CSE 596
CSE Capstone Design

Course Syllabus (version: May 30, 2022)

Instructors:
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Office Hours: MS Teams Meeting by appointment

Class Schedule: TTh 4pm-5:15pm DC 117
This is a 3-semester hour course and is scheduled to meet two days a week for 75 minutes for fourteen weeks. However, the course involves additional activities such as meeting with clients, team meeting, and design review sessions which may require more time.

- If the University transitions all courses to 100% online, we will continue working on the project via online meeting.
- If a student falls ill or must quarantine, the student must notify the instructor promptly and the instructor will schedule make-ups accordingly.
- If the instructor falls ill, students will be notified promptly and the instructor will schedule online classes if he is able.

Catalog Description:
CECS 596 CECS Capstone Design (3 Credits): This course requires solving a real-world design problem in computer engineering. It uses hardware and software design methods and tools learned in previous coursework emphasizing teamwork, written and oral communication.

Prerequisites and Textbook:
Senior standing, CSE 525 and CSE 550 (pre- or co-requisites). No textbooks required.

Objectives:
1. To learn and practice the fundamental concepts of engineering design.
2. To solve a client's problem by designing and recommending a cost-effective solution considering **constraints, standards, and security**.
3. To provide a real-world learning experience utilizing computer engineering and computer science design methodologies and tools acquired in other courses leading to this one.

Engineering Standards and Constraints (MUST be considered at the design process and addressed in all presentations and the final report)

Constraints

Economic: Cost.
Environmental: the waste the product produces. E.g., to minimize the power consumption.

Manufacturability: Can be assembled or implemented in the lab.
Ethical: Common morals.
Social: Contribution of the project to the society.
Political: Political concerns or limitations.
Sustainability: Easily maintained, modified, or upgraded.
Health and Safety: Health and safety issue related to the product.

Engineering Standards: Characteristics and technical details that must be met by the products, systems and processes. UML diagrams.

Technical standard: established norm or requirement

Coding standards: clarity, aesthetic integrity, consistency, direct manipulation, feedback, methaphors, and user control

Types of **IEEE standards**:

IEEE Std 12207 – Software life cycle processes
IEEE Std 730 – Software Quality Assurance Plans
IEEE Std 1012 – Software V&V (Verification and Validation)
IEEE Std 1233 – system requirement specification
IEEE Std 1016 – Software Design Document
IEEE Std 829 – Software Test Document

Incorporating Engineering Standards into H/W and S/W System Diagram

UML diagrams: System Diagram, Software Overview Diagram, Activity Diagram, Use CaseDiagram, Interaction Overview Diagram, Communication Diagram, Class Diagram

XML

Other Engineering Standards

ISO, ASTM, ASME, SAE, ANSI, etc.

CAC Student Outcomes: This course supports following CAC student outcomes

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions. (CAC 1)
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline. (CAC 2)
3. Communicate effectively in a variety of professional contexts. (CAC3)
4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles. (CAC4)
5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline. (CAC 5)
6. Apply computer science theory and software development fundamentals to produce computing-based solutions. (CAC 6)

EAC Student Outcomes: This course supports following EAC student outcomes

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (EAC 1)
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social,

environmental, and economic factors. (EAC 2)
3. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (EAC 6)
4. Acquire and apply new knowledge as needed, using appropriate learning strategies. (EAC 7)

Topics Covered:
1. Review of HW and SW design philosophies and methodology
2. Project management and documentation requirements
3. Team building exercises
4. Review of activity, problem definition, and interim reports; assessment of design configurations
5. Project design activity
6. Interim presentations, formal evaluation of design and product demo
7. Final assessment and presentation

Capstone Projects & Design Day (showcase) and CSE Capstone preview
Each team will present its work at the Engineering Design & Innovation Showcase event at the end of the semester. At least one week prior to the showcase event, CSE faculties will preview each team's work (poster, demo, etc.).

Evaluation:
Needs assessment, system requirements specification, proposed system design specification, system design specification, critical thinking essay, constraint satisfaction, functionality of final design, test plan, oral report, final written report. **All final products (hardware, software, code, etc.) MUST be submitted to pass the course.**

10% Initial Presentation
20% Progress Report
50% Final Report & Showcase (5% showcase, 45% individual & team reports)
10% Customer Feedback
10% Participation

COVID: As a Community of Care, all Cardinals are expected to abide by public health guidelines and regulations as published by the University. For Fall 2022, this includes:
1) wearing of cloth/paper masks (covering nose and mouth) when in shared indoor spaces like classrooms, or when appropriate physical distancing cannot be maintained. (Per the code of student conduct--revised July 2020--a student who refuses to follow these guidelines may be asked to leave a classroom)
2) staying home when sick—any UofL community member experiencing fever, consistent dry cough, or other symptoms of contagious disease should remain at home until symptoms subside or advised that it is safe to return by a medical professional.
3) practicing good hygiene and responsibility for one's own surrounding.
    a. Cover sneezes and coughs

b. Wash hands frequently with soap and water when possible, use hand sanitizer when soap and water are not available
c. Wipe down frequently touched surfaces
d. Maintain 6 feet physical distancing when possible

