Request to move the

Bachelor of Arts in
Information and Computer Sciences,
University of Hawaiʻi at Mānoa,

From Provisional to Established Status

Summer 2012
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This self-study report is organized according to the “Guidelines for Assessment of Provisional and Established Programs” E5.201.

Introduction

The importance of Computer Science
About one-third of the economic growth in the U.S. in the last decade has been in information and computing technology. While the Internet and the Web are perhaps the most visible aspects of this change, the revolution is pervasive, touching nearly every field and discipline, from computational techniques in the physical and biological sciences, to new interactive media in the fine arts. The impact of the digital and information revolution upon society is profound. The evolution of computing and information technology will continue to be a driving force behind the creation of new industries, careers, and academic disciplines. As a result, there is a genuine and increasing need for workers with an interdisciplinary background who understand the social and organizational uses of technology and who are literate and articulate. These workers require knowledge of computing systems, global communications networks, and interactive information resources. The requisite proficiencies go beyond being comfortable with computing tools. They require the ability to apply computational ways of thinking to design, to writing, to experimentation, to artistic expression, and to problem solving.

The mission of the Department of Information and Computer Sciences (ICS) is to: (1) develop leading edge research that fuels economic and entrepreneurial advances, prepares information and technologically literate citizens, and drives technological improvements in curriculum and teaching and (2) provide professional education for students specializing in computer science and basic computer science education for all interested students.

A brief history of the Department of Information and Computer Sciences
The formative roots of the Department of Information and Computer Sciences (ICS) extend back to the late 1960's. At that time, UH began a project to provide radio-linked satellite computers to the existing University time-shared computing system. The purpose of this project, then known as the ALOHA system, was to make the full information processing capabilities of the central computing facility on the Mānoa campus available to all operating units of UH on Oahu and the neighbor Islands. Norman Abramson, the principal designer of the ALOHA.net, whose principles formed the design philosophy of the Ethernet, became the first chair of a new interdisciplinary program that awarded a Master of Science (M.S.) degree in Information and Computer Sciences (the science of processing information by natural or artificial systems). This M.S. program was designed both for students interested in careers in information sciences and those who expected to use information sciences in another profession. Other professors in the initial Information Sciences program included W. Wesley Peterson (a winner of the Japan Prize for his work on error correcting codes), David Pager, (the inventor of an early parser for computer languages), Wilbert Gersch, and Art Lew.

During the early 1970's the Information Sciences program became the Department of Information and Computer Sciences. In the mid 1970's, Professor Peterson, the ICS chair from 1973 until 1984, initiated an interdisciplinary program leading to B.S. degree
in Computer Science. This program was designed to give students an understanding of computers, their operation, programming, and applications, and to provide the knowledge and skill needed for a career in the computer field. Special fields of emphasis for the B.S. degree are computer systems, data analysis, data processing systems, and scientific computation.

In 1986, the ICS Department joined with three other programs, the Department (now School) of Communications in the College of Social Sciences, the Department of Decision Sciences (now Information Technology Management) in the College of Business, and School of Library and Information Studies (now the Library and Information Science program) to provide an interdisciplinary Ph.D. degree in "Communication and Information Sciences" (CIS). In 1994, CIS became organizationally housed in the College of Natural Sciences. In 1995, the ICS Department moved from Keller Hall to the newly constructed Pacific Ocean Sciences and Technology (POST) building. In 1998, the B.A. in ICS and the Ph.D. in Computer Science were established.

In 1997, the School of Library and Information Studies (SLIS) merged with the ICS Department and changed its name to the Library and Information Science (LIS) Program. The LIS Program offered courses through the UH Mānoa Outreach College as early as 1957. In 1965, the Graduate School of Library Studies (GSL) was formed. In 1987, the school recognized the rapidly changing world of libraries and information technologies and the role of information in society, by simultaneously changing its name to the School of Library and Information Studies and offering the Master's in Library and Information Studies degree, now the Master of Library and Information Science (MLISc) degree.

Responding to the dot-com boom, the ICS Department grew substantially from 2000. The six degree programs\(^1\) associated with ICS in 2003 accounted for a total of 888 majors, making it larger than the entire College of Engineering and the largest Department in the University of Hawaii system. This explosive growth motivated a special legislative allocation specifically to ICS of $1M (which the UH administration made part of the ICS budget) in order to support its mission and students. These additional resources were used to establish strong research and educational programs in areas including networking, human computer interaction, software engineering, high performance computing, bioinformatics, and information assurance. The end of the dot-com boom has meant that enrollment is down from that peak. However the department still teaches a large number of students, and continues its role as a premier educational and research program in Information and Computer Science. The total enrollment in all six ICS-related degree programs was 477 in Fall 2011.

