KNIGHT FOUNDATION SCHOOL OF
COMPUTING & INFORMATION SCIENCES

Annual Assessment Summary 2019-2021
for the
Bachelor of Science in Computer Science

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I. INTRODUCTION

This report is prepared in accordance with the intent of the Assessment Plan originally adopted by the Knight Foundation School of Computing & Information Sciences (then the School of Computer Science) in Spring 2003, with the last version approved in Spring 2015. Its purpose is to summarize the results of the various assessment mechanisms utilized by KFSCIS in support of the BS in Computer Science program, and to present the resulting findings and recommendations to the Undergraduate Committee, the Undergraduate Program Director, the Faculty of the School, and the Director.

Since the last Assessment cycle of Summer 2015 to Spring 2017, no modifications were made to the Assessment Mechanisms and Procedures.

The goals of the assessment process are to assess the extent to which the Student Outcomes and Program Educational Objectives of the BS in Computer Science program have been attained in the period under review, to identify specific areas of the program where a need for improvement is indicated, and to present a set of recommendations for achieving those improvements.

This review was conducted for the period Summer 2019 to Spring 2021.

Important Note: During this assessment period, the School received a substantial donation from the Knight Foundation. Accordingly, the name of the School was changed from SCIS to KFSCIS.

II. OVERVIEW

A. Terminology

The BS in Computer Science *Program Educational Objectives* (Appendix A-1) document describes the overriding goals of the program relating to the cumulative persistent effects of the students' educational experiences. The objectives are broad in nature and define expected general characteristics of the program's graduates within some years after graduation.

The BS in Computer Science *Student Outcomes* (Appendix A-2) are more specific in nature. These describe characteristics of students at the time of graduation, and define the specific knowledge, skills, and behaviors that they are expected to acquire as they complete the requirements of the program. Attainment of each Student Outcome enables the attainment of one or more of the Program Educational Objectives.

Do note that the Program Educational Objectives were reorganized in one of the previous assessment cycles, and the new set became effective in Fall 2015. The Student Outcomes were rewritten (mostly, reorganized) to match those prescribed by ABET, and the new ones also became effective in Fall 2015. No modifications are made to those PEOs and SOs in this assessment cycle.

The syllabus of each required and elective course of the BS in Computer Science program presents a set of *Course Outcomes*. The Course Outcomes identify specific knowledge units and levels of attainment (e.g., mastery, familiarity, awareness) expected of a student completing the course. Attainment by students of Course Outcome enables attainment of one or more of the Student Outcomes.

B. Assessment Mechanisms & Procedures

Consistent with current educational practice, KFSCIS follows a systematic process of collecting and utilizing data on the degree of attainment of the Student Outcomes and Program Educational Objectives. The *SCIS Assessment Plan* (Appendix B-1) specifies the participants and schedule for this process, and the means of evaluating the data and enacting program changes indicated by the evaluation. The *SCIS Assessment Mechanisms & Procedures* document (Appendix B-2) specifies the implementation of the Assessment Plan. The SCIS Assessment Plan and Assessment Procedures and Mechanisms were adopted in 2003, amended in 2010 to incorporate additional direct assessment measures, and last amended in spring 2015 to align better with our changed operations.

The following indirect assessment mechanisms have been employed in this assessment cycle:

Mechanism	**Target**	**Frequency**
Course Outcomes Survey by Students	Course Outcomes	Semester
Course Outcomes Survey by Instructors	Course Outcomes	Semester
Graduating Student (Exit) Survey	Student Outcomes	Semester
Alumni Survey	Program Educational Objectives	Continual
IAB Members and Employers Survey	Program Educational Objectives	Continual

The following direct assessment mechanisms have been employed since Spring 2010:

Mechanism	**Target**	**Frequency**
Course Embedded Assessment	Course Outcomes and Student Outcomes	At least once in the Assessment Period
Capstone Project Assessment	Student Outcomes	Semester

Additional input is solicited and may be received from other program constituents including:

- ACM Student Chapter,
- Upsilon Pi Epsilon Honor Society Chapter,
- KFSCIS Women In Computer Science group,
- STARS Student Chapter,
- Programming Team,
- Google Developers Club, and
- KFSCIS Industry Advisory Board.

C. Process

The required and elective courses of the BS in Computer Science are each assigned, based on subject area, to one of eight groups: Applications, Computer Organization, Computer Systems, Foundations, Professional Development, Programming, Capstone/Senior Project, and Software Engineering.

Each subject area group is managed by a faculty Subject Area Coordinator (SAC). Periodically, the assessment data and comments from Student and Instructor Course Outcome Surveys are considered by the Subject Area Coordinators. These provide the information for the Subject Area Coordinators' reports.

The SAC reports and assessment data from all other sources are evaluated by the KFSCIS Assessments Coordinator whose evaluations and recommendations are presented in an assessment report.

The assessment report is considered by the KFSCIS Undergraduate Committee, and by the KFSCIS Undergraduate Program Director. The Undergraduate Committee's curricular recommendations are presented to the KFSCIS faculty for approval. Responsibility for enactment of approved recommendations rests with the KFSCIS Undergraduate Program Director.

III. DATA

A. Course Outcomes Survey by Students

This survey is completed by students in each section of a required or elective CS class. For each course outcome, the student states the extent to which (s)he agrees with the following two assertions:

1: *I believe that this is a valuable outcome for this course*, and
2: *The subject matter of this outcome was covered adequately in class*

To each assertion, the student responds on a 5-point scale as follows:

5: I agree strongly, 4: I agree moderately, 3: I am not sure, 2: I disagree moderately, 1: I disagree strongly

For each outcome, a weighted mean of the responses to each question is calculated. The means are provided for each course, cumulatively over all semesters of the period under review.

BS in Computer Science Required or Elective Course		# Responding	Value of Outcome	Coverage Adequacy
CAP 4052	Game Design and Development	NO	DATA	AVAILABLE
CAP 4104	Human-Computer Interaction	56	4.39	4.34
CAP 4403	Robot Vision	NO	DATA	AVAILABLE
CAP 4612	Introduction to Machine Learning	NO	DATA	AVAILABLE
CAP 4630	Artificial Intelligence	18	4.5	4.22
CAP 4641	Natural Language processing	24	4.13	3.27
CAP 4710	Principles of Computer Graphics	16	3.94	3.93
CAP 4770	Introduction to Data Mining	48	4.73	4.69
CAP 4830	Modeling & Simulations	32	4.53	4.60
CDA 3102	Computer Architecture	329	4.38	4.40
CDA 3103	Fundamentals of Computer Systems	114	4.60	4.49
CDA 4101	Structured Computer Organization	95	4.54	4.51
CDA 4625	Introduction to Mobile Robotics	32	4.69	4.67
CEN 4010	Software Engineering I	336	4.47	4.16
CEN 4021	Software Engineering II	40	5.00	4.95
CEN 4072	Software Testing	212	4.27	4.07
CEN 4083	Cloud Computing	56	4.60	4.50
CGS 1920	Introduction to Computing	161	4.82	4.66
CGS 3095	Technology in the Global Arena	623	4.75	4.66
CIS 3950	Capstone I	506	4.69	4.48
CIS 4731	Fund. Of Blockchain Technologies	NO	DATA	AVAILABLE
CIS 4911	Senior Project	396	4.61	4.19
CIS 4951	Capstone II	528	4.66	4.43
CNT 4713	Net-Centric Computing	133	4.02	3.61
COP 2210	Computer Programming I	590	4.75	4.59
COP 3337	Computer Programming II	730	4.40	3.92
COP 3530	Data Structures	364	4.55	4.30

COP 4226	Advanced Windows Programming	24	4.67	4.67
COP 4338	Computer Programming III	392	4.18	3.54
COP 4520	Introduction to Parallel Computing	2	4.92	4.58
COP 4534	Algorithm Techniques	18	4.84	4.61
COP 4555	Principles Programming Languages	192	4.61	4.45
COP 4604	Advanced Unix Programming	NO	DATA	AVAILABLE
COP 4610	Operating Systems Principles	180	4.67	4.55
COP 4655	Mobile Appl. Development	25	4.04	3.68
COP 4710	Database Management	434	4.57	4.44
COP 4722	Survey of Database Systems	68	4.18	4.16
COP 4751	Advanced Database Management	28	4.36	4.43
COT 3100	Discrete Structures	644	4.34	4.04
COT 3510	Applied Linear Structures	NO	DATA	AVAILABLE
COT 3541	Logic for Computer Science	92	4.38	4.42
COT 4431	Applied Parallel Computing	NO	DATA	AVAILABLE
COP 4521	Intro. To Comp. Geometry	NO	DATA	AVAILABLE
CTS 4408	Database Administration	84	4.42	4.48
		=====	=====	=====
		7622	4.53	4.29

Table 1: Value & Adequacy of Coverage of Course Outcomes 05/19 – 04/21

Notes: (1) In this assessment cycle, MAD 2104 is almost completely replaced by COT 3100. MAD 2104 was taught by the Department of Mathematics; COT 3100 is taught by KFSCIS, and hence, for the second time now, we have Student Course Outcomes available for this required course. (2) *The overall scores for Value of Outcomes (4.53) and Coverage Adequacy (4.29) are essentially the same as found in the last Assessment Report (4.58 and 4.34 respectively).* (3) No data is available for CAP 4052, CAP 4403, CAP 4612, CIS 4731, COP 4604, COT 3510, COT 4431, and COT 4521. These courses were not offered in this Assessment cycle; many are new courses. (4) The new courses offered in this cycle based on the curriculum changes are CAP 4830, CDA 3102, CIS 3950, CIS 4951, COP 4655, COP 4751, and CTS 4408.

The semester data for each course (**RV designation is for Online and Hybrid sections of courses**) are presented here grouped under the eight subject areas. The Subject Area Coordinator (SAC) reports are included in Appendix C.

Subject Area: Applications -- (SAC: Leonardo Bobadilla)

CAP 4052 Game Design and Development
This course was not offered during this Assessment cycle.
CAP 4104 Human-Computer Interaction
CAP 4612 Introduction to Machine Learning
This course was not offered during this Assessment cycle.
CAP 4630 Artificial Intelligence
CAP 4641 Natural Language Processing
CAP 4710 Computer Graphics
CAP 4770 Intro. To Data Mining
CAP 4830 Modeling and Simulations

CAP 4104 – Human-Computer Interaction

	# Responding	Value of Outcome	Coverage Adequacy
SPR 2021	56	4.39	4.34
	=======	=======	=======
	56	4.39	4.34

Table 2-CAP 4104: Student Rating of Course Outcomes

CAP 4630 – Artificial Intelligence

	# Responding	Value of Outcome	Coverage Adequacy
FALL 2019	6	3.50	3.00
FALL 2020	12	5.00	4.83
	=======	=======	=======
	18	4.50	4.22

Table 2-CAP 4630: Student Rating of Course Outcomes

CAP 4641 – Natural Language Processing

	# Responding	Value of Outcome	Coverage Adequacy
SPR 2020	4	4.75	4.00
SPR 2021 – RV	20	4.00	3.12
	=======	=======	=======
	24	4.13	3.27

Table 2-CAP 4641: Student Rating of Course Outcomes

CAP 4710 – Principles of Computer Graphics

	# Responding	Value of Outcome	Coverage Adequacy
SPR 2020	8	2.88	2.86
SPR 2021	8	5.00	5.00
	=======	=======	=======
	16	3.94	3.93

Table 2-CAP 4710: Student Rating of Course Outcomes

CAP 4770 – Introduction to Data Mining

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019 – RV	6	5.00	5.00
FALL 2019 – RV	6	5.00	5.00
SUM 2020 – RV	6	5.00	5.00
FALL 2020 – RV	12	5.00	4.92
SPR 2021 – RV	18	4.28	4.22
	=======	=======	=======
	48	4.73	4.69

Table 2-CAP 4770: Student Rating of Course Outcomes

CAP 4830 – Modeling and Simulations

	# Responding	Value of Outcome	Coverage Adequacy
SPR 2021	32	4.53	4.60
	=======	=======	=======
	32	4.53	4.60

Table 2-CAP 4830: Student Rating of Course Outcomes

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 3103 Fundamentals of Computer Systems
CDA 4101 Structured Computer Organization
CNT 4713 Net-centric Computing
COP 4610 Operating Systems Principles

CDA 3102 – Computer Architecture

	# Responding	Value of Outcome	Coverage Adequacy
FALL 2020	7	3.71	4.29
SPR 2021	238	4.32	4.43
SPR 2021 – RV	84	4.60	4.31
	=======	=======	=======
	329	4.38	4.40

Table 2-CDA 3102: Student Rating of Course Outcomes

CDA 3103 -- Fundamentals of Computer Systems

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	12	4.92	4.92
SUM 2019 – RV	24	4.00	4.17
FALL 2019	60	4.75	4.52
FALL 2019 – RV	18	4.67	4.50
	=======	=======	=======
	114	4.60	4.49

Table 2-CDA 3103: Student Rating of Course Outcomes

CDA 4101 -- Structured Computer Organization

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	30	4.37	4.28
FALL 2019	35	4.57	4.60
FALL 2019 – RV	5	5.00	5.00
SPR 2020	15	4.67	4.87
SPR 2020 RV	5	4.00	4.00
FALL 2020 – RV	5	5.00	4.20
	=======	=======	=======
	95	4.54	4.51

Table 2-CDA 4101: Student Rating of Course Outcomes

CNT 4713 – Net-Centric Computing

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019 – RV	21	4.95	2.81
FALL 2019	21	3.62	3.62
FALL 2019 – RV	7	2.57	3.17
SPR 2020	14	1.00	1.00
SPR 2020 – RV	7	5.00	5.00
SPR 2021	56	4.51	4.27
SPR 2021 – RV	7	5.00	5.00
	=======	=======	=======
	133	4.02	3.61

Table 2-CNT 4713: Student Rating of Course Outcomes

COP 4610 -- Operating Systems Principle

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	25	4.56	4.56
FALL 2019	35	4.86	4.21
FALL 2019 – RV	5	5.00	5.00
SPR 2020 – RV	15	4.53	4.53
SUM 2020	5	5.00	4.80
SUM 2020 – RV	10	5.00	4.89
FALL 2020 – RV	5	5.00	5.00
SPR 2021	40	4.55	4.50
SPR 2021 – RV	40	4.53	4.67
	=======	=======	=======
	180	4.67	4.55

Table 2-COP 4610: Student Rating of Course Outcomes

Subject Area: Computer Systems (SAC: Gregory Reis)

CAP 4453 Robot Vision
The course was not offered during the evaluation period.
CDA 4625 Intro. To Mobile Robotics
CEN 4083 Cloud Computing
CIS 4731 Fund. Blockchain Technologies
The course was not offered during the evaluation period.
COP 4604 Advanced UNIX Programming
The course was not offered during the evaluation period.
COP 4710 Database Management systems
COT 4431 Applied Parallel Computing
The course was not offered during the evaluation period.