Faculty have the responsibility to help students meet these recommendations by:

1) allowing for remote participation in class
2) allowing students absent for reason of illness to make up missed work and not penalize students for these absences
3) not requiring doctor's notes for absences of less than the equivalent of two weeks of class. If the absences occur on the day of a scheduled assessment, the student may be asked to provide documentation for the absence
4) Notifying physical plant when classrooms are not adequately stocked with cleaning supplies and arranging classroom furniture or seating charts to maximize physical distancing where possible.

Computer Issues and IT Support: Speed IT staff are available by appointment from 9 am to 4 pm to assist you with your technology needs. You may schedule an appointment by sending a detailed email including any relevant error codes and screen snips at SPDHelp@Louisville.edu (preferred) or 502-852-7620.

Title IX/Clery Act Notification

Sexual misconduct (including sexual harassment, sexual assault, and any other nonconsensual behavior of a sexual nature) and sex discrimination violate University policies. Students experiencing such behavior may obtain **confidential** support from the PEACC Program (852-2663), Counseling Center (852-6585), and Campus Health Services (852-6479). To report sexual misconduct or sex discrimination, contact the Dean of Students (852-5787) or University of Louisville Police (852-6111).

Disclosure to University faculty or instructors of sexual misconduct, domestic violence, dating violence, or sex discrimination occurring on campus, in a University-sponsored program, or involving a campus visitor or University student or employee (whether current or former) is **not confidential** under Title IX. Faculty and instructors must forward such reports, including names and circumstances, to the University's Title IX officer.

For more information, see http://louisville.edu/hr/employeerelations/sexual-misconduct-brochure.

Final Report Outline and Instructions
CECS 596: CECS Capstone Design

The following outline details the mandatory sections of every project final team report. Please note that the highlighted **CAC and EAC items** are student outcomes that are needed for course assessment.

Report Submission (Electronic Submission Required):

A single PDF file to include an individual portfolio and a team report.

INDIVIDUAL PORTFOLIOS (minimum of 15 pages)

Each student needs to submit an individual portfolio that includes the following:

1. Student Name
2. Project title and list of Group team members
3. Overview of task assignment and project activities.
   (CAC 5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline)
4. Areas of self-development and new learning that were needed/attempted.
   (EAC 7. Acquire and apply new knowledge as needed, using appropriate learning strategies)
5. Outline of specific contributions including portions of code and/or hardware if relevant.
6. How does your project relate to trends and emerging areas of CECS?
   (CAC 4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles)

TEAM REPORT (minimum of 50 pages)

Each team needs to prepare a team report that will be clearly identified and attached to the individual portfolio that includes the following:

1. Title Page - Include Project Title, Date, Team Members, and "Customer(s)"
2. Table of Contents
3. Introduction/Executive Summary **(CAC 3. Communicate effectively in a variety of professional contexts)**
4. System Description
   a. Needs Assessment/ System Requirements
   b. Initial Systems Specification (External design document)
      (EAC 1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics and CAC 1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions)

c. Final Specifications (finalized internal design document)
(EAC 1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics and CAC 1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions and CAC 6. Apply computer science theory and software development fundamentals to produce computing-based solutions)

d. System Diagrams - Detail all interfaces between the environment and the components
(EAC 2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors)

e. Hardware Overview Diagram **(CAC 2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline)**

f. Software Overview Diagram **(CAC 2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline)**

g. Economical, technical and time and constraints

5. Detailed Implementation:
   a. Hardware Detailed Implementation
   b. Software Detailed Implementation
   (EAC 1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics and EAC 2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors, and CAC 6. Apply computer science theory and software development fundamentals to produce computing-based solutions)
6. Test/Evaluation Experimental Procedure and Analysis of Results
   (EAC 6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions)
7. Societal impact of project including legal and ethical considerations.
   (CAC 4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles)
8. The contribution of your project to society and expected positive and/or negative effects.
   (CAC 4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles)
9. Engineering standards, constraints, and security **(EAC 2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors)**
10. Conclusions
11. Recommendations for Future Work

Appendices:

- Customer Contact Information
- Data Sheets
- Additional Drawings and Diagrams
- Source Code (could be included in Electronic version if lengthy)
- Experimental and/or Simulation Test Results
- Software installation instructions
- User's Manuals
- Quotes, including ordering information
- White Papers

Guideline for EAC and CAC items

EAC 1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

Where Measured: Initial Systems Specification (External design document) and Final Specifications (finalized internal design document) included in project report

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
- Clearly demonstrates a formal system design. - Describes system in a scientific way and uses formulas when necessary. - Well defined problem specification translated from original statement of needs. - Solution approach clearly follows from problem definition.	- Represents the system in a clear definition. - Identifies expectation in a formal method. - Problem formulation clear but not well formalized. - Selection of methodology and approach not well connected to formulation.	- Describes system in a non-scientific way. - Informal explanation of system specification. - Specifications are not formally defined and not well mapped to original statement of need.	- Unable to convey specification in a scientific method. - Describes it in a layman language. - Specification does not follow any standard and is ad-hoc.

