Department of Computer Science and Engineering

Standardized Capstone Project Guidelines

Revision Date: 11/09/2020

Preamble

For consistency and documentation purposes, this document presents a set of recommended undergraduate capstone project guidelines. The document contains guidelines including but not limited to group formation, timings, deliverables, as well as the role of the Coordinator (CI) which replaces the prior role of the CI.

General Guidelines

1. Each capstone project shall be supervised by a maximum of two faculty members, one of which must be a full-time faculty member of the Department of Computer Science and Engineering with prime involvement in the related activities.
2. Student groups shall typically comprise between four to six student members in each group, unless in extreme cases, subject to the judgment of the CI.
3. Typically, first choice is given to students in forming their groups; however, it is up to the discretion of the CI to reorganize groups as needed.
4. Historically, a few students always remain without group affiliation, and those have typically formed a technically frail group of their own. For any such students that remain without group affiliation, the CI shall fragment them across all existing groups.
5. To guarantee consistency in evaluating and following up on students, a faculty examination committee composed of three full time faculty members including the CI will be assigned by the Chairman of the department (after due consultation with the respective faculty members) to evaluate student groups all the way through their senior project life cycle. Such assignment will be considered part of faculty teaching load. This committee will be formed during or before the first departmental meeting of the semester.
6. Important Dates:
    a. During its first departmental meeting, the CI for Capstone I shall be selected for the subsequent semester.
    b. On or before **15 September**, and on or before **15 February** of each semester, the Department of Computer Science and Engineering shall duly announce to **all** undergraduate students the name of the CI for Capstone I of the subsequent semester, and that students who will be registered in Capstone I during the subsequent semester need to initiate their process of:
        - Forming a group.
        - Securing a supervisor.
        - Deciding with their supervisor on a capstone project topic and abstract, and
        - Requesting any needed computational resources for their projects.
    c. On or before **1 October**, and on or before **1 March** of each semester, the Department shall send a reminder communication of (a).
    d. On or before **15 October**, and on or before **15 March** of each semester, the Department shall solicit from students information regarding:
        i. Project group formations.
        ii. The supervisor(s) for each group.

        iii. The topic and abstract for each project.
        iv. The needed resources.
    e. On or before **1 November**, and on or before **1 April** of each semester, the department must have:
        i. Underwent due process of reviewing the needed resources.
        ii. Initiated the formal process of ordering any needed resources for the students engaging in Capstone I during the subsequent semester.
7. Since the preamble phase of Capstone I provides a head start opportunity for students engaging in Capstone I the semester after, the expectation of the department regarding the deliverables and timelines of Capstone I will be modified accordingly.
8. The capstone project has to incorporate **appropriate engineering standards** and **multiple constraints.** Engineering standards used in the project must be explicitly mentioned and justified in the senior project artifacts.
9. **Capstone Reinforcement Outcomes**: Besides the technical deliverables of the capstone projects, any capstone project must now have at least one of three outcomes:
    a. **Research**: That the work of the capstone project is an innovation that will undergo a realistic and complete research cycle with a draft publication at the end of Capstone II. The publication will be part of the assessment of the project by the examining technical committee.
    b. **Commercialized Product**: That the work of the capstone project will have a clear path towards commercialized productization, with a complete business plan and reasonable evidence that the product is on its way to commercialization.
    c. **Community Deployment**: That the work of the capstone project will be deployed within the community (such as a school, hospital, university, NGO, etc). This will involve students engaging with their community as clients, and evidence must be provided to support this deployment (such as written testimonials, visuals of deployment, or the like).
10. The department shall conduct ideation sessions at the beginning of each semester open to all students to help them develop ideas for their capstone projects. The ideation sessions are open to all students who wish to attend.

