Syllabus Fall 2022

1. **Course number and name:** CSCI 7100 Algorithm Analysis

2. **Credits and contact hours:** 3 credit hours / 3 contact hours

3. **Instructor:** Bogdan Chlebus

4. **Textbook, supplemental materials:** "Introduction to Algorithms" by T.C. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein, Forth Edition.

   Earlier editions of the textbook will NOT do:
   we will cover new chapters that belong only to the fourth edition.

5. **Course information:**

   a. **Course description:**

      Advanced algorithm design and techniques. Advanced data structures: B-trees, operations on disjoint sets. Graph algorithms: representing graphs, traversing graphs, minimum spanning trees, shortest paths, maximum flows, matchings in bipartite graphs. Parallelism in algorithms. Online algorithms.

   b. **Prerequisites or co-requisites:** graduate standing

   c. **Core, elective:** core

6. **Goals for the course:**

   Students will be able to:

   - Understand and use the notions of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them to problem solving.
   - Demonstrate an understanding of methods of discrete mathematics in analysis of combinatorial algorithms.
   - Demonstrate an understanding of advanced methodologies to analyze combinatorial algorithms for correctness and performance.
   - Apply advanced techniques to design combinatorial algorithms.
   - Master combinatorial properties of graphs and trees and use these concepts in design of advanced data structures.
   - Prove asymptotic bounds on performance metrics of algorithms.

7. List of topics covered:

- Methods of discrete mathematics used in analysis of algorithms, including manipulation of finite sums, assessing asymptotic bounds on rate of growth of functions, and solving recurrences.

- Advanced methodologies to design and analyze combinatorial algorithms, including divide and conquer, amortized analysis, and competitiveness in online algorithms.

- Design and analysis of advanced data structures, including B-trees and data structures for disjoint sets.

- Design and analysis of graph algorithms, including representing graphs and traversing graphs.

- Advanced algorithms for selected optimization problems in networks, including minimum spanning trees, single-source shortest paths, all-pairs shortest paths, maximum flows, and matchings in bipartite graphs.

- Elements of algorithms for parallel processing, including multithreaded algorithms.

- Online algorithms and competitive analysis.

8. Grading:

There are six homework assignments and three take-home exams.

Homeworks contribute 50% towards the grades, and exams contribute 50% as well.

Grading is on a curve, which means it is relative, rather than based on absolute numerical thresholds or scales.

Grades are assigned depending on the final distribution of aggregate numerical scores.