FITC Institute Final Report
Appendix K

Curriculum Analysis Report:

Florida State University Computer Science Program

June 9, 2015

Chandrahasa Ambavarapu, Graduate Research Assistant
Jinxuan Ma, Ph.D., Post-Doctoral Researcher
Heather Kelleher, Graduate Research Assistant
Laura I. Spears, Research Coordinator
Charles R. McClure, Ph.D., Director, Information Institute
Marcia A. Mardis, Ed.D., Associate Professor
Susan C. Thomas, Program Coordinator

1. Introduction

The Florida IT Career Alliance (FITC) Assessment Project examined the Florida State University (FSU) Computer Science (CS) curriculum using a computer science curriculum framework, employing a syllabus analysis assessment method. This analysis posed one research question: To what degree are the learning outcomes in the FSU CS program's courses similar to the learning outcomes in the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE) Computer Society computer science (CS) (hereafter referred to as ACM/IEEE CS) curriculum guidelines?

Syllabus analysis is a subset of curriculum analysis, a process that is commonly used to examine academic program content. Course syllabus analysis is an efficient and non-obtrusive means of assessing knowledge and skill sets within a curriculum (Apigian & Gambill, 2008; Madson, Melchert, & Whipp, 2010; Veltri et al., 2011). A course syllabus, which contains information such as class schedules, assignment descriptions, student learning objectives, subject content, and grading criteria, is often considered a "contract" between the instructor and the

student, a permanent record for academic institutes, and a reference tool for students (Parkes & Harris, 2002).

Every decade, the ACM and the IEEE Computer Society jointly sponsor a volume on computer science, which primarily aims to provide modern curricular guidance for undergraduate CS programs internationally. In 2001, this volume was fragmented into 5 disciplines: computer science (CS), computer engineering (CE), information systems (IS), information technology (IT), and software engineering (SE). The purpose of publishing curriculum guidelines is to help train future generations of computing professionals (The Joint Task Force on Computing Curricula: ACM/IEEE Computer Society, 2013).

According to the FSU CS program website,[1] the FSU CS department offers two bachelor's degree programs in computer science: a) Bachelor of Art in Computer Science(BA/CS); and b) Bachelor of Science in Computer Science(BS/CS). The main difference between the two programs is that the BS/CS is considered the science track while the BA/CS is labelled as the humanities track. The BA/CS track requires fewer credits related to mathematics and the theoretical foundations of computer science, so it does not possess credentials granted by the Accreditation Board for Engineering and Technology (ABET), while the BS/CS does.

2. Method

2.1 Data Collection

The FSU B.A. and BS/CS program flowcharts[2] provide a list of courses a student is supposed to take through their four-year college degree program. A bachelor's degree in computer science is a 120 credit hours program. The major program of studies in the BS/CS program requires a student to take 60 credit hours, 40 are in the required CS courses. The remaining 11-12 hours come from electives in CS, and 9 hours are in discrete mathematics and probability or statistics. The BS/CS major at FSU is 52 credit hours. Computer and math courses contribute to 43 hours, and the remaining 9 hours are computer science electives, including 3 hours of an upper-division programming language elective for CS majors and at least 6 hours of courses numbered above 4000.

A total of 12 courses from the BA/CS and 17 courses from the BS/CS were chosen for the analysis (See Appendices A&B). These courses represent the major programs of study in the FSU CS department. Syllabi from the terms Spring 2014 and Fall 2014 were collected. This included the courses related to computer science, mathematics, and statistics. As there is overlap between the courses required for each program, the total number of distinct course syllabi analyzed was 17 (N=17). The ACM/IEEE CS 2013 undergraduate curriculum guidelines were used as a standard to compare the course contents listed in the syllabi with the learning outcomes offered in the ACM/IEEE guidelines.

2.2 Data Analysis

[1] http://www.cs.fsu.edu/current/undergrad/bs_ba_in_cs_diff.php
[2] http://www.cs.fsu.edu/current/undergrad/flowchart.pdf and http://www.cs.fsu.edu/current/undergrad/csba_flowchart.pdf

Curriculum Analysis Report:
Florida State University Computer Science Program

The FSU CS program's syllabi analysis was conducted using the Python programming language to implement text preprocessing and keyword extraction. Python programming is utilized for automating tedious tasks such as extracting relevant sections from the syllabus, tokenizing the text, extracting keywords and identifying these keywords and patterns in the syllabi and in ACM/IEEE undergraduate curriculum guidelines. The extracted keywords were listed in various syllabus sections, including Course Description, Course Objectives, and Course Content/Schedule.

