COE Continuous Improvement COMMITTEE

Activity Report

Term T172

COMPUTER ENGINEERING

Program

at

King Fahd University of Petroleum & Minerals
DHAHRAN, SAUDI ARABIA

2nd of October, 2018

Table of Contents

Summary

This report gives a brief summary of the ABET related activities at the Computer Engineering Department in the academic term 172. The continuous improvement committee (CIC) has coordinated the assessment of four student outcomes (SOs i, j, f, h). Starting from 181, the COE department will move to the new SOs (1-7). The COE department has also been revising the COE program over the last three terms. The CIC is wholly part of the curriculum revision committee providing invaluable comments and suggestions to improve the curriculum and ensure it continues to provide quality engineering education that conform to the highest international standrads.

1. Introduction

Table 1 below show ABET activities planned for the current accreditation cycle semester wise. Starting from T181, the new course mapping to SOs for assessment purposes is summarized in Table 2. Following the old plan, the CIC arranged for the assessment of SOs **i, j, f, h** in COE 300, COE 351 (COOP), and COE 485 (Senior Project). Instructors of these courses were informed by the CIC at the beginning of T172 about the assessment of these SOs in their courses. They were given the assessment tools (Rubrics, please see the Appendix) and were asked to prepare assessment plans. These plans were reviewed, modified when necessary and ratified by the CIC. Instructors submitted their assessment results to the SO coordinators in the CIC, who in turn consolidated the assessment results for each SO. Section 2 of this report summarizes the assessment results for the four student outcomes that were assessed in T172 including a compilation of corrective actions that will be applied starting in T181.

Table 1: Planned CIC activities for the current ABET accreditation cycle (151-202).

Term	151	152	161	162	171	172	181	182	191	192	201	202
CIC Activity	Corrective Actions		SO b, c, k assessment	Curriculum revision		SO i, j, f, h assessment	SO 1,3, 5 assessment	SO 2,6,7 assessment	Corrective actions		SO 1,3,5 assessment	SO 2,6,7 assessment

2. T172 Assessment Results

The COE department adopts the following criteria for judging a student's achievement of an outcome based on rubric scores (out of 4):

- Achieved (A): Score > 2.5,
- Marginally Achieved (M): Score: ≈ 2.5
- Need Improvement (NI): Score < 2.5

An important measure used to evaluate the overall achievement of a certain student outcome is the percentage of students who achieved 60% (i.e. 2.5/4) or more in the rubrics. This determines the urgency of corrective actions; any percentage less than 70% warrant corrective actions. We also keep an eye on the maximum and minimum rubric scores; larger spread is indicative of either an outcome delivery/injection problem, an assessment problem, or both.

Table 2: Mapping of student outcomes assessment to COE core courses of the new COE Curriculum.

Course \ Outcome	(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	Total outcomes assessed by a course
COE 202 & 203 Digital Logic Design								**0**
COE 300 Principles of Comp. Eng. Design								**2**
COE 301 Computer Organization								**1**
COE 306 Introduction to Embedded Systems								**2**
COE 241 Data & Comp. Communications								**0**
COE 344 Computer Networks								**1**
COE 351 COE Coop Training								**6**
COE 399 COE Summer Training								**6**
COE 485 Senior Design Project								**5**
Depth Elective Courses: **COE 444 Inter. Design and Management** **COE 405 Design& Modeling of Digital Sys.**								 **1** **1**
Total number of courses used to assess an outcome	**3**	**3**	**1**	**3**	**3**	**3**	**2**	

2.1 SO *b* Assessment results

OUTLINE OF THE ASSESSMENT METHOD

The assessment method for generating the rubrics b scores of the COE 344 laboratory experiments was based on two (2) lab experiments among the thirteen (13) lab experiments assignments in the COE 344 lab. The first lab experiment considered is week10 lab. The students is requested to design and implement an experiment to find out the network path of an IP packet between a source and a destination located on different networks. The second lab experiment considered is week14 lab. The students is requested to design and implement an experiment to study, analyze and understand how an IPv4 duplicate is detected. These two tasks were requested during the same lab experiment time so the students benefit from the lab environment and lab material.