Role of the Coordinator

The Coordinator now has new a new role in the capstone project cycle. Refer to the Harvard Business Review Article Here for **partial** relevance to the role of an Innovator (https://hbr.org/2014/11/a-chief-innovation-officers-actual-responsibilities)

This includes but is not limited to:

- Is a catalyst for innovation and any related activities during a capstone project cycle.
- Working closely with the supervisors on identifying innovative and ground breaking areas for the capstone projects.
- Possibly creating themes for capstone projects in a given cycle.
- Managing and organizing ideation sessions, as well as technical vitality sessions relevant to capstone projects.

- Exposing capstone related innovation to the marketplace and various stakeholders, including publishing success story articles.
- Enforcing that appropriate engineering standards are used in all projects and properly documented along with relevant constraints.

Capstone I Guidelines

1. During the first week: The CI will communicate to students the guidelines governing senior projects. Guidelines communicated to students will be a part or whole of this document. Students will be expected to finalize their proposal and a literature survey.
2. During the second week:
    a. If any minor number of students remain unaffiliated with a group, the CI shall typically assign such students to respective groups.
    b. The CI will ask each group to present in front of their colleagues their topic, abstract, a brief discussion of the topic, and their needed resources.
3. **Initial Proposal Presentation**: During the third week: Students will undergo their assessed proposal presentation in front of the technical examining committee and the CI. During this presentation, an indication of at least one of the Capstone Reinforcement Outcomes must be clearly proposed (Research, Commercialized Product, or Community Deployment).
4. Around the fourth week, students shall be given a lecture about ethical values, with primary focus on the domain of computing. They will be expected to write up a 5 page paper (font size 12, single spaced) outlining some of the ethical issues they encountered at AUC, and second, some of the ethical issues they may expect to encounter during their senior project. A faculty member shall deliver this lecture, and grade the papers. The grades shall be submitted to the CI.
5. Around the fifth week, students will also be a lecture about entrepreneurship. An assignment is left to the judgment of the faculty member delivering the lecture.
6. Around the sixth week, students will also be a lecture about research methodology. An assignment is left to the judgment of the faculty member delivering the lecture.
7. **Progress Presentation I**: Around the middle of the semester, students shall present to their supervisor their progress. Progress at this stage must include a survey about related work, a prototype as well as a set of high level requirements. A prototype must be presented. This progress presentation is not only a requirements presentation. Progress towards one of the Capstone reinforcement Outcomes must also be presented.
8. **Progress Presentation II**: By the end of the semester:
    a. Students shall present to the CI, faculty examination committee, and audience another round of progress. The examining committee must observe reasonable progress in the project. Students must clearly present their progress since the last presentation. An evolving prototype of the system must be demonstrated during this presentation. Progress towards one of the Capstone reinforcement Outcomes must also be presented.
    b. Typical progress at this stage includes a more refined set of requirements, enhanced prototype, and design.

c. The faculty examination committee, through the CI will provide written feedback to each group.
d. A detailed requirements specification document and detailed design specification document is due by the end of the semester. This is the binding contract upon which students will be graded for in Capstone II.

Capstone II Guidelines

1. **Progress Presentation III**: By the third week of the semester:
    a. Students will present to their supervisors a progress presentation clearly indicating what they have achieved since their previous progress presentation. Reasonable and clear progress must be presented as compared to the prior presentation.
    b. **Notable** Progress towards one of the Capstone reinforcement Outcomes must also be presented.
    c. Typical progress at this stage includes a refined design and must demonstrate a further advancement in the implementation of the system.
2. During the semester, the students will attend an additional lecture about each of the following: ethics, entrepreneurship, and research. Assignments are left to the judgment of the faculty members delivering each of these lectures.
3. **Progress Presentation IV**: During the third quarter of the semester:
    a. Students will present again to their CI, faculty examination committee, and audience, a pre-release version of their project.
    b. All major features must be demonstrated at this stage.
    c. **Close to Completion** progress towards one of the Capstone reinforcement Outcomes must also be presented.
    d. Written feedback is given to students.
4. **Dry Run**: Sufficiently before the final demonstration to the general audience, the supervisors shall observe a dry run of all projects and the status quo of the Capstone Reinforcement Outcomes.
5. **Final Demo**: By the end of the semester, student groups will demonstrate to the general audience.
6. **Technical Interview**: Student groups will then undergo a final examination in the presence of their CI, supervisor(s), and examination committee. External examiners might also be part of this final examination process. A final demo might also be requested during the interview.
7. **All finalized artifacts** will be delivered to the CI and to the supervisors, including but not limited to, documents and source code, both in hard and soft copies. Documents have to clearly demonstrate which **engineering standards** have been used and justify why these standards were selected.

