Summary of ABET requirements related to outcomes, assessments, etc.

Key Points

1. ABET is focused on specific student outcomes that the program must enable its students to attain. Our program outcomes are listed below. These outcomes are extremely broad but these are the ones that ABET has, in effect, specified.

2. Various courses in the curriculum are intended to help students achieve the various outcomes but we cannot demonstrate this by simply presenting the contents of these courses. Instead, we are required to have a **documented assessment process** that we follow **regularly** that assesses the extent to which each outcome is achieved, **analyzes** the results of the assessments, and identifies any **weaknesses** in the **program** as a whole to effect **changes** in the program with the goal of improving the extent to which the outcomes are achieved.

3. The assessment results as well as their analysis etc. must also be regularly documented.

4. The assessments are not just for use by individual instructors of particular courses but, rather, at the level of the program.

5. These assessments are **not** related to the assessments that a course instructor may conduct (for purposes of assigning course grades etc). They are different in the following respects:
   - The focus is on the extent to which *program outcomes* are achieved (rather than specific course topics although ...).
   - The focus is not on individual students but, rather, on the overall (average?) extent to which the outcomes are achieved.
   - The focus is on using the assessment results to inform program improvements.
   - The assessment process, the assessment results, the analysis/evaluation of the results, the identified program improvements must all be regularly documented.

In other words, ABET's focus is on how we measure the extent to which the students in the program achieve the program's outcomes listed above and how we use the results to inform changes in the program to address any weaknesses that the assessment may reveal; and it requires all of this to be documented.

BS-CSE program's student outcomes

Students in the BS-CSE program will attain:

a. an ability to apply knowledge of computing, mathematics including discrete mathematics as well as probability and statistics, science, and engineering;
b. an ability to design and conduct experiments, as well as to analyze and interpret data;
c. an ability to design, implement, and evaluate a software or a software/hardware system, component, or process to meet desired needs within realistic constraints such as memory, runtime efficiency, as well as appropriate constraints related to economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability considerations;
d. an ability to function on multi-disciplinary teams;
e. an ability to identify, formulate, and solve engineering problems;
f. an understanding of professional, ethical, legal, security and social issues and responsibilities;
g. an ability to communicate effectively with a range of audiences;

h. an ability to analyze the local and global impact of computing on individuals, organizations, and society;
i. a recognition of the need for, and an ability to engage in life-long learning and continuing professional development;
j. a knowledge of contemporary issues;
k. an ability to use the techniques, skills, and modern engineering tools necessary for practice as a CSE professional;
l. an ability to analyze a problem, and identify and define the computing requirements appropriate to its solution;
m. an ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices;
n. an ability to apply design and development principles in the construction of software systems of varying complexity.

Our current continuous improvement processes

Assessment processes:

1. POCAT
2. Student exit-survey
3. Alumni survey

Evaluation:

1. Discussions in UGSC of POCAT results
2. Discussions in UGSC of the results of the surveys
3. Annual student forum and discussion of forum feedback in UGSC

Documentation:

- POCAT: The results are documented regularly on the UGSC website (but the documentation of the discussion of the results is somewhat lacking).
- Surveys:
- Forum:

DEFINITIONS

Program Educational Objectives (PEOs) are broad statements that describe what graduates are expected to attain within a few years after graduation. PEOs are based on the needs of the program's constituencies.

Student Outcomes describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills, and behaviors that students acquire as they progress through the program.

Assessment is one or more processes that identify, collect, and prepare data to evaluate the attainment of student outcomes. Effective assessment uses relevant direct, indirect, quantitative and qualitative measures as appropriate to the outcome being measured. Appropriate sampling methods may be used as part of an assessment process.

Evaluation is one or more processes for interpreting the data and evidence accumulated through assessment processes. Evaluation determines the extent to which student outcomes are being attained. Evaluation results in decisions and actions regarding program improvement.

EAC CRITERIA

Criterion 1. Students

Student performance must be evaluated. Student progress must be monitored to foster success in attaining student outcomes, thereby enabling graduates to attain program educational objectives. Students must be advised regarding curriculum and career matters.

The program must have and enforce policies for accepting both new and transfer students, awarding appropriate academic credit for courses taken at other institutions, and awarding appropriate academic credit for work in lieu of courses taken at the institution. The program must have and enforce procedures to ensure and document that students who graduate meet all graduation requirements. Criterion 2. Program Educational Objectives

The program must have published PEOs that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There must be a documented, systematically utilized, and effective process, involving program constituencies, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission, the program's constituents' needs, and these criteria.

Criterion 3. Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the PEOs.

