

**Course Announcement**  
**CS 39000ATA: Analysis and Theory of Algorithms**  
**Fall 2023, 3 credits**

CS 39000ATA is a faster-paced, proof-oriented version of CS 38100 offered to CS, DS and AI majors with a strong theoretical computer science interest. The course covers the topics of CS 38100 as well as advanced algorithm topics not covered in CS 38100. The course has a stronger focus on problem-solving, proofs, and algorithmic creativity.

The 3-credit course counts as fulfilling the CS 38100 course requirement. Students who already have taken CS 38100 can take the course for credit, but cannot count the course as an elective for one of their concentrations.

**Course material**

- Growth of functions; asymptotic analysis; recurrences
- Divide and conquer
  - QuickSort, QuickSelect, Fourier transforms
- Dynamic programming
- Greedy algorithms
  - Dijkstra's algorithm, Stable matching, spanning tree
  - Information compression
- Advanced data structures
  - Augmented self-balancing binary search trees
  - Competitive analysis
- Randomized algorithms
- Linear programming
  - Duality and the minimax theorem; convex optimization
  - Max flow/min cut
- Lower bound techniques and problem reductions
- NP-completeness
- Approximation algorithms
- Selected topics chosen from online learning, interactive proofs, algorithms on large graphs/social networks, parallel/high-performance computation, quantum computing.

CS 39000ATA has the same course prerequisites as CS 38100: CS 25100 and MATH 26100. A strong grasp of CS 25100 and CS 18200 material is expected.

CS, DS and AI majors with a combined GPA of at least 3.6 in CS 25100 and CS 18200 are eligible to enroll. The course will provide a small enrollment environment allowing in-class discussions and short student presentations. The course will have weekly lectures and PSOs. Course work includes homeworks, one midterm, and a final exam.

Students who should consider taking CS39000ATA include those in the Algorithmic Foundations Track, having completed competitive programming courses, involved in theoretical CS research, planning to pursue graduate school, or enrolled in an Honors program.

Expected Instructor: Paul Valiant