PROVIDED MATERIALS

All requested injections of lab experiments by students are related to the lab experiment material.

EVIDENCES

The following items are enclosed in the course file as evidence:

- Lab handouts containing students' lab work from each lab section. The overall number of reports is six (6).
- Filled rubrics for outcomes b (rubrics filled for six (6)).
- Excel sheets with detailed scores for rubrics b. This includes outcomes generated from each one of the 6 students.
- Notebooks used by the students throughout the semester to write down lab notes, observations, analysis, feedback and conclusions.

ASSESSMENT RESULTS

Table 3 below summarize the assessment results for SO ***b*** (Experimental design and analysis).

Table 3: Assessment results for SO *b* in T161 (Experimental design and analysis).

Outcome	Avg.	Min.	Max.	Std. Dev.
1. Identifying clear goals for the experiment	3.42	2.00	4.00	0.80
2. Choosing the appropriate experimental test bed (Hardware, Software, Emulation, Simulation, or hybrid) to achieve the identified objectives of the experiment	3.00	2.00	4.00	0.84
3. Designing and conducting the experiment	3.08	2.00	4.00	0.92
4. Ability to analyze and interpret the data	3.25	2.00	4.00	0.99
	3.19	**2.00**	**4.00**	**0.84**

OBSERVATIOSN AND COMMENTS

After combining the assessment results from all sections: COE 344-51, 52 and 53 for each lab work, the following observations are reported:

- 83% of the students taken as a sample were at around or above the average and showed proficient level in "identifying clear goals for the experiments."
- 66% of the students taken as a sample were at around or above the average and showed apprentice level when requested to "choose the appropriate experimental test bed."
- 66% of the students were above the average and showed proficient level in "Designing and conducting and experiment."
- 66% of the students were above the average and showed a proficient level in their "Ability to Analyze and Interpret the Data."

SUGGESTIONS FOR CORRECTIVE ACTIONS

- Some students show a strong interest in the lab material however, they need more practice and work. This can be implemented through light homework where the student continues hos learning curve outside lab time.
- Better technical synchronization is needed between lecture and lab since the material requested to be injected as experimental design should have been covered in detail in the lecture.

Suggested improvements to the assessment process

- Better statistical tools other than average, min, max and STD should be used to understand an outcome behavior. The use of these tools needs some training but the results interpretation will be much more interesting.
- The students need to get introduced to scientific writing about how to write reports and give interpretations of results and provide feedback. They also need to learn how to use tools to show their results such as graphs and charts.
- It is observed that the English writing needs to be improved for many students.

The overall assessment for this SO is: **Satisfactory.**

2.2 SO *c* Assessment results

Table 4 below summarizes the assessment results of SO ***c*** (from three different courses) along with the observations and suggested corrective actions by the course instructors.

The overall assessment for this SO is**: Needs Improvement**.

2.3 SO *k* Assessment results

Table 5 below summarizes the assessment results of SO ***k*** (from three different courses) along with the observations and suggested corrective actions by the course instructors. Outcome K (Use the

techniques, skills, and modern engineering tools necessary for engineering practice) was achieved in COE 485 (Senior Design Project), COE 444 (Internetwork Design and Management), and COE 351 (COOP). In many situations, students use a tool they are already familiar with; as such a tool would have been used in a prior course. However, in few cases, students used tools that are not used in any course quite well.

Suggested Corrective Actions:

- Instructors should indicate the need to justify selecting the tool explicitly in COE 351, COE 444, and COE 485.
- The COOP coordinator should emphasize to the COOP students the importance of documenting the process of tool selection and usage. The coordinator should ask the students to use the knowledge from COE 300 on decision making as a mechanism to achieve this objective.

