School of Computing and Information Sciences

Summary of Direct Assessment Data for the BS in Computer Science
Academic Year 2012 -2013

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In accordance with the SCIS Assessment Plan for the BS in Computer Science, several direct measures of attainment of Student Outcomes were undertaken.

BS in CS Student Outcomes (Revised Fall 2010)
To complete the program of study for the BS in Computer Science, every student will
a) Demonstrate proficiency in the foundation areas of Computer Science including mathematics, discrete structures, logic and the theory of algorithms.
b) Demonstrate proficiency in various areas of Computer Science including data structures and algorithms, concepts of programming languages and computer systems.
c) Demonstrate proficiency in problem solving and application of software engineering techniques.
d) Demonstrate mastery of at least one modern programming language and proficiency in at least one other.
e) Demonstrate understanding of the social and ethical concerns of the practicing computer scientist.
f) Demonstrate the ability to work cooperatively in teams.
g) Demonstrate effective communication skills.
h) Have experience with contemporary environments and tools necessary for the practice of computing.

The Direct Assessment Schedule for AY 2012-13 is attached as an appendix.

The Course Outcomes for the BS-CS courses are included into the common course syllabi and may be viewed at http://www.cis.fiu.edu/courses.php

Drafts (Spring 2012 vintage) of the Student Learning Outcomes for the BS-CS courses may be viewed at: http://users.cis.fiu.edu/~pestaina/learning_outcomes.html

The raw data summarized in this report, and the assessment rubrics utilized to derive the data, may be inspected at http://users.cis.fiu.edu/~pestaina/cis4911.html

BS-CS Student Outcome (a): Foundation Areas
Course-embedded Assessment in MAD 2104 Discrete Mathematics, Fall 2012

The final examination responses in one section of MAD 2104 were analyzed by applying the *Discrete Structures Assessment* rubric. On each exam, the response to each of 16 questions was rated 1 (substantially correct answer) or 0. Ratings of the exams of 19 Computer Science majors who passed the course (C or higher grade) are summarized:

# answers rated 1	16	15	14	13	12	11	10	<= 9
% answers rated 1	**100%**	**94%**	**88%**	**81%**	**75%**	**69%**	**63%**	**<= 56%**
# exams	1	1	1	2	1	5	3	5
Cumulative # exams	1	2	3	5	6	11	14	19
Cumulative % exams	5%	11%	16%	26%	32%	58%	74%	100%

TABLE 1-1: MAD 2104, Rubric Score by Number of Exams

The following table shows, for each rubric item, the associated MAD 2104 Student Learning Outcome, and the number and percentage of exam responses that were rated 1:

Rubric Item #	Student Learning Outcome	Discrete Structures Rubric Item Description	Answers rated 1 #	%
1	1.1	Understand Terminology of SETS	13	68
2	1.2	Write SET Theory Proof	7	37
3	1.1	Understand Terminology of RELATIONS	17	89
4	1.2	Perform Operations on RELATIONS	11	58
5	1.1	Understand Terminology of FUNCTIONS	18	95
6	1.2	Perform Operations on FUNCTIONS	10	53
7	2.1	Understand Notation of LOGIC	19	100
8	2.1	Apply Methods of LOGIC	17	89
9	3.1	Know Structure of PROOFS	11	58
10	3.2	Apply MATHEMATICAL INDUCTION	3	16
11	4.1	Compute PERMUTATIONS	14	74
12	4.1	Compute COMBINATIONS	14	74
13	5.1	Know Terminology of GRAPHS	16	84
14	5.2	Apply Methods of GRAPHS	15	79
15	6.1	Use Disjunctive Normal Form in BOOLEAN ALGEBRA	13	68
16	6.2	Apply Minimization Techniques in BOOLEAN ALGEBRA	18	42

TABLE 1-2: MAD 2104, Rubric Ratings by Rubric Item

Expectation:
a. 75% of the completed exams should achieve a rubric rating total of at least 75%.
b. Each of the 16 rubric items should be rated 1 on at least 75% of exams.

