• Originally taught by Donald Knuth at Stanford in the 1970s
• Later taught by Ken Ross at Columbia since 1999
• Taught by Swapneel Sheth and Chris Murphy at Penn since 2013
• Taught by Dennis Shasha at NYU since 2001
• NO exams
• NO homework
• NO (expensive) textbooks
• NO lectures
• 4 open-ended projects

• No “correct” answers
WHAT IS COMPUTER SCIENCE?

Computer Science is an activity in which we create, implement, analyze, and communicate solutions to algorithmic problems.
EDUCATIONAL OBJECTIVES

• Emphasize four aspects of problem solving:
  - Create/Think about an approach (develop intuition, identify algorithms, data structures)
  - Implement a solution (programming, reuse and modify code, team collaboration)
  - Analyze the results (understand behavior)
  - Communicate your solution to others (group discussion, written reports, presentation, incorporate feedback from others)
EDUCATIONAL OBJECTIVES (2)

- Using Bloom's taxonomy:
  - A lot of courses focus on “knowledge” and “comprehension”
  - This course focuses on “analysis,” “synthesis,” and “evaluation”
- Problem-Based Learning (PBL)
COURSE DETAILS

• Intended Audience
  - Upperclassmen and graduate students
  - Prerequisites: Data Structures, Algorithms, 2+ years of programming experience
  - Recommended: Machine Learning, Artificial Intelligence, etc.

• Class Size and Teams
  - 20-30 students; teams of size 3-4
  - New teams for each project; two students cannot work together more than once
COURSE DETAILS (2)

• Course Structure

- 4 projects, roughly 3 weeks each
- Start: introduce problem; provide simulator, GUI, API; team formation
- Students work with their groups outside of class time
- Subsequent Class Meetings: discuss students’ insights and ideas; demonstrate progress; demos; cooperative problem solving
- End: Tournaments run by TA
COURSE DETAILS (3)

• Open Source Nature
  - Steal other people’s ideas/code!
  - But you must attribute/cite it

• Communication and Presentation
  - Final report containing details of solution, analysis of approach, overview of implementation, analysis of tournament results
  - 10 minute presentation in class
 COURSE DETAILS (4)

• Evaluation and Grades
  - Novelty of Approach
  - Correctness, Generality, and Efficiency of the solution
  - Thoroughness and Clarity of report and presentation
  - Class participation (attendance is mandatory!)
  - Peer Evaluations
PROBLEM 1 - PARALLEL SOCCER
PROBLEM 2 - ORGANISMS
PROBLEM 3 - GUNSLINGER
PROBLEM 4 - MOSQUITO
DEMO
OUTCOMES

• The class has been taught 35+ times across 3 institutions by the authors

• More details in the paper
WANT TO ADOPT THIS COURSE?

• Recommendations and Advice
  - Teaching the class; What makes a good problem?

• Repository of Existing Problems available
  - Three different sets of problems maintained at the three institutions
  - 85+ problems available
  - For all problems - code, GUI, simulators available