

Computer Science Honors Capstone Program
198:495 – Fall 2022
198:496 – Spring 2023

Coordinator: Sesh Venugopal
Course Modality: In Person
Prerequisites: Senior CS major, approval by faculty mentor
Meeting Times: TBD
Office Hours: TBD, after meeting times are determined
Email: sesh.venugopal@rutgers.edu

Course Description

This course is a capstone program for our undergraduate honors students. The program will run through the academic year, with one course each in the fall and spring semesters. Each course will carry 3 credits, for a program total of 6 credits.

Students will work on projects that are oriented toward research and new ideas. A project could forge a new direction that is outside the scope of our course offerings, with a software component to test ideas. Alternatively, a project could be a theoretical research investigation without any software component. Whatever the structure of a project, the emphasis will be on a strong investigative component.

Students can work individually or in groups. Having students to work in groups of 2-3 is appropriate for projects that involve building proof-of-concept application software, and allows us to scale to a larger cohort of interested students.

For certain aspects of the class, student work will be evaluated by the CS UG Honors Committee as well as by the course instructor and project mentor.

Learning Objectives

Project Definition

Students can define their project topic, scope, directions, goals, and result. They can place their problem in the context of state of the research or practice in the field. Students can work backward from the result to establish periodic milestones and timelines toward the result.

Project Exposition

Students can identify and survey literature that is most closely related to their area of work, and extract canonical results, knowledge, or state of practice from the survey.

Students can write about their project at various levels: summarize the project in a “one-sheet”; describe the functional scope of their work linking all components together and their relation to existing work in the area; detail their approach to exploring each component. They can write a complete technical paper that narrates their work from start to end.

Students can put together an oral presentation of their work at the functional level of scope, components, and their relation to existing work in the area, as well as describe in detail their approach to any

component of their project. For projects that build software, student can do a live demo of their application.

Students can critique the verbal and written exposition or demo of their own or other projects.

Project Evaluation

Students can define metrics for the evaluation of project completion milestones for each component of their project in relation to the pre-established goals including scope and functionality of each component. If they are building an application, they can build a suite of test cases that establish the correctness of their implementation.

Students can assess whether their results meet the goals they have established and can explain any shortcomings in terms of needs for additional resources, time, or technical development.

Collaborative Work

Students can apportion work with collaborators based on equity of division, personal interest in one or more aspects of the work, and agreement of everyone in the group on the work split.

Students can determine how their share of the work links to that of the collaborators, and how to integrate individually developed work components into the whole.

Students can adapt to differences in work schedules between collaborators.

Students can engage in constructive discussion with collaborators on shortcomings in each other's work that may jeopardize the project as a whole, and find ways to work through such issues.

Career in CS Research

Students can describe the kinds of work computer scientists undertake in a research field, whether in academia or industry. They can understand the process of obtaining funding, establishing research collaborations, and identifying fruitful areas of work. Students can describe the benefits and challenges of research as a career and identity

Text/Resources

No required text.

Content for pedagogical aspects of the course will be made available online.

Here are a few sample references:

Project Definition

[Project Definition Guidelines and Examples](#)

[Project Definition](#)

Collaboration

[Collaborative Teamwork](#)

[Building the Perfect Team](#)

[In Science Today a Genius Never Works Alone](#)

Computing and Code Management

[Version Control with Git\(Hub\)](#)

[Version Control with Git \(Free Udacity Course\)](#)

[Git Tutorials](#)

[What is Cloud Computing](#)

[Cloud Computing for Science and Engineering](#)

Technical Writing in Computer Science

[Why Every Developer Should Know a Bit of Technical Writing](#)

[Technical Writing: Tips for CS Students](#)

[Writing a \(Computer Science\) Paper](#)

Academic Presentations

[How to Make Academic Presentations](#)

[How to Give a Technical Presentation/Scientific Talk](#)

[How to Avoid Death by Powerpoint](#)

Literature Review

[Computer Science Literature Review Report](#)

[Write a Literature Review](#)

[Computer Science Literature Review](#)

[Simple Rules for Writing Literature Review](#)

Career in CS Research

[What Does a Computer Research Scientist Do?](#)

[Can Technology End Poverty?](#)

[Tussles in Cyberspace: Defining Tomorrow's Internet](#)

[Why I'm Leaving Harvard](#)

In addition to general pedagogical content as above, faculty project mentors might assign readings specific to the project area.

