

Department of Mathematics and Computer Science

Assessment Plan

MAY 2002

Introduction

The Mathematics and Computer Science department at California State University Hayward is committed to developing and implementing a comprehensive assessment plan that is tied to the department's mission and can be used to guide decision making, maintain accountability, and foster understanding. With its priority focus on the students, the department provides an environment in which teaching, scholarship, research and professional activity are valued and supported. We aim to continuously improve programs and processes through introspective assessment and evaluation.

Outline of Process

1. Define department mission statement.
2. Define department program goals.
3. Define student learning outcomes.
4. Identify where and how learning outcomes are delivered.
5. Identify performance indicators.
6. Identify assessment tools to be used.
7. Implement assessment tools.
8. Assess achievement of objectives and learning outcomes.
9. Identify problems and develop goals and strategies for improving delivery of learning outcomes.
10. Specify resource needs.

1. Mission Statement

The mission of the Department of Mathematics and Computer Science is to provide excellent instruction in the areas of mathematics and computer science, and to foster scholarship and service on the part of the faculty.

2. Program Goals

GOAL 1: To provide our students with a mastery of the fundamental concepts of Mathematics and/or Computer Science.

Objective 1.1: Students will complete a comprehensive major program. They will gain both depth and breadth in Mathematics and/or Computer Science.

Objective 1.2: Students majoring in Mathematics and/or Computer Science will have the opportunity to take courses from faculty who have a continuing commitment to the quality of the overall program and who are experts in their respective fields.

Objective 1.3: Students will have access to faculty outside of class time for advising, course assistance, and other academic concerns.

Objective 1.4: Students will have access to a Departmental Student Center that will provide a resource for students to handle routine administrative matters.

GOAL 2: To provide our students with the ability to apply their knowledge and problem solving skills to new situations, with a broad appreciation of their discipline, and with the desire and ability to pursue lifelong learning.

Objective 2.1: Students in selected options will participate in a supervised capstone experience.

Objective 2.2: Students will be encouraged to attend departmental colloquia.

Objective 2.3: Students will have the opportunity to share their knowledge by teaching others.

GOAL 3: To provide our students with opportunities to participate in a mix of collegiate and social experiences that contribute to values for successful living.

Objective 3.1: Students will have the opportunity to participate in Mathematics and Computer Science clubs.

Objective 3.2: Students will have the opportunity to socialize and get to know one another at departmentally sponsored events.

Objective 3.3: Students will have the opportunity to attend professional meetings in Mathematics and/or Computer Science.

Objective 3.4: Students will have the opportunity to participate in internships and service learning experiences.

Objective 3.5: Students will be provided with the opportunity to gain additional knowledge and exposure to research and industrial technologies.

3. Student Learning Outcomes

Student learning outcomes will be defined separately for the Mathematics and Computer Science programs as the specific achievements required in each program differ to a large extent. In each case, learning outcomes describe the desired results commensurate with graduation from the program. Within a program, the outcomes required for the B.S. and M.S. degrees are similar. The additional outcomes expected of M.S. degree students, above and beyond those expected of B.S. degree students, will be identified. The degree programs offered by the department include the B.S. in Mathematics, the B.S. in Computer Science, the M.S. in Mathematics, and the M.S. in Computer Science. Please note that outcomes 1 and 2 cover skills and knowledge areas respectively and are specific to the degree program. Outcomes 3-7 cover more general areas of achievement and are common to all the degree programs.

3.1 B.S. and M.S. in Computer Science

The goals of the B.S. and M.S. degrees in Computer Science are similar and hence they share most of the same outcomes. The M.S. degree, however, is designed to extend the student's knowledge in a

broad manner beyond the depth required for the B.S. degree. In particular, the degree program should increase the student's general understanding of theoretical principles and provide specific professional background. Therefore, while the outcomes are similar, the levels of achievement required in the two degrees will be different.

Outcome 1: Students possess technical competence in the field of Computer Science including the following skills:

- 1.1:** The ability to design and implement a basic computer program in a current programming language on a current development platform.
- 1.2:** The ability to integrate sophisticated data structures into program design.
- 1.3:** The ability to use structured programming techniques in programs.
- 1.4:** The ability to design and implement a computer program of reasonable size and advanced complexity using accepted software engineering design principles.

