduate
Planned Learning Activities: Task based learning

CONTENTS (Tentative)

This course focuses on advanced algorithms and methods for extracting patterns, relationships and insights from large graphs. The course covers the following topics:

1. Introduction
   - Graph data structures and graph databases
   - Paths, flows, fundamental graph algorithms
2. Mining Subgraph Patterns
   - Triangles, k-cores, k-trusses, cycles, cliques, frequent subgraphs
3. Subgraph Pattern Matching
   - Graph and subgraph isomorphism, approximate pattern matching
4. Nearest-Neighbors Search
5. Graph Centrality
   - Betweenness, closeness, eigenvector, PageRank
6. Spectral Graph Theory
   - Spectral clustering, Laplacian matrix, Graph Fourier Transform
7. Graph Similarity & Graph Kernels
8. Modularity Maximization & Influence Maximization
9. Graph Embeddings & Classification
   - Graph coarsening & Graph Neural Networks
   - Node classification, context embeddings, link prediction
10. Mapping Graph Algorithms to Linear Algebra
    - GraphBLAS

OBJECTIVE

This course aims to provide the students with a deep understanding of the most prominent graph mining algorithms, their scalable implementations, and their real-life applications.

LEARNING OUTCOME

Demonstrate deep knowledge of the fundamental graph mining algorithms and methods. Apply this knowledge to design effective solutions to real-life graph analytics problems. Show ability to develop efficient and scalable implementations of graph mining algorithms. Evaluate time-space and cost-performance tradeoffs in the design and implementation phases.
# ASSESSMENT METHODS AND GRADING (Tentative)

<table>
<thead>
<tr>
<th></th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examinations</td>
<td>40 (Written, oral, or both)</td>
</tr>
<tr>
<td>Programming HWs</td>
<td>30</td>
</tr>
<tr>
<td>Research Project</td>
<td>30</td>
</tr>
</tbody>
</table>