Observations:
a. 32 % of the completed exams achieved a rubric rating total of 75% or better.
b. 8 of the 16 rubric items were rated 1 on at least 74% of exams.

BS-CS Student Outcome (a): Foundation Areas
Course-embedded Assessment in MAD 3512 Theory of Algorithms, Fall 2012

33 students enrolled in MAD3512 completed a 10-question multiple choice assessment quiz. Results of only the 27 students who passed the course are considered. The results are summarized as follows:

# correct answers	10, 9	8	7	6	5	4	3	<= 2
% correct answers	>= 90%	80%	70%	60%	50%	40%	30%	<= 20%
# quizzes	0	6	8	6	4	1	2	0
Cumulative # quizzes	0	6	14	20	24	25	27	27
Cumulative % quizzes	0%	22%	52%	74%	89%	93%	100%	100%

TABLE 2-1: MAD 3512, Quiz Score by Number of Students

The following table shows for each quiz question, the associated MAD 3512 Student Learning Outcome, and the number and percentage of correct answers:

Quiz Question	Student Learning Outcome	Correct Answers	
		#	%
1	1.1	25	93
2	1.2	27	100
3	1.3	16	59
4	1.4	14	52
5	2.1	14	52
6	1.3	24	89
7	3.2	5	19
8	4.1	11	41
9	3.1	17	63
10	2.2	19	70

TABLE 2-2: MAD 3512, Scores for each Quiz Question

Expectation:
a. 75% of the quizzes should be scored 75% or higher
b. Each of the 16 rubric items should be scored 1 on at least 75% of the quizzes.

Observations:
a. 32 % of the quizzes were scored 75% or better. 74% achieved a score of 63%.
b. 8 of the 16 rubric items were answered correctly on at least 74% of the quizzes.

BS-CS Student Outcome (b) (CS Core: Data Structures and Algorithms)
Course-embedded Assessment in COP 3530 Data Structures

17 students enrolled in one section of COP 3530 answered a 7-question multiple choice assessment quiz in their mid-term exam, and a 7-question multiple choice quiz in their final exam. The results of these quizzes are combined to form a single course-embedded assessment event comprising 14 quiz questions. The results may be summarized as follows:

# of Correct Answers	**14**	**13**	**12**	**11**	**10**	**9**	**8**
%-score	**100%**	**93%**	**86%**	**79%**	**71%**	**64%**	**57%**
# of quizzes	0	1	4	2	5	4	1
Cumulative **# of quizzes**	0	1	5	7	12	16	17
Cumulative **% of quizzes**	**0%**	**6%**	**29%**	**41%**	**71%**	**94%**	**100%**

TABLE 3-1: COP 3530, Number of Correct Answers by Number of Quizzes

The following table summarizes the COP 3530 quiz results by individual question. The midterm quiz questions are labeled M1 … M7, while the quiz questions from the final exam are labeled F1 … F7. Each is mapped to a COP 3530 Student Learning Outcome.

Quiz Question	Student Learning Outcome	Correct Answers	
		#	**%**
M1	1.1	14	82%
M2	1.1	15	88%
M3	1.1	15	88%
M4	1.2	9	53%
M5	1.1	15	88%
M6	3.2	15	88%
M7	2.2	12	71%
F1	2.1	16	94%
F2	4.1	13	76%
F3	4.2	12	71%
F4	5.1	13	76%
F5	6.1	3	18%
F6	4.2	16	94%
F7	7.1	8	47%

TABLE 3-2: COP 3530, Scores for each Quiz Question

Expectation:
a. 75% of the quizzes should have 10 or more correct answers (71% score or higher).
b. Each quiz question should be answered correctly on at least 75% of quizzes.

Observations:
a. 71% (12 of 17) of quizzes have 10 or more correct answers.
b. 9 of 14 quiz questions were answered correctly on at least 75% of quizzes.