Capstone I Grade Breakdown

1. Initial Proposal Presentation (attended by examination committee): 10%
2. Literature Survey: 5%
3. Participation and Assignments of ethics, research, and entrepreneurship lectures: 10%
4. Quiz: 5%
5. Progress Presentation I (attended by supervisors only) : 15%
6. Progress Presentation II (attended by examination committee): 15%
7. Requirements specification document: 10%
8. Design specification document: 10%
9. Supervisor personal evaluation: 10%
10. Progress towards satisfaction of at least one “Empowerment Outcome”: 10%

Items 1, 6, and 10 are graded by the examination committee
Items 2, 5, 7, 8, and 9 are graded by the supervisors
Item 3 is graded by faculty members delivering the ethics, research, and entrepreneurship lectures respectively
Item 4 is graded by the CI

Capstone II Grade Breakdown

1. Participation and Assignments of ethics, research, and entrepreneurship lectures: 5%
2. Progress Presentation III (attended by supervisors only): 15%
3. Progress Presentation IV (attended by examination committee): 15%
4. Dry run (attended by supervisors only): 10%
5. Final Demo (attended by examination committee): 15%
6. Technical Interview (interview by examination committee): 10%
7. Delivery of all artifacts (including proper documentation of used engineering standards and constraints): 5%
8. Supervisor personal evaluation: 10%
9. Satisfaction of at least one “Empowerment Outcome”: 15%

Item 1 is graded by faculty members delivering the ethics, research, and entrepreneurship lectures respectively
Items 2, 4, 7, and 8 are graded by the supervisors
Items 3, 5, 6, and 9 are graded by the examination committee

Requirements Specification Document Structure

(Refer to IEEE Standard 830-1998):

1. Introduction
1.1 Purpose
1.2 Document conventions
1.3 Intended audience
1.4 Additional information
1.5 Contact information/SRS team members
1.6 References

2. Overall Description
2.1 Product perspective
2.2 Product functions
2.3 User classes and characteristics
2.4 Operating environment
2.5 User environment
2.6 Design/implementation constraints
2.7 Assumptions and dependencies

3. External Interface Requirements
3.1 User interfaces
3.2 Hardware interfaces
3.3 Software interfaces
3.4 Communication protocols and interfaces

4. System Features
4.1 System feature A
  4.1.1 Description and priority
  4.1.2 Action/result
  4.1.3 Functional requirements
4.2 System feature B

5. Other Nonfunctional Requirements
5.1 Performance requirements
5.2 Safety requirements
5.3 Security requirements
5.4 Software quality attributes
5.5 Project documentation
5.6 User documentation

6. Other Requirements
Appendix A: Terminology/Glossary/Definitions list
Appendix B: To be determined

Any SRS should have the following features (Courtesy: NASA Software Assurance Technology Center)

