Spring 2012 **Summary of Direct Measure Assessment Data for the BS in Computer Science**

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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 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.

In accordance with the SCIS Assessment Plan for the BS in Computer Science, direct measures of attainment of Student Outcomes were performed as follows:

1. Course-embedded Assessment of BS in CS Student Outcome (a) (Foundations area) in MAD 2104 Discrete Mathematics.
2. Course-embedded Assessment of BS in CS Student Outcome (a) (Foundations area) in MAD 3512 Theory of Algorithms.
3. Course-embedded Assessment of BS in CS Student Outcome (b) (Computer Science core) in COP 3530 Data Structures.
4. Course-embedded Assessment of BS in CS Student Outcome (b) (Computer Science core) in COP 4338 Computer Programming III and COP 4610 Operating Systems.
5. Course-embedded Assessment of BS in CS Student Outcome (d) (Computer Programming) in COP 3337 Programming II, COP 3530 Data Structures, and COP 4338 Computer Programming III.
6. Course-embedded Assessment of BS in CS Student Outcome (e) (Social and Ethical) in CGS 3092 Social and Ethical concerns in Computing
7. Assessment of all BS in CS Student Outcomes, (a) through (h), via observation of the three Senior Projects presented in Spring 2012.

The following data-source documents are referenced in this summary and may be viewed at http://users.cs.fiu.edu/~pestaina/cis4911.html#spring2012

1. Results of application of the Discrete Structures Assessment Rubric to the final exam of 1 section of MAD 2104, applied by Dr. Sue Gorman.
2. Results of Embedded Assessment Quiz in MAD 3512 prepared by Dr. Dev Roy.
3. Results of Embedded Assessment Quiz in COP 3530 prepared by Dr. Mark Weiss.
4. Results of application of Computer systems rubrics in COP 4338 by Dr. Mark Weiss, and in COP 4610 by Dr. Jinpeng Wei.
5. Results of application of the various Programming Assessment Rubrics to completed projects in COP 3337, COP 3530 and COP 4338, applied by Dr. Mark Weiss and Prof. Norman Pestaina (COP 3337).
6. Results of application of the Ethics & Social Issues Assessment Rubric to completed projects in CGS 3092 by Dr. Scott Graham.

Embedded Assessment of BS-CS Student Outcome (a) in MAD 2104 Discrete Mathematics

The final examination responses in one section of MAD 2104 were analyzed by applying the *Discrete Structures Assessment* rubric. Ratings of the exams of the 8 Computer Science majors in this section who passed the course (C or higher grade) are summarized:

Rubric Score	# of Students	Cumulative %
16 = 100%	1	13% (1/ 8)
15 = 94%	1	25% (2 / 8)
14 = 88%	1	38% (3 / 8)
12 = 75%	3	75% (6 / 8)
10 = 63%	1	74% (7 / 8)
9 = 56%	1	100% (8 / 8)

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

Student Learning Outcome	Discrete Structures Rubric Item	Scored Rating of 1	
		#	%
1.1	Understand Terminology of SETS	8	100
1.2	Write SET Theory Proof	4	50
1.1	Understand Terminology of RELATIONS	7	88
1.2	Perform Operations on RELATIONS	2	25
1.1	Understand Terminology of FUNCTIONS	7	88
1.2	Perform Operations on FUNCTIONS	6	75
2.1	Understand Notation of LOGIC	8	100
2.1	Apply Methods of LOGIC	7	88
3.1	Know Structure of PROOFS	8	100
3.2	Apply MATHEMATICAL INDUCTION	4	50
4.1	Compute PERMUTATIONS	6	75
4.1	Compute COMBINATIONS	5	63
5.1	Know Terminology of GRAPHS	8	100
5.2	Apply Methods of GRAPHS	7	88
6.1	Use Disjunctive Normal Form in BOOLEAN ALGEBRA	7	88
6.2	Apply Minimization Techniques in BOOLEAN ALGEBRA	6	75

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

Expectation:

a. 75% of students completing the exam should achieve a rating of at least 75% on the rubric.
b. Each of the 16 rubric items should be scored 1 on at least 70% of sampled exams.

Observation:

a. Exactly 75% of students achieved a rating of 75% or better
b. 12 of the 16 rubric items were scored 1 by at least 75% of the sample. Of the remaining 4 rubric items 3 were scored 1 by at least 50% of the sample and 1 was scored 1 by only 25%.

Discussion:

The learning outcomes involving proof techniques (1.2, 3.2) and relations are rated lowest.