BS-CS Student Outcome (b) (CS Core: Concepts of Programming Languages)
Embedded Assessment in COP 4555 Principles of Programming Languages, Spring 2013

30 students enrolled in one section of COP 4555 completed a 10-question multiple choice assessment quiz. The results are summarized as follows:

# of Correct Answers	**10**	**9**	**8**	**7**	**6**	**5**	**4**
%-score	**100%**	**90%**	**80%**	**70%**	**60%**	**50%**	**40%**
# of quizzes	0	3	5	8	11	1	2
Cumulative **#** of quizzes	0	3	8	16	27	28	30
Cumulative **%** of quizzes	**0%**	**10%**	**27%**	**53%**	**90%**	**93%**	**100%**

TABLE 4-1: COP 4555, Number of Correct Answers by Number of Students

The following table shows for each quiz question the associated COP 4555 Student Learning Outcome, and the number and percentage of correct answers:

Quiz Question	Student Learning Outcome	Correct Answers	
		#	**%**
1	1.1	20	67%
2	2.1	17	57%
3	6.3	8	27%
4	1.1	24	80%
5	1.1	16	53%
6	3.1	24	80%
7	3.1	27	90%
8	4.1	15	50%
9	5.1	24	80%
10	6.2	27	90%

TABLE 4-2: COP 4555, Scores for each Quiz Question

Expectation:
a. 75% of the quizzes should have 7 or more correct answers (70% score or higher)..
b. Each quiz question should be answered correctly on at least 75% of quizzes.

Observations:
a. 53 % (16 of 33) quizzes have 7 or more correct answers.
b. 5 of 10 quiz questions were answered correctly on at least 75% of quizzes.

BS-CS Student Outcome (b) (CS Core: Computer Systems - Database)
Course-embedded Assessment in COP 4710 Database Management, Fall 2012

20 students enrolled in one section of COP 4710 completed a 5-question multiple choice assessment quiz. The results are summarized as follows:

# of Correct Answers	**5**	**4**	**3**	**2**
%-score	**100%**	**80%**	**60%**	**<= 40%**
# of quizzes	9	10	1	0
Cumulative **#** of quizzes	9	19	20	20
Cumulative **%** of quizzes	**45%**	**95%**	**100%**	**100%**

TABLE 5-1: COP 4710, Number of Correct Answers by Number of Quizzes

The following table shows for each quiz question the associated COP 4710 Student Learning Outcome, and the number and percentage of correct answers:

Quiz Question	Student Learning Outcome(s)	Correct Answers	
		#	**%**
1	1.1, 2.1, 3.1	20	100%
2	4.1	20	100%
3	3.2, 5.1	16	80%
4	5.2, 7.1	13	65%
5	6.1	19	95%

TABLE 5-2: COP 4710, Scores for each Quiz Question

Expectation:
a. 75% of the quizzes should have 4 or 5 correct answers (80% score or higher)..
b. Each quiz question should be answered correctly on at least 75% of quizzes.

Observations:
a. 95% (19 of 20) of quizzes have 4 or 5 correct answers.
b. 4 of 5 quiz questions were answered correctly on at least 75% of quizzes.

BS in CS Student Outcome (b) (CS Core: Computer Systems - Operating Systems)
Course-embedded Assessment in COP 4610 Operating Systems, Fall 2012
Course-embedded Assessment in COP 4338 Computer Programming III, Fall 2012

This outcome criterion is evaluated by application of 2 rubrics, *Computer Systems Memory Management Rubric* and *Computer Systems Information Management Rubric,* to 22 and 21 completed projects respectively in COP 4610. A third rubric, *Computer Systems Multithreading* is applied to 15 completed projects in COP 4338. All rubrics evaluate 12 rubric-points.