CDA 4625 – Intro. To Mobile Robotics

	# Responding	Value of Outcome	Coverage Adequacy
SPR 2021	32	4.69	4.67
	32	4.69	4.67

Table 2-CDA 4625: Student Rating of Course Outcomes

CEN 4083 – Cloud Computing

	# Responding	Value of Outcome	Coverage Adequacy
SPR 2020 – RV	8	3.62	2.62
SUM 2020 – RV	8	5.00	5.00
FALL 2020 – RV	8	4.25	4.38
SPR 2021	32	4.84	4.88
	56	4.60	4.50

Table 2-CEN 4083: Student Rating of Course Outcomes

COP 4710 -- Database Management Systems

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	7	4.14	3.57
SUM 2019 – RV	28	5.00	4.96
FALL 2019	28	4.82	3.86
FALL 2019 – RV	21	4.86	4.80
SPR 2020	28	4.86	4.86
SPR 2020 – RV	7	5.00	5.00
SUM 2020 – RV	7	5.00	5.00
FALL 2020	7	4.71	4.71
FALL 2020 – RV	7	5.00	5.00
SPR 2021	266	4.46	4.38
SPR 2021 – RV	28	4.18	4.14
	=======	=======	=======
	434	4.57	4.44

Table 2-COP 4710: Student Rating of Course Outcomes

Subject Area: Foundations (SAC: Hadi Amini)

CAP 4506 Introduction to Game Theory
[This course was offered in Spring 2019 – No course evaluations were submitted]
COP 4534 Algorithm Techniques
COP 4555 Principles of Programming Languages
COT 3100 Discrete Structures
COT 3510 Applied Linear Structures
The course was not offered during the evaluation period.
COT 3541 Logic for Computer Science
COT 4521 Introduction to Computational Geometry
The course was not offered during the evaluation period.
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

COP 4534 – Algorithm Techniques

	# Responding	Value of Outcome	Coverage Adequacy
Fall 2019	3	5.00	4.67
SPR 2020	3	5.00	5.00
FALL 2020	3	5.00	5.00
SPR 2021	9	4.67	4.33
	=======	=======	=======
	18	4.84	4.61

Table 2-COP 4534: Student Rating of Course Outcomes

COP 4555 -- Principles of Programming Languages

	# Responding	Value of Outcome	Coverage Adequacy
FALL 2019	60	4.60	4.40
SPR 2020	18	4.83	5.00
SPR 2020 – RV	18	4.89	4.89
FALL 2020	24	5.00	5.00
FALL 2020 – RV	6	5.00	5.00
SPR 2021	24	3.67	2.67
SPR 2021 – RV	42	4.69	4.71
	=======	=======	=======
	192	4.61	4.45

Table 2-COP 4555: Student Rating of Course Outcomes

COT 3100 – Discrete Structures

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	21	4.81	4.81
SUM 2019 – RV	21	4.57	4.57
FALL 2019	35	4.91	4.86
FALL 2019 – RV	7	5.00	4.71
SPR 2020	42	4.17	3.54
SPR 2020 – RV	14	5.00	5.00
SUM 2020	21	4.52	4.00
SUM 2020 – RV	7	5.00	4.71
FALL 2020	14	4.79	4.71
FALL 2020 – RV	21	4.62	4.55
SPR 2021	7	5.00	5.00
SPR 2021 – RV	434	4.19	3.84
	=======	=======	=======
	644	4.34	4.04

Table 2-COT 3100: Student Rating of Course Outcomes

COT 3541 -- Logic for Computer Science

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	12	4.25	4.11
SUM 2019 – RV	4	5.00	5.00
FALL 2019	28	4.57	4.86
FALL 2019 – RV	4	4.50	5.00
SPR 2020 – RV	20	4.50	4.40
SUM 2020	4	3.75	3.75
FALL 2020 – RV	4	5.00	4.00
SPR 2021 – RV	16	3.81	3.88
	=======	=======	=======
	92	4.38	4.42

Table 2-COT 3541: Student Rating of Course Outcomes

Set 2 (Math) Electives

MAD 3305 Graph Theory
MAD 3402 Numerical analysis
MAD 4203 Introduction to Combinatorics
MHF 4302 Mathematical Logic

The Set 2 Elective courses are taught by faculty of the Mathematics Department. There are no assessment data available for these courses.

Subject Area: Professional Development (SAC: Richard Whitaker)

CGS 1920 Introduction to Computing (1 credit)
CGS 3095 Technology in the Global Arena
ENC 3249 Professional and Technical Writing for CS (Taught by English Department)
STA 3033 Probability and Statistics (Taught by Statistics Department)
PHY 2048/9 Physics with Calculus I and II (Taught by Physics Department)

CGS 1920 -- Introduction to Computing

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019 – RV	14	4.36	4.57
FALL 2019	28	4.89	4.71
FALL 2019 – RV	14	4.86	4.36
SPR 2020	7	4.14	4.14
SPR 2020 – RV	14	5.00	4.79
FALL 2020	21	5.00	4.71
FALL 2020 – RV	7	4.86	4.57
SPR 2021	35	4.76	4.59
SPR 2021 – RV	21	5.00	5.00
	=======	=======	=======
	161	4.82	4.66

Table 2-CGS 1920: Student Rating of Course Outcomes

CGS 3095 – Technology in the Global Arena

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	40	4.95	4.80
SUM 2019 – RV	56	4.68	4.25
FALL 2019 – RV	16	3.93	4.33
SPR 2020	56	4.84	4.84
Sum 2020 – RV	8	5.00	5.00
FALL 2020	24	5.00	5.00
FALL 2020 – RV	8	4.12	4.25
SPR 2021	136	4.92	4.90
SPR 2021 – RV	232	4.73	4.62
	=======	=======	=======
	576	4.78	4.69

Table 2-CGS 3095: Student Rating of Course Outcomes

Subject Area: Programming (SAC: Janki Bhimani)

COP 2210 Computer Programming I
COP 3337 Computer Programming II
COP 3530 Data Structures
COP 4226 Advanced Windows Programming
COP 4338 Computer Programming III
COP 4520 Introduction to Parallel Computing

COP 2210 – Computer programming I

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	80	4.71	4.75
FALL 2019	60	4.62	4.03
FALL 2019 – RV	10	5.00	4.40
SPR 2020	30	4.97	4.76
SPR 2020 – RV	10	5.00	5.00
SUM 2020	40	4.80	4.72
SUM 2020 – RV	70	4.47	4.22
FALL 2020	20	4.60	4.60
SPR 2021	90	4.84	4.84
SPR 2021 – RV	180	4.81	4.64
	=======	=======	=======
	590	4.75	4.59

Table 2-COP 2210: Student Rating of Course Outcomes

COP 3337 -- Computer Programming II

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	30	4.03	2.28
SUM 2019 – RV	70	4.59	4.39
FALL 2019	60	4.67	4.08
FALL 2019 – RV	20	4.55	3.95
SPR 2020	90	4.26	3.88
SPR 2020 – RV	30	3.17	2.93
SUM 2020	20	4.70	3.05
SUM 2020 – RV	20	5.00	3.80
FALL 2020	60	3.55	2.58
FALL 2020 – RV	10	4.00	2.80
SPR 2021	140	4.31	4.31
SPR 2021 – RV	180	4.82	4.44
	=======	=======	=======
	730	4.40	3.92

Table 2-COP 3337: Student Rating of Course Outcomes

COP 3530 -- Data Structures

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	21	5.00	4.76
SUM 2019 – RV	7	4.71	4.71
FALL 2019	35	4.97	4.97
FALL 2019 – RV	35	4.86	3.89
SPR 2020	7	5.00	5.00
SPR 2020 – RV	28	4.54	4.43
SUM 2020	7	4.71	5.00
SUM 2020 – RV	7	4.14	4.14
FALL 2020 – RV	28	3.79	2.85
SPR 2021	84	4.54	4.40
SPR 2021 – RV	105	4.42	4.30
	=======	=======	=======
	364	4.55	4.30

Table 2-COP 3530: Student Rating of Course Outcomes

COP 4226 -- Advanced Windows Programming

	# Responding	Value of Outcome	Coverage Adequacy
FALL 2019 – RV	16	4.94	4.94
FALL 2020 – RV	8	4.12	4.12
	=======	=======	=======
	24	4.67	4.67

Table 2-COP 4226: Student Rating of Course Outcomes

COP 4338 -- Computer Programming III

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	14	3.00	2.79
SUM 2019 – RV	35	4.46	3.09
FALL 2019 – RV	56	4.45	3.80
SPR 2020	7	4.71	5.00
SPR 2020 – RV	21	4.62	4.43
SUM 2020 – RV	7	5.00	4.43
FALL 2020 – RV	14	4.36	4.07
SPR 2021	126	4.17	4.10
SPR 2021 – RV	112	3.91	2.65
	=======	=======	=======
	392	4.18	3.54

Table 2-COP 4338: Student Rating of Course Outcomes

COP 4520 -- Introduction to Parallel Computing

	# Responding	Value of Outcome	Coverage Adequacy
SPR 2019	2	4.92	4.58
	=======	=======	=======
	2	4.92	4.58

Table 2-COP 4520: Student Rating of Course Outcomes

Subject Area: Capstone/Senior Project (SAC: Masoud Sadjadi)

CIS 3950 Capstone I
CIS 4911 Senior Project
CIS 4951 Capstone II
These are all Capstone Project courses. We are substituting Capstone I and II for CIS 4911.
IDS 4918 VIP Program – [Essentially Project Course for non-majors]

CIS 3950 – Capstone I

	# Responding	Value of Outcome	Coverage Adequacy
FALL 2020 – RV	22	4.82	4.50
SPR 2021 – RV	484	4.68	4.48
	=======	=======	=======
	506	4.69	4.48

Table 2-CIS 3950: Student Rating of Course Outcomes

CIS 4911 -- Senior Project

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	55	4.65	4.60
FALL 2019	99	4.70	3.98
SPR 2020	33	4.27	3.94
SUM 2020 – RV	22	5.00	5.00
FALL 2020 – RV	33	4.42	3.75
SPR 2021 – RV	154	4.60	4.22
	=======	=======	=======
	396	4.61	4.19

Table 2-CIS 4911: Student Rating of Course Outcomes

CIS 4951 – Capstone II

	# Responding	Value of Outcome	Coverage Adequacy
FALL 2020 – RV	22	4.95	5.00
SPR 2021 – RV	506	4.65	4.40
	=======	=======	=======
	528	4.66	4.43

Table 2-CIS 4951: Student Rating of Course Outcomes

Subject Area: Software Engineering (SAC: Monique Ross)

CEN 4010 Software Engineering I
CEN 4021 Software Engineering II
CEN 4072 Software Testing

CEN 4010 -- Software Engineering I

	# Responding	Value of Outcome	Coverage Adequacy
SUM 2019	8	4.25	4.75
SUM 2019 – RV	32	4.97	4.47
FALL 2019	16	4.00	4.00
FALL 2019 – RV	16	3.44	2.94
SPR 2020 – RV	32	4.09	4.03
SUM 2020 – RV	8	5.00	3.86
FALL 2020	8	5.00	3.75
FALL 2020 – RV	24	4.46	4.39
SPR 2021	48	4.65	4.38
SPR 2021 – RV	144	4.50	4.17
	=======	=======	=======
	336	4.47	4.16

Table 2-CEN 4010: Student Rating of Course Outcomes

CEN 4021 -- Software Engineering II

	# Responding	Value of Outcome	Coverage Adequacy
FALL 2019	4	5.00	4.50
FALL 2020	20	5.00	5.00
SPR 2021	16	5.00	5.00
	=======	=======	=======
	40	5.00	4.95

Table 2-CEN 4021: Student Rating of Course Outcomes

CEN 4072 -- Software Testing

	# Responding	Value of Outcome	Coverage Adequacy
FALL 2019	8	4.55	4.25
SPR 2020	6	5.00	5.00
FALL 2020	12	5.00	5.00
SPR 2021	186	4.19	3.97
	=======	=======	=======
	212	4.27	4.07

Table 2-CEN 4072: Student Rating of Course Outcomes

B. Course Outcomes Survey by Instructors

This survey, called the Instructor Course Appraisal (ICA), is completed by each instructor of a required or elective CS course section.