EAC 2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Where Measured: System Diagrams and Engineering standards, constraints, and security - Detail all interfaces between the environment and the components

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
Clear design of system modules and interaction among modules well defined and documented.	System design lacks clear modular definition but overall is clear.	System design is not well defined at most levels.	System design is not clearly defined and lacks formal explanation.

EAC 6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Where Measured: Test/Evaluation Experimental Procedure and Analysis of Results required in project report.

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
Test Plan well defined in advance, executed and analyzed	Test Plan well defined, executed and data collected with some analysis.	Test plan explained and data collected.	Test plan not defined and sparse data collection.

EAC 7. Acquire and apply new knowledge as needed, using appropriate learning strategies.

Where Measured: In the individual portfolio section on "Areas of self-development and new learning that were needed/attempted".

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
- Clearly identifies exploration of new tools and techniques to speed up the development process. - Identifies areas of self-learning that were needed to complete the project. - Uses approaches that were not taught in the classroom.	- Uses approaches that were not taught in the classroom. - Mentions new tools and techniques.	- Mentions new tools and techniques as alternatives but does not use them in project.	- Fails to identify new approaches beyond classroom taught techniques.

CAC 1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

Where Measured: Initial Systems Specification (External design document) in project report

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
Clear analysis of the given complex computing problem with well defined application of principles of relevant disciplines	Analysis of the computing problem or application of relevant disciplines lacks clear definition but overall is clear.	Analysis or application is not well defined at most levels.	Analysis or application is not clearly defined and lacks formal description.

CAC 2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

Where Measured: Hardware Overview Diagram and Software Overview Diagram – explain in all applicable sections (H/W or S/W or both)

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
Clear design of h/w or s/w and they are well defined, evaluated, and documented.	H/W or S/W Design lacks clear definition or evaluation but overall is clear.	H/W or S/W design is not well defined, evaluated at most levels.	H/W or S/W design is not clearly defined and evaluate. It also lacks formal description.

CAC 3. Communicate effectively in a variety of professional contexts.

Where Measured: Introduction/Executive Summary part of project report and presentation.

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
- Clear, succinct statements of need. - Minimal linguistic errors. - Good use of technical vocabulary. - Well prepared presentation that respects time allocation.	- Clear and understandable communications. - Some errors that do not interfere with meaning. - Acceptable presentation.	- Acceptable writing. - Some errors that may interfere with meaning. - Presentation is not well-timed.	- Writing is not to the point and requires multiple corrections. - Presentation is not well prepared.

CAC 4. Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

Where Measured: In project report section on "Societal impact of project including legal and ethical considerations", and "The contribution of your project to society and expected positive and/or negative effects". In the individual portfolio section on "How does your project relate to trends and emerging areas of CSE?"

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
- Analyzes and clearly addresses issues raised as to ethical responsibilities arising from the project results.	- Addresses issues related to ethical responsibilities arising from the project results. - Cites some similar cases.	- Mentions issues related to ethical responsibilities. - Fails to provide examples of such situations.	- Does not explicitly mentions issues related to ethical responsibilities. - Fails to identify project impact on society.

- Provides appropriate examples and reasoning to support hypothesis. - Relates issues to professional code of conduct. - Clearly identifies project positive and negative impacts on society. - Provides options to improve any potentially negative impact. - Able to relate project concepts to current trends and issues in the profession.	- Identifies some impact on society without clear explanation. - Aware of current trends in the profession but does not clearly relate them to project.	- Vague on impact of project on society. - Fails to document relevant issues in the profession but some indication of their value.	- Fails to explicitly mention any contemporary issues.

CAC 5. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

Where Measured: Overview of task assignment and project activities required in student individual portfolio.

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
Team roles clearly identified and synergies apparent in reporting, presentations and activities.	Team is productive and communicates regularly.	Team communication not well defined. Roles are lacking clarity.	Ineffective team. Individual efforts with minimal interactions.

CAC 6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Where Measured: Final Specifications required in project report.

Exceeds Expectation	Meets Expectation	Needs Improvement	Unacceptable
4	3	2	1
Clear and through review of theory and development fundamentals and carefully apply the appropriate ones.	Applied the appropriate ones but the review is incomplete.	Application is appropriate without any reviews.	Incorrect application of theory or development fundamentals.