Rubric Raw Score →	**12**	**11**	**10**	**9**	**8**	**7**	**<= 6**
Rubric Percentage Score →	**100%**	**92%**	**83%**	**75%**	**67%**	**58%**	**<= 50%**
Computer Systems Memory Management							
# of Projects (Max = 22)	18	0	4	0	0	0	0
Cumulative # of Projects	18	18	22	22	22	22	22
Cumulative % of Projects	**82%**	**82%**	**100%**	**100%**	**100%**	**100%**	**100%**
Computer Systems Information Management							
# of Projects (Max = 21)	10	7	2	0	0	2	0
Cumulative # of Projects	10	17	19	19	19	21	21
Cumulative % of Projects	**48%**	**81%**	**90%**	**90%**	**90%**	**100%**	**100%**
Computer Systems Multithreading							
# of Projects (Max = 15)	6	2	3	1	1	2	0
Cumulative # of Projects	6	8	11	12	13	15	15
Cumulative % of Projects	**40%**	**53%**	**73%**	**80%**	**87%**	**100%**	**100%**

Table 6: Results of application of the Computer Systems Rubrics

Expectation:
On each 12-point rubric, 75% of rated projects should be rated at 75% (9 of 12) or higher.

Observations:
a. On the *Memory Management Rubric*, 100% of projects are rated at 75% or higher.
b. On the *Information Management Rubric*, 90% of projects are rated at 75% or higher.
c. On the *Multithreading Rubric*, 80% of projects are rated at 75% or higher.

BS-CS Student Outcome (c): Software Engineering
Course-embedded Assessment in CEN 4010 Software Engineering I , Fall 2012

Completed projects in CEN 4010 were evaluated by application of the 3 Software Engineering rubrics: *Requirements & Analysis Rubric*, *Design Document Rubric*, and *Implementation & Validation Rubric*. On each rubric, the projects are scored against 10 rubric-points to obtain a rating expressed as a % of the maximum possible rating. These data are summarized in the following table. The Projects were completed by 8 groups or 2, 3 or 4 students each.

Rubric Raw Score →	10	9	8	7	<= 6
Rubric Percentage Score →	100%	90%	80%	70%	<= 60%
Requirements & Analysis Rubric					
# of Projects (Max = 8)	4	1	1	1	0
Cumulative # of Projects	4	5	6	8	8
Cumulative % of Projects	50%	63%	75%	100%	100%
Design Document Rubric					
# of Projects (Max = 8)	5	1	0	2	0
Cumulative # of Projects	5	6	6	8	8
Cumulative % of Projects	63%	75%	75%	100%	100%
Implementation & Validation Rubric					
# of Projects (Max = 8)	3	0	1	3	1
Cumulative # of Projects	3	3	4	7	8
Cumulative % of Projects	38%	38%	50%	88%	100%

Table 7: Results of application of the Software Engineering Rubrics

Expectation:
On each Software Engineering rubric, 75% of projects should be rated at 75% or better.

Observation:
a. On the *Requirements & Analysis Rubric*, 75% of evaluated project achieved an 80% rating.
b. On the *Design Document Rubric*, 75% of evaluated project achieved an 80% rating.
c. On the *Implementation & Validation Rubric*, 50% of evaluated project achieved an 80% rating, while 88% of evaluated projects achieved a 70% rating.

BS-CS Student Outcome (d): Computer Programming
Course-embedded Assessment in COP 3530 Data Structures, Spring 2013
Course-embedded Assessment in COP 3337 Computer Programming II, Spring 2013
Course-embedded Assessment in COP 4338 Computer Programming III, Fall 2012

For the "*mastery of one programming language*" facet of outcome (d), completed COP 3530 Java programming assignments were evaluated via 4 rubrics: *Programming: Abstraction Rubric*, *Programming: API Usage Rubric*, *Programming: Recursion Rubric*, and *Programming: Linked Structures Rubric*. A 5th, *Programming: Inheritance Rubric* was applied to one Java assignment in COP 3337. All rubrics utilize an 8-point scale except for the API Usage Rubric which uses a 16-point scale, underlined normalized to 8 for this report. These data are summarized in the following table.