- The Instructor separately rates the individual course outcomes in respect of two criteria
  Appropriateness: *Essential* *Very Appropriate* *Appropriate* *Inappropriate*
  Coverage: *Extensive* *Adequate* *Not Enough* *Not At All*
- The Instructor separately rates the course prerequisites in respect of two criteria
  Relevance: *Irrelevant* *Incidental* *Useful* *Highly Useful*
  Student Mastery: *Good* *Adequate* *Deficient* *Non-existent*
- The Instructor rates the students' overall preparation for taking the course
  Student Preparation: *Good* *Adequate* *Deficient* *Non-existent*
- In addition, the Instructor may append general comments and suggestions specific to each course prerequisite or outcome.

These responses, comments and suggestions from the ICAs, together with the data from the Student Course Outcomes surveys (see **Table 1**) and student comments, form the basis of the Subject Area Coordinators' reports. The summaries included in this section are mostly based on these SAC reports, with occasional augmentation directly from the ICAs. As noted in the preceding section, the complete SAC reports from which these observations are taken are included in Appendix C.

Note: The data here are qualitative; no numeric scores are assigned to responses.

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.

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.

CAP 4612 Introduction to Machine Learning

This course was not offered during this Assessment cycle.

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.

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.

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.

CAP 4770 Intro. To Data Mining

- No change in the curriculum or outcomes is suggested.

CAP 4830 Modeling and Simulations

- No change in the curriculum or outcomes is suggested.

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 the use interactive textbooks (Zybooks) since it was helpful in improving student learning.

CDA 3103 Fundamentals of Computer Systems

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

CDA 4101 Structured Computer Organization

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

CNT 4713 Net-centric Computing

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

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.

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 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

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.

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.

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 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.

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 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.

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.

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.

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 survey.
- The only comment from a participant in the survey was very positive.
- The course appraisals by instructors must be performed.

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 adjudged 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 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.

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.

COT 3510 Applied Linear Structures

The course was not offered during the evaluation period.

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.

COT 4521 Introduction to Computational Geometry

The course was not offered during the evaluation period.

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

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.

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.

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.

STA 3033 Probability and Statistics (Taught by Statistics Department)

- No opinion

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

- No opinion

Subject Area: Programming (SAC: Janki Bhimani)

COP 2210 Computer Programming I

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

COP 3337 Computer Programming II

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

COP 3530 Data Structures

- Students expressed that half-semester format is a rather tight timeframe for this class, so term 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.

COP 4226 Advanced Windows Programming

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

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.

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.

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 a 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 have 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.

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

- The course was not offered in this assessment period.

Subject Area: Software Engineering (SAC: Monique Ross)

CEN 4010 Software Engineering I

- The UPC should reconsider the pre-requisites 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.

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.

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.

C. Graduating Student (Exit) Survey of Student Outcomes

The Student Outcomes Survey is completed by students in the semester in which they expect to graduate. Each student rates each outcome with respect to two criteria, attainment and relevance.

Attainment: *This program outcome has been met for me personally*

5: I agree strongly	*2: I disagree somewhat*
4: I agree moderately	*1: I disagree moderately*
3: I agree somewhat	*0: I disagree strongly*

Relevance: *How meaningful do you consider this outcome to be for you personally?*

5: Extremely meaningful	*2: Somewhat meaningless*
4: Moderately meaningful	*1: Moderately meaningless*
3: Somewhat meaningful	*0: Extremely meaningless*

Data was collected (number of responses is in parenthesis) for Summer 2019 (1), Fall 2019 (5), Spring 2020 (24), Summer 2020 (11), Fall 2020 (9), and Spring 2021 (16) for a total of 66 responses during the period of this Assessment. Raw data and calculation of statistics for each semester is presented in Appendix D-1. The summary of the whole is presented in Appendix D-2.

The following table summarizes the responses of 66 graduating students completing the survey between summer 2019 and spring 2021. The mean responses are expressed as percentages of 5, the maximum rating.

Exit Survey (Graduating Students) 66 Respondents	*Outcome Attainment*		*Perceived Relevance*	
Student Outcomes	*Mean*	*Percentage*	*Mean*	*Percentage*
a: Ability to apply knowledge of Computing and Mathematics	4.27	85.45	4.44	88.79
b: Ability to analyze problem – identify and define its computing requirements	4.25	84.92	4.63	92.62
c: Ability to design, implement, and evaluate a computer-based system	4.18	83.69	4.54	90.77
d: Ability to function effectively on teams to accomplish a common goal	4.18	83.69	4.51	90.15
e: Understanding of professional, ethical, legal, security, and social issues	3.92	78.46	4.23	84.62
f: Ability to communicate effectively with a range of audiences	3.89	77.85	4.46	89.23
g: Ability to analyze local and global impact of computing on society	3.79	75.76	4.03	80.62
h: Recognition for the need for and an ability to engage in continuing professional development	4.28	85.54	4.52	90.46

i: Ability to use current techniques skills, and tools necessary for computing practice	3.95	79.08	4.52	90.46
j: Ability to apply mathematical foundations and algorithmic principles in design of computer systems	4.14	82.77	4.46	89.23
k: Ability to apply design and development principles to construct complex software systems	4.15	83.08	4.58	91.69
	====	====	====	====
Average Ratings of Student Outcomes	4.09	81.80	4.45	89.00
	====	====	====	====
Overall Satisfaction for CS Areas, Outcomes 'a', 'b', 'c', 'e', 'g', 'l', 'j', and 'k':	4.08	81.60	4.43	88.60

Table 3: Exit Survey of Attainment & Relevance of Student Outcomes

The Average Rating Scores of Student Outcomes with respect to attainment (4.09) and perceived relevance (4.45) are a bit lower than those found in the previous Assessment cycle (4.43 and 4.66 respectively).

D. Alumni Survey of Program Educational Objectives

Alumni responding to the survey are asked to rate the contribution of their broad educational experience at FIU to their personal growth, capacity for life-long learning, communication skills, social and ethical awareness, career preparation, and preparation for graduate study. They rate their preparation in the major areas of the BS-CS curriculum. The respondents also provide "overall" ratings of their FIU educational experience and the student's preparation at graduation. Finally, the alumni provide a rating of their overall satisfaction with the BS in CS program.

Responses to the survey questions are on the following scale

4: Excellent, 3: Good, 2: Satisfactory, 1: Poor and 0: Unsatisfactory

The table below summarizes the responses to this survey. The means for the current survey cycle, May 2021 to Nov 2021, are compared with corresponding means for earlier cycle, May 2019 to November 2019. The numbers in the first column refer to the BS-CS Program Objectives included in Appendix A-1. The raw data for the current cycle along with the statistical results for the current assessment period are presented in Appendix E-1. Although 116 alumni responded, every evaluative query was not answered by at least 40 of them. Hence, for all practical purposes, we are reporting results for 76 respondents.

		May 2021 to Nov. 2021		May2019 to Nov. 2019	
	Alumni Survey of Program Objectives	116 Respondents		122 Respondents	
	Program Educational Objective	*Outcome Average*	*Attainment Percentage*	*Outcome Average*	*Attainment Percentage*
2.4	Capacity for personal growth	3.36	83.90	3.39	84.72
2.4	Capacity for life-long learning	3.48	86.99	3.39	84.72

2.2	Development of communication skills	3.15	78.77	3.11	77.78
2.3	Awareness of social, ethical responsibility	3.03	75.71	3.06	76.39
1	Preparation for career in CS	3.05	76.37	3.11	77.78
1	Preparation for graduate study	3.13	78.13	2.92	72.92
	Overall preparation upon graduation	3.01	75.19	3.06	76.56
2.1	Computer Programming	3.10	77.61	3.36	84.03
2.1	Systems Development	2.8	70.08	2.78	69.44
2.1	Data Structures & Algorithms	3.21	80.22	3.25	81.25
2.1	Computer Architecture & Organization	2.91	72.76	2.86	71.53
	Overall FIU educational experience	3.20	80.01	3.16	79.05
	Overall satisfaction with BS-CS program	3.11	77.66	3.12	78.05

Table 4: Alumni Survey of Attainment of Program Educational Objectives

E. Employer Survey of Program Educational Objectives

This is the fourth biennial Assessment for which we have surveyed the Employers of our students and the members of the Industrial Advisory Board of the School (many employ our graduates). The survey instrument is included in Appendix E-2. The raw data along with statistical results is included in Appendix E-3, and the results are included in the table below. Note that the participation for this survey last time (May through November 2019) was pretty low (9 responses; only 5 completed). This time around (May through November 2021), it is substantially improved (50 responses; 28 completed).

	Employer Survey of Program Objectives	(28) Respondents	
		Outcome Attainment	
	Program Educational Objective	*Average*	*Percentage*
2.4	Ability to learn new Emerging Concepts	3.48	87.00
2.1	Mastery of CS concepts & ability to solve problems	3.19	79.81
2.2	Ability to communicate verbally	3.32	83.04
2.2	Ability to communicate in written form	3.24	81.00
2.3	Understanding of social, ethical concerns	3.09	77.27
2.2	Ability to work cooperatively in a team	3.36	83.93
1	(Will you consider hiring our graduates – 28-YES, 0-NO) (an important gauge of Preparation for career in CS)	4.00	100.00

OVERALL ATTAINMENT OF PROGRAM OBJECTIVES	3.29	82.14

Table 5: Employer Survey of Attainment of Program Educational Objectives

A comparison of results of the current and the last Assessment shows that the Overall Attainment of Program Objectives is reduced from 3.66 to 3.29. But one should not place too much credence to this as last time, only 5 responses were recorded. So far as "Hiring of Our Graduates" is concerned, 100% of 28 respondents indicated that they would do so in the future, too.

Some comments from the Employers who chose to make them are included below:

- The technical acumen of the graduates is very good, but there is a lack of customer service skills and soft skills.

- Our previous interns/FTE from FIU have performed very well.

- Wonderful graduates. Would emphasize interpersonal and communications skills... technical foundation is excellent.

- I believe FIU has an excellent computer science program. I have hired 3 CompSci FIU undergraduates in the last 2 years. As a group, they have experience in mainstream programming languages (Java and Python). This is not the case at other South Florida programs. For example, FAU [insert -> Florida Atlantic University] graduates that don't take certain elective courses only have experience with C/C++. I have not found one FIU intern candidate taking the computer science software and design track. I highly suggest the software testing course to prepare candidates for modern software development. I also suggest entry level AWS certification to learn cloud (IAAS, ie networking) computing concepts.

- I'm always pleased to see the quality and quantity of INNOVATION displayed by the students at every single Capstone/Senior Project exhibit at the end of the semester. Thank you!!

- I would like to see demonstrations of developing algorithms to solve specific problems, or completion of a course emphasizing this.

- The FIU students have been very successful as developers in our WF Technology program. They are very mobile as well in opting to relocate for the position. We have been more than happy with our FIU hires.

- Graduates do well in our recruitment process, showing skills, such as highly knowledgeable, engaged, and enthusiastic. Those who accept offers advance in the company or can leverage opportunities for other exciting career prospects.

- It has been a pleasure working with FIU in recruiting future talent for this company. The firm is excited to begin in person recruiting again in the upcoming semesters.

F. Course Embedded Direct Assessment

SCIS began applying course-embedded assessment of the BS in CS program in fall 2010 in order to supplement the direct measures obtained via capstone assessment in the Senior Project (see the following section). This strategy was applied using either multiple-choice (M-C) quizzes or observing student assignments and/or projects. Appendix-F contains the Direct Assessment Summaries for all courses subject to this direct assessment excluding the Senior Project. Most of the student ratings are based on their performance in M-C quizzes and a few observations are derived from their assignment and/or project work.

The evaluation of these assessments is included in section IV.B (Evaluation – Student Outcomes).

G. Capstone Project Assessment

Current requirements of the BS in Computer Science include completion of a capstone course, CIS 4911, Senior Project. Beginning with the first offering of CIS 4911, KFSCIS has performed assessment of all Student Outcomes via evaluation of the presentations and artifacts of all completed projects. Each project is rated by 2 or more evaluators (exactly 2 in this assessment cycle) according to a rubric *Senior Project Assessment of Student Outcomes of the BS in Computer Science*, and scored on the following scale:

Rating	Criterion
n/a	The project does not provide clear evidence about this particular outcome
1	The project demonstrates **poor** attainment of this outcome
2	The project demonstrates **fair** attainment of this outcome
3	The project demonstrates **good** attainment of this outcome
4	The project demonstrates **very good** attainment of this outcome
5	The project demonstrates **excellent** attainment of this outcome

The current version of the rubric was finalized in spring 2015, and these Direct Measurements apply to the Student Outcomes effective in Fall 2015. The rubric and associated check-list and score grid are included as Appendix G-1 of this report.