This list of required skill set outcomes is extended for the M.S. degree with the following additional outcome:

- 1.5:** The ability to design and implement computer programs of large size and advanced complexity with limited guidance and on a regular basis.

Outcome 2: Students possess a fundamental understanding of Computer Science theory including the following areas of expertise:

- 2.1:** The ability to use mathematical problem-solving techniques through differential calculus and linear algebra, and including discrete structures and statistics.
- 2.2:** The ability to design and analyze algorithms.
- 2.3:** The ability to incorporate software engineering principles in project design.
- 2.4:** A familiarity with computer architecture concepts and operating system mechanisms.
- 2.5:** The ability to analyze the aspects of differing programming languages.

This list of required knowledge outcomes is extended for the M.S. degree with the following additional outcomes:

- 2.6:** The ability to analyze sophisticated algorithms and recognize variations of known problems.
- 2.7:** A command of the material covered in the three Computer Science groups: Theory, Architecture, and Systems.

Outcome 3: Students are able to work effectively as a team member. This includes contributing a fair share of work, encouraging others to participate, cooperating with team members, sharing information, and helping to reconcile differences among fellow team members.

Outcome 4: Students have an understanding of their professional and ethical responsibilities and appreciate the impact of computer science solutions in the societal context.

Outcome 5: Students have an ability to communicate effectively, both in written and oral form. This includes the ability to articulate ideas clearly and concisely; prepare written materials

that flow logically and that are grammatically correct, and to make presentations that are planned and delivered effectively.

Outcome 6: Students are able to successfully find employment in the industry.

Outcome 7: Students seeking advanced degrees are prepared to do so.

3.2 B.S. and M.S. in Mathematics

The goals of the B.S. and M.S. degrees in Math are similar and hence they share many of the same outcomes. The M.S. degree, in general, is designed to extend the student's knowledge in a broad manner beyond the depth required in the B.S. degree. One exception is Option II of the M.S. degree, Mathematics Teaching, which is intended for those who hold a secondary teaching credential and who intend to pursue a career in secondary teaching. In addition, in both the undergraduate and graduate programs, the options provide widely varying learning tracks. As such, learning outcomes have been identified which may apply to certain options only. The connection will be made clear in section 6.3 and 6.4. Again, while some outcomes are shared between the B.S. and M.S. degrees, the levels of achievement required in the two instances will be different.

Outcome 1: Students possess technical competence in the field of Mathematics including the following skills:

- 1.1:* The ability to apply the techniques of Calculus to Mathematics, Science, and Engineering
- 1.2:* The ability to develop and analyze linear models systems in mathematics, science and engineering, using matrix theory and differential equations.
- 1.3:* The ability to understand and use axiomatic definitions to create and analyze examples in groups, rings and real analysis.
- 1.4:* The ability to read and create proofs.
- 1.5:* The ability to solve problems as individuals and in a group setting, to combine ideas from several areas in mathematics, and to present results effectively to others

This list of required skill set outcomes is extended for the M.S. degree with the following additional outcomes. Not all outcomes apply to all options of the degree. The set of outcomes appropriate to each option will be specified in Section 6.3.

- 1.6:* The ability to analyze and classify structures in different areas of Mathematics.

Outcome 2: Students possess a fundamental understanding of Mathematics theory including the following areas of expertise:

- 2.1:* Understand the role of Calculus in Mathematics, Science, and Engineering.
- 2.2:* Understand the role of linear systems and models in Mathematics, Science, and Engineering.
- 2.3:* Understand the relation between the modern formulation of algebraical systems and the classical problems of algebra such as solving systems of polynomials and classical construction problems.
- 2.4:* Understand the role of precise definitions and proofs in the structure of real analysis.

2.5: Understand how the mathematics learned in various courses tie together.

This list of required knowledge outcomes is extended for the M.S. degree with the following additional outcomes. Again, not all outcomes are appropriate to all options.

2.6: Comprehend sophisticated mathematical articles.

2.7: A command of the material covered in the four major areas of applied mathematics: Applied Analysis and Differential Equations, Linear Programming, Numerical Analysis, and Probability.

2.8: A command of the material covered in the four major areas of theoretical mathematics: Algebra, Complex Analysis, Real Analysis, and Topology.

2.9: Understand the role of a teacher in the context of classroom, school district, and national education goals.

Outcome 3: Students are able to work effectively as a team member. This includes contributing a fair share of work, encouraging others to participate, cooperating with team members, sharing information, and helping to reconcile differences among fellow team members.