Embedded Assessment of BS-CS Student Outcome (a) in MAD 3512 Theory of Algorithms

Course Outcomes:

1. Be familiar with formal languages
2. Master finite state machines
3. Master Turing machines
4. Be familiar with primitive recursive and recursive functions
5. Be exposed to recursive unsolvability

23 students enrolled in MAD3512 completed a 7-question multiple choice assessment quiz. The results are summarized as follows:

# of Correct Answers	**7**	**6**	**5**	**4**	**3**	**2**
%-score	**100%**	**86%**	**71%**	**57%**	**43%**	**29%**
# of Students	1	7	8	6	0	1
Cumulative **#** of Students	1	8	16	22	22	23
Cumulative **%** of Students	4	35	70	96	96	100

TABLE 2-1: MAD 3512, Number of Correct Answers by Number of Students

Question #	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Student Learning Outcome	**1.1**	**1.3**	**1.4**	**2.1**	**2.2**	**3.1**	**3.2**
# Correct Answers	18	19	20	23	12	13	10
% Correct Answers	78.3	82.6	87.0	100.0	52.2	56.5	43.5

TABLE 2-2: MAD 3512, Number and Percentage of Correct Answers to each Question

Expectation:

a. 75% of students completing the assessment quiz should score 5 (70%) or higher.
b. Each quiz question should be answered correctly by at least 75% of students.

Observation:

a. 71% of students achieved the threshold score of 5, or better.
b. Only 4 of the 7 questions were answered correctly by at least 75% of students. The remaining 3 questions were answered correctly by approximately 50% of students.

Discussion:

The available data includes the results of quizzes completed by some students who did not complete the course successfully. The course instructor was unable to identify and exclude these quizzes from the sample.

Embedded Assessment of BS-CS Student Outcome (b) in COP 3530 Data Structures

Course Outcomes

1. Be familiar with basic techniques of algorithm analysis
2. Be familiar with writing recursive methods
3. Master the implementation of linked data structures such as linked lists and binary trees
4. Be familiar with advanced data structures such as balanced search trees, hash tables, priority queues and the disjoint set union/find data structure
5. Be familiar with several sub-quadratic sorting algorithms including quicksort, mergesort and heapsort
6. Be familiar with some graph algorithms such as shortest path and minimum spanning tree
7. Master the standard data structure library of a major programming language (e.g. java.util in Java 1.2)

14 students completing one section of COP 3530 answered a 6-question multiple choice assessment quiz in their mid-term exam, and an 8-question multiple choice quiz in their final exam. The results of these quizzes are combined to form a single course-embedded assessment event. The quizzes and scores are attached. 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 Students	1	2	2	1	4	2	2
Cumulative **#** of Students	1	3	5	6	10	12	14
Cumulative **%** of Students	7%	21%	36%	43%	71%	86%	100%

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

The following table summarizes the COP 3530 quiz results by individual question. Questions from the midterm exam are labeled M1 … M6, while questions from the final exam are labeled F1 … F8. Each is mapped to a Student Learning Outcome (**SLO**) associated with a Course Outcome.

	M1	**M2**	**M3**	**M4**	**M5**	**M6**	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
SLO	**1.1**	**1.1**	**1.1**	**1.1**	**1.2**	**2.2**	**2.2**	**1.1**	**3.2**	**4.2**	**4.2**	**5.1**	**6.1**	**7.1**
N	13	14	10	13	12	11	6	11	10	8	12	7	14	8
%	93%	100%	71%	93%	86%	79%	43%	79%	71%	57%	86%	50%	100%	57%

TABLE 3-2: COP 3530, Number and Percentage of Correct Answers to each Question

Expectation:

a. 75% of students completing the assessment quiz should answer 10 or more questions correctly.
b. Each quiz question should be answered correctly by at least 75% of students.

Observation:

a. 10 of 14 students (71%) answered 10 or more of 14 questions correctly;.
b. 8 of 14 questions were answered correctly by 75% or more students. 2 of 14 questions were answered correctly by 71% of students. 3 of 14 questions were answered correctly by at least 50% of students. Only 1 question was answered correctly by fewer than 50% of students.

Discussion:

The Student Learning Outcomes are included with the raw data and may be useful to the COP 3530 course instructors and subject area coordinator in determining instructional areas for increased focus.

Embedded Assessment of BS in CS Student Outcome (b) (Computer Science core) in COP 4338 Computer Programming III, and COP 4610 Operating Systems.

Completed projects in COP 4338 and COP 4610 were evaluated by application of the Computer Systems Multithreading rubric (COP 4338), and the Computer Systems Storage Management rubric (COP 4610). On each rubric, the projects are scored against several rubric-points to obtain a rating expressed as a % of the maximum possible rating. These data are summarized in the following table. The COP 4338 projects are individual assignments while the COP 4610 projects are team projects.

