CS 594 Graph Algorithms, Fall 2019, UIC
Syllabus
Instructor: Anastasios Sidiropoulos

Website. https://sidiropo.people.uic.edu/courses/2019_fall_cs594_graphalg/

Grading policy. The course will include homework assignments and a final project. The project will be completed in teams of either one or two students and will consist of either a paper presentation or the implementation and experimental evaluation of an algorithm. Each student will also be responsible for scribing for at least one lecture. The resulting notes should be formatted in latex and sent to the instructor at most one week after the lecture. All resulting lecture notes will be posted on the course website. The assignment of students to lectures will be posted on the course website. The final grade will be computed using the following formula: $0.3 \cdot (\text{scribe notes}) + 0.3 \cdot (\text{homework}) + 0.4 \cdot (\text{project})$.

Description. The course discusses fundamental problems and techniques in the rapidly evolving field of algorithmic graph theory. The topics that will be covered include:

Community detection: How to find well-connected subgraphs, with applications to the analysis of social networks.

Graph clustering: Algorithms for partitioning a graph, optimizing various connectivity objectives, such as spectral partitioning, min-cuts, sparsest-cuts, multiway-cuts, and so on.

Distances in graphs: Algorithmic methods for geometric problems in graphs, such as the Traveling Salesperson Problem, Minimum Spanning Trees, shortest paths, and so on.

Flows in graphs: Min-cut/max-flow duality, and its extensions to multi-commodity flows. Connections to the geometry of graphs, and applications to divide & conquer.

Graph compression: Methods for representing succinctly large graphs, such as spectral sparsifiers, vertex sparsifiers, graph spanners, and so on.

Algorithmic graph-minor theory: Dynamic programming on graphs via tree decompositions. Algorithms for graphs on surfaces.

Relevant textbooks.

- R. Ahuja, L. Magnanti, and J. Orlin, Network Flows: Theory, Algorithms, and Applications.
- B. Mohar and C. Thomassen, Graphs on Surfaces.

Description of the intended student audience: The course will be accessible to students with some knowledge of algorithms, graph theory, discrete mathematics, and probability theory. Programming experience is not necessary.