Outcome 4: Students have an understanding of their professional and ethical responsibilities and appreciate the impact of mathematics in the societal context.

Outcome 5: Students have an ability to communicate effectively, both in written and oral form. This includes the ability to articulate ideas clearly and concisely; prepare written materials that flow logically and that are grammatically correct, and to make presentations that are planned and delivered effectively.

Outcome 6: Students are able to successfully find employment in educational institutions and industry.

Outcome 7: Students seeking advanced degrees are prepared to do so.

4. Identification of Delivery Mechanisms for Learning Outcomes

Tables 1 and 2 show delivery mechanism/learning outcome matrices for the Computer Science and Mathematics programs respectively. Check marks are used to indicate the mechanisms that address each learning outcome. Current mechanisms include required course work within the major and without, the university writing skills test (WST), department colloquia, student clubs, and co-op and internship programs. Additional mechanisms may be added as necessary in order to achieve learning outcomes.

5. Performance Indicators

Performance indicators are measures of student achievement of learning outcomes. The indicators identified for the Mathematics and Computer Science programs include:

Indicator 1: Scores earned on course exams and homework assignments in courses that are identified as crucial to each degree program.

Indicator 2: Scores earned on research papers and team projects.

Indicator 3: Scores earned on oral presentations or levels of classroom discussion.

- Indicator 4:* Scores earned on comprehensive exams.
- Indicator 5:* Placement rate of alumni in the chosen field.
- Indicator 6:* Acceptance rate of alumni in graduate programs.
- Indicator 7:* Results of an exit survey.
- Indicator 8:* Results of an alumni survey.
- Indicator 9:* Results of internship experiences.
- Indicator 10:* Results of an employer survey.

Performance indicators will be measured via the assessment tools described in the following section.

6. Assessment Tools

A variety of tools will be employed in order to gather performance indicators and determine if student learning outcomes have been achieved. Two overall policies govern the selection of assessment tools:

- Policy 1:* All graduating students will undergo the assessment procedure to the extent possible.
- Policy 2:* Assessment tools must be standardized in order to provide useful measures of student achievement. The degree of standardization required will be determined by the department.

Towards this end, the assessment tools in the list below have been identified. All degree programs will use tools 3-5: exit, alumni, and employer surveys. For each degree program, the assessment tools that are unique to that program are listed along with the parameters used to define the tool, and conformance to the two assessment policies listed above. Please note that not all assessment tools are appropriate to all degree programs. For instance, comprehensive exams are typically used only within the graduate setting.

- Tool 1:* Gateway courses
- Tool 2:* Comprehensive exams
- Tool 3:* Exit survey
- Tool 4:* Alumni survey
- Tool 5:* Employer survey

Tool 1: Gateway courses

The concept behind gateway courses is to identify (or create) a set of courses, placed at key points in a student's academic career, which provide checks on their skills and command of theory. To be effective, these courses should integrate the concepts learned in previous coursework and require that these concepts actively be put to use. In addition to providing assessment data for the department, gateway courses provide valuable feedback to the students regarding their mastery of subject matter crucial to the major.

Tool 2: Comprehensive exams

Comprehensive exams also serve as a gateway to graduation in that they must be passed successfully in order to complete the requirements for graduation. They are intended to evaluate a student's command of subject areas that have been identified as critical to the degree program. In addition,

problems included on the comprehensive exams emphasize integration of concepts from multiple areas. Comprehensive exams are typically used at the graduate level.

Tool 3: Exit surveys

Exit surveys are meant to elicit the student's opinion on a number of points including the effectiveness of instruction, the applicability of coursework, future career goals, preparation for career or further academic work, and the strengths and weaknesses of the major. They may be used to determine if a student feels that their own personal learning outcomes have been achieved, and to identify elements of the degree program or its operation that may require reconsideration.

Exit surveys meet the policy 1 guideline in that they are distributed to all graduating students. They meet the policy 2 guideline in that one single survey form has been approved by the department for use by all students.

Tool 4: Alumni surveys

Alumni surveys are meant to elicit the opinions of students after they have worked in industry or an academic environment for a number of years. The interval provides the student with the time to determine the worth of their degree from the viewpoint of a working professional or advanced graduate student. This type of survey will provide information that is impossible to gather using exit surveys. Points addressed will include the value of the degree in the job search, student preparation for industry or academic work, and strengths and weaknesses of the major.