The data from these semester-wise assessment events are summarized in Appendices G-2 through G-7. The summary evaluation of these assessments is included in Appendix G-8, and is presented in Section IV.B (Evaluation – Student Outcomes).

Note that beginning in Fall 2020, CIS 4911 is substituted by two courses, Capstone I (CIS 3950) and Capstone II (CIS 4951). For a couple of years, we will offer all three courses, and then CIS 4911 will be phased out.

IV. EVALUATION

In this section of the report, the data presented in the previous section are evaluated. For quantitative data, the threshold value at which KFSCIS deems a measured item to satisfy its criteria is 75% of the maximum attainable rating.

Measured Item	Scale	Threshold
Course Outcomes	1 to 5	3.75
Student Outcomes	0 to 5	3.75
Program Objectives	0 to 4	3.00

A. Course Outcomes

The Subject Area Coordinator (SAC) reports (Appendix C) present the data obtained for each course via surveys by students and instructors. The Course Outcomes for each required or elective course of the BS in Computer Science program are evaluated for relevance and attainment by the SAC. Their evaluations are contained in the SAC reports.

The evaluation of the Course Outcomes by the Assessment Coordinator (AC) is based on the student ratings of the course outcomes summarized in Table 1.

AC-Evaluation-01: The data for Course Outcomes by Student Surveys for courses not taught during the period of evaluation and the MAD courses (2104 and 3512) are not available. Note that KFSCIS began offering its own Discrete Mathematics course (COT 3100) in Spring 2017 to replace MAD 2104. The course outcomes data for this course are quite impressive (Value of Outcomes = 4.34/5, Coverage Adequacy = 4.04/5).

AC-Evaluation-02: The Value of Course Outcomes rating of every course for which data are available, exceeds the 3.75 acceptability threshold. In fact, students ascribe at least **high** value (4.00 or higher) to the outcomes of every course except CAP 4710 with the rating of the Value of Course Outcomes of over 83% of courses (30 out of 36) to be **very high** (4.34 or higher). The overall rating for the Value of Course Outcomes is 4.53 which is which is just a tad lower than that observed in the last Assessment cycle (4.59).

AC-Evaluation-03: The student rating of the Adequacy of Coverage of Course Outcomes for every course except four (CAP 4641 - 3.27, CNT 4713 – 3.61, COP 4338 – 3.54, and COP 4655 – 3.68) exceeds the acceptability threshold of 3.75. In fact, students ascribe at least **high** value (4.00 or higher) to the adequacy of coverage of all except two courses (CAP 4710 and COP 3337), with the rating of **very high** (4.34 or higher) for 23 out of 36 courses (64%). The overall rating for the Adequacy of Coverage of Course Outcomes is 4.29 which is just a bit lower than that observed in the last Assessment cycle (4.34).

AC-Evaluation-04: Note that in this assessment cycle, the overall student participation is quite a bit lower than that in the last cycle. This may be due to the disruption of our offerings during the pandemic. Also, KFSCIS discontinued the practice of taking the netbook computers in classes to force the students to complete the surveys. However, we do ask faculty members to announce in

class the importance of students doing these assessments. We should explore student incentives (priority in advising, student workshop registrations, etc.) to entice more students to complete these surveys.

B. Student Outcomes

Evaluation of the level of attainment of the BS in CS Student Outcomes utilizes data obtained via several direct and indirect assessment mechanisms listed below:

Indirect Mechanisms:

- The Graduating Student (Exit) Survey,
- Course Outcomes Surveys by Students and by Instructors.

Direct Mechanisms:

- Capstone Project Assessment via (mostly) CIS 4911 Senior Project presentations. For Fall 2020 and Spring 2021 terms, the evaluations of Capstone I and II (CIS 3950 and CIS 4951) were also conducted. As stated above, CIS 4911 will be gradually phased out and substituted by Capstone I and II.
- Course-embedded Assessment by multiple-choice questions in several required courses taken by the BS-CS majors: COT 3100 (Discrete Structures), MAD 3512 (Theory of Algorithms), COP 3337 (Programming II), COP 4338 (Programming III), COP 3530 (Data Structures), COP 4710 (Database Management), COP 4555 (Principles of Programming Languages), COP 4610 (Operating Systems), CDA 3102 (Computer Architecture), and CEN 4010 (Software Engineering I).
- Course-embedded Assessment by portfolio inspection in CGS 3095 (Ethics and Social Issues in Computing).

The direct assessment events performed from summer 2017 to spring 2019 are documented in the summary provided in Appendix F. The rating sheet and the rubric used for evaluation of Senior Project for assessment of Student Outcomes is provided in Appendix G-1.

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

Indicators

1.	Graduating Student Ratings	Relevance 88.79%	Attainment 85.45%	Sample: 66
2.	Course Outcomes CAP 4630	Value: 90.0%	Coverage: 84.4%	Sample: 18
3.	Course Outcomes CAP 4770	Value: 94.6%	Coverage: 93.8%	Sample: 48
4.	Course Outcomes COP 4520	Value: 98.4%	Coverage: 91.6%	Sample: 2

5. Course Outcomes COP 4534 Value: 96.8% Coverage: 92.2% Sample: 18

6. Course Outcomes COT 3100 Value: 86.8% Coverage: 80.8% Sample: 644

7. Course Outcomes COT 3541 Value: 87.6% Coverage: 88.4% Sample: 92

8. Course-Embedded Assessment – COT 3100

   Fall 2019 Event: 31 students completed a 16-question multiple choice assessment quiz.
   Criterion: At least 75% of students should score 75% or higher.
   Observation: 19 out of 31 (61.29%) students scored at least 12 points.
   Summary Observation: COT 3100 has now completely replaced MAD 2104 (taught by Math Department Faculty) in our curriculum.

9. Course-Embedded Assessment - MAD 3512

   Fall 2019 Event: 24 students were graded for Course Learning Outcomes for a maximum score of 100.
   Criterion: At least 75% of students should score 75% or higher.
   Observation: 9 out of 24 (37.50%) students scored at least 70 points. This is better than the result of last year (21.21%) but still quite low.

10. Senior Project Assessment

    Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome a). This event was replicated in all semesters from summer 2019 to spring 2021.
    Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
    Observation: Summer 2019: 3.75 Fall 2019: 3.06 Spring 2020: 3.40
    Summer 2020: 3.20 Fall 2020: 3.20 Spring 2021: 3.45
    Weighted over the entire assessment period (138 projects): 3.29

Outcome Evaluation: Graduating students consider this Student Outcome highly relevant, and more than 85% believe that they have attained it. Indicators 2 through 7 substantially exceed the acceptable threshold for the Value and the Coverage of Course Outcomes for CAP 4630 (new), CAP 4770, COP 4520, COP 4534, COT 3100, and COT 3541. Indicator 8 shows that the students do not attain the desired acceptable level of proficiency for COT 3100. In fact, it is somewhat lower than that reported in the last Assessment Report. Indicator 9 clearly shows the improvement in student performance since we started teaching the pre-requisite course, Discrete Mathematics, in KFSCIS. Finally, indicator 10 shows that our Senior Projects have not quite incorporated this curriculum component to a significant level, although the student attainment is a bit more than reported in the last Assessment Report. Attainment of Student Outcome (a) is rated as **almost acceptable.**

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

Indicators

1.	Graduating Student Ratings	Relevance 84.92%	Attainment 92.62%	Sample: 65
2.	Course Outcomes CAP 4104	Value: 87.8%	Coverage: 86.8%	Sample: 56
3.	Course Outcomes CAP 4630	Value: 90.0%	Coverage: 84.4%	Sample: 18
4.	Course Outcomes CAP 4641	Value: 82.6%	Coverage: 65.4%	Sample: 24
5.	Course Outcomes CAP 4710	Value: 78.8%	Coverage: 78.6%	Sample: 16
6.	Course Outcomes CAP 4770	Value: 94.6%	Coverage: 93.8%	Sample: 48
7.	Course Outcomes CDA 3102	Value: 87.6	Coverage: 88.0	Sample: 329
8.	Course Outcomes CDA 3103	Value: 92.0%	Coverage: 89.8%	Sample: 114
9.	Course Outcomes CDA 4101	Value: 90.8%	Coverage: 90.2%	Sample: 95
10.	Course Outcomes CDA 4625	Value: 93.8%	Coverage: 93.4%	Sample: 32
11.	Course Outcomes CEN 4010	Value: 89.4%	Coverage: 83.2%	Sample: 336
12.	Course Outcomes CEN 4021	Value: 100%	Coverage: 99.0%	Sample: 40
13.	Course Outcomes CEN 4083	Value: 92.0%	Coverage: 90.0%	Sample: 56
14.	Course Outcomes COP 3530	Value: 91.0%	Coverage: 86.0%	Sample: 364
15.	Course Outcomes COP 4338	Value: 83.6%	Coverage: 70.8%	Sample: 392
16.	Course Outcomes COP 4555	Value: 92.2%	Coverage: 89.0%	Sample: 192
17.	Course Outcomes COP 4610	Value: 93.4%	Coverage: 91.0%	Sample: 180
18.	Course Outcomes COP 4710	Value: 91.4%	Coverage: 88.8%	Sample: 434
19.	Course Outcomes COP 4722	Value: 83.6%	Coverage: 83.2%	Sample: 68
20.	Course Outcomes COP 4751	Value: 87.2%	Coverage: 88.6%	Sample: 28
21.	Course Outcomes CTS 4408	Value: 88.4%	Coverage: 89.6%	Sample: 84

22. Course-Embedded Assessment – CEN 4010

Spring 2020 Event: 47 students were evaluated via 12 binary scores for their Project work.
Criterion: 75% of students should score at least 75% or higher.
Observation: 46 out of 47 (97.87%) students received at least 9 positive acceptable scores.

23. Course-Embedded Assessment - COP 4555

Fall 2019 Event: 44 students completed a 10-question multiple choice assessment quiz.
Criterion: 75% of students should score at least 75% or higher.
Observation: **56.82%** of the students answered at least 7 questions correctly.

24. Course-Embedded Assessment - COP 3530 (Hybrid)

Fall 2019 Event: 29 students completed a 16-question multiple choice assessment quiz.
Criterion: 75% of students should score at least 75% or higher
Observation: 13 out of 29 (44.83%) students answered at least 12 questions correctly.

25. Course-Embedded Assessment - COP 3530 (Online - RVC)

Fall 2019 Event: 44 students completed a 14-question multiple choice assessment quiz.
Criterion: 75% of students should score at least 75% or higher
Observation: 12 out of 44 (27.27%) students answered at least 12 questions correctly.

26. Course-Embedded Assessment - COP 4710

Fall 2019 Event: 39 students completed a 16-question multiple choice assessment quiz.
Criterion: 75% of students should score at least 75% (12) or higher.
Observation: 28.21% of the students (11 out of 39) answered at least 12 questions correctly. 19 out of 39 (**48.72**%) of the students answered at least 10 questions correctly.

27. Course-Embedded Assessment – COP 4338 (Computer Systems – Processes)

Fall 2019 Event: 41 students completed a multiple-choice assessment quiz worth 6 points on the topics of Execution and Locking.
Criterion: 75% of students should score at least 6 points.
Observation: 33 out of 41 (80.49**%)** students answered at least 5 questions correctly.

28. Course-Embedded Assessment – COP 4610 (Systems – Storage Management)

Fall 2019 Event: The artifacts (submitted programs/projects) of 29 students were evaluated against the appropriate rubrics with the maximum possible score being 8.
Criterion: 75% of students should score at least 75% (6 or higher) points.
Observation: 25 out of 29 (**86.21%)** students scored at least 6 points.

29. Course-Embedded Assessment – COP 4610 (Systems – Memory Management)

Fall 2019 Event: The artifacts (submitted programs/projects) of 31 students were evaluated against the appropriate rubrics with the maximum possible score being 9.
Criterion: 75% of students should score at least 7 points.
Observation: **38.71%** of the students scored at least 7 points. 17 out of 31 (54.84%) students scored at least 6 points.