The overall assessment for this SO is**: Satisfactory**.

Table 4: Summary of assessment results of SO *c* along with the observations and suggested corrective actions by the course instructors

Course	Number of Students	Outcome Score	Assessment Method	Evidence Provided	Comments	Proposed Corrective Actions
COE 301 **Computer Organization**	**17**	**Ave = 2.4** **Min = 1.3** **Max = 3.7**	Engineering Design aspects are addressed through a Course Project for designing processor data-path and control.	Copies of student project reports Rubrics for outcome C	**El-Maleh and Abu-Amara** Engineering design aspects are addressed through a Course Project for designing a pipelined MIPS-like CPU. Students were given a modified instruction set that leads to a different design than the conventional MIPS design. In the project description, students were asked to consider design alternatives during the design process and to justify why a given alternative was chosen. The project and the project report are used to assess this outcome. In addition, Q4 of Major Exam II and Q2 of the final exam were testing student ability on design. The scores of students on the project and the two questions is given below including a score that combines the three components used in assessment out of 4.	**El-Maleh and Abu-Amara** As can be seen from the results, the overall performance of students on their ability to design needs improvement. The performance on exam questions was on the low side. Part of that because in Exam II students did not have a chance to digest the CPU design aspects of the course as the exam was right after the material has been covered. The question on the final exam was about pipelined CPU design. Unfortunately due to the low weight of the project on pipelining part (3% out of 10%), many students decided not to do it due to being pressured with other projects. Thus, this reflected on their understanding of the concepts and their performance in the exam. Looking at the project marks which really reflects student performance eon designing a whole functioning CPU, once can see that 8 out of 11 have scored around 7 out of 10. This means that they have done well in the single cycle CPU design part. This is the part that has the real design component in the project. As corrective actions to improve this outcome, we recommend that the weight on the project be increased to at least 15%. In addition, CPU design questions should be moved to the final exam with more weight put on the final exam to better assess this outcome after the students have done the project.

Outcome C Assessment Scores in COE 301

COE 301/ICS 233: Term 161

ID#	EXIIQ4(23)	Project(10)	FQ2(20)	Scor(4)
201035160	3.5	5.6	5.0	1.3
201320370	10.0	6.9	13.0	2.4
201321670	7.5	6.9	7.5	1.9
201327830	19.0	9	16.5	3.4
201334710	11.0	7.1	5.5	2.0
201343170	12.0	10.3	13.5	3.0
201346150	10.0	8.9	11.0	2.5
201354810	17.0	7.2	13.5	2.8
201356490	21.5	9.3	18.5	3.7
201356810	16.0	6	12.0	2.5
201371350	10.0	5.9	7.5	1.9
AVG	**12.5**	**7.6**	**11.2**	**2.5**
MAX	**21.5**	**10.3**	**18.5**	**3.7**
MIN	**3.5**	**5.6**	**5.0**	**1.3**

Stuid	Exam2-Q04	Final-Q02	Project	Score
	23.00	20.00	10.00	4.00
201228980	7.00	4.50	6.50	1.57
201279680	6.00	16.50	6.70	2.34
201320950	2.50	4.00	6.50	1.28
201324710	3.50	5.00	5.50	1.27
201335750	11.50	11.00	5.50	2.13
201370930	10.00	9.00	4.50	1.78
Average	6.75	8.33	5.87	1.73
Std. Deviation	3.53	4.88	0.85	0.44
Max	11.50	16.50	6.70	2.34
Min	2.50	4.00	4.50	1.27
Median	6.50	7.00	6.00	1.68

COE 485

Senior Design Project

15

Ave = 2.5
Max = 3.5
Min = 1

Outcome	Avg.	Min.	Max.	Std. Dev.
Requirements	**2.88**	**2.50**	**3.00**	**0.22**
Problem formulation	**2.34**	**1.00**	**3.00**	**0.83**
Design Alternatives	**2.38**	**2.00**	**3.00**	**0.50**
Economical assessment	**2.19**	**2.00**	**3.00**	**0.31**
Structured Design	**2.63**	**2.00**	**3.50**	**0.53**

Students did not really document their design process well enough to show examiners and evaluators how did they formulate design problems, seek different solutions and evaluate them based on many criteria including economical feasibility.

Total | **32** | **2.44** (Weighted Average)

*** Summarized as is from course instructor's reports**

Table 5: Summary of assessment results of SO *k* along with the observations and suggested corrective actions by the course instructors.

Course	Number of Students	Average Outcome Score	Assessment Method*	Evidence Provided	Comments*	Proposed Corrective Actions*
COE 485	**15**	**3.3**	Rubrics: Tool Selection Tool Usage	Rubrics for outcome K Final reports for COE 485 Student Presentations and Demos		
COE 444	**13**	**3.12**	Rubrics form filled by instruction for each student	Course project	By **Tarek Sheltami**: All the students selected tools that they had a prior experience without justifications.	**By Tarek Sheltami:** Instructors should indicate the need to justify selecting the tool explicitly in the next offering.
COE 351	**4**	**3.16**	Rubrics form filled by the COOP advisor	Progress report Final report Public presentation	By **Yahya Osais**: Students do use different tools in the different stages of the projects they are involved in during their COOP. However, they still need to be trained on how to decide that a tool is really appropriate for the job at hand.	By **Yahya Osais**: The COOP coordinator should emphasize to the COOP students the importance of documenting the process of tool selection and usage. He will ask the students to use the knowledge from COE 300 on decision making as a mechanism to achieve this objective.
Total	**32**	**3.21**	*** Summarized as is from course instructor's reports**			

Appendix : Rubrics for Assessing SOs b, c, and k

Outcome (b) Rubrics

An ability to design and conduct experiments, as well as to analyze and interpret data

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Identifying clear goals for the experiment		Clearly identify the objectives of the experiment, the expected results, and possible pitfalls to watch for	Clearly identify the objectives of the experiment and some of the expected results but does not think of the possible pitfalls	Identify some of the objectives of the experiment but omits the expected results and possible pitfalls	Does not identify any objectives for the experiment and/or expected results
Choosing the appropriate experimental test bed (Hardware, Software, Emulation, Simulation, or hybrid) to achieve the identified objectives of the experiment		Chooses the best test bed suitable for achieving the objectives with proper justification	Chooses the best test bed suitable for achieving the objectives with no justification	Chooses a test bed that is not optimum but somehow achieves the identified objectives	Chooses a test bed that does not achieve the objectives at all
Designing and conducting the experiment		Student groups design and conduct the experiment with no errors at all	Student groups design and conduct the experiment with some minor errors that do not adversely affect the objectives	Student groups design and conduct the experiment with some errors that affect the results and the objectives	Student groups design and conduct the experiment with major conceptual or procedural errors that render the results useless and leave the objectives unachieved
Ability to analyze and interpret the data		Analysis and interpretation of results exceed requirements of experiment and demonstrate significant higher-order thinking ability	Analysis and interpretation of results meet requirements of experiment and demonstrate some higher-order thinking ability	Results are analyzed but not interpreted; very limited evidence of higher-order thinking ability	No evidence of significant analysis and interpretation of results; fail to meet requirements of the experiment; demonstrate only lower-level thinking ability

Outcome (c) Rubrics

Ability to design a system, process, or component to meet desired needs subject to given constraints.
Analyze and evaluate alternative solutions.