Alumni surveys meet the policy 1 guideline in that they are distributed to all graduates for which the department has address information. The department will require assistance in tracking alumni and maintaining such a list. It is possible that the university could offer this assistance through their alumni programs. The policy 2 guideline can be met if a standardized form of the survey is approved for use by all degree graduates.

Tool 5: Employer surveys

Employer surveys are meant to elicit the opinions of the supervisors of our graduates several years after graduation. The interval provides the supervisor the time to observe the graduate's work and identify strengths and weaknesses, both in the graduate's skill set and in their command of critical areas of knowledge. These surveys can provide a qualitative assessment of the achievement of student learning outcomes from the point of view of the student's supervisor.

Employer surveys present a problem when considering guideline 1. It will be difficult to contact the employers of a significant portion of our graduates due to lack of tracking information. It is possible that the university may be able to offer assistance through their alumni association tracking efforts or through the career development center. In addition, the Computer Science program has instituted an Industry Advisory Board (IAB) consisting of local employers. This board may be used to provide a link to industry and to supply possible contacts for employer information regarding our graduates from both programs. Employer surveys can meet guideline 2 if a single form of the survey is approved for use by the supervisors of all graduates.

6.1 B.S. in Computer Science

The B.S. in Computer Science will be assessed using gateway courses and the exit, alumni, and employer surveys listed above. The gateway courses identified for the B.S. in Computer Science are:

CS 2360 - Programming Methods and Introduction to Software Engineering

This course provides a gateway at the **sophomore** level. CS 2360 focuses on basic programming skills and software engineering principles. The course incorporates concepts from CS 1160. Outcomes addressed: 1.1, 1.3, 2.3.

CS 3240 - Data Structures and Algorithms

This course provides a gateway at the **junior** level. CS 3240 focuses on advanced programming skills and analysis of programs. The course incorporates concepts from CS 2360 and 2430. Outcomes addressed: 1.1, 1.2, 1.3, 2.1, 2.2, 2.3.

CS 4560 - Operating Systems

This course provides a gateway at the **senior** level. CS 4560 focuses on computer science theory and application level programming. The course incorporates concepts from CS 2360, 3240, and 3430. Outcomes addressed: 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4.

These gateway courses meet the policy 1 guideline in that all students must either take the courses at CSUH or receive transfer credit. Most of our transfer students take the sophomore gateway course at CSUH and virtually all of them take the junior level and senior level courses at CSUH. This provides a consistent basis for evaluation.

These gateway courses must be further standardized in order to meet policy 2. The courses are already standardized based on the catalog description and master syllabi maintained for the courses. A standard text is used in CS 2360, the sophomore gateway course. In addition, a grade of C or better is required in order to receive credit for any of the gateway courses. Two additional factors in standardization that would be appropriate would be the approval of the course texts used in the junior and senior gateway courses by the Computer Science Undergraduate Curriculum Committee and an agreement on the skill level required to earn a C in the courses.

6.2 M.S. in Computer Science

The M.S. degree in Computer Science will be assessed using gateway courses, comprehensive exams, and the exit, alumni, and employer surveys listed above. The gateway courses identified for the M.S. in Computer Science are:

Admission to the Program

While not an actual course, admission to the program requires completion of all the gateway courses identified in the B.S. program or their equivalent. This requirement provides a gateway for **entering** students. Required coursework focuses on basic and advanced programming skills and theory. Outcomes addressed: 1.1, 1.2, 1.3, 1.4, 2.1, 2.2, 2.3, 2.4.

CS 6260 - Computational Complexity

This course provides a gateway at the **first-year** level. CS 6260 focuses on advanced computer science theory and analysis of algorithms. The course incorporates concepts from CS 4170 and CS 4245. Outcomes addressed: 2.1, 2.2, 2.6, 2.7.

CS 6909 - Departmental Thesis

This course provides a gateway at the **second-year** level. CS 6909 focuses on the development of a large project with limited guidance, and incorporates concepts from a variety of graduate-level courses. Students may optionally choose to take a comprehensive exam rather than undertake a thesis. The comprehensive exam acts a different type of gateway at this level (described below). Outcomes addressed: 1.1, 1.2, 1.3, 1.4, 1.5.