30. Senior Project Assessment

Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome b). This event was replicated in all semesters from summer 2019 to spring 2021.
Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
Observation: Summer 2019: 5.00 Fall 2019: 5.00 Spring 2020: 5.00
Summer 2020: 5.00 Fall 2020: 5.00 Spring 2021: 5.00
Weighted over the entire assessment period (138 projects): 5.00

Evaluation: Graduating students consider this Student Outcome highly relevant, and more than 92% believe that they have attained it. Indicators 2 through 21 comfortably (rating of **Very High)** meet the acceptable threshold for the Value and the Coverage of Course Outcomes for all relevant courses (sole exceptions – Coverage in CAP 4641 and COP 4338). Three new courses are introduced in this Assessment period; CDA 3102 (which will replace CDA 3103 and CDA 4101 in the future), COP 4751, and CTS 4408. For three of the eight course-embedded assessments for relevant courses (Indicators 22 through 29) the students attained the desired level of proficiency (97.87, 80.49, and 86.21% of students pass the criterion). We are frankly surprised by this result, particularly for COP 3530 and Memory Management aspects of COP 4610. Finally, our Senior Projects Assessment (Indicator 30) shows that the students have achieved the highest level of proficiency for this outcome. Although the Course-Embedded assessments do not meet our strict criteria, the performance of students in the Capstone Project is exceptionally good for this criterion. Attainment of Student Outcome (b) is rated as **very good.**

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

Indicators

1.	Graduating Student Ratings	Relevance 90.77%	Attainment 83.69%	Sample: 65
2.	Course Outcomes CAP 4104	Value 87.8%	Coverage: 86.8%	Sample: 56
3.	Course Outcomes CAP 4630	Value 90.0%	Coverage: 84.4%	Sample: 18
4.	Course Outcomes CAP 4641	Value 82.6%	Coverage: 65.4%	Sample: 24

5.	Course Outcomes CAP 4770	Value 94.6%	Coverage: 93.8%	Sample: 48
6.	Course Outcomes CDA 4625	Value 93.8%	Coverage: 93.4%	Sample: 32
7.	Course Outcomes CEN 4010	Value 89.4%	Coverage: 83.2%	Sample: 336
8.	Course Outcomes CEN 4021	Value 100%	Coverage: 99.0%	Sample: 40
9.	Course Outcomes CEN 4072	Value 85.4%	Coverage: 81.4%	Sample: 212
10.	Course Outcomes CNT 4713	Value 80.4%	Coverage: 72.2%	Sample: 133
11.	Course Outcomes COP 2210	Value: 95.0%	Coverage: 91.8%	Sample: 590
12.	Course Outcomes COP 3337	Value: 88.0%	Coverage: 78.4%	Sample: 730
13.	Course Outcomes COP 3530	Value: 91.0%	Coverage: 86.0%	Sample: 364
14.	Course Outcomes COP 4226	Value: 93.4%	Coverage: 93.4%	Sample: 24
15.	Course Outcomes COP 4338	Value: 83.6%	Coverage: 70.8%	Sample: 392
16.	Course Outcomes COP 4610	Value: 93.4%	Coverage: 91.0%	Sample: 180

17. Course-Embedded Assessment – CEN 4010

    Spring 2020 Event: 47 students were evaluated for their Project work.
    Criterion: 75% of students should score at least 75% or higher.
    Observation: 46 out of 47 (97.87%) students received at least 9 positive acceptable scores.

18. Course-Embedded Assessment – COP 3337 (Inheritance and Polymorphism)

    Fall 2019 Event: 26 students completed an 8-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 6 points.
    Observation: **80.77%** (21 out of 26) of the students answered at least 6 questions correctly.

19. Course-Embedded Assessment – COP 3337 (Exceptions)

    Fall 2019 Event: 25 students completed an 8-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 6 points.
    Observation: **92.0%** of the students (23 out of 25) answered at least 6 questions correctly.

20. Course-Embedded Assessment – COP 3530-Hybrid (Abstraction)

    Fall 2019 Event: 35 students completed an 8-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 6 points.

Observation: **68.57%** of the students (24 out of 35) answered at least 6 questions correctly.

21. Course-Embedded Assessment – COP 3530-Online-RVC (Abstraction)

    Fall 2019 Event: 50 students completed an 8-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 6 points.
    Observation: **82.0%** of the students (41 out of 50) answered at least 6 questions correctly.

22. Course-Embedded Assessment – COP 3530-Hybrid (API Usage)

    Fall 2019 Event: 35 students completed a 12-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 9 points.
    Observation: **80.0%** of the students (28 out of 35) answered at least 9 questions correctly.

23. Course-Embedded Assessment – COP 3530-Online-RVC (API Usage)

    Fall 2019 Event: 50 students completed a 12-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 9 points.
    Observation: **88.0%** of the students (44 out of 50) answered at least 9 questions correctly.

24. Course-Embedded Assessment – COP 3530-Hybrid (Linked Structures)

    Fall 2019 Event: 32 students completed an 8-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 6 points.
    Observation: **75.0%** of the students (24 out of 32) answered at least 6 questions correctly.

25. Course-Embedded Assessment – COP 3530-Online-RVC (Linked Structures)

    Fall 2019 Event: 50 students completed an 8-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 6 points.
    Observation: **68.0%** of the students (34 out of 50) answered at least 6 questions correctly.

26. Course-Embedded Assessment – COP 3530-Hybrid (Recursion)

    Fall 2019 Event: 33 students completed an 8-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 6 points.
    Observation: **69.7%** of the students (23 out of 33) answered at least 6 questions correctly.

27. Course-Embedded Assessment – COP 3530-Online-RVC (Recursion)

    Fall 2019 Event: 50 students completed an 8-question multiple choice assessment quiz.
    Criterion: 75% of students should score at least 6 points.
    Observation: **78.0%** of the students (39 out of 50) answered at least 6 questions correctly.

28. Course-Embedded Assessment – COP 4338 (C Language)

Fall 2019 Event: 41 students completed a 6-question multiple choice assessment quiz.
Criterion: 75% of students should score at least 7.5 points.
Observation: **80.49%** of the students (33 out of 41) answered at least 5 questions correctly.

29. Senior Project Assessment

Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome c). This event was replicated in all semesters from summer 2019 to spring 2021.
Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
Observation: Summer 2019: 5.00 Fall 2019: 4.94 Spring 2020: 4.60
Summer 2020: 5.00 Fall 2020: 5.00 Spring 2021: 5.00
Weighted over the entire assessment period (138 projects): 4.87

Evaluation: Except for the Coverage of outcomes in CAP 4641 (65.4%) and COP 4338 (70.8%) and three course-embedded assessments, all indicators suggest that attainment of Student Outcome c) is **very good**. In particular, the improvement for Senior Project (4.27 to 4.87) as compared to the previous Assessment Report is very encouraging.

d) Demonstrate the ability to work cooperatively in teams.

Indicators

1.	Graduating Student Ratings	Relevance 90.15%	Attainment 83.69%	Sample: 65
2.	Course Outcomes CEN 4010	Value: 89.4%	Coverage: 83.2%	Sample: 336
3.	Course Outcomes CEN 4021	Value: 100%	Coverage: 99.0%	Sample: 40
4.	Course Outcomes CIS 3950	Value: 93.8%	Coverage: 89.6%	Sample: 506
5.	Course Outcomes CIS 4911	Value: 92.2%	Coverage: 83.8%	Sample: 396
6.	Course Outcomes CIS 4951	Value: 93.2%	Coverage: 88.6%	Sample: 528

7. Senior Project Assessment

Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome d). This event was replicated in all semesters from summer 2019 to spring 2021.
Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
Observation: Summer 2019: 5.00 Fall 2019: 4.94 Spring 2020: 4.80
Summer 2020: 5.00 Fall 2020: 5.00 Spring 2021: 5.00
Weighted over the entire assessment period (138 projects): 4.93

Evaluation: All indicators suggest that attainment of Student Outcome d) is **excellent**. Note that CIS 4911 is being transitioned to a combination of CIS 3950 and CIS 4951.

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

Indicators

1. Graduating Student Ratings Relevance 84.62% Attainment 78.46% Sample: 65

2. Course Outcomes CGS 3095 Value: 95.0% Coverage: 93.2% Sample: 623

3. Course-Embedded Assessment CGS 3095 (Social and Ethical Concerns in Computing)

   Fall 2019 Event: Individual projects for 76 students were graded on a 4-point scale.
   Criterion: 75% of students should score at least 3 points.
   Observation: 72.37**%** of the students (55 out of 76) received at least 3 points.

4. Senior Project Assessment

   Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome e). This event was replicated in all semesters from summer 2019 to spring 2021.
   Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
   Observation: Summer 2019: 3.00 Fall 2019: 2.00 Spring 2020: 2.00
   Summer 2020: 2.00 Fall 2020: 2.00 Spring 2021: 2.55
   Weighted over the entire assessment period (138 projects): 2.14

   Evaluation: Graduating students rate this outcome as extremely relevant and feel that they have attained it (Indicator 1). Current students find this outcome to be Highly Valuable and believe that it is extremely well-covered in the classroom (Indicator 2). Evaluation of student projects in CGS 3095 (Indicator 3) shows that students demonstrate **a pretty good** understanding of social and ethical issues in computing. Senior project assessment (Indicator 4) shows that there is not much in student projects that evaluates these topics. On balance, attainment of Student Outcome e) is rated as **good.**

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

Indicators

1. Graduating Student Ratings Relevance 89.23% Attainment 77.85% Sample: 65

2. Course Outcomes CGS 3095 Value: 95.0% Coverage: 93.2% Sample: 623

3. Course Outcomes CEN 4010 Value 89.4% Coverage: 83.2% Sample: 336

4. Course-Embedded Assessment CGS 3095 (Effective Communication Skills)

   Fall 2019 Event: Presentation of projects for 76 students were graded on a 4-point scale.
   Criterion: 75% of students should score at least 3 points.
   Observation: 68.42**%** of the students (52 out of 76) received at least 3 points.

5. Senior Project Assessment

   Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome f). This event was replicated in all semesters from summer 2019 to spring 2021.
   Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
   Observation: Summer 2019: 5.00 Fall 2019: 5.00 Spring 2020: 5.00
   Summer 2020: 5.00 Fall 2020: 3.80 Spring 2021: 4.10
   Weighted over the entire assessment period (138 projects): 4.68

   Evaluation: All indicators (except the evaluation of Communication Skills in CGS 3095) suggest that attainment of Student Outcome f) is **excellent**.

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

Indicators

1. Graduating Student Ratings Relevance 80.62% Attainment 75.76% Sample: 65

2. Course Outcomes CGS 3095 Value: 95.0% Coverage: 93.2% Sample: 623

3. Course-Embedded Assessment CGS 3095 (Social and Ethical Concerns in Computing)

   Fall 2019 Event: Individual projects for 76 students were graded on a 4-point scale.
   Criterion: 75% of students should score at least 3 points.
   Observation: 71.05**%** of the students (54 out of 76) received at least 3 points.

4. Senior Project Assessment

   Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome g). This event was replicated in all semesters from summer 2019 to spring 2021.
   Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
   Observation: Summer 2019: Fall 2019: 3.00 Spring 2020: 3.00
   Summer 2020: 3.00 Fall 2020: 3.00 Spring 2021: 0.90
   Weighted over the entire assessment period (130 projects): 2.52

Evaluation: Graduating students rate this outcome as extremely relevant and feel that they have attained it (Indicator 1). Current students of CGS 3095 find this outcome to be Highly Valuable and believe that it is Very-well covered in the classroom (Indicator 2). Evaluation of student projects in CGS 3095 shows that students demonstrate **a good** understanding of social and ethical issues in computing (Indicator 3), although this attainment is quite below that observed in the previous Assessment Report. Finally, in the last Report, there was no evaluation of this Student Outcome through the Senior Project course whereas a few students did indicate attainment of this outcome in this Assessment cycle. Attainment of Student Outcome g) is rated as **very good.**

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

Indicators

1. Graduating Student Ratings Relevance 90.46% Attainment 85.54% Sample: 65

2. Senior Project Assessment

Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome h). This event was replicated in all semesters from summer 2019 to spring 2021.
Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
Observation: Summer 2019: 4.50 Fall 2019: 5.00 Spring 2020: 5.00
Summer 2020: 5.00 Fall 2020: 5.00 Spring 2021: 5.00
Weighted over the entire assessment period (138 projects): 4.97

Evaluation: All indicators suggest that attainment of Student Outcome h) is **excellent**.

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

Indicators

1. Graduating Student Ratings Relevance 90.46% Attainment 79.08% Sample: 65

2. Course-Embedded Assessment – CEN 4010

Spring 2020 Event: 47 students were evaluated via 12 binary scores for their Project work.
Criterion: 75% of students should score at least 75% or higher.
Observation: 46 out of 47 (97.87%) students received at least 9 positive acceptable scores.

3. Senior Project Assessment

Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome i). This event was replicated in all semesters from Summer 2017 to Spring 2019.

Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
Observation: Summer 2019: 4.63 Fall 2019: 4.91 Spring 2020: 4.80
Summer 2020: 5.00 Fall 2020: 5.00 Spring 2021: 5.00
Weighted over the entire assessment period (138 projects): 4.90

Evaluation: All indicators suggest that attainment of Student Outcome i) is **excellent** understanding that most of this is measured in the Senior Project.

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.