SRS Quality Characteristic	What It Means
Complete	SRS defines precisely all the go-live situations that will be encountered and the system's capability to successfully address them.
Consistent	SRS capability functions and performance levels are compatible, and the required quality features (security, reliability, etc.) do not negate those capability functions. For example, the only electric hedge trimmer that is safe is one that is stored in a box and not connected to any electrical cords or outlets.
Accurate	SRS precisely defines the system's capability in a real-world environment, as well as how it interfaces and interacts with it. This aspect of requirements is a significant problem area for many SRSs.
Modifiable	The logical, hierarchical structure of the SRS should facilitate any necessary modifications (grouping related issues together and separating them from unrelated issues makes the SRS easier to modify).
Ranked	Individual requirements of an SRS are hierarchically arranged according to stability, security, perceived ease/difficulty of implementation, or other parameter that helps in the design of that and subsequent documents.
Testable	An SRS must be stated in such a manner that unambiguous assessment criteria (pass/fail or some quantitative measure) can be derived from the SRS itself.
Traceable	Each requirement in an SRS must be uniquely identified to a source (use case, government requirement, industry standard, etc.)
Unambiguous	SRS must contain requirements statements that can be interpreted in one way only. This is another area that creates significant problems for SRS development because of the use of natural language.
Valid	A valid SRS is one in which all parties and project participants can understand, analyze, accept, or approve it. This is one of the main reasons SRSs are written using natural language.
Verifiable	A verifiable SRS is consistent from one level of abstraction to another. Most attributes of a specification are subjective and a conclusive assessment of quality requires a technical review by domain experts. Using indicators of strength and weakness provide some evidence that preferred attributes are or are not present.

Words to try to avoid in an SRS (Courtesy: NASA Software Assurance Technology Center):
Adequate - be able to – easy - provide for - as a minimum - be capable of – effective – timely – as applicable - but not limited to - if possible – tbd - as appropriate - capability of - if practical - at a minimum - capability to – normal

Design Specification Document Structure

1. Introduction
1.1 Purpose
1.2 Document conventions
1.3 Intended audience
1.4 Additional information
1.5 Contact information/SDS team members
1.6 References

2. Design Overview
2.1 Background Information
2.2 Constraints
2.3 Design Trade-offs
2.4 User Characteristics

3. System Architecture
3.1 Hardware Architecture
3.2 Software Architecture
3.3 Communications Architecture

4. Data Design
4.1 Database Management System Files
4.2 Non-Database Management System Files

5. Detailed Design
5.1 Hardware Detailed Design
5.2 Software Detailed Design (With a design of each component).
5.3 Communications Detailed Design

6. Interfacing to External Systems
7. Usability Design Approach (Sample Screens)
8. Requirements Traceability Matrix
9. Glossary of Terms

The American University in Cairo
Department of Computer Science and Engineering

CSCE 491/4980 Group Formation Form

Semester and Year:

Student Group Members:

1.

2.

3.

4.

5.

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Proposed Topics and Supervisor Approval Form

Semester and Year: _____

Proposed Topic: _____

Student Group Members:

1. _____
2. _____
3. _____
4. _____
5. _____

Name of First Supervisor: _____

Signature of First Supervisor: _____

Optional:

Name of Second Supervisor: _____

Signature of Second Supervisor:_____

The American University in Cairo
Department of Computer Science and Engineering

Progress Presentation Evaluation Form

Examination committee member, kindly assign a grade out of 100.

Committee Member: _____
Semester and Year: _____
Presentation: _____
Group: _____
Grade (100): _____

Confidential comments to the CI and/or supervisor(s):

Committee Member Signature and Date: _____

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Written Feedback to Project Group

Committee Member: _____
Semester and Year: _____
Presentation: _____
Group: _____

Public comments to be given back to the student group:

Committee Member Signature and Date: _____

The American University in Cairo
Department of Computer Science and Engineering

External Examiner Evaluation Form

(Computer Science)

Departmental Mission

The mission of the Department of Computer Science and Engineering at AUC is to provide a high quality science and engineering education within the liberal arts context. The undergraduate program in Computer Science and Computer Engineering are accredited by both the American Accreditation Board for Engineering and Technology (ABET) and the Supreme Council of Egyptian Universities.