These gateway courses meet the policy 1 guideline in that all students must fulfill the entry and first-year requirements through coursework at CSUH or through similar programs at other universities. A large proportion of incoming graduate students take their prerequisite courses at CSUH and virtually all of them take CS 6260 at CSUH. This provides a consistent basis for evaluation. The second-year gateway is also applied to all students, although they have a choice as to how to fulfill the requirement (thesis or comprehensive exam).

These gateway courses must be further standardized in order to meet policy 2. The courses are already standardized based on the set of courses required for admission, the GPA required (3.0) when calculated on this set of courses, and the catalog description and master syllabus maintained for CS 6260. Additional factors in standardization that would be appropriate would be the approval of the course text for CS 6260 by the Computer Science Graduate Curriculum Committee, and an agreement on the level of achievement required in CS 6260 and CS 6909 in order to receive a passing grade.

The M.S. in Computer Science specifies a **comprehensive exam** as a second option for fulfilling the second-year gateway. This exam consists of three two-hour sections, each covering one area of computer science. These areas are Computer Architecture and Operating Systems, Compilers and Programming Languages, and Data Structures, Analysis of Algorithms and Computational Complexity. Outcomes addressed: 2.1, 2.2, 2.4, 2.5, 2.6, 2.7.

Comprehensive exams meet the policy 1 guideline in that all students graduating with an M.S. in Computer Science must take and pass the exam, except for those students who pursue the departmental thesis option.

Comprehensive exams meet the policy 2 guideline in that they are already standardized as to content and percentages earned needed to fulfill the requirement. This standardization is ensured by the graduate curriculum committee. The information is made available to the students through provision of exam syllabi, listing topics to be covered on each exam, and supplying copies of recent exams.

Table 3 shows the relation between assessment tools and the learning outcomes they are meant to evaluate for the Computer Science program.

6.3 B.S. in Mathematics

The B.S. in Mathematics will be assessed using gateway courses and the exit, alumni, and employer surveys listed above. The gateway courses identified for the B.S. in Mathematics are:

MATH 2304 - Calculus III

This course provides a gateway at the **sophomore** level. MATH 2304 focuses on basic and advanced integrals and derivatives, and sequences and series. The course incorporates concepts from MATH 1304 and 1305. Outcomes addressed: 1.1, 2.1.

MATH 3100 - Linear Algebra

This course provides a gateway at the **junior** level. MATH 3100 requires students to demonstrate mastery of proofs and the theory of linear algebra going beyond the level of Math 2101. The course incorporates concepts from MATH 2101, 2150, 2304, and 3000. Outcomes addressed: 1.2, 2.2.

At the **senior** level, the three options (Option A - Mathematics, Option B - Applied Mathematics, Option C - Mathematics Teaching) within the Math major diverge and require coursework that is largely option-dependent. As result, multiple gateway courses are necessary at this level.

MATH 3301 - Analysis II or MATH 3122 - Abstract Algebra II

These courses provide gateways at the **senior** level for students pursuing Options A or B. MATH 3301 focuses on the theory of differentiation and integration in real variables, convergence of sequences and series of functions, and the general introduction to function spaces. Math 3122 focuses on rings, ideals, quotient rings, and fields. Both courses incorporate concepts from MATH 2101, 2150, 2304, and 3000. MATH 3301 also builds upon material learned in MATH 3300. MATH 3122 also builds upon MATH 3121. Outcomes addressed by MATH 3301: 1.3, 2.4. Outcomes addressed by MATH 3122: 1.3, 2.3.

MATH 4901 - Senior Seminar

This course provides a gateway at the **senior** level for students pursuing Option C. The course focuses on advanced topics in mathematics and relationships between major areas. The course incorporates concepts from MATH 2101, 2150, 3100, and 3121. Outcomes addressed: 1.5, 2.5.

These gateway courses meet the policy 1 guideline in that all students must either take the courses at CSUH or receive transfer credit. Most of our transfer students take the sophomore gateway course at CSUH and virtually all of them take the junior level and senior level courses at CSUH. This provides a consistent basis for evaluation.

These gateway courses must be further standardized in order to meet policy 2. The courses are already standardized based on catalog descriptions and the master syllabi maintained for the courses. In addition, the text for the sophomore gateway course is chosen by the Mathematics Undergraduate Curriculum Committee. Additional factors in standardization that would be appropriate would be identification of the skill level required to pass the courses, and approval by the Curriculum Committee of course texts for the remaining gateway courses.