Student outcomes are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Criterion 4. Continuous Improvement

The program must regularly use appropriate, documented processes for assessing and evaluating the extent to which the student outcomes are being attained. The results of these evaluations must be systematically utilized as input for the continuous improvement of the program. Other available information may also be used to assist in the continuous improvement of the program.

Criterion 5. Curriculum [In the following, one year is the lesser of 32 semester hours (or equivalent) or one-fourth of the total credits required for graduation.]

The faculty must ensure that the program curriculum devotes adequate attention and time to each component, consistent with the outcomes and objectives of the program and institution. The professional component must include:

(a) one year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline. Basic sciences are defined as biological, chemical, and physical sciences.

(b) one and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study. The engineering sciences have their roots in mathematics and basic sciences but carry knowledge further toward creative application. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other. Engineering design is the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs.

(c) a general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

(d) must include probability and statistics, including applications appropriate to the program name; discrete mathematics; mathematics through differential and integral calculus; sciences (defined as biological, chemical, or physical science); and engineering topics necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components.

Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.

Criterion 6. Faculty

The program must demonstrate that the faculty members are of sufficient number and they have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students.

The program faculty must have appropriate qualifications and must have and demonstrate sufficient authority to ensure the proper guidance of the program and to develop and implement processes for the evaluation, assessment, and continuing improvement of the program. The overall competence of the faculty may be judged by such factors as education, diversity of backgrounds, engineering experience, teaching effectiveness and experience, ability to communicate, enthusiasm for developing more effective programs, level of scholarship, participation in professional societies, and licensure as Professional Engineers.

Criterion 7. Facilities

Classrooms, offices, laboratories, and associated equipment must be adequate to support attainment of the student outcomes and to provide an atmosphere conducive to learning. Modern tools, equipment, computing resources, and laboratories appropriate to the program must be available, accessible, and systematically maintained and upgraded to enable students to attain the student outcomes and to support program needs. Students must be provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories available to the program.

The library services and the computing and information infrastructure must be adequate to support the scholarly and professional activities of the students and faculty.

Criterion 8. Institutional Support

Institutional support and leadership must be adequate to ensure the quality and continuity of the program.

Resources including institutional services, financial support, and staff (both administrative and technical) provided to the program must be adequate to meet program needs. The resources available to the program must be sufficient to attract, retain, and provide for the continued professional development of a qualified faculty. The resources available to the program must be sufficient to acquire, maintain, and operate infrastructures, facilities, and equipment appropriate for the program, and to provide an environment in which student outcomes can be attained.

CAC CRITERIA

Criteria 1, 2, 4, 7, 8: Same as for EAC

Criterion 3. Student Outcomes

The program must have documented student outcomes that prepare graduates to attain the program educational objectives. There must be a documented and effective process for the periodic review and revision of these student outcomes.

The program must enable students to attain, by the time of graduation:

(a) An ability to apply knowledge of computing and mathematics appropriate to the program?s student outcomes and to the discipline

(b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution

(c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs

(d) An ability to function effectively on teams to accomplish a common goal

(e) An understanding of professional, ethical, legal, security and social issues and responsibilities

(f) An ability to communicate effectively with a range of audiences

(g) An ability to analyze the local and global impact of computing on individuals, organizations, and society

(h) Recognition of the need for and an ability to engage in continuing professional development

(i) An ability to use current techniques, skills, and tools necessary for computing practice.

(j) An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.

(k) An ability to apply design and development principles in the construction of software systems of varying complexity.

Criterion 5. Curriculum

The program's requirements must be consistent with its program educational objectives and designed in such a way that each of the student outcomes can be attained. The curriculum must combine technical and professional requirements with general education requirements and electives to prepare students for a professional career and further study in the computing discipline associated with the program, and for functioning in modern society.

The technical and professional requirements must include at least one year of up-to-date coverage of fundamental and advanced topics in the computing discipline associated with the program. In addition, the program must include mathematics appropriate to the discipline beyond the pre-calculus level. For each course in the major required of all students, its content, expected performance criteria, and place in the overall program of study must be published.

Students must have the following amounts of course work or equivalent educational experience:

a. Computer science: One and one-third years that must include:

1. Coverage of the fundamentals of algorithms, data structures, software design, concepts of programming languages and computer organization and architecture.

2. An exposure to a variety of programming languages and systems.

3. Proficiency in at least one higher-level language.

4. Advanced course work that builds on the fundamental course work to provide depth.

b. One year of science and mathematics:

1. Mathematics: At least one half year that must include discrete mathematics. The additional mathematics might consist of courses in areas such as calculus, linear algebra, numerical methods, probability, statistics, number theory, geometry, or symbolic logic.

2. Science: A science component that develops an understanding of the scientific method and provides students with an opportunity to experience this mode of inquiry in courses for science or engineering majors that provide some exposure to laboratory work.

