CSE4/529: Algorithms for Modern Computing Systems

Fall 2021

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Read this before sending e-mail to miller@buffalo.edu

Overview: This course is concerned with the design, analysis, and implementation of algorithms for sequential and parallel models of computation. Traditional algorithmic techniques, including divide-and-conquer, will be discussed. Models of computation include the traditional RAM, as well as standard parallel models, including the shared-memory PRAM, as well as networked models configured as arrays, rings, meshes, hypercubes, and pyramids. We also consider innovative parallel models that involve dynamic reconfiguration. In addition, we discuss algorithmic strategies for Network of Workstations, clusters, grids, and clouds. Problem domains include computational geometry, graph theory, image analysis, sorting, and searching. Time, space, and processor complexity of solutions to problems are a critical component to the course.

Changes for Fall 2021: I have been teaching this course for 35+ years. It was originally labeled CS4/531 and then CSE4/531. In 2013, it was relabled as CSE4/529 to distinguish it from a traditional course in algorithms, which retained the label of CSE4/531, and to allow students to take both a course in algorithms for modern compute systems and a course in traditional sequential algorithms. Last year, the balance was approximately 50:50 in terms of undergraduate students:graduate students.

Unfortunately, the objectives, pace, and level of detail of CSE429 and CSE529 are quite different. Since the Department of Computer Science and Engineering will not teach distinct CSE429 and CSE529 courses, it is important to note that in **Fall of 2021, CSE4/529 will be taught as an undergraduate course** for the first time. Graduate students are welcome to enroll in the CSE529 component of the course. Further, while graduate students will take the same course, they will be graded on a different scale. Note that in the past, this course was taught as a graduate course that undergraduates were able to take (and were graded on a different scale from the graduate students).

COVID-19 Concern: As of now, SUNY plans to have classes taught in person, subject to appropriate health guidelines. If it is determined that the course will be taught in an on-line fashion, then the following will be observed.

The course may be presented as a synchronous on-line course via Zoom. **I will not be recording lectures (you are not permitted to record audio or video of lectures).** Please do not register for this course if taking such a course is problematic.

- We meet on-line via UB's Zoom system.
- Our success as an online class will depend on the same commitment that we bring to a face-to-face class.
- We will adopt the same norms as a face-to-face class: take notes; participate by asking and answering questions; wear classroom-ready clothing; show respect for your fellow students, the professor, the department, and the university.
- For everyone's benefit, join the course in a quiet place whenever possible.
- Turn on your video whenever possible.
- Mute your microphone unless you are speaking.
- If you want to contribute, please unmute your mic and speak clearly. Alternatively, use the Chat area, but note that chat is difficult to follow while lecturing.
- Close browser tabs not required for participating in class. `

Prerequisites: Calculus I, Calculus II, Discrete Structures, and a course in *Advanced Data Structures*. Students are responsible for the material in chapters 1-13 of *Introduction to Algorithms*, by Cormen, Leiserson, and Rivest. This includes asymptotic notation, recurrence equations, and quicksort. In addition, students are also responsible for pointers, lists, stacks, queues, binary trees, and balanced trees (e.g., AVL, Red/Black, B-trees).

Lecture: TTh, afternoon, TBD.

Important University Information:

- All undergraduate students should read the Undergraduate Educational Affairs Syllabus.
- All graduate students should read the Graduate Course Syllabi Guidelines.