6.4 M.S. in Mathematics

The M.S. degree in Mathematics will be assessed using gateway courses, comprehensive exams, and the exit, alumni, and employer surveys listed above. The three options offered in the M.S. degree - Pure Mathematics (I), Mathematics Teaching (II), and Applied Mathematics (III) - differ significantly in their requirements, but appropriate gateways can be identified for each one individually. The gateway courses identified for the M.S. in Mathematics are:

Admission to the Program

While not an actual course, admission to the program requires completion of 36 quarter units of Mathematics courses including Analysis, Abstract Algebra, Linear Algebra, and Differential Equations, with an average GPA of "B" or higher (Options I and III) or completion of 24 quarter units of Mathematics and possession of valid teaching credentials (Option II). This requirement provides a gateway for **entering** students. Coursework required focuses on basic and advanced Mathematics skills and theory. Outcomes addressed: 1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4.

There is wide latitude given to students in selecting courses throughout the three options of the M.S. program. As such, it is not possible to identify courses that all students must take and which could serve as gateway courses at the **first-year** level. If this is found to be a failing of the program after analysis, discussion could be begun on the merits of implementing appropriate gateway courses for each option.

Second-year gateways are option-specific. Option II students must pass a gateway course while students pursuing Option I or III must pass a comprehensive exam (described below).

MATH 6899 - Project

This course provides a gateway at the **second-year** level for students selecting Option II only. Students selecting Options I or III fulfill a different gateway requirement by completing a comprehensive exam. MATH 6899 focuses on development of a large project with limited guidance and incorporates concepts from a variety of graduate-level courses. Outcomes addressed: 1.5, 2.5, 2.9, 3, 4, 5.

These gateway courses meet the policy 1 guideline in that all students must fulfill the entry requirements through coursework at CSUH or through similar programs at other universities. The second-year gateway is also applied to all students, although they have a choice as to how to fulfill the requirement (project or comprehensive exam).

These gateway courses must be further standardized in order to meet policy 2. The courses are already standardized based on the set of courses required for admission, and the GPA required (3.0) when calculated on this set of courses. Additional factors in standardization that might be appropriate would be an agreement on the level of achievement required in MATH 6899 in order to receive a passing grade or text approval by the governing curriculum committee.

The M.S. in Mathematics specifies a **comprehensive exam** as a second option for fulfilling the second-year gateway for students pursuing Options I or III only. There is a separate exam for each option covering four areas appropriate to the emphasis. The option I exam consists of problems covering Algebra, Complex Analysis, Real Analysis, and Topology. The option III exam consists of problems covering Applied Analysis & Differential Equations, Linear Programming, Numerical Analysis, and Probability. Outcomes addressed: 2.7, 2.8, 6, 7.

Comprehensive exams meet the policy 1 guideline in that all students graduating with an M.S. in Mathematics must take and pass them, except for the students who pursue the project option (Option II only).

Comprehensive exams meet the policy 2 guideline in that they are already standardized as to content and the percentages earned which are required to pass the requirement. This standardization is ensured by the graduate curriculum committee. The information is made available to the students through the provision of exam syllabi, listing topics to be covered on each exam, and supplying copies of recent exams.

Table 4 shows the relation between assessment tools for the Mathematics program and the learning outcomes they are meant to evaluate.

7. Implementation of Assessment Tools

Many of the assessment tools identified in section 6 are partially implemented or have been discussed by department committees. The following list gives current status and action items for completion of each assessment tool.

Tool 1: Gateway courses

Status: Appropriate courses have been identified for each degree program.

Action items:

1. Undergraduate and Graduate Curriculum Committees must consider issues of standardization of the gateway courses. This may include approval of texts and master syllabi, agreement on competencies to be met, and possible enforcement of prerequisite coursework.
2. Mechanisms for tracking pass rate must be identified.

Tool 2: Comprehensive exams

Status: Both graduate degree programs have comprehensive exam mechanisms in place.

Action items:

1. Mechanisms for tracking pass rate must be identified.

Tool 3: Exit survey

Status: A new exit survey was discussed and approved by the undergraduate curriculum committees of Mathematics and Computer Science. Students are provided with the exit survey when they apply for graduation.

Action items:

1. Methods to improve return rate of exit surveys must be identified.
2. An analysis procedure for returned surveys must be developed.