Coursework Requirements

Fall Semester

Students will meet at least once a week with the coordinator to get instructions and direction on getting their projects underway and maintaining progress toward writing and presenting a full project proposal.

Students will be required to have their full project proposal ready in mid-November. The full proposal will consist of the following components: why this project, what are the objectives, what is the approach, what is the work done so far, and what is the timeline for achieving the objectives through the spring semester. One or more class meetings will be used for students to present their proposals.

The UG Honors Committee will evaluate each full proposal and determine whether a project is feasible to be continued into the spring semester. Students can begin to work on accepted projects as soon as they are greenlighted.

Spring semester

Students will work actively on their projects.

At meetings with the coordinator in class at least once a week, as well as outside, students will get direction from the coordinator in making progress with their work, assessing the need for and setting up meetings with their mentors, and specific guidance and support on the usage of computing and other resources.

In the first week of April, over multiple class meetings students will present their work to the UG Honors committee. They will also submit, by April 10, a thesis report of an acceptable length to be determined by their faculty mentor.

Grade Evaluation

Fall Semester

Work done through the semester: 30%

Development of 1-2 pages project overview: 5%

Regular progress in reviewing state of research/practice in project area: 10%

Regular progress in putting together project approach & methods: 10%

Class presentations on above: 5%

For group projects each student in the group will be separately assessed for class presentations credit.

One-sheet Project Summary - Topic, Context, Directions, and Goals: 5%

Oral Presentation of Proposal: 5%

For group projects each student in the group will present a part of the proposal, and will be separately assessed for credit.

Full Project Proposal Submission to Honors Committee: 60%

This is a 10-15-page double-spaced report.

Grade for the full project proposal is based on the following rubric:

Project Definition	15%
<i>Topic of project:</i> Is the topic well defined and understandable	2%
<i>Project in context of state of the research or practice:</i> Where does the project sit in relation to current work in the area? Does it complement or extend work? How novel is the project idea? What is the creativity and potential impact of the project idea?	5%
<i>Directions of exploration:</i> Are the directions of exploration meaningful? Do they differ adequately from existing work, or if not, do they indicate greater depth than existing work?	5%
<i>Goals:</i> What are the goals of the exploration? What are proposed termination points?	3%

Project Exposition	30%
<i>Context:</i> Identification and enumeration of literature/systems/frameworks that supply context and related work for the project. Are citations done with clarity and completeness?	10%
<i>Functional scope of project:</i> what are the components of exploration, how do they add up to the whole, what are the details of the paths of exploration in each component?	10%
<i>Work so far:</i> What is the work done so far in the areas of the exploration? What resources (computing, data storage, etc.) were used in the work so far, and what additional resources will be	10%

required to complete the project? For group projects, 5% for group, 5% for individual: 1. How is the work distributed between members of the group? 2. What is the work done so far by each member of the group? Individual credit of 5% will be given for this part	
---	--

Project Evaluation	15%
<i>Feasibility:</i> How feasible are the project goals, evaluated on the basis of work done so far toward the goals?	8%
<i>Verification:</i> How will results be evaluated for correctness/completeness and divergence if any from established goals?	7%

Spring Semester

Written and oral presentations through the semester: 30%

Technical writing sample: 10%

Midterm progress report: 10%

Mock oral project presentation/demo: 10%

For group projects, each student in the group will be separately assessed for technical writing and mock oral presentation/demo credit.

Final Oral Presentation to Honors Committee: 10%

For group projects, each student in the group will present a part of the project and will be separately assessed for credit.

Final Report Submission to Honors Committee: 60%

This is a 25-30-page double-spaced report.

For group projects: 50% credit for group, 10% for each individual in group:

Each student is required to separately write a 8-10-page double-spaced report that will detail their individual contribution in some of the areas of the final group report detailed in the rubric below. It will also present their personal perspective on goals, directions of exploration, results, and retrospective analysis presented in the final group report – in effect, what would they have done differently if they were to start over? A portion of the credit for some of the rubric items will be given out individually, adding up to 10% of course credit – the breakdown is shown in the rubric below.

Following is the grading rubric:

<i>Introduction:</i> Topic and scope including areas of exploration and goals (For group project, the group report is worth 3% and each individual report is worth 2%)	5%
<i>Context:</i> Existing work in the area	5%
<i>Core Work:</i> Detailed description of all components of project (For group project, the group report is worth 25% and each individual report is worth 6%)	30%
<i>Results:</i> Interpretation of results and findings in each area of exploration	10%
<i>Contribution to area:</i> How does the finished work complement/extend existing work, and how does it contribute to the topic area as a whole?	5%
<i>Retrospective analysis:</i> What areas of exploration were successful, which ones were middling, which ones were dead ends, and why? To what extent were each of the project goals met?	5%

What were the reasons for gaps, if any, between finished work and the goals laid out in the proposal? (For group project, the group report is worth 3% and each individual report is worth 2%)	
--	--

The UG Honors Committee will make decisions to place projects in one of the following ranks: honors, high honors, or highest honors. The committee will also take into consideration the capstone project work to nominate students for the SAS Henry Rutgers Scholarship.

Syllabus

Fall Semester

Weeks 1,2: Students present high level idea for project.

Weeks 3,4: Pedagogy and interactive discussions for problem definition. Defining project topic, scope, investigative components, and goals. Discussion to establish milestones and timelines toward the project goals and apportioning of work for project groups.

Weeks 5,6: Pedagogy and discussion on literature review in project area, distilling and summarizing findings, relating project to state of research or practice in the project area.

Weeks 7,8: Students submit draft of project proposal including problem definition and details of collaboration if working in group. Students present project outline in class, and critique each other's proposals.

Weeks 9,10: Pedagogy for delineating LCSR computing resources and collaborative tools for code management. Pedagogy and discussion of various software services including cloud computing and storage engines.

Weeks 11,12: Students get assistance and mentoring as they work with toward finishing up the full project proposal with detailed problem definition, objectives, work done so far, timelines for milestones toward end results.

Weeks 13,14: Students present full proposal to UG committee.

Spring Semester

Weeks 1,2,3: Pedagogy on technical writing for various kinds of audiences. Students present writing samples and learn to critique each other's work.

Weeks 4,5,6: Discussion on collaborative work, dealing with various interpersonal aspects including work styles and times, agreeing on a communication channel for short and long messages. Apportioning work, establishing APIs for distributed software development, setting deadlines. Students present the collaboration process in their group.

Weeks 7,8: Students present progress, issues, addressing slippage in time toward project completion, planning on timelines and work schedule to finish project. Students submit a dry run of work-in-progress thesis report.

Week 9: Discussion of career in CS research.

Weeks 10: Students do mock presentations and demos to get feedback to help them work out kinks toward the final submission.

Week 11: Students work toward submission of their final thesis report and do an oral presentation of their project to the UG Honors Committee. The final thesis report will be submitted by April 10.

Academic Integrity Policies

Rutgers University regards acts of dishonesty (e.g. plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) as serious offenses against the values of intellectual honesty. These policies are detailed here:

<https://nbprovost.rutgers.edu/academic-integrity-students>

In addition, the Computer Science departments has established policies for academic integrity that pertain specifically to programming assignments:

<https://www.cs.rutgers.edu/academics/undergraduate/academic-integrity-policy/programming-assignments>

Rutgers CS Diversity and Inclusion Statement

Rutgers Computer Science Department is committed to creating a consciously anti-racist, inclusive community that welcomes diversity in various dimensions (e.g., race, national origin, gender, sexuality, disability status, class, or religious beliefs). We will not tolerate micro-aggressions and discrimination that creates a hostile atmosphere in the class and/or threatens the well-being of our students. We will continuously strive to create a safe learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Our goal is to maintain an environment where students, staff, and faculty can contribute without the fear of ridicule or intolerant or offensive language. If you witness or experience racism, discrimination micro-aggressions, or other offensive behavior, you are encouraged to bring it to the attention to the undergraduate program director, the graduate program director, or the department chair. You can also report it to the Bias Incident Reporting System <http://inclusion.rutgers.edu/report-bias-incident/>