Criterion 6. Faculty

Each faculty member teaching in the program must have expertise and educational background consistent with the contributions to the program expected from the faculty member. The competence of faculty members must be demonstrated by such factors as education, professional credentials and certifications, professional experience, ongoing professional development, contributions to the discipline, teaching effectiveness, and communication skills. Collectively, the faculty must have the breadth and depth to cover all curricular areas of the program. Some full time faculty members must have a Ph.D. in computer science.

The faculty serving in the program must be of sufficient number to maintain continuity, stability, oversight, student interaction, and advising. The faculty must have sufficient responsibility and authority to improve the program through definition and revision of program educational objectives and student outcomes as well as through the implementation of a program of study that fosters the attainment of student outcomes.

Rubric for Assessment of CSE Capstone Design Projects (for use by capstone course instructors) (pdf)

Background: This rubric is intended to help assess key aspects of the outcomes that the capstone design courses contribute to. The instructor of each section of each CSE capstone design course should complete *one* of these rubrics for *each project team* in the class and give a copy of the completed rubric to Neelam at the end of the semester; note that it is one rubric per *team*, not per student. Please *do not* modify this rubric in any manner. An ideal time to complete this rubric, for any given team, would be during or immediately following the final (in-class) presentation/demo of the project by the team.

The rubric includes seven dimensions. Each dimension is assigned a score of 1 through 4, these values representing increasing degrees of achievement as described below. The instructor should assign, in the rightmost column, a value between 1 and 4 --fractional values okay-- for each dimension. Additional comments may be noted at the bottom.

Course number, semester, instructor name: ________________________________

Title of capstone project being evaluated: ________________________________

Students in the team: ____

	1	2	3	4	Points assigned
Problem formulation	Unclear formulation; Relation to original requirements not mentioned, nor changes in scope.	Mostly clear but relation to original requirements and/or rationale for changes in scope not clear.	Satisfactory formulation; Relation to client's original requirements, changes in scope andrationale thereof mostly clear with some gaps.	Excellent problem formulation; Relation to client's original requirements and changes in the scope, if any, explained and justified.	
Design approach	Poor design; No exploration of alternative approaches; No attention to effective use of resources.	Some attention to alternative design approaches but not a careful analysis of their their advantages/ disadvantages; Team picked an approach based on superficial comparisons.	Careful consideration of alternative design approaches and their resource requirements; Not all trade-offs fully analyzed.	Thorough consideration and evaluation of a good set of design approaches; Careful analysis of resource requirements of each and the resulting trade-offs; Where appropriate, client's input sought before making final choice.	
Implementation (including resource considerations, testing approach, adherence to standards, etc. If implementation is incomplete, assess based on current state.	Not even basic consideration of memory and other resource requirements; System is very buggy. No systematic testing, nor use of standard approaches/ processes such as agile.	Limited amount of attention to memory and other resource usage; Team has followed a standard (agile/ waterfall/ ...) process but not consistently. Team has put some effort into systematic testing but some bugs remain.	Careful attention to memory and other resource usage and how system might scale with increased demand for services; The team adopted and mostly followed a standard process in its work; The team used a systematic approach to testing and the system seems bug-free.	Meticulous attention to resource usage and to user interface factors; Has ensured that system can evolve to deal with increased demand for services. Team has consistently followed a standard process in its work; Adopted a suitable testing approach, followed it systematically, and thoroughly tested the system. Client involved at all appropriate points.	
Other factors such as use of professional tools, security considerations; ethical issues.	Little attention paid to factors beyond minimal functional requirements; No systematic use of professional tools; Ethical issues related to	Some use of common tools seen in earlier courses; Modest effort to ensure basic reliability and security properties; Mostly ignored ethical issues and potential impact on society of	Good use of professional tools going beyond ones previously seen; System designed to be reliable/ secure under normal operation and under stress; Some consideration of impact of	Excellent use of professional tools and systems, identified by careful research; Detailed analysis of security holes with implementation designed to deal with ones that can be reasonably handled and documentation of rest;	