Rubric Raw Score →	**8**	**7**	**6**	**5**	**<= 4**
Rubric Percentage Score →	**100%**	**87.5%**	**75%**	**62.5%**	**<= 50%**
Programming: Abstraction Rubric					
# of Projects (Max = 17)	15	0	0	0	2
Cumulative # of Projects	15	15	15	15	17
Cumulative % of Projects	**88%**	**88%**	**88%**	**88%**	**100%**
Programming: API Usage Rubric					
# of Projects (Max = 17)	11	6	0	0	0
Cumulative # of Projects	11	17	17	17	17
Cumulative % of Projects	**65%**	**100%**	**100%**	**100%**	**100%**
Programming: Recursion Rubric					
# of Projects (Max 17)	17	0	0	0	0
Cumulative # of Projects	17	17	17	17	17
Cumulative % of Projects	**100%**	**100%**	**100%**	**100%**	**100%**
Programming: Linked Structures Rubric					
# of Projects (Max = 17)	15	0	1	0	1
Cumulative # of Projects	15	15	16	16	17
Cumulative % of Projects	**88%**	**88%**	**94%**	**94%**	**100%**
Programming: Inheritance & Polymorphism Rubric					
# of Projects (Max = 19)	1	9	4	4	1
Cumulative # of Projects	1	10	14	18	19
Cumulative % of Projects	**5%**	**53%**	**74%**	**95%**	**100%**

Table 8-1: Results of application of the Computer Programming Rubrics

For the "*proficiency in at least one other*" facet, completed COP 4338 C Language programming assignments were evaluated via the 12-point *Programming: C_Language Proficiency Rubric*:

Rubric Raw Score →	**12**	**11**	**10**	**9**	**<= 8**
Rubric Percentage Score →	**100%**	**92%**	**83%**	**75%**	**<= 67%**
Programming: C_Language Proficiency Rubric					
# of Projects (Max = 15)	1	9	3	2	0
Cumulative # of Projects	1	10	13	15	15
Cumulative % of Projects	**7%**	**67%**	**87%**	**100%**	**100%**

Table 8-2: Results of application of the C_Language Proficiency Rubric

Expectation:
On each Computer Programming rubric, 75% of projects should be rated at 75% or better.

Observations:
a. On the *Programming: Abstraction Rubric*, 88% of evaluated projects achieved a 75% rating.
b. On the *Programming: API Usage Rubric*, 100% of evaluated projects achieved a 75% rating.
c. On the *Programming: Recursion Rubric*, 100% of evaluated projects achieved a 75% rating.
d. On the *Programming: Linked Structures Rubric*, 94% of evaluated projects achieved a 75% rating.
e. On the *Programming: Inheritance & Polymorphism Rubric*, 74% of evaluated project achieved a 75% rating.
f. On the *Programming: C_Language Proficiency Rubric*, 100% of evaluated project achieved a 75% rating.

BS in CS Student Outcome (e): Social & Ethical Concerns
Course-embedded Assessment in CGS 3095 Technology in the Global Arena, Fall 2012

An assessment rubric is applied to CGS 3095 student projects, requiring both written and oral presentation. These are separately analyzed to determine whether the presentations address a) issues of Social Concern and b) issues of Ethical Concern. For each facet, the analysis identifies whether an assertion is supported by evidence, and whether counter arguments are provided. This analysis yields 8 scores, 4 Social, 4 Ethical, for an overall outcome rating in the range 0 .. 8.

Rubric Raw Score →	**4**	**3**	**2**	**1**	**0**
Rubric Percentage Score →	**100%**	**75%**	**50%**	**25%**	**0%**
Social Issues in Computing					
# of Projects (Max = 31)	31	0	0	0	0
Cumulative # of Projects	31	31	31	31	31
Cumulative % of Projects	**100%**	**100%**	**100%**	**100%**	**100%**
Ethical Issues in Computing					
# of Projects (Max = 31)	8	0	13	7	3
Cumulative # of Projects	8	8	21	28	31
Cumulative % of Projects	**26%**	**26%**	**68%**	**90%**	**100%**
Rubric Raw Score →	**8**	**7**	**6**	**5**	**4**
Rubric Percentage Score →	**100%**	**87.5%**	**75%**	**62.5%**	**50%**
Social & Ethical Issues in Computing					
# of Projects (Max = 31)	8	0	13	7	3
Cumulative # of Projects	8	8	21	28	31
Cumulative % of Projects	**26%**	**26%**	**68%**	**90%**	**100%**

TABLE 9: Summary of Ethics & Social Issues Assessment Rubric ratings, Fall 2012

Expectation:
On the Ethics *and Social Issues Asessment Rubric* each facet, Social and Ethical, 75% of projects should be rated at 75% or better.

Observations:
a)   Social Issues: 100% (31 of 31) of projects were rated at 75% or higher.
b)   Ethical Issues: 26% (8 of 31) of projects were rated at 75% or higher.
c)   On the issues taken together, 68% (21 of 31) of projects were rated at 75% or higher.

Direct Assessment of all BS in CS Student Outcomes in CIS 4911 Senior Project

Each project was evaluated by 2 faculty members to obtain ratings of attainment of each BS-CS outcome. The ratings are on a scale of 1 to 5, or 0 if the project provided insufficient evidence about a particular outcome. A mediated rating was obtained when the paired ratings differed by more than 1 point. The scoring rubric followed by the raters is attached. 6 projects were evaluated in Fall 2012 and 9 in Spring 2013. The summarized ratings are presented here:

FL 2012	(a) Math Found	(b) Data Struct	(b) Prog Langs	(b) Dbase Systms	(b) Oper Systms	(c) Softw Eng	(d) Comp Prog	(e) Social Ethical	(f) Team Work	(g) Comm Skills	(h) Envr Tools
PR.1	**2**	**2.5**	**4**	**4.5**	**4.5**	**5**	**4.5**	**2.5**	**5**	**5**	**5**
PR.2	2	2.5	2	4	3	5	4	3	5	5	5
PR.3	3.5	4.5	4	5	5	5	5	3	5	5	5
PR.4	1.5	1	2.5	4.5	2	5	5	3.5	4	5	5
PR.5	5	3	3	3.5	2	3.5	5	1.5	4	5	5
PR.6	1	1	3	5	1	5	4.5	2.5	n/a	5	5
FL 2012	**2.33**	**2.42**	**3.08**	**4.42**	**2.92**	**4.75**	**4.67**	**2.67**	**4.60**	**5.00**	**5.00**

TABLE 10-1: Summary of BS-CS Outcome ratings in Senior Projects, Fall 2012

SP 2013	(a) Math Found	(b) Data Struct	(b) Prog Langs	(b) Dbase Systms	(b) Oper Systms	(c) Softw Eng	(d) Comp Prog	(e) Social Ethical	(f) Team Work	(g) Comm Skills	(h) Envr Tools
PR.1	2	3.5	3	5	4	5	4.5	3.5	2	5	5
PR.2	2	3	2.5	5	4.5	5	4.5	5	5	5	5
PR.3	2	2	3	5	2	5	4	5	5	5	5
PR.4	2	2	4	5	1	5	5	4	5	5	5
PR.5	*2*	*3*	3.5	5	*2*	5	5	5	5	5	5
PR.6	2	1	3	5	3	5	4	5	5	5	5
PR.7	2	2	3	5	2	5	2	4	5	5	5
PR.8	2	3	3	1.5	1.5	5	4	2.5	5	5	4
PR.9	1	2	3	5	3	5	3	1	1	5	5
SP 2013	**1.89**	**2.39**	**3.11**	**4.61**	**2.56**	**5.00**	**4.00**	**3.89**	**4.22**	**5.00**	**4.89**

TABLE 10-2: Summary of BS-CS Outcome ratings in Senior Projects, Spring 2013

AY 2012	(a) Math Found	(b) Data Struct	(b) Prog Langs	(b) Dbase Systms	(b) Oper Systms	(c) Softw Eng	(d) Comp Prog	(e) Social Ethical	(f) Team Work	(g) Comm Skills	(h) Envr Tools
ALL	**2.13**	**2.40**	**3.10**	**4.53**	**2.70**	**4.90**	**4.27**	**3.40**	**4.36**	**5.00**	**4.93**

TABLE 10-3: Summary of BS-CS Outcome ratings in Senior Projects, Academic Year 2012-13