Indicators

1. Graduating Student Ratings Relevance 89.23% Attainment 82.77% Sample: 65

2. Senior Project Assessment

Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome j). This event was replicated in all semesters from summer 2017 to spring 2019.
Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
Observation: Summer 2019: 3.38 Fall 2019: 3.00 Spring 2020: 3.00
Summer 2020: 3.00 Fall 2020: 3.00 Spring 2021: 3.05
Weighted over the entire assessment period (138 projects): 3.03

Evaluation: Existing students rate this outcome as extremely relevant and feel that they have attained it (Indicator 1). Students do not demonstrate attainment of this outcome in their Senior project, but this is indicative more of the non-application of theoretical concepts in their projects rather than their attainment. Overall, the attainment of Student Outcome j) is rated as **good.**

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

Indicators

1. Graduating Student Ratings Relevance 91.69% Attainment 83.08% Sample: 65

2. Course Outcomes CEN 4010 Value: 89.4% Coverage: 83.2% Sample: 336

3. Course-Embedded Assessment – CEN 4010

Spring 2020 Event: 47 students were evaluated via 12 binary scores for their Project work.
Criterion: 75% of students should score at least 75% or higher.
Observation: 46 out of 47 (97.87%) students received at least 9 positive acceptable scores.

4. Senior Project Assessment

Event: Artifacts of all completed Senior Projects are assessed, by application of the *Senior Project Assessment of Student Outcomes of the BS in Computer Science* rubric, for attainment of outcome k). This event was replicated in all semesters from summer 2017 to spring 2019.
Criterion: Attainment should be rated at **75% or 3.75** on a 1—5 scale, or better.
Observation: Summer 2019: 5.00 Fall 2019: 5.00 Spring 2020: 5.00
Summer 2020: 5.00 Fall 2020: 5.00 Spring 2021: 5.00
Weighted over the entire assessment period (138 projects): 5.00

Evaluation: Attainment of this outcome through Course-Embedded Assessment in CEN 4010 (Indicator 3) is phenomenal. All other Indicators also show that Attainment of Student Outcome k) is rated is **Excellent.**

C. Program Educational Objectives

The principal means of assessing attainment of the Program Educational Objectives of the BS in Computer Science program are the Alumni and Employer Surveys of Program Objectives.

The alumni responses are summarized in Table 4 (Section III.D) showing the averages of the 116 responses in the period from May 2021 to November 2021. The alumni responses provide ratings of the specific facets of each objective, and overall ratings of some objectives. The Alumni Survey raw data are included in Appendix E-1.

The employer survey (Appendix E-2) responses are summarized in Table 5 (Section III.E) showing the averages of the 5 responses in the period from May 2021 to November 2021. These responses provide ratings of specific facets of each objective and the overall rating of their combination. The relevant data is included in Appendix E-3.

Attainment of Student Outcomes enables attainment of the Program Educational Objectives, and so some Student Outcome data are again noted in this section where relevant. Additionally, the other constituent groups within the KFSCIS umbrella; WICS, ACM, STARS, UPE, GDSC (Google Development Student Club – new), Programming Team, and Industrial Advisory Board (IAB) may provide indicators of the attainment of the program objectives. The activity reports of the student organizations are included in Appendix H, and the minutes of the IAB meetings during the assessment period are included in Appendix I. Since the beginning of 2015, we hold two Board meetings per year.

1. Be successful in applying for entry level professional positions in computing-related fields, or for admission to graduate programs.

Indicators

- Alumni Survey of Program Educational Objectives:
  Please rate how your educational experience at FIU contributed to your preparation for a career in computer science
  May 2021 to November 2021: **76.37%** Previous cycle: **77.78%**
  Please rate how your educational experience at FIU contributed to your preparation for graduate study
  May 2021 to November 2021: **78.13%** Previous cycle: **72.92%**

- Employer Survey of Program Educational Objectives:
  Please rate the following skill of our graduates: Will you consider employing our graduates in the future
  May 2021 to November 2021: **100%** Previous Cycle: **100.00%**

  This is at best a very indirect metric to gauge the overall attainment of this Program Objective from the employers' viewpoint.

- Student Chapter activities (Appendix H): Students are given plenty of opportunity to participate in a variety of activities that improve their association with the computing communities and learn the field outside the classroom. Some examples are given below.

  ACM Chapter: Through their five programs; ACM Build, ACM Learn, ACM Grow, ACM Reach, & ACM Scale; this Student Chapter provides students the opportunity to gain experience at various software and hardware workshops (GitHub, GitLab, Robotics, and Android), participate in the professional development sessions, have access to industry professionals, give back to the community, and create a semester-long project in a team-based environment taught by mentors who have gone on to do internships at Google, Facebook, PlayStation, and more!

  WICS: Organized many Workshops and Learning Sessions for the following topics: Thriving in CS Panels, landing a job in Tech, Overcoming Imposter Syndrome, Finding Your Voice, Finding Your Career Path, Not underestimating one's potential, and so on. The club also provided opportunity to members and other students to attend Industry Professional Sessions with Program Managers and Software Engineers from Microsoft, SnapChat, Visa, Adobe, Bank of America, Disney, All State, ServiceNow, Deloitte, Geico and JP Morgan Chase. Internship information session with Kaseya was hosted by WICS.

  Upsilon Pi Epsilon: As the only honor society in the field of Computing, UPE's mission is to provide our students with a community that recognizes their academic achievements and promotes career development. The organization accomplishes this mission by offering various programs and activities through which students can gain knowledge, develop their skills, and kick-start their professional careers. UPE taught students software and hardware development skills through various Workshops (Game Dev, Coding Cupid, Python, 3D printing, and so on). It also organized many events including Google Cloud Platform, Hacking and Cyber Security, SparkDev Game Night, SparkDev Demo Day, Machine Learning with Google, etc. Many events were organized to prepare students for a career in the Tech Industry. Some examples include MITRE Super Day, Advance Interview Preparation, Advance Resume Reviews, Advance Certifications,and so on. It also involved students in hackathons through its organization of events like ShellHacks, Global Game Jam, and Hack Night. Finally, it conducted the Google ignite CS Program to give students the opportunity to promote computer science education and reach out to the community.

  STARS: Provided High Quality peer-to-peer tutoring services for an average of 20 courses per term. Chat groups that use WhatsApp application are used to provide this fully online service. On average, 90 to 150 students per semester register for access to one or more course support chat groups.

  Programming Team activities: Programming Team members received weekly tutorials, training sessions, weekly mock competitions, travel to attend coaching camps and retreats, and master classes by visiting expert coaches; Team members were recommended and received internship opportunities at Ultimate Software, Google, Apple, Uber, and more, where many have become full-time employees; Members were provided scholarships in

2020-2021 to the tune of $11,250. Beginning in 2017, FIU has been a site for the ACM Regional Programming Competition. The competition is organized by the Academy for CS Education with FIU undergraduate and graduate student volunteers. The competition brings about 20-30 teams from across S. Florida to FIU's campus from across the southeastern states. The competition was successfully held in Fall 2019. In Spring semester, the Academy hosts the Annual FIU High School Programming Competition, attended by about 40 teams from Florida high schools, the largest competition of its kind in South Florida. The High School Programming Competitions as well as the Robotics Competitions were canceled for 2019-20 and 2020-21 due to pandemic.

Google Developers Student Club: Google Developer Student Clubs (GDSC), otherwise known as Developer Student Clubs @ Florida International University (DSC @ FIU) was founded in Fall 2020 in order to help students meet people with similar interests, learn about a wide range of technology, and apply their new learnings and connections to help the local community. DSC @ FIU is part of Google Developer's GDSC initiative, which is creating university-based community groups powered by Google for students interested in Google Developer technology. The club has organized various events including Cloud Hero Workshop, ShellHacks Intro to Python Workshop, and Game Night. In Spring 2021, some members participated in the 2021 Google Solution Challenge. Workshops held included Resume Roast, Computer Vision with Deep Learning, GitHub, and Testing your Application. Other activities included ShellHacks TensorFlow Workshop, Tech Internship Panel, and Intro to Python Series.

Evaluation: Employers truly like the training provided to our students, and overwhelmingly indicate that they will continue to hire them. Our alumni observe that they are well equipped for their professional careers after graduation. And our student chapters are doing exceedingly well in holding workshops on a variety of topics of interest to their membership and providing them an opportunity to learn about new topics and participating in newer academic activities. Attainment of Program Educational Objective 1 is deemed **acceptable** with a rating of **very good**.

2.1 Be prepared for career accomplishment, responsibility and advancement in computing-related professions by virtue of having received in the BS program, a high-quality technical education in computing.

Indicators

- Alumni Survey of Program Educational Objectives:
  Please rate the quality of your preparation upon graduation in Computer Programming
  May 2021 to November 2021: **77.61%** Previous cycle: **84.03%**
  Please rate the quality of your preparation upon graduation in Systems Development
  May 2021 to November 2021: **70.08%** Previous cycle: **69.44%**
  Please rate the quality of your preparation upon graduation in Data Structures & Algorithms
  May 2021 to November 2021: **80.22%** Previous cycle: **81.25%**
  Please rate the quality of your preparation upon graduation in Computer Architecture & Organization
  May 2021 to November 2021: **72.76%** Previous cycle: **71.53%**

Calculated Overall rating of Technical Preparation upon Graduation
May 2021 to November 2021: **75.19%** Previous cycle: **76.56%**

- Employer Survey of Program Educational Objectives:
  Please rate the following skill of our graduates: Mastery of the fundamental computer science concepts and ability to solve computing problems using them
  May 2021 to November 2021: **79.81%** Previous Cycle: **85.00%**

- Enabling Student Outcomes – Graduating Student Survey:
  a) A - Ability to apply knowledge of computing and mathematics: **85.45%**
  b) B - Ability to analyze problem - identify and define its computing requirements: **84.92%**
  c) C - Ability to design, implement, and evaluate a computer-based system: **83.69%**
  d) I - Ability to use current techniques, skills, and tools necessary for computing practice: **79.08%**
  e) J - Ability to apply mathematical foundations and algorithmic principles in design of computer systems: **82.77%**
  f) K - Ability to apply design and development principles to construct complex software systems: **83.08%**

Evaluation: This Program Educational Objective is paramount. The percentage ratings shown above for the current Alumni survey cycle are almost the same as those reported in the 2017 assessment report:

Alumni Survey Period	**5/21 to 11/21**	**5/19 to 10/19**
# Responses	**116**	**122**
Computer Programming	77.61	84.03
Systems Development	70.08	69.44
Data Structures & Algorithms	80.22	81.25
Architecture & Organization	72.76	71.53

The ratings for preparation in the Systems Development and Computer Organization & Architecture areas have been consistently slightly below acceptable while the ratings for Data Structures & Algorithms and Computer programming have consistently been high. Note that ratings are just about the same as compared to the ones received in the last assessment cycle (exception – Computer Programming). *It is interesting to note that when they graduate, the students feel that they have attained proficiency in essentially all CS areas at a very high rating, but it diminishes considerably when they have worked in the industry for a while.*

Attainment of Program Educational Objective 2.1 is deemed **acceptable** with a rating of **very good**.

2.2 Be prepared for career accomplishment, responsibility and advancement in computing-related professions by virtue of having received in the BS program, communication and team-work skills.

Indicators

- Alumni Survey of Program Educational Objectives:
  Please rate how your educational experience at FIU contributed to the development of your communication skills
  May 2021 to November 2021: **78.77%** Previous cycle: **77.78%**

- Employer Survey of Program Educational Objectives:
  Please rate the following skill of our graduates: Ability to communicate verbally
  May 2021 to November 2021: **83.04%** Previous Cycle: **95.00%**
  Please rate the following skill of our graduates: Ability to communicate in written form
  May 2021 to November 2021: **81.00%** Previous Cycle: **95.00%**
  Please rate the following skill of our graduates: Ability to work cooperatively in teams
  May 2021 to November 2021: **83.93%** Previous Cycle: **95.00%**

- Enabling Student Outcomes – Graduating Student Rating:
  a) D - Ability to function effectively on teams to accomplish a common goal: **83.69**
  b) F - Ability to communicate effectively with a range of audiences: **77.85%**

Evaluation: It is interesting to note that the perspective on this outcome/objective is quite similar from students' graduation to employment. While the enabling outcomes are rated to be excellent by employers, the alumni assign only acceptable rating. This circumstance underscores the need to have continuing communication and dialog with our alumni.

Attainment of Program Educational Objective 2.2 is deemed **acceptable** with a rating of **very good.**

2.3 Be prepared for career accomplishment, responsibility and advancement in computing-related professions by virtue of having received in the BS program, awareness of the ethical and social responsibilities of their profession.

Indicators

- Alumni Survey of Program Educational Objectives:
  Please rate how your educational experience at FIU contributed to the development of your awareness of social and ethical responsibility
  May 2021 to November 2021: **75.71%** Previous cycle: **76.39%**

- Employer Survey of Program Educational Objectives:
  Please rate the following skill of our graduates: Understanding of Social and Ethical Concerns
  May 2021 to November 2021: **77.27%** Previous Cycle: **87.50%**

- Enabling Student Outcomes – Graduating Student Rating:
  a) E - Understanding of professional, ethical, legal, security, and social issues: **78.46%**
  b) G - Ability to analyze local and global impact of computing on society: **75.76%**

Evaluation: It is interesting to note that the perspective on this outcome/objective is quite similar from students' graduation to employment. The enabling outcomes are rated high by graduating students, alumni, as well as employers.