	system and impact on society not considered.	systems of this kind.	system on society including potential harm system may cause in some situations.	Analysis of ethical issues related to system and its impact on society including implications of ACM/IEEE Code as it applies to the system, in consultation with client.	
Effectiveness as a project team	Dysfunctional team; Members blamed each other for problems in project; Team spirit completely lacking.	Team functioned at minimal level of effectiveness; Members concentrated on distinct parts of system without concern for impact on other members' work. In presentations, individual members did not make any attempt to help other members address audience questions.	Generally effective team; Embers interested in presenting a positive picture of the team's work; Members helped each other during team presentations. Team members had a general idea of other members' work.	Very effective team; Team members went out of the way to describe how each member contributed to various aspects of project. Team worked as a cohesive unit during presentations, with members seamlessly handing over the conversation from one to another to answer questions etc.	
Effectiveness of written communication	Documentation consisted of little more than (poorly commented) system code; Hardly any mention of system's scope, design rationale, implementation choices, etc.	Ocumentation mostly effective at conveying main aspects of project including scope and design/ implementation choices (but not the rationale behind the choices); Skimpy user manual; Information future teams may need to evolve system lacking.	Team's documentation clearly presented all important aspects of project: original scope, changes made, implementation choices, processes used etc. Test scripts and important parts of code explained; Lessons learned were summarized; Well-written user manual.	Excellent documentation; Project's original scope, design choices, relevant code details, processes and tools used, and test scripts all described in a structured and integrated manner; Information to enable future designers to evolve system included; Well-designed user manual provided all necessary information; Illustrations, graphics, and layout executed to excellent effect.	
Effectiveness of oral communication	Presentations not effective; Failed to present information about some essential aspects of project; Team members ineffective in responding to even simple questions.	Presentations adequate at conveying main ideas behind project including design choices etc. but not engaging or inspiring. Team responded appropriately to specific questions about specific aspects of project but some responses were unclear.	Presentations were well done and presented all important aspects of project; Team explained rationale behind its choices and summarized important lessons learned; Responses to questions were reasonable although some went into too much technical detail, compromising their effectiveness.	Team's presentations were polished, informative and engaging. In answering questions, the team provided the right level and type of detail for questions ranging from implementation detail to test methodology to future evolution of project.	

Comments:

Assessment of Poster Presentations in CSE Capstone Design Courses

Code of capstone project being evaluated:

Information about person completing this rubric (check all that apply):
☐ CSE/CIS student ☐ non-CSE/CIS student ☐ CSE faculty member ☐ non-CSE faculty member
☐ IT professional ☐ other (____________)

This rubric and the assessments it provides are an important part of our continuous improvement process designed to help us identify ways to improve our BS program.

The rubric includes six dimensions, these being Problem formulation, Design approach, Implementation approach, Other factors, Effectiveness as a team, and Communication effectiveness, along which the capstone project should be evaluated. For each dimension, there is a description of the corresponding characteristics that are expected of the ideal capstone team and its work. The visitor to the poster session is asked to consider the following statement for each dimension: "Based on what I saw and heard at the poster session, this project team exhibited, in an exemplary manner, all or most of the characteristics corresponding to this dimension"; and then choose one of "Strongly Agree", "Agree", "Disagree", or "Strongly Disagree" (or "Not Applicable" if the item is not relevant to the particular project).

Additional comments related to any of the six dimensions or about other aspects of the project may be entered in the box at the bottom of the rubric.

Problem Formulation	Team has come up with a clear formulation of the problem based on sponsor's goals; any changes in the project scope were clearly explained and justified. ☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Not Applicable
Design Approach	The team has produced a high-quality design that, for the most part, meets the sponsor's goals; in doing so, the team has gone through a suitable iterative process considering various alternatives, including resource (memory, bandwidth etc.) implications. ☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Not Applicable
Implementation Approach	The team has paid careful attention to all key performance factors that may affect the system. The team has also considered scalability issues as well as possible evolution of the system to meet changing needs. The team has, in its implementation (or plans for it), applied important lessons from key courses in the curriculum; and it has adopted and consistently followed a standard process. **Note: If the team has not fully completed an implementation of the project because of midstream changes in its scope or other reasons, please complete this dimension on the basis of briefly discussing, with the team, its implementation plans and ideas. ☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Not Applicable
Other factors	The team has effectively used appropriate professional tools and systems. It has carefully analyzed its design and implementation to identify potential security holes and documented them. The team has considered the implications of various aspects of the ACM/IEEE Code as it applies to this system and appropriately discussed the relevant questions with the project sponsor. ☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Not Applicable
Effectiveness as a Project Team	The students in this team seem to have worked together very effectively on various aspects of the project from initial formulation based on the sponsor's goals/ requirements, through exploring design alternatives, working on the implementation details, the documentation of the project, through the preparation of the poster. The students also worked effectively as a team in responding to questions and comments from visitors to the poster session. ☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Not Applicable
Communication Effectiveness	The team has produced a well-designed poster that pays careful attention to the items included and the level of detail presented. The poster effectively integrates elements related to basic background of the project with key technical factors. Responses to questions perfectly complemented the poster with the team providing the right level of detail. ☐ Strongly Agree ☐ Agree ☐ Disagree ☐ Strongly Disagree ☐ Not Applicable

Comments: