

## **BS in Computer Science - Resolution of Recommendations arising from the 2019-2021 Assessment report**

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Based on its consideration of the Biennial Assessment Report of the BS in Computer Science program for 2019-2021 cycle which included recommendations made by the Subject Area Coordinators (SAC), the Undergraduate Committee (UGC) of the School of Computing and Information Sciences discussed them and made several recommendations of its own. These recommendations were evaluated by Dr. Nagarajan Prabakar, the Director of Undergraduate Programs, who made no additional academic recommendations. Resolution of these recommendations concludes the 2019-2021 assessment cycle for the BS in Computer Science Program, and are summarized below:

### **A. Recommendations originated by the Subject Area Coordinators:**

#### **Subject Area: Applications (SAC: Leonardo Bobadilla)**

##### **CAP 4052 Game Design and Development**

**This course was not offered during this Assessment cycle.**

- SAC recommends that the course should be offered more often.

*UPC recommends for this course to be offered at least once per year. UPC has compiled a list of courses with recommended annual frequencies to be used for reference when planning future schedules.*

##### **CAP 4104 Human-Computer Interaction**

- The course was offered only once.
- The instructor expressed a concern related to the preparation and time availability of the students.
- The course should be offered more often.
- The instructor and the Undergraduate Program Committee (UPC) should consider some prerequisites to ensure students are better prepared before taking the class.

*Feedback did not specify further details on specific areas of under preparation, so it is too big a challenge to know what prerequisites are desired, plus CAP4104 is a prerequisite for other electives so we have to watch pipeline length. UPC recommends no changes, other than ensuring the course is offered at least once per year. UPC has compiled a list of courses with recommended annual frequencies to be used for reference when planning future schedules.*

##### **CAP 4612 Introduction to Machine Learning**

**This course was not offered during this Assessment cycle.**

*UPC will recommend for this course to be offered twice per year; once in either fall or spring and again in the summer. UPC has compiled a list of courses with*

*recommended annual frequencies to be used for reference when planning future schedules.*

#### **CAP 4630 Artificial Intelligence**

- The course went through a revision modification by the instructor based on the feedback of the students. This substantially improved the course outcomes and the flow of the course as determined by the evaluations.
- As suggested by some students, the number of questions in exams can be reduced, if found appropriate by the instructor.

*UPC recommends instructors for this course to take inventory of exams and ensure in their best judgment the length seems appropriate. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback.*

#### **CAP 4641 Natural Language Processing**

- A student mentioned that it would be good to cover practical aspects of the subject. That seems to be a valid suggestion for the UPC to consider.

*As theory is not a prerequisite for this course, the first two weeks need to be devoted to a necessary background on basic concepts (i.e. finite automata), limiting the amount of content that can be removed while keeping the course comprehensive. For now, the feedback regarding practical applications will be noted and supplied to future instructors. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback. No changes are recommended by UPC.*

#### **CAP 4710 Computer Graphics**

- A student had some comments about the lack of guidance for certain topics from one instructor. The situation seemed to improve with the change of instructor.
- No change in the curriculum or outcomes is suggested.

*No changes recommended by UPC.*

#### **CAP 4770 Intro. To Data Mining**

- No change in the curriculum or outcomes is suggested.

*No changes recommended by UPC.*

#### **CAP 4830 Modeling and Simulations**

- No change in the curriculum or outcomes is suggested.

*No changes recommended by UPC.*

**Subject Area: Computer Organization (SAC: Dong Chen)**

**CDA 3102** Computer Architecture

New course to replace CDA 3103 and CDA 4101 starting in Spring 2020

- CDA-3102 (offered beginning in Fall 2020) is a new course to replace CDA-3103 and CDA-4101.
- Continue to use interactive textbooks (Zybooks) since it was helpful in improving student learning.

*The textbook in the official Syllabus is already available as a ZyBook, and faculty will be encouraged to use this electronic version. UPC has compiled a list of candidate courses for textbook changes, to be discussed at future meeting(s) involving administrators and corresponding instructors. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback.*

**CDA 3103** Fundamentals of Computer Systems

- It is now a discontinued course; no recommendations are warranted.

*No changes recommended by UPC.*

**CDA 4101** Structured Computer Organization

- It is now a discontinued course; no recommendations are warranted.

*No changes recommended by UPC.*

**CNT 4713** Net-centric Computing

- No change is needed on the course outcomes or syllabus.

*No changes recommended by UPC.*

**COP 4610** Operating Systems Principles

- For all five outcomes of the course, most of the students (more than 90%) agree with their Value and Coverage, either strongly or moderately. There is no significant concern expressed by the students or faculty.
- No change is needed on the course outcomes or syllabus.

*No changes recommended by UPC.*

**Subject Area: Computer Systems (SAC: Gregory Reis)**

**CAP 4453** Robot Vision

The course was not offered during the evaluation period.

- The SAC recommends trying to offer the course at least once a year since it was accepted by the Undergraduate Committee and students need to take electives in order to graduate in the 4-year desired period.
- The syllabus of this course should match the template of our School. The current version has a format that hinders reading of the document

*UPC recommends offering this course once per year. UPC has compiled a list of courses with recommended annual frequencies to be used for reference when planning future schedules. Administrators will meet with relevant faculty who have taught this course to coordinate Syllabus updates.*

#### **CDA 4625 Intro. To Mobile Robotics**

- Continue having hands-on labs and encourage students to continue learning about electronics and the basics of assembling a robot with sensors and actuators.
- It will be interesting to implement the computer vision programs developed in the labs into the robots.
- Consider giving the students more practice of Bayes Theorem and Gaussian Distribution in the prerequisite course STA-3033.

*As STA is not a KF-SCIS class we do not control the outcomes of that course. A recommendation will be issued to instructors teaching CDA4625 to provide either background or some optional reading materials on Bayes and Gaussian, and will be encouraged to see if incorporating with physical robots is a practical option. UPC has compiled a list of candidate courses for textbook changes, to be discussed at future meeting(s) involving administrators and corresponding instructors. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback.*

#### **CEN 4083 Cloud Computing**

- The assignments need to be written with a greater level of details including the specific goals and expectations.
- Further, assignments should not be designed with the assumption that students had previous experience in Cloud Computing.

*CEN4083 instructors will be encouraged to take inventory of assignments; ensure no prior knowledge is assumed, and check for an appropriate level of detail. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback.*

#### **CIS 4731 Fund. Blockchain Technologies**

The course was not offered during the evaluation period.

- The SAC recommends trying to offer the course at least once a year since it was accepted by the Undergraduate Committee and students need to take electives in order to graduate in the 4-year desired period.

*UPC recommends offering this course at least once per year. UPC has compiled a list of courses with recommended annual frequencies to be used for reference when planning future schedules.*

#### **COP 4604** Advanced UNIX Programming

The course was not offered during the evaluation period.

- The SAC recommends trying to offer the course at least once a year since it was accepted by the Undergraduate Committee and students need to take electives in order to graduate in the 4-year desired period.

*The UPC recommends offering this course once per year. UPC has compiled a list of courses with recommended annual frequencies to be used for reference when planning future schedules. The UPC will be redesigning the Syllabus for this course as well, as its last update was in 2012.*

#### **COP 4710** Database Management systems

- Some sections offered only two exams which made up a large portion of the final grade. It would be beneficial to distribute the grade across different assignments, hands-on labs, case studies, and work in groups.
- The SAC suggests more small projects, and less homework assignments taken from the textbooks and focused only on the theoretical foundations of database management.

*The syllabus and course objectives do not have any information about grade percentages and homework assignments; UPC recommends no changes. Future instructors will be advised of these prior student concerns. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback.*

#### **COT 4431** Applied Parallel Computing

The course was not offered during the evaluation period.

- The SAC recommends trying to offer the course at least once year since it was accepted by the Undergraduate Committee and students need to take electives in order to graduate in the 4-year desired period.

*UPC recommends this course to be offered once per year. UPC has compiled a list of courses with recommended annual frequencies to be used for reference when planning future schedules.*

#### **Subject Area: Foundations (SAC: Hadi Amini)**

#### **CAP 4506** Introduction to Game Theory

[This course was offered in Spring 2019 – No course evaluations were submitted]

- The evaluations for this course were not available. The instructor may encourage students to participate in the survey.
- The only comment from a participant in the survey was very positive.
- The course appraisals by instructors must be performed.

*No changes recommended by the UPC.*

#### **COP 4534** Algorithm Techniques

- A concern expressed by one faculty member is about students' preparation for this course: a) Students generally lack background in basic discrete probability theory, and b) Students' preparation in combinatorics is not satisfactory. In general, the students' preparation for taking this course was judged to be Deficient.
- The SAC recommends including an introductory lecture covering basic probability theory would be helpful.
- The UPC should consider including basic discrete probability theory as well as solving more basic Combinatorics problems in the Discrete Structures course.

*Administrators will meet with relevant faculty that teach Discrete Structures as to the practicality of encapsulating probability and combinatorics in the Discrete Structures course.*

#### **COP 4555** Principles of Programming Languages

- Although COP 3530 is a pre-requisite for the course, students were found to be deficient in that knowledge.
- Basic mathematical maturity of students in general, is Deficient.
- The instructors should briefly review the COP3530 necessary materials during the first part of the course.
- No change is needed on the course outcomes or syllabus.

*UPC agrees with recommendation of a review of relevant COP3530 topics; no changes recommended by UPC to syllabus or outcomes. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback.*

#### **COT 3100** Discrete Structures

- A student in an online session asked for more time for the exams.
- Zybooks lends itself as a valuable resource.
- Some instructors raised the concern for deficient skills in MAC-1105, COP-2210, and COP-2250 during the first week of the semester.
- Instructors are encouraged to evaluate the students' understanding of the prerequisite materials during the first week of semester and provide additional resources to students who need it.
- No change is needed for the course outcomes or its syllabus.
- Given the high registration for this course, student participation in the course evaluation system since 2019 is consistently low. Perhaps students who complete course evaluation

before the final exam week, may be provided incentives to encourage them to participate in evaluation.

*Instructors should be informed that the prerequisite for COT-3100 is MAC-XXXX and COP-XXXX, which is not necessarily College Algebra (MAC-1105) or our Programming I (COP-2210/2250). UPC agrees with point 4 above; for an opening-round evaluation of incoming knowledge. UPC has compiled a list of candidate courses for textbook changes, to be discussed at future meeting(s) involving administrators and corresponding instructors. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback. UPC does not recommend any enforcement of extra credit for course evaluations, particularly now that online evaluations are now in place with records of student completion. KF-SCIS has migrated to an online Course Evaluation (CE) system that records percentages of students that respond. Instructors will be encouraged to offer bonus points based on this percentage.*

#### **COT 3510 Applied Linear Structures**

The course was not offered during the evaluation period.

*No changes recommended by UPC.*

#### **COT 3541 Logic for Computer Science**

- One student's concern involves adding an additional layer of complexity when explaining some topics of the course which makes it more difficult when grasping the concept being taught.
- One instructor feels very strongly about adding this course to mandatory courses.
- No change is needed for the course outcomes or its syllabus.

*Student feedback regarding complexity will be collected and provided to future instructors of the course. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback.*

*UPC voted in 2019 to remove the requirement of COT3541 for computer science and stands by its recommendation as the course is oriented around AI-type concepts (i.e. satisfiability), not general logic, and was not determined to be foundational. No further changes recommended by UPC.*

#### **COT 4521 Introduction to Computational Geometry**

The course was not offered during the evaluation period.

*No changes recommended by UPC.*

#### **MAC 2311-2312 Calculus I and II (No data is available)**

#### **MAD 2104 Discrete Mathematics (Now substituted by COT 3100)**

**MAD 3305, MAD 3401, MAD 3512, MAD 4203, MHF 4302** are Math Electives

*These courses are from other departments; no changes recommended by UPC.*

**Subject Area: Professional Development (SAC: Richard Whitaker)**

**CGS 1920** Introduction to Computing (1 credit)

- The faculty members that have taught this course have discussed changing the title of this course to “Introduction to the Field of Computing”. This should be considered by the UPC.
- No other changes are recommended.

*UPC recommends changing the name of CGS1920 to Introduction to the Field of Computing.*

**CGS 3095** Technology in the Global Arena

- A few students commented that the textbook was not helpful for the course.
- No other changes are recommended.

*Official course syllabus only makes a suggestion for the textbook, so no changes are recommended by UPC. A re-evaluation of this textbook will be performed in the future by members of the UPC and instructors of CGS3095. UPC has compiled a list of candidate courses for textbook changes, to be discussed at future meeting(s) involving administrators and corresponding instructors.*

**ENC 3249** Professional and Technical Writing for CS (Taught by English Department)

- Using the CGS 3095 course which has writing assignments as a proxy, students’ writing skills were found to range from deficient to adequate.
- No changes are recommended.

*Different department; no changes are recommended by UPC*

**STA 3033** Probability and Statistics (Taught by Statistics Department)

- No opinion

*No changes recommended by UPC (different department)*

**PHY 2048/9** Physics with Calculus I and II (Taught by Physics Department)

- No opinion

*No changes recommended by UPC (different department)*

**Subject Area: Programming (SAC: Janki Bhimani)**

**COP 2210** Computer Programming I



- The SAC recommends continuing the use of interactive textbooks (Zybooks) and ZyLabs along with the lecture handouts, since they were helpful in improving student learning.

*Instructors will be asked to reevaluate the course textbook and the electronic ZyBooks will be on the table for consideration. UPC has compiled a list of candidate courses for textbook changes, to be discussed at future meeting(s) involving administrators and corresponding instructors.*

#### **COP 3337 Computer Programming II**

- No change is needed for the course outcomes or its syllabus.

*No changes recommended by UPC.*

#### **COP 3530 Data Structures**

- Students expressed that the half-semester format is a rather tight timeframe for this class, so terms A and B should be avoided given the high importance of this course towards career making in computer science.
- No change is needed for the course outcomes or its syllabus.

*UPC recommends COP3530 to only be offered during Term C.*

#### **COP 4226 Advanced Windows Programming**

- No change is needed for the course outcomes or its syllabus.

*No changes recommended by UPC.*

#### **COP 4338 Computer Programming III**

- Students requested to have more online sessions for this course and reduced homework.
- No change is needed for the course outcomes or its syllabus.

*UPC will explore if more online sessions can be offered; no changes recommended to course outcomes/syllabus*

#### **COP 4520 Introduction to Parallel Computing**

- Only two students filled the survey when the course was offered in Spring 2019, and not much is learned from them.

*KF-SCIS has migrated to an online Course Evaluation (CE) system that records percentages of students that respond. Instructors will be encouraged to offer bonus points based on this percentage.*

#### **Subject Area: Project (SAC: Masoud Sadjadi)**

### CIS 3950 Capstone I [Along with Capstone II course (CIS 4951), it substitutes CIS 4911]

- The course was offered in Fall 2020 and Spring 2021.
- Students raised three main concerns: a) Inadequate tools forced to be used for communications, meetings, announcements, assignment submissions, etc., b) The role and responsibilities of Capstone I & II students were not clear, and c) The projects need to be more diverse.
- **SAC Recommendations:**
  - Allow students to pick the tools for communications among themselves so that they can easily conduct their meetings and do online/offline communications.
  - The role of the Capstone I and Capstone II students should be clearly communicated to the students.
  - The instructor should seek different ways to attract more diverse project proposals to be made available to students.

### CIS 4911 Senior Project

- CIS-4911 is going to be phased out and eventually replaced by Capstone I & II.
- Students raised the following concerns: a) Inadequate tools forced to be used for communications, meetings, announcements, assignment submissions, etc., b) Unclear role of Capstone I, II, and Senior Project students working together in one project, c) Lack of sufficient communications delay in responding to the students by the instructor (raised by two students), d) Large group sizes, e) Grades to be better communicated throughout the semester, f) Project list should be given earlier, g) No end of semester surprises should be forced upon students for the final deliverables, and h) Provide virtual computers.
- This is a 3-credit course that is taken by students in their final semester before graduation. It is being replaced by Capstone I and II courses which may be taken in contiguous semesters, or even spaced out appropriately.
- **SAC Recommendations:**
  - Allow students to pick the tools for communications among themselves so that they can easily conduct their meetings and do online/offline communications.
  - The role of the Capstone I, Capstone II, and Senior Project students assigned to the same project should be clearly communicated to the students.
  - The instructor must be consistent in responding to all students on time. It appears that only two students (out of hundreds who have taken this course) complained about lack/delayed responses by the instructor.
  - The instructor should seek different ways to attract more project proposals so that the group sizes are more manageable.
  - The instructor must make sure that the grades are being communicated to the students throughout the semester (only one student complained).
  - The instructor should project the list of available projects during the first week of the semester.
  - The expectations of the end of the semester final deliverable should be communicated better at the beginning of the semester to avoid any surprises.

- The instructor should ask the school to provide students with virtual computers if they need one or more for their projects. In the past, the instructor has arranged for all students to receive a virtual machine at the beginning of the semester, but as very few students used such pre-assigned virtual machines, it turned out to be a big waste of resources. Hence, it was decided to do the assignments on a need basis. The instructor should clearly communicate to all students at the beginning of the semester that they can request one or more virtual machines for their projects.

### **CIS 4951 Capstone II**

- The course was offered in Fall 2020 and Spring 2021.
- Students raised the following concerns: a) Inadequate tools forced to be used for communications, meetings, announcements, assignment submissions, etc., b) The role and responsibilities of Capstone I & II students were not clear, c) The projects need to be more diverse, d) The load on Capstone II students is more than two credits, and e) Some project product owners/mentors were not responsive.
- **SAC Recommendations:**
  - Allow students to pick the tools for communications among themselves so that they can easily conduct their meetings and do online/offline communications.
  - The role of the Capstone I and Capstone II students should be clearly communicated to the students.
  - The instructor should seek different ways to attract more diverse project proposals to be made available to our students.
  - The load for Capstone II students should be better distributed. Those students who have contributed significantly to the project while taking their Capstone I should be rewarded while taking their Capstone II by having less workload.
  - The instructor should recruit more responsible project product owners/mentors and clearly communicate to them that they are expected to be available to their assigned students and answer their questions daily. They must also be available and well-prepared for the Planning, Review, and Retrospective meetings.

Future instructors will be advised of these prior student concerns and they are being incorporated into the capstone courses during this current semester. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback.

*Capstone I-II and Software Project recommendations have been implemented starting in 2021-2022.*

### **IDS 4918 VIP Program – [Essentially Project Course for non-majors]**

- The course was not offered in this assessment period.

*No changes recommended by UPC.*

### **Subject Area: Software Engineering (SAC: Monique Ross)**

### CEN 4010 Software Engineering I

- The UPC should reconsider the prerequisites for this class. While students are not complaining, faculty evaluations suggest that the absence of database knowledge, as well as opportunities for students to practice teamwork and full stack development prior to this course is of concern.

*UPC recommends removing “Data Structures” as a prerequisite topic for CEN4010.*

### CEN 4021 Software Engineering II

- The instructors expressed concern related to effective team work.
- **SAC Recommendation:** Continue to investigate opportunities for students to work in teams prior to Software Engineering I and II to help foster good habits related to working with others.

*UPC will encourage future instructors in prerequisite programming courses to consider and foster team-based learning. UPC proposes tying Syllabi directly to assessment comments accessible to faculty, so that future instructors for this course will receive this feedback.*

### CEN 4072 Software Testing

- The instructors have noted concerns related to basic mathematical understanding necessary to be successful in test generation (noting specifically the BA-CS students).
- **SAC Recommendation:** Consider whether this course is appropriate for the BA-CS students as an elective.

*UPC recommends changing the prerequisite requirements for the course to encapsulate some mathematics, so that advisors and students will be aware of the knowledge required upon entering the course. Administrators will meet with instructor(s) of CEN4072 to ensure appropriate modification. UPC does not recommend removing CEN4072 as a BS-IT elective, in case a strong BS-IT student with appropriate mathematical background desires to take the class.*

## B. Recommendations of the Assessments Coordinator

All Academic recommendations of the Assessment Coordinator have been addressed above in Section A.

The procedure-oriented recommendations of the Assessment Coordinator will be resolved later after we complete the ABET review of the BS in CS Program in Fall 2022. Note that this time around, we are undergoing ABET Review of two additional Programs; BS in IT and BS in CyS. Based on the outcome of those reviews, we will modify our Assessment procedure (if needed) to synchronize the procedure across all three Programs.