Attainment of Program Educational Objective 2.3 is deemed **acceptable** with a rating of **good.**

2.4 Be prepared for career accomplishment, responsibility and advancement in computing-related professions by virtue of having received in the BS program, an ability to engage in continued professional development activities.

Indicators

- Alumni Survey of Program Educational Objectives:

Please rate how your educational experience at FIU contributed to your capacity for personal growth

May 2021 to November 2021: **83.90%** Previous cycle: **84.72%**

Please rate how your educational experience at FIU contributed to your capacity for lifelong learning

May 2021 to November 2021: **86.99%** Previous cycle: **84.72%**

- Employer Survey of Program Educational Objectives:

Please rate the following skill of our graduates: Ability to learn new and Emerging Concepts and Technologies

May 2021 to November 2021: **87.00%** Previous Cycle: **90.00%**

- ACM Chapter activities (Appendix H)
  - ❖ Organization of student-led, faculty-led, and industry-led Workshops
  - ❖ helping students secure internships, improve their resume writing skills, teaching them how to use Git version control in order to learn how to interview with companies
  - ❖ Build Activity: Introduction to Python
  - ❖ Organizing Social Events
  - ❖ Provide access to Industry Professionals
  - ❖ Organize Professional Development Sessions
  - ❖ Teach "Giving back to the Community" and provide opportunities to do the same

- UPE Activities (Appendix H)
  - ❖ Organization of technical Workshops
  - ❖ Organizing Information Sessions (Software, Hardware, and Game Development Programs)
  - ❖ Conducted other Activities (Google Ignite CS, Gaming Tournament, ShellHacks, Global Game Jam, Hack Night, and others)
  - ❖ Google igniteCS Program continues to give students the opportunity to promote computer science education and reach out to the community. Through the program,

students currently visit many elementary and middle schools in Miami-Dade County every week, teaching hundreds of students, Computer Science and Information Technology.
    - ❖ Prepare students for a career in Tech Industry through various events
    - ❖ Organizing a Town Hall Meeting between students, School administrators, and faculty

- WICS Activities (Appendix H)
    - ❖ Participating in Grace Hopper Celebration every year
    - ❖ Organizing Workshops and Learning Sessions to assist Women in CS to gain more confidence in themselves.
    - ❖ Hosting 1:1 Industry Professional Sessions with Program Managers and Software Engineers from Microsoft, SnapChat, Visa, Adobe, Bank of America, Disney, AllState, ServiceNow, Deloitte, Geico and JP Morgan Chase.
    - ❖ Hosting Internship Information Sessions.

- STARS Activities (Appendix H)
    - ❖ Providing high quality Peer Tutoring Services for many courses (an average of 20 courses per term) with primary focus on Java programming, Data Structures, Databases, and Networking. On average, 90 to 150 students register for access to one or more course support chat groups. Their retention rate is excellent.
    - ❖ Scheduling Midterm and Final Exam Review Sessions
    - ❖ In Summer 2019, STARS offered fully online tutoring services via the use of WhatsApp chat groups. This in support of our online offerings served a very useful purpose deemed extremely helpful by online students. The practice was continued in subsequent terms, too.

- Programming Team Activities (Appendix H)
    - ❖ The teams have received scholarships, weekly tutorials, training sessions, weekly mock competitions, travel to attend coaching camps and retreats, and master classes by visiting expert coaches
    - ❖ Most programming team member have served an internship at Ultimate Software, Google, Apple, Uber, and more. Many have since become full time employees at their interning companies
    - ❖ Other team members have enrolled in graduate studies
    - ❖ Scholarships for Team Members were provided in 2020-2021 ($11,450). No funds were provided in 2019-2020.
    - ❖ In the summer of 2019, a 5-day training camp for competition problem solving was held on the campus of FIU in partnership with the programming team from UNAL, Bogota, Colombia
    - ❖ Beginning in 2017, FIU has been a site for the **ACM Regional Programming Competition**. The competition is organized by the Academy for CS Education with FIU undergraduate and graduate student volunteers. The competition brings about 20-30 teams from across S. Florida to FIU's campus from across the southeastern

states. The competition was successfully held in Fall 2019. FIU's teams placed 17, 19 and 25th in Division 1. Due to the pandemic, FIU was not a site in 2020-21. It was held virtually and both Divisions were merged into one large division, making the competition much more fierce than ever before. FIU's teams placed 37, 55, 57 and 64th.

- ❖ In Spring of each year, the Academy hosts the Annual **FIU High School Programming Competition**, attended by about 40 teams from Florida high schools, the largest competition of its kind in South Florida.

- Google Developers Student Club (Appendix H)
  - ❖ Help students learn a wide range of technology.
  - ❖ Create University-based community groups powered by Google for students interested in Google Developer Technology.
  - ❖ Participate in Google Developer's Annual Solution Challenge
  - ❖ Participate in various workshops like ShellHacks Intro to Python, Cloud Hero, and Game Night.
  - ❖ Host a Tech Internship Panel for students to attend.

Evaluation: It is not clear that attainment of this objective is directly enabled by specific courses in the Computer Science major. Rather, it is the collective breadth represented by the entire BS in Computer Science program that may have an enabling effect. In addition, the breadth component common to all FIU majors, the Core Curriculum and non-major elective courses, is a principal contributor to any graduated student's realization of personal growth and capacity for life-long learning.

Alumni clearly feel that their education at FIU contributed greatly to their personal growth and lifelong learning experiences. Employers, too, give this Objective an Excellent rating.

Involvement with the School's student organizations is another excellent enabler of this objective. A variety of experiences are provided to students so that they can learn how to engage in Continued Professional Development. These include Workshops, Technical Events, Competitions, and Preparing for their future in the job market. However, these experiences are voluntary and are not exploited by many of our graduates, particularly night students.

Attainment of Program Educational Objective 2.4 is deemed **acceptable** with a rating of **very good**.

V. RECOMMENDATIONS

A. Recommendations of the Subject Area Coordinators

Subject Area: Applications (SAC: Leonardo Bobadilla)

CAP 4052: The course was not offered in this Assessment Cycle. It should be offered more often. Currently, no changes are recommended.

CAP 4104: The course should be offered more often. Perhaps the instructor should suggest some prerequisites to ensure students are better prepared before taking the class.

CAP 4612: The course has not been offered during the evaluation period. It should be offered more often.

CAP 4630: Students in the last Assessment cycle complained that the course covered too much material, and the SAC agreed with them. The course went through a revision modification by the instructor based on the feedback of the students. This substantially improved the course outcomes attainment 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. Instructors should consider this and act accordingly.

CAP 4641: A student suggested that it would be good to cover practical aspects of the subject. That seems to be a valid suggestion for our consideration.

CAP 4710: No change in the curriculum or outcomes is suggested.

CAP 4770: No change in the curriculum or outcomes is suggested.

CAP 4830: No change in the curriculum or outcomes is suggested.

Overall observation: Student participation in the course evaluation system since Summer 2019 is consistently low. This may be due to the migration of the evaluation process to fully online mode after Spring 2018. Perhaps students who complete course evaluation before the final exam week, may be given preference in advising, student workshop registrations, etc.

Subject Area: Computer Organization (SAC: Dong Chen)

CDA 3102: It was observed that the use of interactive textbooks (Zybooks) improves student learning, and it should be continued. Note that in the future, this course will replace CDA 3103 and CDA 4101.

CNT 4713: No change is needed on the course outcomes or syllabus.

COP 4610: No change is needed on the course outcomes or syllabus.

Overall observation: Student participation in the course evaluation system since Summer 2019 is consistently low. This may be due to the migration of the evaluation process to fully online mode after Spring 2018 and Covid-19 pandemic. Perhaps students who complete course evaluation before the final exam week, may be given preference in advising, student workshop registrations, extra credits, etc. Also, the Covid-19 pandemic has some impact on students' course preparation and faculty's course delivery format. Continuing to provide interactive textbooks or Zoom videos might reduce the impacts and help improve student learning.

Subject Area: Computer Systems (SAC: Gregory Reis)

CAP 4453: This course was not offered during the period between Summer 2019 and Spring 2021 mainly because it is a recently designed course. I recommend that we 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 at the School's website should match the template of our School. The current version has a format that hinders the reading of the document.

CDA 4625: 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. A last recommendation would be to have more practice of Bayes Theorem and Gaussian Distribution in the prerequisite course STA-3033.

CEN 4083: The assignments need to be written with a greater level of details including the specific goals and expectations. Moreover, assignments should not be designed with the assumption that students had previous experience in Cloud Computing.

CIS 4731: This course was not offered during the period between Summer 2019 and Spring 2021 mainly because it is a recently designed course. I recommend that we 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.

COP 4604: This course was not offered during the period between Summer 2019 and Spring 2021 mainly because it is a recently designed course. I recommend that we 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.
No changes are recommended.

COP 4710: 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. I would suggest more small projects, and less homework assignments taken from the textbooks and focused only on the theoretical foundations of database management.

COT 4431: This course was not offered during the period between Summer 2019 and Spring 2021 mainly because it is a recently designed course. I recommend that we 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.

Subject Area: Foundations (SAC: Hadi Amini)

CAP 4506: The instructor should encourage students to participate in survey (only 4 students participated in two terms). Also, the course appraisals by instructor could be beneficial. No changes are recommended.

COP 4534: Instructors found students' preparedness for the class to be deficient. An instructor comment suggested that students should have some basic knowledge of solving combinatorics problems as well as learn discrete probability theory better before taking this course. We should consider modifying the Discrete Structures course to include these topics. The instructors could also provide an introductory lecture on discrete probability Theory.

COP 4555: The instructors are recommended to briefly review the necessary topics of COP3530 (a pre-requisite) during the first part of the course. No change is needed on the course outcomes or syllabus.

COT 3100: Students' preparation for this course was rated as deficient for both, mathematical as well as Programming skills. Instructors are encouraged to evaluate the students' understanding of the prerequisite materials during the first week of semester and provide additional resources to student who have lack of required knowledge.

Additional Recommendation: 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 given preference or receive incentives to encourage them to participate in the course evaluation.

COT 3510: This is a new course (Applied Linear Structures for Computing) that will be offered beginning in Fall 2021.

COT 3541: A student mentioned some concern for the required theory for the course. An instructor suggested that the course should be added to the List of Required Courses in our curriculum. No change is recommended for the course outcomes or syllabus.

COT 4521: No evaluations were available for this course, and hence, no recommendations are made.

MAD 3512: Neither student evaluations nor instructor appraisals are available for this course. No changes are recommended.

Subject Area: Professional Development (SAC: Richard Whitaker)

CGS 1920: No changes are recommended in the curriculum or course outcomes. However, the faculty members who have taught the course feel that the Course Title should be changed to "Introduction to the Field of Computing."

CGS 3095: No changes are recommended. The students did indicate that the textbook was not very helpful.

ENC 3249: No changes are recommended. However, technical writing should be emphasized more in this course as instructors found the students' writing skills in CGS 3095 to be "deficient to adequate."

Subject Area: Programming (SAC: Janki Bhimani)

COP 2210: Continue the use interactive textbooks (Zybooks) and ZyLabs along with the lecture handouts, since they were helpful in improving student learning.

COP 3337: No change is needed on the course outcomes or syllabus.

COP 3530: No change is needed in the course outcomes or syllabus. Students did indicate that half-semester format is a rather tight timeframe for this course, and should be avoided.

COP 4226: No change is needed on the course outcomes or syllabus.

COP 4338: No change is needed on the course outcomes or syllabus.

COP 4520: No evaluations are available for this course for this assessment period. No change is recommended for the course outcomes or syllabus.

Subject Area: Capstone/Senior Project (SAC: Masoud Sadjadi)

CIS 3950: This course is new and has only been offered for one year. Therefore, it is understandable to have some issues during the first couple of years that this course is being offered. Nevertheless, the following recommendations are provided based on the instructor's and the students' comments/feedback.

- 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.
- Finally, the instructor should seek different ways to attract more diverse project proposals to be available to our students to pick from.

CIS 4911: This is a three-credit course, and it must be taken during the last semester before graduation by our Computer Science students. There is plenty to be learned and performed during one semester and that is why we are replacing it with Capstone I and II that are being taken by our students in two semesters consequently or even with some semesters skipped in between. We have continued offering this course along with Capstone I & II to accommodate

those students who were not offered or were unaware of Capstone I & II when they joined our program and would need to graduate within the next semester. However, we are hoping that over time, this course is phased out and fully replaced by Capstone I & II. Having said the above, based on the comments/feedback by the instructor and the students, here are some 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 been arranged for all students to receive a virtual machine at the beginning of the semester, but as a very few students used such pre-assigned virtual machines, it turned out to be a big waste of resources. So, it was decided to do the assignments on a need basis. The instructor should clearly communicate to all students that they can request for one or more virtual machines for their projects at the beginning of the semester.

CIS 4951: This course is new and has only been offered for two semesters. Therefore, it is understandable to have some issues during the first couple of years that this course is being offered. Nevertheless, the following recommendations are provided based on the instructor's and the students' comments/feedback.

- 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 available to our students to pick from.
- 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 have 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.

IDS 4918: This course was not offered in this assessment period. No changes are recommended.

