

Senior Design Problem Submissions

Dept. of Computer Science, Bucknell University

The Dept. of Computer Science invites partners in academia and in industry to submit problems on which student teams may work for two consecutive semesters in their Senior Design experience.

As students are required to follow the traditional Engineering Design Process, we ask that submissions do not specify particular solutions. For the sake of maximizing student learning experiences, submissions should include a broad statement of the problem, as well as information that students can use to rank objectively the solutions they generate in brainstorming. A template for submissions is provided with this document to guide our partners in organizing the information they will provide to the instructor.

Project ideas will be shared with student teams on Monday, September 9, 2013, and teams will select the proposals that are best aligned with the interests and skill sets. We ask that interested partners contact the instructor soon to request clarifications and/or to submit problem proposals:

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Background

The CSCI senior design experience is a two semester course sequence in which students carry a project from idea through to implementation. Working in teams of 3 or 4 members, in frequent interactions with an external partner, students traverse the complete product development cycle.

In the fall, the weekly workload includes 2 hours of classroom contact plus 6 hours outside class. Teams work on developing the understanding necessary to tackle their problems, identifying three possible solutions, ranking them according to criteria, goals and constraints, and selecting one solution for implementation. Teams use this information to elaborate a persuasive proposal that could be presented to angel investors and venture capitalists to obtain funding. Once the proposal is completed, teams start working on the design and implementation of their solutions. Concurrently, in our class time, teams explore topics in design, software engineering and design, intellectual property and licensing, failure models and effect analysis. Typically, the class invites professionals who are interested in talking about some of these topics.

In the spring, the workload includes 3 hours of classroom contact plus 9 hours outside class. The primary activity of the semester is the implementation of the teams' products

according to agile methods (Scrum) in 1-week long sprints. Teams contact their external partners with regular frequency to solicit clarifications and/or obtain feedback on their emerging prototypes. Additionally, teams use classroom time to report their progress to the class and to the instructor. The implementation activities include the elaboration and application of a test plan for the teams' products (and possibly the use of automated test frameworks, whenever applicable). The Senior Design experience culminates with public, technical presentations at the end of the semester and with the delivery of the teams' products, supporting documentation (developer and user manuals), and a final report.

Partnerships with Our Student Teams

The primary mission of the Senior Design experience is to foster the students' development into capable, responsible professionals. The collaboration with external partners in Senior Design projects is of immense value in achieving this goal. At the same time, we expect that our students will be able to contribute to the advancement of our partners' interests by testing out ideas and/or developing product prototypes.

To provide the best conditions for our students' learning experiences and to enable the successful completion of our partners' projects, we expect that frequent interactions are essential. We strongly encourage our partners to communicate with teams in person or using the best means of teleconferencing available. Although these communications are to be expected at the stages of project kickoff and at each design/development milestone, we encourage weekly interactions, whenever possible. Additionally, we encourage class visits to those partners who are interested and will consider invitations to site visits very fondly.

The majority of the students in Computer Science Senior Design will have completed coursework on the fundamentals of the discipline, in basic engineering, in mathematics, and in natural sciences. This includes:

- Calculus (three courses), differential equations, discrete math, statistics and probability theory, physics (two courses), chemistry;
- Introduction to engineering, statics, foundations of electrical engineering, digital electronics;
- Computational thinking, programming in different language paradigms, algorithms and data structures, computer organization, operating systems, and computer ethics.

Students will often have taken computer science electives such as web information retrieval, databases, networks, security, graphics, compilers, data mining, and analysis of algorithms. It is common for students to work quickly to become conversant with new programming languages and technologies that are required in their projects.

In summary, our students have received good preparation to contribute to our partners' interests and expect that Senior Design teams are highly likely to deliver.

Resources and Intellectual Property

Student teams will have access to state-of-the-art computing resources available at Bucknell University. In case a project requires the use of proprietary hardware, software, or data, the Department will work with partners to investigate possible options.

Students in this class are prepared to work under the terms of non-disclosure and/or licensing agreements for that may be requested by our partners. We ask that partners communicate their needs for these types of agreements at the time they submit their problems to the instructor.

Problem Submission Template

Problem description

Provide here a broad description of the **problem** for which the team will develop a solution. Try to *focus on the problem* without indicating any specific solution for implementation. Think of this as a statement to identify a “need that can be satisfied by the product of engineering effort.” (A. Ertes and J. Jones, “The Engineering Design Process”) Feel free to provide any background information you believe is necessary to motivate the understanding of the problem. Expect teams to research the problem and to come back to you for clarifications. For instance:

“In many educational scenarios, it is important for a teacher to be able to show students content that is generated in some format of digital video. The instructor will store videos in a variety of formats in a central server and select one video at a time to send to roughly 200 students with individual devices. The content distribution strategy should minimize the pressure on the server.”

Goals

Provide here a synthesis of the objectives that any solution chosen by the team will have to meet. Think of these as the essential requirements of the engineering product. For instance:

- *Support the most prevalent digital video formats (WMV, MPEG-4 and H.264)*
- *Deliver video content over the Internet using nonproprietary, application level protocols.*
- ...

Constraints

Provide here a list of the constraints the any identified solution will have to meet to be considered valid. For instance:

- *Minimal rate of 24 frames per second*
- *Deliver content to players accessible through modern web browsers*
- ...

Criteria

Provide here any number of criteria that will help the team to develop a method to create an objective ranking of the solutions their propose. For instance:

- *Minimize network bandwidth utilization on server’s outgoing link*
- *Minimize start up latency for the viewer*
- ...

Resources, Intellectual Property, and Licensing

- Indicate the resources the team is expected to need. This is particularly important if the resources go beyond the University's standard software development resources and anything available as open source or free software.
- Indicate whether you as a partner are in the position to provide access to any specialized, proprietary data, hardware, or software.
- Indicate whether our partnership will require any form of nondisclosure agreement.
- Indicate whether there are any particular licensing or intellectual property conditions that apply to the product the team will produce.