

Parallel Algorithms

CSC 721

Course Syllabus

Spring 2023

Instructor: Dr. Grey Ballard

Email: ballard@wfu.edu

Office: Manchester 234

Office Hours: 11-12:15 Tues and 2-3:15 Thurs, or by drop-in or appointment

Class: 2:00–3:15 TR, Manchester 017

Required Text: *Algorithms* by Dasgupta, Papadimitriou, Vazirani (McGraw-Hill 2008)

Recommended Text: *Introduction to Algorithms* by Cormen, Leiserson, Rivest, and Stein (MIT Press 2022)

Course Schedule: <http://users.wfu.edu/ballard/teaching/CSC721/>

1 Course Description

Design and analysis of algorithms. Topics may include time and space complexity analysis, divide-and-conquer algorithms, the fast Fourier transform, NP-complete problems, and efficient algorithms for operations on lists, trees, graphs, and matrices.

Here are the big questions we'll tackle in this class:

Given an algorithm,

- is it correct?
- how long does it take?
- can we do any better?

Given a problem or computation, how do we come up with an efficient algorithm for solving it? What algorithmic techniques might be effective?

2 Learning Outcomes

By the end of this course, students should be able to:

1. analyze algorithms using asymptotic complexity analysis (Big-Oh and related notation);
2. prove correctness of algorithms using rigorous techniques such as mathematical induction and proof by contradiction;
3. design efficient algorithms for combinatorial problems, using approaches that include
 - divide and conquer,
 - dynamic programming,
 - greedy methods, and
 - parallelization;
4. identify NP-complete problems and devise strategies to deal with them.

This class is a graduate class, and there will be high demands of classroom preparedness and participation. I will assume that all students have taken an undergraduate algorithms course (an equivalent of CSC 301). Readings/videos for each lecture will be posted on the course schedule, and they will come from a variety of sources.

3 Projects

The project can be done individually or in groups of 2 and should either be connecting your research to topics in this class or digesting a topic of interest related to this class. The main output of the project is a report (in ACM format: <https://www.acm.org/publications/proceedings-template>) and a presentation to the class at the end of the semester. Potential topics include:

- Linear programming and the simplex method (Chapter 7 in DPV)
- Quantum algorithms (Chapter 10 in DPV)
- Maximum flow / minimum cut (Chapter 7 in DPV / Chapter 26 in CLRS)
- Computational geometry (Chapter 33 in CLRS)
- Cache complexity analysis
- Fast matrix multiplication
- Sublinear algorithms

In the case of topics covered by textbooks, the project must survey at least two research papers to highlight the original discoveries and/or recent advances in the area.

4 Lectures

Each student will present one lecture on a scheduled topic to the class. The day and topic will be planned in advance, and the student should meet with me to discuss the plan around a week before the day of the lecture. The lecture should include slides with stated learning objective(s) and be interactive, including in-class exercises and/or group work. The student will also contribute one homework problem to the assignment for that unit.

5 Assessment and Grading

Course grades are determined using the following weightings:

- 60% assignments
- 20% lecture
- 20% project

Letter grades are assigned based on the following categorization:

A	93 or above	C	73–76.99
A⁻	90–92.99	C⁻	70–72.99
B⁺	87–89.99	D⁺	67–69.99
B	83–86.99	D	63–66.99
B⁻	80–82.99	D⁻	60–62.99
C⁺	77–79.99	F	below 60

6 Contacting Me

In general, email is the best way to reach me, and I'm happy to take questions over email. The easiest way to find me in person is to stop by my office during office hours, though please feel free to drop by any time. If you want to be sure to find me then you can also email ahead to schedule a time; it helps to propose a few times that work for you so that I can choose one that works for me too.

7 Emergency Preparedness Policy

In the event of a major disruption of normal university activities (such as might result from a health emergency or other disaster), a course continuation contingency plan will be enacted in order to allow completion of the course. During this time, students should continue with the reading and other assignments listed on the syllabus and monitor email, Canvas, and the WFU website for information. If students have questions or are in doubt about how to proceed, they should contact the instructor by email if available, otherwise they should contact by phone.

8 Center for Learning, Access, and Student Success

Wake Forest University provides reasonable accommodations to students with disabilities. If you are in need of an accommodation, then please contact me privately as early in the term as possible. Retroactive accommodations will not be provided. Students requiring accommodations must also consult the Center for Learning, Access, and Student Success (118 Reynolda Hall, 336-758-5929, class.wfu.edu).

9 Grievance Procedure

For complaints in the academic (i.e., classroom) setting, the student should talk personally with or send a written complaint explaining the concern directly to the instructor. Should the student and instructor be unable to resolve the conflict, the student may then turn to the chair of the involved department (in the Wake Forest School of Business, this would be the dean) for assistance. The chair (or dean) will communicate with both parties, seek to understand their individual perspectives, and within a reasonable time, reach a conclusion and share it with both parties. If the student's complaint is not resolved by these procedures, the student should consult with the Office of Academic Advising for assistance. The Associate Dean for Academic Advising will consult with the parties to obtain a resolution. Finally, a student may appeal to the Committee on Academic Affairs which will study the matter, taking input from all parties, and reach a final decision concerning resolution. <https://bulletin.wfu.edu/undergraduate/wake-forest-college/student-complaints/>