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Requirements are translated accurately and with great precision into system behavior and features clearly described without ambiguity and without entering into any design details		Requirements are translated accurately and with great precision into system behavior and features clearly described without ambiguity and without entering into any design details.	Requirements are translated accurately into system behavior and features clearly described with some ambiguity. The description of behavior and features enters into some details and proposes design solutions thinking it is just translating the requirements.	Requirements are not translated accurately into system behavior and features. Some features not clearly described. Some consistency errors.	Specification does not follow the requirements consistently. Several consistency errors. No clear difference between system behavior description and features and design solutions.
Potential conceptual problems are addressed and properly formulated. Some system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly or alike		Potential conceptual problems are addressed and properly formulated. Some system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly or alike	Potential conceptual problems are addressed but not properly formulated. Some system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly with some errors on the assumptions.	Potential conceptual problems are recognized but not properly formulated. No system behavior is translated into some mathematical formulas describing necessary conditions for the system to function properly.	Potential conceptual problems are not identified in any way.
Different design alternatives are proposed and clearly discussed and compared. The comparison is rigorous and accurate.		Different design alternatives are proposed and clearly discussed and compared. The comparison is rigorous and accurate.	Different design alternatives are proposed and clearly discussed and compared. Some rigor missing in the comparison although accurate statements are made.	A small subset of the possible design alternatives is considered. No thorough comparison is performed and statements are not accurate.	No design alternatives are proposed.

The analysis of the technical and economic constraints leads to the optimal design solution. The justification and argumentation is thorough, accurate and consistent.		The analysis of the technical and economic constraints leads to the optimal design solution. The justification and argumentation is thorough, accurate and consistent.	The analysis of the technical and economic constraints leads to the optimal design solution. The justification and argumentation is accurate and consistent but not thorough. Missing justifications for some aspects.	The analysis of the technical and economic constraints does not lead to the optimal design solution. The justification and argumentation are a little accurate and superficial.	The design solution is presented without any analysis. Some inappropriate justification and argumentation is present with a lot of inconsistencies.
A structured design methodology is followed that breaks the overall solution into sub-components adequately using trade-offs. Relations and interactions between sub-components are well defined. No redundancy or overlapping in the sub-components roles.		A structured design methodology is followed that breaks the overall solution into sub-components adequately using trade-offs. Relations and interactions between sub-components are well defined. No redundancy or overlapping in the sub-components roles.	A structured design methodology is followed that breaks the overall solution into sub-components adequately using trade-offs. Relations and interactions between sub-components are not well defined. A little redundancy or overlapping in the sub-components roles.	No structured design methodology is followed. Breaking the overall solution into sub-components follows an ad-hoc methodology with no clear rules. Trade-offs are not identified. Relations and interactions between sub-components are not well defined. A lot of redundancy or overlapping in the sub-components roles.	No structured design methodology is followed. Breaking the overall solution into sub-components follows is purely arbitrary. Trade-offs are confused with solution parameters. Relations and interactions between sub-components are anarchically defined. Sub-components are not really sub-components and suffer from a lack of clear identity.

Outcome (k) Rubrics

Use the techniques, skills, and modern engineering tools necessary for engineering practice

Outcome	Score (1 - 4)	Exemplary (4)	Proficient (3)	Apprentice (2)	Novice (1)
Tool Selection		Selection of tools is based on sound technical criteria. Relevant industry standard class tools (software CAD, simulation, test equipment, emulators, measurement and lab equipment, planning and project management tools) are selected for carrying out specific tasks	Selection of tools is based on prior knowledge of the tools. Relevance of the selected tools is close to the standard practices.	Selection of tools is not based on technical criteria. Tools are selected based on personal preference	Selection of tools is not discussed. Use of the wrong set of tools is commonly noticed.
Tool Usage		Usage of the tools shows a good awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Any issue with the tools is resolved using the tools documentation, FAQs or the customer support. Accurate description of credible problems encountered is noticed.	Usage of the tools is shows a fair awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Some issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is not always seen.	Usage of the tools is shows a little awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Improper use of the tools documentation. Several issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is missing.	Usage of the tools is shows no awareness of the tools capabilities and features. Tools are used incorrectly and in an inconsistent way with the stated objectives. Improper use of the tools documentation. Most issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is missing.