



# Computer Engineering Program

University of California, Santa Barbara

## CE Senior “Capstone” Design Projects

During the senior year, students must dedicate a minimum of eight units (two quarters) of either CMPSC 189 A/B or ECE 189 A/B to their Computer Engineering Senior Electives as part of the 32 Units of the required Computer Engineering Senior Electives. The Senior Project brings together previous learned knowledge, builds confidence, and teaches team-environment skills. A variety of projects are acceptable. The chosen project must be approved by the class instructor.

### ECE 189A (F) and 189 (B) REQUIREMENTS

All projects must involve the design and implementation of a complete digital system: both hardware and software. Students are expected to form their own teams with a minimum of three and a maximum of eight members. The project, composition of the team, and overall cost estimate must be approved by the instructor at/near the beginning of Fall Quarter before the detailed project definition and implementation begins.

The Fall Quarter section of ECE 189A includes the phases of project definition, high-level subsystem requirements definition, detailed system design (both software and hardware), and ends with all segments ready for manufacturing (e.g. printed circuit boards, complete bill of materials, assembly diagrams). During the Winter Quarter, the projects are manufactured by outside vendors.

In the Spring Quarter section of ECE 189B, the manufactured projects are available. The phases of final assembly, debug/verification, as well as subsystem and full system integration are performed. At the end of the quarter, there is a design presentation by each group.

### A List of Project Possibilities:

- **Micromouse** – a battery-powered autonomous robot that can solve a maze on its own. Design includes processor/memory, sensor subsystem, power system, motor control system, as well as control and maze solving software.
- **R/C or autonomous robot** – a battery-powered roving platform (either radio-controlled or autonomous) with sensors for obstacle avoidance, mapping, and local navigation. The platform should be able to support simple delivery or surveillance tasks.
- **Embeddable computer system** – a general-purpose computer for hosting embedded system applications. Single-board, small form factor, with digital I/O, analog input and output channels, networking.
- **Teleconferencing CODEC** – a system that acquires one or more channels of video and audio, digitizes it, encodes it, and transmits over a network connection to an identical CODEC that receives the encoded data stream, decodes it, and generates audio and video. Video inputs and outputs would be in NTSC, PAL, or S-video and audio would be a microphone or preamp signal.

- **Wireless optical communication link** – using a laser and photodetector, build a pulsed light communications link suitable for connecting two computers through free space. Maximizing the distance between sender and receiver is a major design objective as well as minimizing error rates and system costs.
- **Student's own idea:** students having an idea for a project, should write it up in a couple of paragraphs, including a block diagram, and a rough cost estimate. Then ***bring them to the ECE 189 A/B instructor before the end of the Spring Quarter preceding the Fall Quarter when the student plans to take ECE 189A.***

### 2002-2003 Senior Projects:

- **Auto-Pilot:** able to take over control of an R/C model plane and fly it around a pre-planned trajectory using GPS.
- **IR Badge:** infrared LEDs on a small electronic badge automatically exchange information and match and display interests of the wearers. Displays used visible LEDs and also incorporated sound.
- **MP3 Player:** portable MP3 player with small LCD screen and internal disk.
- **Paging Service:** wireless pager that receives messages and displays them on an integrated LCD screen.
- **“Sentry” Intrusion Detection Robot:** autonomous surveillance robot that can roam about within a large space to detect motion and heat (IR) signatures.

## CMPSC 189A (W) and 189B (S) REQUIREMENTS

Student groups will design a significant computer-based project. Multiple groups may cooperate towards one large project. Each group will work independently and interaction among groups is via interface specifications and informal meetings.

The projects for CMPSC 189A and 189B will involve system software projects related to networking and operating systems. The projects will have three components: proposal, implementation (about seven weeks) and demonstration. All projects must be approved by the instructor(s) as well as the other members of the class. Projects in related areas may be possible with the instructor's consent.

The class will meet three hours/week w/ the instructor to discuss new concepts, material related to the projects, and implementation issues. There will also be a three hour/week lab with the TA.

- **CMPSC 189A:** students will go through a meta-process of design, specification, and the implementation cycle of a complex software system.
- **CMPSC 189B:** uses the same process listed above for producing a more elaborate project in a slightly different area.

### 2002-2003 Senior Projects:

- **Ad Hoc Instant Messages:** implementation of Instant Messaging for mobile, ad hoc systems.
- **Vortex-based Peer-to-Peer File Sharing:** P2P system for sharing streaming media using distributed "vortex" files (replicated and segmented files).
- **Distributed Password Cracking:** distributed high-performance computational and dictionary-based password cracker.
- **Interactive History Textbook:** timelines-based interactive history textbook using distributed databases.