- **Important Dates**

  - Exam I (tentatively set for in-class during class time): Thursday, October 7
  - Exam II (tentatively set for in-class during class time): Thursday, November 18
  - **No Class:** Tuesday, November 23
  - Last Day of Classes: Dec 10
  - Final Exam: TBD

- **Important Information**

  - **Plagiarism** in any way, shape, or form, including obtaining an unauthorized copy of the book, will earn you an **F in the course**. In addition, other sanctions may be sought, including, but not limited to, being **dismissed from the university**. Feel free to review the departmental policy and university policy on plagiarism and academic integrity.
  - **Lectures may *not* be recorded. This includes, but is not limited to, video and audio recording.**
  - CSE4/529 will be taught as an ungraduate-level course in algorithms for modern computing systems. Note: This is new for Fall 2021.
  - There will be no programming projects in this class.
  - Class attendance is *required*.
  - There will be no makeup exams.
  - If you have a medical issue, documentation is required.
  - If you have a conflict with the final exam, you must handle the situation in terms of making

arrangements in your other class(es).
- This will be a paper and pencil course. There will be **no programming assignments**.
- Introduction to Asymptotic Notation
- **Learning Outcome** (Middle States Accreditation): Ability to understand the fundamental principles of the field of Analysis of Algorithms.

Optional Reading Material:

- *Algorithms Sequential & Parallel (Third Edition)*, R. Miller and L. Boxer, Cengage Learning, 2013.
- Historically, students recommend reading the material in the book prior to attending lectures. The majority of students who do well in the course state that they read the book prior to attending class.

Projected Order of Material:

- NB: Students responsible for Chapts 1-3
- Asymptotic Analysis
- Divide-and-Conquer (Chapt 9)
- Intro to Parallel Algorithms and Architectures (Chapt 4)
- Combinational Circuits and Sorting Networks (Chapt 5)
- Parallel Prefix (Chapt 7)

Succeeding in this course (student view): Students consistently state that the following is key to success in this class.

- Work on the course an hour or so per day, seven days/week. Don't let this course slide!.
- Read the material thoroughly prior to lecture.
- Attend lecture, pay attention, take notes by hand, participate.
- Transcribe notes daily. Do/create practice problems.
- Spend time with the TAs at least once a week. Be prepared. Work through problems and/or discuss areas of confusion.

Piazza: TBD

Grading Policy:

1. Graded Materials
    - CSE429
        - A maximum of 1 point per week (10 points maximum) for attending a TAs office hour and having a significant discussion with the TA on CSE429 material: 10% of your grade.
        - Midterm I: 25% of your grade.
        - Midterm II: 30% of your grade.
        - Final Exam: 35% of your grade.
        - Extra Credit: Minimum of 6 points, presented in no guaranteed distribution, over the exams.
    - CSE529
        - Midterm I: 30% of your grade.
        - Midterm II: 30% of your grade.
        - Final Exam: 40% of your grade.

        - Extra Credit: Minimum of 6 points, presented in no guaranteed distribution, over the exams.
2. Course Grades
    - CSE 429 Final Letter Grades. These are the final "curved" grades. These numbers include the additional bonus points (i.e., there will be more than 100 points available in the course). There will be "+"s and "-"s that will be determined after the numeric grading for the semester is complete.
        - A: 75+
        - B: 60+
        - C: 50+
        - D: 35+
        - F: <35
    - CSE 529 Final Letter Grades. These are the final "curved" grades. These numbers include the additional bonus points (i.e., there will be more than 100 points available in the course). There will be "+"s and "-"s that will be determined after the numeric grading for the semester is complete.
        - A: 85+
        - B: 75+
        - C: 60+
        - D: 50+
        - F: <50
3. Sample Exams (Midterms only)
    - 2013 Midterm I
    - 2013 Midterm II
    - 2014 Midterm I
    - 2014 Midterm II
    - 2015 Midterm I
    - 2015 Midterm II
    - 2016 Midterm I
    - 2016 Midterm II
    - 2017 Midterm I
    - 2017 Midterm II
    - 2018 Midterm I
    - 2018 Midterm II
    - 2019 Spring Midterm I
    - 2019 Spring Midterm II
    - 2019 Fall Midterm I
    - 2019 Fall Midterm II
    - 2020 Fall Midterm I
    - 2020 Fall Midterm II

- **Personnel**
    - **Dr. Russ Miller**
        - Office Hours: TTh, after class & by appointment

Disclaimer: *I reserve the right to change any part of this tentative syllabus at any time.*
