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
    - Graph and subgraph isomorphism, approximate pattern matching
3. Transportation Theory
4. Spectral Graph Theory
    - Spectral clustering, Laplacian matrix, Graph Fourier Transform
5. Graph Kernels
6. Node Embeddings
7. Graph Neural Networks
8. Graph Centrality
9. Community Detection
10. Mapping Graph Algorithms to Linear Algebra

REFERENCE BOOKS

Algorithm Design by Jon Kleinberg and Éva Tardos
Graph Algorithms: Practical Examples in Apache Spark and Neo4j by Mark Needham and Amy E. Hodler
Graph Representation Learning Book by William L. Hamilton

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)

	Percentage (%)
Examinations	40 (Written, oral, or both)
Homeworks	20
Research Project	40