Computer Systems	Multithreading (COP 4338)	Storage Management (COP 4610)
Sample Size	21	7
N >= 75%	20	5
% >= 75%	95%	71%

Table 4-1: Results of application of the =Computer Systems rubrics

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

Observation:

a) On the Multithreading rubric, all but one evaluated project achieve the expected rating.

b) On the Storage Management rubric, the number of evaluated projects achieving the threshold 75% rating is marginally lower than the 75% standard.

Discussion:
There seems to be a need for fine-tuning of the COP 4610 rubrics.

Embedded Assessment of BS-CS Student Outcome (d) in COP 3337 Computer Programming II, COP 3530 Data Structures, and COP 4338 Computer Programming III

In précis, Outcome d) requires mastery of one programming language and proficiency in another; at the present time, Java and C respectively.

Students' mastery of each of 6 facets of Java programming is evaluated by application of facet-focused rubrics to completed programming projects in COP 3337 and COP 3530. On application of each rubric, all projects are scored against several rubric points resulting in a rating expressed as a % of the maximum. The acceptable rating is set at 75%. The rating data are summarized in the following table:

Computer Programming	API Usage (COP 3530)	Recursion (COP 3530)	Linked Structures (COP 3530)	Abstraction (COP 3530)	Inheritance (COP 3337)	Exceptions (COP 3337)
Sample Size	14	17	16	14	15	14
N >= 75%	13	17	13	14	14	10
% >= 75%	93%	100%	81%	100%	93%	71%

Table 4-1: Results of application of the Java Programming rubrics

Students' facility in a second language is evaluated by application of the C-Language Programming rubric to completed early programming project(s) in COP 4338. The projects are scored against several rubric points to obtain a rating expressed as a % of the maximum. Later projects are also evaluated against the Computer Systems Multithreading rubric in similar fashion. In either case, the acceptable rating is set at 75%. These data are summarized in the following table:

	C-Language	Multithreading
Sample Size	21	21
N >= 75%	21	20
% >= 75%	100%	95%

Table 4-2: Results of application of the C-Language and Multithreading rubrics

Expectation:

a. For each Java-based Programming rubric, 75% of projects should be rated at 75% or better.
b. For each of the C-Language Programming and Computer Systems rubrics, 75% of projects should be rated at 75% or better.

Observation:

a. Only on the Exceptions rubric are fewer than 75% of rated projects below the 75% acceptability threshold, and marginally so. On all other 5 rubrics, significantly more than 75% of rated projects score above the 75% threshold, including 2 rubrics at the maximum 100% rate.
b. On the C-Language Programming rubric, all projects are rated at or above the 75% threshold. On the Multithreading rubric, only 1 of the 21 rated projects falls below 75%.

Embedded Assessment of BS in CS Student Outcome (e) in CGS 3092 Social and Ethical Concerns in Computing

An assessment rubric is applied to student projects, requiring both written and oral presentation. The written and oral (Power Point) presentations of each project 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 about that facet is supported by evidence, and whether counter arguments on that assertion are provided. This analysis yields 8 binary (0/1) scores, 4 Social, 4 Ethical, for an overall outcome rating in the range 0 .. 8.

		SOCIAL	ETHICAL	OVERALL
PROJECT NO. & TITLE (abbreviated)		**4**	**4**	**8**
1	Chinese Surveillance: An Ethical Dillema	4	4	8
2	SOPA/PIPA	4	4	8
3	Computer Privacy	4	4	8
4	GPS Enabled Devices – Privacy?	4	4	8
5	Google and Privacy	4	4	8
6	Is hacking ever ethical?	4	4	8
7	Virtual Goods as Intellectual Property	4	4	8
8	Do Games Teach Ethics?	4	4	8
9	First Amendment Rights in Cyberspace	4	2	6
10	Advanced Imaging Technology TSA	4	4	8
11	Digital Trade Act - SOPA/PIPA?	4	2	6
12	Do programmers Have Responsibility?	4	0	4
13	Software Patent Conflicts	4	4	8
14	Biometrics: The Effects on Insurance etc	4	2	6
15	Illegal Downloading and the Impact	4	4	8
16	Ethical Considerations- Japanese Anime	4	4	8
17	Gaming – Player Ethics	4	4	8
18	The First Amendment- Cyber Hate etc	4	4	8
18	Profiling Potential Employees	4	4	8
20	Internet Cross Dresser	4	0	4
21	GPS Enabled Devices – Privacy?	4	4	8
22	Forms of Online Aggression	4	0	4

		SOCIAL	ETHICAL	OVERALL
	# Ratings >= 75% (3/4 or 6/8)	22 of 22	16 of 22	19 of 22
	% Ratings >= 75% (3/4 or 6/8)	100.0%	72.7%	86.4%

TABLE 5: Summary of Ethics & Social Issues Assessment Rubric ratings, Spring 2012

Expectation:

a) For the *Social Concerns* facet of this outcome, 75% of the projects should be rated at 75% (3 of 4) or higher.
b) For the *Ethical Concerns* facet of this outcome, 75% of the projects should be rated at 75% (3 of 4) or higher.
c) 75% of the projects should have *overall* ratings of 75% (6 of 8) or higher.