Internal evaluation and assessment of the Computer Science and Engineering Programs at the American University in Cairo is an on-going process. Through this CSCE 4981 Exam, we are kindly asking the Examiner to evaluate the graduating class in their achievement and fulfillment of CSCE 4980/4981 Senior Project according to the defined criteria.

Computer Science Learning Outcomes

The Computer Science program of AUC enables students to achieve and demonstrate by the time of graduation:

1. The ability to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. The ability to design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
3. The ability to communicate effectively in a variety of professional contexts
4. The ability to recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles
5. The ability to function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline
6. The ability to apply computer science theory and software development fundamentals to produce computing-based solutions

The main objective of 4980/4981 Exam is to assess the achievement of the graduating class of these learning outcomes.

Evaluation Form for Computer Science

Project: _____

Examiner Name: _____

Academic Rank: _____

Affiliation: _____

a) Please comment as to what extent the students have achieved the following program outcomes:

Program Outcome	Excellent	Good	Fair	Poor	N/A
1. The ability to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions .					
2. The ability to design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.					
3. The ability to communicate effectively in a variety of professional contexts.					
4. The ability to recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.					
5. The ability to function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.					
6. The ability to apply computer science theory and software development fundamentals to produce computing-based solutions.					

b) Please comment on the adequacy of students in the following subject areas:

Subject Area	Adequacy of Education				
	Excellent	Good	Fair	Poor	N/A
Theoretical Computer Science Foundation (Algorithms, Theory of Computing, … etc.)					
Systems Software Development (e.g., Compiler, Operating Systems, Security,…)					
Applications Software Development					
Computer Architecture					
Distributed & Web-based Systems					
Knowledge Systems & Machine Intelligence (e.g., AI, Expert Systems, … etc)					
Data Storage & Retrieval (e.g., DBMSs, Database Applications, … etc)					
Data Communications & Computer Networks					

c) Please comment as to what extent the students have achieved the following performance criteria?

Performance Criteria	Excellent	Good	Fair	Poor	N/A
Knowledge & awareness of professional code of ethics					
Evaluating the social and ethical impact of computing					

d) Please assess the readiness of the students for their coming professional career.

1 Very high 2 High 3 Good 4 Fair 5 Poor

e) Other comments you want to make:

The American University in Cairo
Department of Computer Science and Engineering

External Examiner Evaluation Form

(Computer Engineering)

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Computer Engineering Learning Outcomes

The Computer Engineering program of AUC enables students to achieve and demonstrate by the time of graduation:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. an ability to 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.
3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The main objective of 4980/4981 Exam is to assess the achievement of the graduating class of these learning outcomes.

Evaluation Form for Computer Engineering

Project: _____

Examiner Name: _____

Academic Rank: _____

Affiliation: _____

a) Please comment as to what extent the students have achieved the following program outcomes:

Program Outcome	Excellent	Good	Fair	Poor	N/A
1. The ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.					
2. The ability to 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.					
3. The ability to communicate effectively with a range of audiences.					
4. The ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.					
5. The ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.					
6. The ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.					
7. The ability to acquire and apply new knowledge as needed, using appropriate learning strategies.					

b) Please comment on the adequacy of students in the following subject areas:

Subject Area	Adequacy of Education				
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Applications Software Development					
Computer Architecture					
Embedded Systems					
Digital Design					
Distributed & Web-based Systems					
Knowledge Systems & Machine Intelligence (e.g., AI, Expert Systems, … etc)					
Data Storage & Retrieval (e.g., DBMSs, Database Applications, … etc)					
Data Communications & Computer Networks					

c) Please comment as to what extent the students have achieved the following performance criteria?

Performance Criteria	Excellent	Good	Fair	Poor	N/A
Knowledge & awareness of professional code of ethics					
Evaluating the social and ethical impact of computing					
Incorporating appropriate engineering standards and multiple constraints					

d) Please assess the readiness of the students for their coming professional career.

1 Very high 2 High 3 Good 4 Fair 5 Poor

e) Other comments you want to make: