

CS-390/CS-590 Course Syllabus

Learning and Teaching Computer Science for All

A Teacher Professional Development class

Course Description

CS-390/590 is a course designed for New Mexico high school science and mathematics teachers or prospective teachers who want to gain the skills necessary to teach an advanced placement, computer concepts course. In particular, CS-390/590 prepares teachers to be in-school, local lab instructors for UNM's dual-enrollment computer concepts course CS-108L, "Computer Science for All".

Both CS-390/590 and CS-108L offer an introduction to computer science through modeling and simulation. Students will learn agent-based modeling of complex systems, see the applicability of computer science across fields and discuss some of the "great ideas" in computer science. Neither course fulfills the computer science course requirements for a <i>major</i> in computer science.

CS-390 and CS-108 count as undergraduate elective credit for non-computer science majors.

CS-590 counts as graduate elective credit for non-computer science majors. CS-590 requires a significantly more extensive final project than CS-390. Otherwise, the courses are the same.

CS-108L is designed as a dual-enrollment course. This means that it can be taken by UNM students for collage credit and by New Mexico high school students for both high school and college credit.

CS-390/590 is a fully on-line course.

CS-108L is a hybrid course with the "lecture" part of the course taught on-line by UNM professors and the lab part of the course taught in-person at both UNM classrooms and across the state in participating high schools.

In CS-390, CS-590 and CS-108L computer programming exercises and activities will use NetLogo, an agent-based modeling environment. Students will become familiar with the iterative design, build, and test development cycle common to computer science and engineering. Students will learn computer science constructs, processes, and tools while creating models of local phenomena as complex systems. Students will learn and use mathematics relevant to modeling and simulation such as probability and statistics, and data analysis. The course also introduces the "great ideas" in computer science that impact our daily lives. In addition to modeling and simulation, algorithms for search engine page ranking, pattern recognition, and data compression will be used to demonstrate the impacts of computer science and the range of applicability of computer science to society.

CS-390/CS-590 covers research-based strategies and techniques to recruit and retain students in computer science, and to engage students during hands-on laboratory based computer science based exercises and project work involving computer programming.

Textbooks

This course will be using a number of free on-line references. The three primary such resources will be:

- 1) Northwestern University's NetLogo Documentation on the web at:
<http://ccl.northwestern.edu/netlogo/index.shtml>
- 2) The community created NetLogo Wiki on the web at:
http://backspaces.net/wiki/NetLogo_Tutorial
- 3) Excerpts from the book "Blown to Bits" This book is available as a free download at bitsbook.com.

Grading

Each student's final course grade is computed as weighted average of seven components:

- 1) Quizzes and Assignments: 15%.
- 2) Blog: 15%.
- 3) Midterm exam: 15%.
- 4) Midterm project: 15%.
- 5) Discussion: 5%.
- 6) Final exam: 20%.
- 7) Final project: 15% (different requirements for CS-390 verses CS-590).

Letter Grade Score Ranges							
>100%	A+		93 - 100%	A		90 - 92%	A-
87 - 89%	B+		83 - 86%	B		80 - 82%	B-
77 - 79%	C+		73 - 76%	C		70 - 72%	C-
67 - 69%	D+		60 - 66%	D		50 - 59%	D-
			< 50%	F			

Syllabus

Week 1: NetLogo: agent based modeling paradigm, interface, commands and windows

CS construct: Looping and simple movement commands

Great ideas: Abstraction, modeling and simulation

Pedagogy: Recruiting students to computer science

Week 2: NetLogo: agents impacting environment

CS constructs: loops, conditionals and expressions

Great ideas: CS in biology, medicine, games and movies.

Pedagogy: Recruiting students to computer science

Week 3: NetLogo: agents reacting to their environment

CS constructs: variables, conditionals, evaluation of expressions

Great ideas: CS in earth sciences, social sciences.

Pedagogy: Best practice to engage students in computer science

Week 4: NetLogo: agents interacting with other agents

CS constructs: functional decomposition, procedures/functions, and variables.
Great ideas: Social and Societal impacts of CS
Pedagogy: Best practice to engage students in computer science

Week 5: NetLogo: instrumenting your model, capturing output from models
CS constructs: lists and list manipulations
Great ideas: Networks, the internet, indexing and page rank?
Pedagogy: The flipped classroom

Week 6: NetLogo: populations with births and deaths
CS constructs: recursion, writing algorithms for more complex agent behaviors
Great Ideas: Emergence in complex systems
Pedagogy: The flipped classroom

Week 7: NetLogo: running experiments, parameter sweeping
Math for Modelers and Data analysis
CS constructs: automation and analysis
Great ideas: Using computational models in scientific investigations
Pedagogy: Peer instruction techniques

Week 8: Midterm Exam (During regular lab class)
Midterm project due

Week 9: NetLogo: more agent behaviors, finding neighbors
CS: lists, searching and sorting algorithms
Great Ideas: Big Data
Pedagogy: Peer instruction techniques

Week 10: NetLogo: more agent behaviors, hill climbing 101
CS: nesting constructs
Great Ideas: Artificial Life
Pedagogy: Assessing student learning

Week 11: NetLogo: more agent behaviors, agent perception
CS: image compression algorithms
Great Ideas: Computer graphics

Pedagogy: Retaining student interest in computer science

Week 12: NetLogo: more agent behaviors, agent memory and decision making
CS: Adaptation
Great Ideas: Artificial intelligence
Pedagogy: Assessing student learning

Week 13: Form Groups
CS: Parallel and Distributed computing
Great ideas: Limits of computing

Week 14: Project Work

Pedagogy: Pathways to computing careers

Week 15: Project Work

Pedagogy: Pathways to computing careers

Week 16: Final presentations of project work / Hill climbing competition

Written Final Exam