Observation:

a) 100% of projects are rated at 100% (4 of 4) on the *Social Concerns* facet of this outcome.
b) 72.7% of projects are rated at 75% (3 of 4) or higher on the *Ethical Concerns* facet of this outcome.
c) 86.4% of projects achieve *overall* ratings 75% (6 of 8) or higher.

Discussion:

The 72.7 % of projects attaining the expected 75% rating on the *Ethical Concerns* facet are, in fact, all rated at 100% (4 of 4). A lower level inspection of the raw data reveals that the deficiencies are predominantly in the oral presentation aspect, while the written components adequately address the *Ethical Concerns* facet. This suggests reasonable attainment of this facet.

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

Each of the three projects was observed for the purpose of obtaining ratings of attainment of BS-CS outcomes by at least 2 faculty members. The ratings are on a scale of 1 .. 5, or 0 if the project provided insufficient evidence about a particular outcome. A mediation rating was obtained when the initial ratings differed by more than 1 point. The scoring rubric followed by the raters is attached.

	Outcome (a)	Outcome (b)	Outcome (c)	Outcome (d)	Outcome (e)	Outcome (f)	Outcome (g)	Outcome (h)
Project 1	2	5	5	5	3	3	5	5
QRS Codes	1	5	5	5	3	3	5	5
Project 2	4	5	5	5	5	5	5	5
vMoodle	1	5	5	5	2	5	5	5
(M)	**2**				**4**			
Project 3	3	4	5	3	2	5	5	5
GME Database	1	4	5	4	3	5	5	5
(M)	**2**							
	Outcome (a)	**Outcome (b)**	**Outcome (c)**	**Outcome (d)**	**Outcome (e)**	**Outcome (f)**	**Outcome (g)**	**Outcome (h)**
Mean	***1.83***	***4.67***	***5.00***	***4.50***	***3.17***	***4.33***	***5.00***	***5.00***

*The means expressed in the final row of the table are averaged over the six **project outcome ratings**, using either the moderated rating or the average of the 2 un-moderated ratings.*

TABLE CIS 4911-1: Summary of Student Outcome ratings in Senior Project

Reliability: Prior to mediation, all 3 projects were each rated across all 8 student outcomes by 2 raters. The consistency of the un-mediated outcome attainment ratings is summarized in the following table.

Identical Ratings	Ratings differing by 1	Ratings differing by 2+
18/24	3/24	3/24
75%	12.5%	12.5%

TABLE CIS 4911-2: Consistency of Student Outcome ratings in Senior Project

The following standard is applied to all BS-BC Student Outcome ratings via the Senior Project.
Expectation: Attainment of all outcomes should be **75% or 3.75** on a 1 — 5 scale, or better.

- Outcome (a): *Demonstrate proficiency in the foundation areas of Computer Science…* ***1.83***

Observation: Project specifications appear to miss several opportunities to incorporate foundations aspects, for example, statistical measures, stem or box plots, hypothesis testing, error estimation, flow graphs, etc.
Moderator's comment: "I think both projects could have had more foundation points with just some better documentation and perhaps this rubric needs to be communicated at the START of senior project and students can get their checklists earlier if this is not already being done."

- Outcome (d): *Demonstrate mastery of at least one modern programming language…* ***4.50***

Observation: Project 3 received a rating of 3 for this outcome from the first evaluator.

- Outcome (e): *Demonstrate understanding of the social and ethical concerns …* ***3.17***

Observation: This aspect is not sufficiently documented in project artifacts. The Moderator's remarks re the Foundations outcome a) probably also apply to this outcome.

- Outcome (f): *Demonstrate the ability to work cooperatively in teams…* ***4.33***

Observation: Student's peer evaluations, and anecdotal evidence, indicate some difficulties with the participation of one of the Project 1 team members.

- Outcome (b): *Demonstrate proficiency in various areas of Computer Science…* ***4.67***
- Outcome (c): *Demonstrate proficiency in problem solving and application of software engineering techniques…****5.00***
- Outcome (g): *Demonstrate effective communication skills…* ***5.00***
- Outcome (h): *Have experience with contemporary environments and tools…* ***5.00***

Observation: For each of these outcomes, all individual ratings were either 4 (very good) or 5 (excellent).