Tool 4: Alumni survey

Status: An alumni survey has been discussed by the undergraduate curriculum committees, but an approved form has not been produced.

Action items:

1. The curriculum committees of Mathematics and Computer Science must create and approve an alumni survey.
2. A resource for alumni address information must be identified to ensure the highest rate of distribution.
3. An analysis procedure for returned surveys must be developed.

Tool 5: Employer survey

Status: An employer survey has been discussed by the undergraduate curriculum committees but an approved form has not been produced.

Action items:

1. The curriculum committees of Mathematics and Computer Science must create and approve an employer survey.
2. A resource for employer address information must be identified to ensure the highest rate of distribution.

3. An analysis procedure for returned surveys must be developed.

8. Assess achievement of objectives and learning outcomes

Evaluation of assessment tools and achievement of objectives and learning outcomes will be done after data has been gathered in academic year 2001-2002.

9. Identify problems and develop goals and strategies for improving delivery of learning outcomes

Identification of potential problems in the assessment process and refinement of the process will be done after data has been evaluated in academic year 2001-2002.

10. Specify resource needs

Resources are necessary for further development and implementation of the proposed Assessment Plan. In this section, the projected resource needs for each of the deliverables described in sections 3-9 above are given.

In addition to various faculty release time and staff considerations, a plan executor referred to as the assessment coordinator is needed. This person would ideally be an outcomes-based education specialist whose specific duties are detailed throughout this section. The assessment coordinator could be shared amongst multiple departments, but we estimate that the Mathematics and Computer Science department, with its large student body, would account for a large time commitment.

Given the newness of the proposed task of specifying and implementing an Assessment plan, the resource figures presented here are estimates, and guidance from the dean's office is sought.

10.1 Assessment Coordinator

An outcomes-based education specialist who would lead the department in planning and implementation, and who would set up the infrastructure for plan modification, implementation and tracking.

This requires organizational, communication, and analytic skills, and would require continued training and networking in the evolving field of assessment.

10.2 Resources for Sections 3, 4, 5 (Student Learning Outcomes, Identification of Delivery Mechanisms for Learning Outcomes, Performance Indicators)

The Department foresees modifications to student learning outcomes, changes in delivery mechanisms, and revisions to performance indicators. It expects this may require release time for faculty member(s) in addition to work by the respective Graduate and Undergraduate Committees

10.3 Resources for Section 6 - Assessment Tools

The development of the assessment tools will be a large task. Of the five assessment tools described in section 6, only tool 2 is completely implemented for our department. Tools 3-5 need to be developed. While we are teaching courses that can be used as gateway courses (tool 1), the standardization of

these courses as described in section 6 requires further work. The assessment coordinator should develop tools 3-5 with consultation from and approval by the faculty. The gateway courses would need to be worked on by both faculty representatives and instructors of the gateway courses, and approved of by the entire faculty. This level of work would require release time for faculty representatives from both Math and Computer Science.

The creation of these tools is not a one-time event, and regular modifications of the tools would need to be performed. Hence, an election of faculty representatives given this task in exchange for release time is required on a yearly basis.

10.4 Resources for Section 7 - Implementation of Assessment Tools

The mechanism developed to track the results of assessment tools will most probably involve the collection and tracking of large amounts of data. We strongly suggest that databases be developed for each of the assessment tools. We propose that the assessment coordinator be in charge of collecting such data. The assessment coordinator will need staff to support this effort whose job would include database administration and data collection. Currently, no database administrator exists for our department and this position would need to be created. Clerical staff will also be required in administering the surveys and exams.

10.5 Resources for Section 8 - Assess achievement of objectives and learning outcomes

We propose that the assessment coordinator and staff first assemble reports on the results of administering our assessment tools using the databases formulated (see section 10.6). The coordinator should present the results to the faculty for discussion and evaluation, and assemble the faculty input into a resulting evaluation report.

10.6 Resources for Section 9 - Identify problems and develop goals and strategies for improving delivery of learning outcomes

The evaluation report discussed in section 10.7 should be discussed by a faculty representative taskforce for the development of future goals and strategies for improving this assessment plan. Part of this work will be the estimation of the resources necessary. Faculty representatives should be granted release time for these tasks, and also be assisted by the assessment coordinator and staff.

Mechanisms/Outcomes	Current language/Current platform	Integrate data structures	Use structured programming	Advanced complexity	Complexity with limited guidance	Math/Stat	Analysis of algorithms	Software engineering	Computer architecture	Programming languages	Analyze sophisticated algorithms	Command of material	Work in team	Ethics	Communicate effectively	Find employment	Prepared for advanced degrees
Undergraduate Coursework																	
1. GE requirements																	
a. English 1A															X		
b. Writing Skills Test															X		
2. Major requirements																	
a. Math and Statistics						X	X										
b. CS 1160	X		X							X							
c. CS 2360	X		X					X		X						X	
d. CS 2430									X	X							
e. CS 3120										X							X
f. CS 3240	X	X	X		X		X									X	X
g. CS 3430									X								
h. CS 4560			X	X	X		X		X							X	X
Graduate Coursework																	
1. Admission requirements	X	X	X		X	X	X		X								
2. Degree requirements																	
a. CS 6000											X			X	X		X
b. CS 6260				X	X		X			X	X						
c. CS 6560			X						X		X						
d. Theory breadth				X			X			X	X						X
e. Architecture breadth									X		X						X
f. Systems breadth	X							X			X					X	X
3. Capstone Experience																	
a. CS 6909 Thesis	X				X										X	X	X
b. Comprehensive exams				X			X		X	X	X	X					X
4. Department colloquia												X					X
5. Student clubs													X	X	X	X	
6. Internship programs	X												X		X	X	

Table 1: Delivery mechanisms for Computer Science program.

Mechanisms/Outcomes	Apply calculus	Manipulate series and sequences	Matrices and determinants	Homomorphisms and factorizations	Combine ideas	Uniform convergence/multiple variables	Apply group theory	Partial derivatives	Vector spaces and transformations	Ideals and rings	Ties between courses	Differentiation of multiple variables	Classification of groups	Command of Applied Math	Command of Theoretical Math	Role of Teacher	Work in team	Ethics	Communicate effectively	Find employment	Prepared for advanced degrees
Undergraduate Coursework																					
1. GE requirements																					
a. English 1A																			X		
b. Writing Skills Test																			X		
2. Major requirements																					
a. Math 1304	X	X																			
b. Math 1305	X	X																			
c. Math 2304	X	X					X														
d. CS 1160					X						X									X	
e. Math 2101			X																		
f. Math 2150														X							
a. Math 3100			X					X													
Option A and B																					
a. Math 3301						X						X									
b. Math 3122				X						X											
Option C																					
a. Math 4901					X						X					X	X	X	X	X	
Graduate Coursework																					
1. Admission requirements	X	X	X	X		X		X	X	X		X									
2. Capstone Experience																					
Option I and III																					
a. Comprehensive exams					X	X	X	X	X	X	X	X	X	X	X						X
Option II																					
a. Math 6899 Project					X						X					X	X	X	X	X	X
3. Department colloquia											X			X	X						X
4. Student clubs																	X	X	X	X	
5. Internship programs																	X	X	X	X	X

Table 2: Delivery mechanisms for Mathematics program.

Tools/Outcomes	Current language/Current platform	Integrate data structures	Use structured programming	Advanced complexity	Complexity with limited guidance	Math/Stat	Analysis of algorithms	Software engineering	Computer architecture	Programming languages	Analyze sophisticated algorithms	Command of material	Work in team	Ethics	Communicate effectively	Find employment	Prepared for advanced degrees
Gateway courses	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Comprehensive exams				X			X		X	X	X	X					X
Exit survey																X	X
Alumni survey																X	X
Employer survey													X		X	X	X

Table 3: Assessment tools for Computer Science program.

Tools/Outcomes	Apply calculus	Manipulate series and sequences	Matrices and determinants	Homomorphisms and factorizations	Combine ideas	Uniform convergence/multiple variable	Apply group theory	Partial derivatives	Vector spaces and transformations	Ideals and rings	Ties between courses	Differentiation of multiple variables	Classification of groups	Command of Applied Math	Command of Theoretical Math	Role of Teacher	Work in team	Ethics	Communicate effectively	Find employment	Prepared for advanced degrees
	Gateway courses	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
	Comprehensive exams						X						X	X	X						X
	Exit survey																			X	X
	Alumni survey																			X	X
	Employer survey																X		X	X	X

Table 4: Assessment tools for Mathematics program.