The ACM/IEEE undergraduate computing curricula guidelines identify essential skills and the *Body of Knowledge* for graduates in the information technology, CS and CE (Computer Engineering) programs. The *Body of Knowledge* is divided into specific *Knowledge Areas*, which are further subdivided into *Knowledge Units* (made up of learning outcomes). The ACM/IEEE CS 2013 curriculum guidelines identify 18 distinct *Knowledge Areas* listed below:

- AL-Algorithms and Complexity;
- AR-Architecture and Organization;
- CN-Computational Science;
- DS-Discrete Structures;
- GV-Graphics and Visualization;
- HCI-Human-Computer Interaction;
- IAS-Information Assurance and Security;
- IM-Information Management;
- IS-Intelligent Systems;
- NC-Networking and Communication;
- OS-Operating Systems;
- PBD-Platform-based Development;
- PD-Parallel and Distributed Computing;
- PL-Programming Languages;
- SDF-Software Development Fundamentals;
- SE-Software Engineering;
- SF-Systems Fundamentals; and
- SP-Social Issues and Professional Practice.

Extracted keywords from each syllabus were compared to the topics and learning outcomes in *Knowledge Units* in the ACM/IEEE CS 2013 curriculum guidelines to examine the degree of similarity.

3. Findings

The analysis of 12 course syllabi for required courses in the BA/CS and 17 course syllabi for required courses in the BS/CS demonstrated similarity to the ACM/IEEE curriculum guidelines in 17 out of 18 Knowledge Areas (94%). There was only one Knowledge Area for which no Knowledge Units and learning outcomes were listed in course syllabi, which was the knowledge area PBD-Platform-based development.

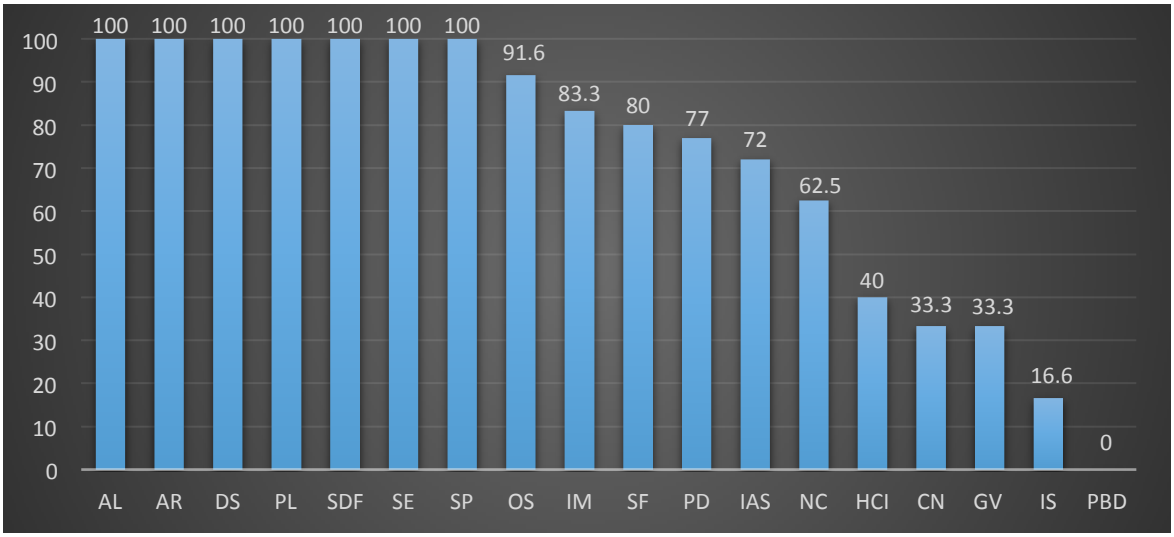

Figure 1: Percentage of Knowledge Unit coverage by Knowledge Area

Presented in Figure 1 are the specific percentages of Knowledge Unit coverage in each Knowledge Area. For each Knowledge Area specified by the ACM/IEEE, there are several Knowledge Units reflecting specific learning outcomes. If these learning outcomes were present in the syllabi for a particular Knowledge Unit, that Knowledge Unit would be considered covered. For example, all of the Knowledge Units for the Knowledge Area Algorithms (AL) were represented in the syllabi analyzed, so it is represented here as 100% Knowledge Unit coverage for that particular Knowledge Area.

The Knowledge Areas that demonstrated more than 60% similarity to the ACM/IEEE CS curriculum guidelines are: AL-Algorithms, AR-Architecture and Organization, DS-Discrete Structures, IAS-Information Assurance, IM-Information Management, NC-Networking and Communication, OS-Operating Systems, PD-Parallel and Distributed Computing, PL-Programming Languages, SDF-Software Development Fundamentals, SE-Software Engineering, SF-Systems Fundamentals, and SP-Social Issues and Professional Practice.

4. Discussion

4.1 Findings Discussion

One of the tasks of the FITC Assessment project was to analyze the FSU undergraduate programs in computer science. This portion of the assessment project sought to answer one research question: To what extent are the learning outcomes listed in the 17 FSU CS course syllabi similar to the learning outcomes in the 2013 ACM/IEEE CS curriculum guidelines? In order to do so, a syllabus analysis was conducted for 12 required courses for the BA/CS and 17 required courses for the BS/CS. The courses were analyzed for the extent to which the syllabi contained learning outcomes that could be compared to the Knowledge Units in the ACM/IEEE undergraduate CS curriculum guidelines from 2013.