Subject Area: Software Engineering (SAC: Monique Ross)

CEN4010: Reconsider the pre-requisites for this class. While students are not complaining faculty evaluations suggest that the absence of database and opportunities for students to practice teamwork and full stack development prior to this course is of concern.

CEN 4021: 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.

CEN 4072: Consider whether this course is appropriate for the CS BA as an elective. The faculty have noted concerns related to basic mathematical understanding necessary to be successful in test generation (noting specifically the CS BA students).

B. Recommendations of the Assessments Coordinator

1. Course Related:

AC-01: The Course Outcomes Surveys for MAD 3512 are not conducted. This is a continuing concern. If possible, some other assessment mechanism should be employed for MAD 3512 on a regular schedule. Further, only 9 out of 24 students (37.5%) performed at an expected level or slightly below (70%). We need to examine the reasons for this inadequate performance of students, and then coordinate the content and delivery of this course better with the Department of Mathematics and Statistics.

AC-02: In 2017, we created a new course (COT 3100) equivalent to Discrete Mathematics (MAD-2104) taught by the Dept. of Mathematics. Now, most, if not all, our students take COT 3100. In the Course Embedded Direct Assessment for COT 3100, 23 out of 31 students (74.19%) demonstrated proficiency in Discrete Structures (11 out of 15 questions answered correctly, i.e., performed at 73.33%). Students seem to be deficient in the pre-requisite knowledge, and hence, it is recommended that instructors gauge it well at the beginning of the term, and take some corrective action.

AC-03: No courses in the Subject Area "Applications" require any changes in the Course Outcomes and Syllabus. However, the preparation of students in CAP 4104 was found to be deficient, and needs looking into by the instructors and the undergraduate committee. Furthermore, the SAC's suggestion that some of the courses be offered more frequently needs to be addressed by the Undergraduate Program Director. A student's suggestion to include more practical aspects of CAP 4641 (Natural Language Processing) in the curriculum should be explored by the instructors and then, the undergraduate committee.

AC-04: No courses in the Subject Area "Computer Organization" require any changes in their course outcomes and syllabus. Note that we are replacing CDA-3103 and CDA-4101 with one course, CDA-3102. It is recommended that the use of interactive textbooks, like Zybooks, be continued in CDA-3102 since it was very helpful in improving student learning.

AC-05: Since the School instituted a new design for the first Programming Course, COP 2210, with fewer sections and a common exam, students in the second Programming Course, COP 3337, were not found deficient in their overall preparation for the course. However, students indicate that there remains a large learning gap between Programming I and II. Students do find Programming II much tougher than Programming I. That may be the nature of the beast, but instructors of these courses should discuss this matter and suggest curriculum changes, if warranted. The use of interactive textbooks (Zybooks) should be continued in COP 2210 as it enhances student learning.

AC-06: Except in truly dire cases, COP 3530 should not be offered in half-terms as it is rather a tight timeframe for this very important and central course in our curriculum.

AC-07: The Coverage Adequacy for Programming III (COP 4338) went down from 4.09 to 3.54 in this assessment cycle. Although no changes are recommended in the Course Outcomes and

Syllabus for this course, the undergraduate committee and the instructors need to look at the possible reasons for this anomaly and address them if so warranted.

AC-08: For four courses in the Subject Area "Foundations (COP 4534, COP 4555, COT 3100, and COT 3541)," students' preparation in mathematical and logical thinking was observed to be deficient. I agree with the SAC's suggestion that some pre-requisite material be covered in these courses at the beginning of the term as it seems to be very difficult to get the students ready for them to suit the requirements of instructors. Indeed, if common problems are detected, then we should modify the curriculum of some pre-requisite courses.

AC-09: In the Subject Area Professional Development, the only suggestion to modify the name of CGS 1920 from "Introduction to Computing" to "Introduction to the Field of Computing" should be considered by the undergraduate committee.

AC-10: Faculty Evaluations for Software Engineering I and II (CEN 4010 and CEN 4021) suggest that the absence of a) database knowledge, b) opportunities for students to practice Teamwork, and c) full slack development hurts the students to get the most out of these courses. Instructors of these courses are encouraged to discuss this issue and make suggestion for curriculum improvement to the Undergraduate Committee.

AC-11: Faculty Members teaching Software Testing (CEN 4072) note that this course should be considered to be included as an Elective for the BA in Computer Science program. The undergraduate committee is encouraged to consider this request.

AC-12: The "Computer Systems" subject area includes some new and some old courses that were not offered in this assessment cycle. The SAC recommends that these courses (CAP 4453, CIS 4731, COP 4604, and COT 4431) should be offered at least once a year, if possible.

AC-13: For adequate preparation of students taking Introduction to Mobile Robotics (CDA 4625), there should be an increased practice of Bayes Theorem and Gaussian Distribution in STA 3033.

AC-14: The Senior Project course (CIS 4911) is gradually being phased out to be substituted by two Capstone Courses (CIS 3950 and CIS 4951). It is important that we define precise roles of new courses clearly. For all these courses offered in future, the instructor should strongly consider the suggestions of the SAC listed above in Section V-A.

2. Procedure Related:

AC-15: In this assessment cycle, student participation in the Course Evaluation System was quite poor. This is mainly due to discontinuing our practice of taking netbook computers to every class and making students fill in these surveys. If that is not doable now for difficulties in its implementation, then we must find other mechanism to improve this participation. Maybe we should look into giving students some incentive to complete these surveys. Three SACs were quite critical of the level of participation of students in our CES.

AC-16: For very few courses, the Instructor Course Appraisals are not completed. The Associate Director (or designee) should ascertain that these are filled by the instructors every term.

AC-17: As suggested in the last Assessment Report regarding the inadequate participation of Employers in the survey, meaningful steps were taken to improve this participation. We increased it from 9 responses (5 answered questions) to 50 (28 answered questions). This is a substantial improvement, and it is suggested to keep following the current strategy in the future to further increase the rate of participation of Employers.

3. General:

AC-18: "Senior Project" course remains the best mechanism to measure the Student Learning Outcomes. Comparison between the previous (2017-2019) and current (2019-2021) assessments shows that the final scores for ***Outcome a*** *(An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline),* ***Outcome e*** *(An understanding of professional, ethical, legal, security, and social issues and responsibilities), and* ***Outcome 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)* respectively were 3.09 and 3.29, 3.00 and 2.14, and 3.05 and 3.03. It is challenging to perform meaningful assessment of these outcomes using the rubric of the Senior Project class because there are essentially none or very few projects attempted by students that address the relevant topics. The point is made for discussion only; no recommendations are made.

AC-19: The quality, the variety, and the number of activities performed by our student clubs (teaching new subjects through workshops, providing opportunities to improve through technical activities, providing outreach to communities by helping students in middle and high schools, and so on) has increased a lot as compared with their past activities. A new Student Club (Google Developers Student Club) has begun which is providing an appropriate training to students to become better employable. STARS has undertaken major responsibility to assist students in their education by providing more and better support for their learning. KFSCIS administrators should continue to support them in whatever way possible, including providing more space for their activities.

AC-20: For a few years now, the meeting of the Industrial Advisory Board is conducted at the end of the Fall and Spring semesters when selected students present their Capstone Projects. Members have been suitably impressed with their work in the past and continue to be impressed now. Many members act as mentors and/or judges for these projects. This has proven to be very beneficial for the students. We should continue to find more and better ways to engage the Board members in student activities.

VI. CONCLUSION

The BS in Computer Science program continues to deliver high quality preparation for entry into the computing work-force, or admission to graduate programs in computing. The delivery of its required coursework (Coverage Adequacy) continues to receive very high ratings from students as expressed in the Surveys of Course Outcomes (4.29/5, 85.8%, Table 1). Evaluations of attainment of its Student Outcomes (81.8 %, Table 3) and Program Educational Objectives (3.20/4, 80.0%, Table 4) uniformly meet or exceed the minimum acceptability criteria.

Striving to ensure that students' educational experiences are relevant to the reality of the work-force they enter, KFSCIS continues to offer capstone experience in the Senior Project course (CIS 4911). This has been a phenomenal success as indicated by the students (Value of Outcome 4.61/5, 92.2%, Table 1) and showed in the measurements using the rubrics for that course. We continue to improve our offerings in many of our focus areas. We have begun substituting CIS 4911 with Capstone I (Value of Outcome 4.69/5, 93.8%) and Capstone II (Value of Outcome 4.66/5, 93.2%) to streamline the process better for students. In this cycle, we offered all three courses at various times, and expect to phase out CIS 4911 in the near future.

The evaluation of Student Learning by various topics as part of the Course Embedded Direct Assessment Mechanism in many courses (COP 3337, COP 3530, COP 4338, and COP 4610) is providing us useful information to fine-tune our curriculum. MAD 3104 (Discrete Mathematics taught by Math Faculty) is now fully substituted by COT 3100 (Discrete Structures taught by CS Faculty) in this assessment cycle. Student indicated Value of Outcomes (4.34, 86.8%) and Coverage Adequacy (4.04, 80.8%) exceed our acceptable criteria.

Our course offerings have diversified (continued process) with the computing field's emphasis on new applications. Accordingly, in this Assessment cycle, we have added many new courses as Electives in a variety of Subject Areas, most importantly, "Applications" and "Computer Systems." We have also introduced other Undergraduate Degree Programs including BA in CS and BS in Cyber Security; and are feverishly working to introduce BS in Data Science. Continuing Bachelor's Programs include BS in IT and BA in IT.

The student chapters have increased their activities in quality, quantity, as well as variety. For example, the FIU-ACM student chapter created a semester-long project for students to complete in a team-based environment taught by mentors who have gone on to do internships at Google, Facebook, PlayStation, and more!

Starting from 2017, FIU has been a site for the **ACM Regional Programming Competition**. The competition is organized by the Academy for CS Education with FIU undergraduate and graduate student volunteers. The competition brings about 20-30 teams from across S. Florida to FIU's campus from across the southeastern states. The competition was successfully held in Fall 2019. FIU's teams placed 17, 19 and 25th in Division 1. Due to the pandemic, FIU was not a site in 2020-21. It was held virtually and both Divisions were merged into one large division, making the competition much fiercer than ever before. FIU's teams placed 37, 55, 57 and 64th.

STARS has provided peer tutoring to all students covering multiple CS and IT courses. On average, 90 to 150 students per semester register for access to one or more course support chat groups. Typically, 25 different courses are covered every semester. This level of involvement of students for student success overseen by a faculty member of the School is already paying dividends in improving our graduation rates.

UPE has remained home to the largest and most active group of students in the School. To this end, in the 2019-2021 academic years, UPE had an active membership of over 700+ students and inducted over 140 new members to the national UPE society. In addition, the FIU UPE chapter hosted the UPE National Convention in March 2020 and April 2021 and won the UPE Outstanding National Chapter Award 2020 and the Continuing Excellence national Chapter Award in 2021. UPE members continue to win the FIU Worlds Ahead Award, with three members winning in 2019, and one in 2020.

WIECS (Women in Engineering and Computer Science) has become very active and many members are supported by the School to attend the annual Grace Murray Hopper Conference. Its membership keeps growing which is very heartening to the School.

The KFSCIS Industrial Advisory Board is increasingly involved in all facets of our operation as indicated by the minutes of its meetings included in Appendix I. The Board meetings are usually held at the end of both, fall and spring semesters. However, due to the pandemic, the Board meeting scheduled for end of spring 2020 was moved to September 2020.

In all meetings, selected presentations of the Senior Projects are made to the Board by student teams, and members have praised the student work profusely. (There were no Capstone Projects demonstrations in the September 2020 meeting.) One Board member is very heavily involved in the evaluation of every project. The overall involvement of the Board has been instrumental in improving the nature of projects handled by the students.

Board members have made many suggestions to improve our work with students and faculty in all aspects. Some of these suggestions include:

- Increasing our concentration of AI and ML in teaching and research,
- Submitting a higher number of patent applications,
- Understanding the needs of local employers to improve the probability of our students acquiring good paying jobs locally,
- Assisting in identifying executives of local companies that hire our graduates and seek their suggestions,
- Develop partnerships to obtain large scale grants,
- Assisting the School and College teams to increase philanthropic donations to the School, and
- Assist the School in hiring new faculty members at all levels. This is further necessitated after receiving the Knight Foundation donation of $10M which calls to hire 20 new faculty members in the next ten years.

In the last few years, and particularly in this assessment period, we have substantially increased student participation in internships and employer participation in job fairs on campus. With a full-time staff member looking after these activities, the student success has been nothing short of phenomenal.

The biennial assessment is working out exceedingly well, and gives us more meaningful information from one report to the next. The participation of the entire faculty is serious and meaningful, and we observe good modifications in our curriculum based on the recommendations made in this report.

The ABET Review of the BS in CS Program was conducted in Fall 2016, and we passed it with flying colors. We are preparing for the upcoming ABET Review in Fall 2022. We will apply for the accreditation of three programs this time; BS in CS, BS in IT, and BS in Cyber Security. Looking at the results of these biennial assessments and using the recommendations of various constituencies (Students, Faculty, Advisory Board members, and Employers) to improve our curriculum, student learning, student placement, and introducing new Degree Programs, we sincerely believe that we are well-placed to succeed in the next ABET Reviews as well.