Based on an analysis of course syllabi from the 12 required courses from the BA/CS and 17 required courses from the BS/CS from the FSU CS program, it was determined that the two CS programs exhibit some similarity to the ACM/IEEE CS curriculum guidelines. The syllabi demonstrated similarity to 17 out of 18 (94%) ACM/IEEE CS Knowledge Areas, with all Knowledge Units being covered in the following Knowledge Areas*: AL-Algorithms, AR-Architecture and Organization, DS-Discrete Structures, PL-Programming Languages, SDF-Software Development Fundamentals, SE-Software Engineering,* and *SP-Social Issues and Professional Practice*.

Some Knowledge Units were covered in the Knowledge Areas: *CN-Computational Science, GV-Graphics and Visualization, HCI-Human-Computer Interaction, IAS-Information Assurance and Security, IM-Information Management, IS-Intelligent Systems, NC-Networking and Communication, OS-Operating Systems, PD-Parallel and Distributed Computing,* and *SF-Systems Fundamentals*. No learning outcomes related to Knowledge Units from the Knowledge Area *PBD-Platform-based Development* were listed in the syllabi analyzed.

4.2 Limitations

In the analysis, only CS related courses from the 2 majors were considered. Electives are sometimes offered as special topics in CS, and course content varies from semester to semester. Only the required CS Courses (40 credit hours) and 8-9 credit hours of mathematics courses were analyzed. Furthermore, only course syllabi were analyzed as a means of curriculum assessment. Some learning outcomes not listed in the course syllabi may be conveyed in other areas of course instruction. The curriculum analysis phase of the FITC assessment focuses on a course syllabus as a unit of analysis, limiting the view of the total learning outcomes delivered by the program curriculum. A more comprehensive analysis would require examination of additional aspects of student learning such as pre-requisite courses, textbooks, course instruction, and other course materials (Veltri et al., 2011).

5. Conclusion

The analysis of 29 (N=29) syllabi in the FSU CS program sought to determine the degree to which *Knowledge Areas* specified by the ACM/ IEEE CS curriculum guidelines are represented in the FSU CS undergraduate courses. These findings would benefit from comparison to the findings from the job post analysis and employer interviews to compare to employers ‘comments about desired skills. Future research may also take into account a greater variety of aspects of the learning environment, as syllabi from the required courses in a program provide a limited understanding of any educational program.

References

Apigian, C. & Gambill, S. (2008). Are we teaching the IS 2009* model curriculum? *Journal of Information Systems Education, 21*(4), 411-420. Retrieved from http://jise.org

Madson, M., Melchert, T., & Whipp, J. (2010). Assessing student exposure to and use of computer technologies through an examination of course syllabi. *Assessment & Evaluation in Higher Education*, *29*(5), 549-561. doi: 10.1080/02602930410001689135

The Joint Task Force on Computing Curricula: Association for Computing Machinery (ACM) and IEEE Computer Society (2013). Computer science curricula 2013: Curriculum guidelines for undergraduate degree programs in computer science. *ACM/IEEE.* doi: 10.1145/2534860

Veltri, N., Webb, H., Matveev, A., & Zapatero, E. (2011). Curriculum mapping as a tool for continuous improvement of IS curriculum. *Journal of Information Systems Education*, *22*(1), 31-42. Retrieved from http://jise.org

Curriculum Analysis Report:
Florida State University Computer Science Program

Appendices

Appendix A: List of 17 Required Courses in the FSU CS Program

Required CS Courses – BS in CS	Credit Hours
COP 3014 Programming I	3
COP 3353 Introduction to UNIX	1
COP 3330 Object-Oriented Programming	3
CDA 3100 Computer Organization I	3
CDA 3101 Computer Organization II	3
CEN 4020 Software Engineering I	3
CEN 4021 Software Engineering II	4
CIS 4250 Ethics in Computer Science	3
COP 4020 Programming Languages	3
COP 4610 Operating Systems & Concurrent Programming	3
COP 4530 Data Structures, Algorithms, and Generic Programming	3
COP 4531 Complexity and Analysis of Data Structure and Algorithms	3
COP 4710 Theory and Structure of Databases	3
COT 4420 Theory of Computation	3
MAD 2104 Discrete Mathematics I	3
MAD 3105 Discrete Mathematics II	3
STA 4442 Introduction to Probability	3

Appendix B: List of 12 Required Courses in the FSU BA in CS Program

Required CS Courses – BA in CS	Credit Hours
COP 3014 Programming I	3
COP 3353 Introduction to UNIX	1
COP 3330 Object-Oriented Programming	3
CDA 3100 Computer Organization I	3
CDA 3101 Computer Organization II	3
CEN 4020 Software Engineering I	3
CEN 4021 Software Engineering II	4
COP 4020 Programming Languages	3
COP 4610 Operating Systems & Concurrent Programming	3
COP 4530 Data Structures, Algorithms, and Generic Programming	3
COP 4710 Theory and Structure of Databases	3
MAD 2104 Discrete Mathematics I	3