Degree programs
The Department of Information and Computer Sciences is part of the College of Natural Sciences at the University of Hawaii at Mānoa. The Information and Computer Sciences (ICS) Department is solely responsible for six academic degrees:

- Bachelor of Arts in Information and Computer Sciences (approved as provisional in 1998)
- Bachelor of Science in Computer Science (approved in 1974)

\(^1\) B.S., M.S. and Ph.D. degrees in CS; B.A. in ICS, MLISc and Ph.D. in CIS.
Master of Science in Information and Computer Sciences (approved in 1965)
Master of Science in Computer Science (approved 1974)
Professional Master Degree Program in Library and Information Science (approved 1969)
Ph.D. in Computer Science (approved as provisional in 1997)

The ICS Department participates in two other joint degree programs with other departments on campus:
Bachelor of Science in Computer Engineering (approved as provisional in 2009)
Ph.D. in Communication and Information Sciences, Interdisciplinary (approved in 1986)

Figure 1 shows the enrollment numbers and graduation rates associated with each of these eight programs over the past five years, as reported from STAR. The ICS department enjoys a strong and significant enrollment of over 470 declared majors in each of the past five years. (From 49 to 85 of these were in the BA program.) Out of this pool of declared majors, we have graduated between 65 and 127 students per year. Dividing these two numbers provides a rough sense of the "throughput" of our department, which varies between 14% and 21%.

In addition to these eight majors, we also provide a minor in Computer Science for students who would like to develop a solid foundation in Computer Science in conjunction with their major degree program. Collaborations such as the minor in Computer Science and the two joint degree programs are vital for the department’s mission, for service to the students, as well as for campus collaboration and support. For example, the Bachelor of Science in Computer Engineering (BSCE) was approved by the Board of Regents as a provisional program in November 2009. ICS provides the Discrete Math curriculum and up to 6 credits of technical electives towards the attainment of this degree.

<table>
<thead>
<tr>
<th>Major</th>
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<td>495</td>
<td>473</td>
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Number of Graduates from ICS Degree Programs

|-------|-------|-----------|-----------|-----------|-----------|-----------|-----------|

5
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<th>Outcome</th>
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<tr>
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<tr>
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<td>4</td>
<td>3</td>
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<td>2</td>
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</tr>
<tr>
<td>TOTAL</td>
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<td></td>
<td></td>
<td>21%</td>
<td>18%</td>
<td>19%</td>
<td>14%</td>
<td>19%</td>
</tr>
</tbody>
</table>

Figure 1: Enrollment and graduation rates for all ICS degree programs

The ICS department also offers hundreds of seats each year in ICS 141-241 (Discrete Mathematics for Computer Sciences) to students looking to fulfill one of their General Education Foundations requirements (FS). These course offerings are large and serve a diverse campus population. Hundreds of students from outside the department take ICS courses to learn about computers. Examples (with 2011-2012 total enrollment) include: ICS 101 (626) and 110 (16). The department has also created Honors sections for select students in various disciplines. This illustrates the importance of the service courses offered by ICS to other departments.

Appendix A provides a listing of ICS undergraduate courses relevant to the B.A. degree program.

ICS Program Review

The ICS program was reviewed in 2008 as part of the periodic review of the entire College of Natural Sciences. The report of the external reviewer (Appendix K) summarizes the status of the department, noting particularly the space shortage in the POST building and the decline in BS and MS enrollment following the collapse of the dot-com bubble. Expansion into bioinformatics was noted as a possible route to increased enrollments.

Assessment of program organization and objectives

In response to E5.201 question 1: Is the program organized to meet its objectives? (Discussion of curriculum, requirements, admissions, advising and counseling, and other aspects of the program, with reference to the objectives.)

The Bachelor of Arts degree program allows ICS students to combine computer science with other disciplines, giving them the opportunity to explore the ways computers, networks and mobile devices affect society. Our B.A. students can contribute to collaborative interdisciplinary teams and have the program flexibility to apply this knowledge to areas beyond traditional computer science programs.

The curriculum for a B.A. in ICS was developed by the ICS faculty in response to numerous student and industry requests for a flexible undergraduate major that would allow students to develop expertise in both computer science and other subject areas.
We defined a program that blends the requirements of a strong computer science core with the flexibility of a liberal arts education. Students earning the B.A. degree in ICS will be particularly attractive to technical organizations that desire people with strong written and oral communication skills.

Upon completion of the B.A. program, student will be able to:

- Use current technical concepts and practices in software development, computer networking, databases, and web related technologies,
- Manage all aspects of solving computer-based problems involving requirements analysis, design, implementation, and project management,
- Participate in collaborative team oriented activities,
- Communicate effectively using modern technologies, using oral, written, and web media.

The B.A. in ICS degree is unique in its ability to allow students to combine Computer Science with another discipline. Many of the B.A. courses are also taken by students pursuing the B.S. in ICS, however the B.A. allows for more electives and customization. It is the careful selection of electives that allows students to customize their degree and their future job opportunities in such diverse areas as business information systems, educational development environments, and multimedia entertainment systems. An academic plan handout is available for students as an advising tool.

**Curriculum and individualized course plans**

Students must complete the Bachelor of Arts General Education Core, which requires, in addition to the Mānoa general education requirements, a certificate, a minor, or at least one course from each of the four Arts and Sciences departments. For the major requirements, B.A. students must complete:

- **Required courses:** ICS 111/L, 141, 211, 212, 241, 311, 312, 313, 321
- **Junior/senior electives:** three ICS (or approved) 400-level courses, including at most three credits of ICS 499 and three credits of ICS 491.
- **Area concentration electives:** four upper division (300-level or above) courses in some area of concentration (e.g., art, business, music, education).

Appendix B presents a sample schedule showing how students can progress through our B.A. curriculum and graduate in eight semesters. The current version of this sample schedule is made available to students on the department web site, the Arts and Sciences advising web site and the VCAA's web site.

Students seeking a B.A. must write a proposal, of one page or less, specifying the seven courses they will use for their ICS and area concentration electives. This course proposal must be approved by an ICS undergraduate advisor. The proposal must explain how these courses form a coherent plan of study combining computer science with another field. Some examples of recent proposals include:


Since 2002, we have increased the number of advanced undergraduate level offerings focused on the B.A. options. Of course, these emerging topics are also of great interest for students pursuing the B.S. degree.

**B.A focus areas: Bioinformatics & Information Assurance/Computer Security**

In addition to allowing students to build their own degree paths, we define two explicit B.A. degree focus areas: the Bioinformatics focus area and the Information Assurance and Computer Security focus area.

**Focus area: Bioinformatics**

Bioinformatics is the application of computer science to the fields of biology and medicine. It deals with many areas in computer science including algorithms, databases and information systems, web technologies, artificial intelligence, information and computation theory, structural biology, software engineering, data mining, image processing, modeling and simulation, signal processing, discrete mathematics, control and system theory, circuit theory, and statistics. Bioinformatics generates new knowledge as well as the computational tools to create that knowledge. Students that have background in a bioinformatics are in demand by academia, industry and the government. The combination of biology and computer science can provide insight into natural design. This insight provides a platform for development of novel engineering solutions, and furthers fundamental knowledge of biological form and function.

Students seeking the B.A. in ICS with a Bioinformatics focus must also earn an appropriate Bioscience degree or a minor in Biology. The requirements include the following:

**B.A. in ICS**

- ICS 111, 141, 211, 212, 241, 311, 312, 313 and 321
- 3 courses (300-level or above) from the minor will double count (BIOL 375, BIOL 4xx, and the course in botany. Biochemistry microbiology, physiology and zoology).
- 4 ICS courses (300-level or above)
- Bioinformatics focus area (3 courses)

**Minor in Biology**

- BIOL 172 (Introduction to biology II)
- BIOL 265 (Ecology and evolutionary biology)
BIOL 275 (Cell and molecular biology)
BIOL 375 (Concepts of genetics)

Minimum of 3 credits in: BIOL 401 (molecular biotechnology), 402 (Principles of biochemistry), 405 (Biochemistry), 406/406L (Cellular biology), 407/407L (Molecular biology), 409 (Biology seminar), 441 (Basic biochemistry) or 499 (Biological problem).

BIOL 171 (Introductory biology), CHEM 161 (General chemistry I), 162 (General chemistry II), 272, (Organic chemistry I), and 273 (Organic chemistry II) if you take BIOL 402, 405, 406, 407 or 441.

Minimum of 3 credits: approved upper level botany, biochemistry, microbiology, physiology and/or zoology.

Focus area: Information Assurance and Computer Security

In response to emerging industry needs and student demand, we provide a focus area in Information Assurance and Computer Security.

Students that complete the series of Information Assurance (IA) courses offered by the ICS department under the umbrella of the Center for Information Assurance and Cybersecurity (CIAC) center at the University of Washington will have knowledge of computer security and information assurance issues and mechanisms, technical expertise to design and build secure information systems, and a global societal and ethical context within which to apply their technical expertise.

This curriculum was built through a team approach in June 2006 with the faculty of the ICS department and the CIAC. The Director of the CIAC teaches a series of information assurance classes for the ICS department including: ICS 425 (Computer Security and Ethics), ICS 426 (Computer System Security) and ICS 491 (Special Topics in Secure Development). Students who successfully complete this series earn a certificate from CIAC, a National Security Agency/Department of Homeland Security Center of Academic Excellence in Information Assurance Education and Research. To date, we have graduated over 75 students who have earned this credential.

One outgrowth of the Information Assurance and Computer Security focus area is a student group called the "ICS Greyhats" that competes in regional and national collegiate cyberdefense competitions. In its first year, the Greyhats placed first in a virtual regional competition that included the University of Alaska Fairbanks and several colleges on the islands. In its second year, the ICS students placed second, losing to students from the Air Force Academy. Membership in the Greyhats is open to all ICS undergraduate students, though those in this focus area take a leadership role.

Part of the Greyhats mission is to reach out to local high schools that want to participate in similar exercises. The Greyhats have been enthusiastically embraced by our students, and the group also exposes local high school students to some of the opportunities available through the ICS department.

While the fraction of students in each focus area for the B.A. varies from year to year, an approximate current breakdown is 56% in the general B.A. program, 41% in the Information Assurance focus area (10% of these students participated in the ICS Greyhats) and the remaining 3% in the Bioinformatics focus area which, in addition to ICS BA students, attracts students from other programs such as biology. Although this number is small, we want to develop bioinformatics to foster cooperation between our department and the many biology-related research projects in the university and
elsewhere in the state and to provide the opportunity for our students to enter this exciting new field.

Distance learning
In 1998, the ICS Department received WASC approval for distance delivery of its bachelor and master programs and we remain committed to expanding access to the University through distance learning. We have focused on Asynchronous Learning Network (ALN) media for learning. ALN classes have no class meetings. Students learn the material “anytime, anywhere” by reading books, handouts, or Web pages and interacting with other students and the instructor via electronic media. Employing ALN enables us to provide educational offerings for the non-traditional student, the working professional and populations such as the military and neighbor island residents who cannot attend campus-based classes.

In 1999, while collaborating with the UH Mānoa Outreach College, we secured a $405,000 grant from the Alfred P. Sloan Foundation to support this program. As a result of this initiative, ICS agreed to offer at least 2 ALN graduate courses each semester. The Outreach College has also marketed our online B.A. classes to students looking for non-traditional methods for completing their computer science degrees. The department offers expanded ALN and hybrid courses each fall, spring and summer semester. ICS distance education offerings are completely integrated into our curriculum as a primary goal of our ALN program is to provide additional access to our courses. Since ICS began offering online classes, we have steadily increased the number of students enrolling in ALN courses each academic year. Since 2004, we have offered an average of 4 classes per semester to an average of 28 students. Appendix E provides a breakdown of distance education classes and enrollments. Distance education is viewed primarily as a second way of presenting our courses. Students do not usually graduate from the distance education program.

Distance education and system articulation
The ICS faculty work closely with their colleagues at the other system campuses to ensure articulation provides a clear path for students. In 2005 (and again in 2010) all campuses of the University of Hawaii system that offer ICS courses agreed to an ICS System Articulation Agreement which remains in place. Given the access to distance education opportunities, it is even more important that articulation be clearly aligned and communicated to students. Many of our colleagues teaching ICS in the system are products of the ICS graduate programs and we routinely include them in discussions concerning curriculum issues. Approximately 40% of students entering the ICS program (and about 60% of those entering the BA program) are transfers from other UH campuses.

Undergraduate mentoring and advising
Since 1998, the ICS department has employed an Educational Specialist to assist in all areas of student services, including recruitment, retention, placement, and outreach services. This position allows consolidation of the Department’s record keeping system for all undergraduate students and helps to manage basic intake services. As a result, the role of faculty advising in our department has moved from bookkeeping activities to mentoring and project supervision activities. The Educational Specialist holds a master’s degree from ICS and is well qualified to mentor ICS students. Because of previous experience advising UH-Mānoa students, the specialist’s advice is useful for
ICS students who are seeking a B.A. degree. Students interested in ICS are first referred to the Educational Specialist who provides consistent advising and serves as the department's contact with the Arts and Sciences Advising office. Students are immediately counseled on the differences between the B.A. degree in Information and Computer Sciences and the B.S. degree in Computer Science in order to plan a degree program that meets their career goals. Through these meetings we find that some students need additional advising and are counseled appropriately.

The department began a program of mandatory student advising in 2009 for students who were: 1) entering UH Mānoa for the first time; 2) transferring into the program from another college or university, or 3) changing their major to a bachelor's degree to either the B.S. in Computer Science or the B.A. in Information and Computer Science. Advising is implemented through individual appointments and several hundred individual advising sessions have been conducted since January 1, 2009 to the present. We plan to continue conducting individual advising appointments and also conduct group sessions with individual follow-up advising.

Assessment of student learning objectives

In response to E5.201 question 2: Is the Program meeting its learning objectives for students? (An assessment of the quality of student learning as indicated by systematic analysis of student performance with reference to standard expectations, surveys of student satisfaction with instructional aspects of the program, etc.)

Curriculum design and learning objectives

The curriculum of the ICS department is influenced by a variety of sources, including the Association of Computing Machinery (ACM) and by the Accreditation Board for Engineering and Technology (ABET).

As one of the oldest professional organizations for computer science, ACM has prepared recommendations\(^2\) for computer science curriculum since the 1960's. Our Department is also guided by ABET curriculum and standards for applied science, computing, engineering, and technology.

In particular, we use ABET objectives as a basis for the development of the ICS curriculum and course syllabi. These 9 objectives include:

1. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
2. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
3. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
4. An ability to function effectively on teams to accomplish a common goal.
5. An ability to use current techniques, skills, and tools necessary for computing practice.

\(^2\) [http://www.acm.org/education/curricula-recommendations](http://www.acm.org/education/curricula-recommendations)
6. An understanding of professional, ethical, legal, security and social issues and responsibilities

7. An ability to communicate effectively with a range of audiences.

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

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

The ICS Department put the student learning objectives for the Bachelor of Arts program into a form that is accessible to the public on the Department's website and is available in printed form at the ICS office. The ICS curriculum for Bachelor of Arts program maps course topics to the student learning objectives. These topics include:

Programming
- Writing programs
- Program structure and organization
- Algorithm correctness
- Language syntax
- Automata theory

Data Structures
- Data storage
- Timing and capacity
- Programming for files
- Hash and index files
- Relational database systems

Machine-level and Systems Programming
- Machine organization
- Addressing modes
- Machine instructions
- Assembler language
- Subroutine linkages
- Higher level language linking
- Basic loader, assembler and compiler theory

Mathematics
- Logic
- Sets, functions and matrices
- Mathematical reasoning
- Counting
- Probability theory
- Program correctness
- Recurrence relationships
- Boolean algebra
- Automata theory

These topics cover the basic technical concepts in information and computer sciences. In addition to course lectures, individual and group assignments are given that develop the student's abilities to solve computer-based problems and to participate in group/team activities. Students are required to present their finding in both written and
oral forms. Appendix J provides a curriculum map showing how these student learning objectives relate to our courses.

The department uses several methods to collect data on student progress and achieving their learning outcomes. Data collection is accomplished by: (1) Written examinations that assess the student's understanding of the theoretical concepts in computers and information sciences. Through tests students are able to demonstrate the skills and knowledge acquired in each course. (2) Class assignments allow students to apply computer concepts and theories to solve specific computer-based problems. (3) Students are involved in group projects where their ability to work collaboratively can be assessed. These projects allow students to develop their managerial skills in designing and implementing software systems. (4) Course presentations are an important part of the curriculum. Students are assessed for their ability to present and explain topics in the information and computer sciences fields. In presenting information, they can use a number of methods that include but not limited to the use of software to present electronic presentations, use of the web, as well as communicate in writing and in person. (5) The department has developed an exit survey and has started to administer it to students when they have their Goldenrod form signed by the ICS educational specialist.

Student performance data collected throughout the semester contributes in an important way to our ongoing assessment of the success of the ICS program. We continuously evaluate our effectiveness at conveying the ideas important to specialists in information and computer science. Specific concepts in programming, data structures, machine organization and mathematics have been discussed and have resulted in changes to course syllabi.

Results of these discussions are also used in advising and counseling ICS students to convey an understanding of the knowledge and skills they are expected to master in the program's courses. From student assessments and achievements in learning the concepts and theories presented in the program, in applying these concepts in their assignments and in communicating them in a coherent fashion, we conclude that the requirements for the Bachelor of Arts in Information and Computer Sciences are being met.

Appendix H presents new assessment procedures we introduced to directly assess the ability of our students to achieve the objectives of studio based learning (SBL) courses (ICS 101, 110, 111, 141, 211, 212, 241, 314, 390, 425, 426, 464, and 491). The results of these assessments of SBL courses as well as conventional assessments of traditional courses are reflected in the assessment reports in Appendix I and have been used to improve these courses as indicated therein.

Appendix J is a curriculum map that shows how the B.A. curriculum requires students to gain proficiency in each of the required concepts in order to obtain their degree.

Infrastructure and learning objectives

ICS students must have access to modern computing infrastructure in order to gain the hands-on learning needed to obtain the learning objectives described above. Infrastructure such as lab space, hardware and software tools all play a role in delivering our academic curriculum. The ICS department has a governing structure that enables curriculum and infrastructure to be planned and developed in a coordinated way. The ICS department's curriculum committee considers all academic related recommendations for modification or addition of new curricula. The ICS Department's
infrastructure committee recommends equipment expenditures based in part on assessment results. Throughout the year, these two committees meet monthly to examine the relationship between the assessment plan, the program objectives, and infrastructure requirements. These results are communicated to the department faculty each month, and each semester the department holds a planning retreat to discuss overall recommendations.

Social media and student assessment

Since 2008, we have been making use of social media to obtain feedback from our students about our program. The social networking site TechHui\(^3\) is designed to support the high technology community in Hawaii. We have created a forum there for ICS students, and as part of the software engineering curriculum, we ask that they join TechHui and use two specially created discussion lists to provide their personal perspective on both positive\(^4\) and negative\(^5\) aspects of the ICS program. Over 600 responses have been recorded so far, providing an informative perspective on what our department does well and the challenges we face.

While students have provided a wide variety of responses, some general themes have emerged. On the positive side, many students state that ICS provides:

- Modern software technology in its labs, and through programs such as MSDNAA, software at low cost to students for their educational use;
- High quality faculty and advisors who are committed to student education;
- Opportunities for students to engage in industry related projects, networking, and mentorship.

On the negative side, recurrent complaints include:

- The rigor of and time required to complete ICS project work;
- The high cost of text books;
- An insufficient number of "focus" courses (i.e. Ethics, Oral, and Writing Intensive focus areas)

To the extent possible, we have addressed these complaints. For example, we now use more on-line materials, and next semester we plan to offer the 120 students enrolled in ICS141 (discrete math) the opportunity to use electronic textbooks. In addition, we have increased the number of focus courses taught by the department every year. Recent focus course offerings have included: Fall 2011, ICS 314 (W), ICS 390 (EOW); Spring 2012, ICS 390 (EOW), ICS 419 (EW), ICS 466 (OW)

Assessment of program resources

In response to E5.201 question 3: Are program resources adequate (Analysis of number and distribution faculty, faculty areas of expertise, budget and sources of funds, and facilities and equipment)

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\(^3\) http://www.techhui.com

\(^4\) http://www.techhui.com/group/uhicsstudents/forum/topics/1702911:Topic:20091

\(^5\) http://www.techhui.com/group/uhicsstudents/forum/topics/1702911:Topic:20093
Due to the overlapping nature of our B.A. and B.S. curriculum, and the fact that students can move between the B.A. and B.S. degree programs at unpredictable times, it is difficult to provide a precise accounting for the department resources dedicated only to the B.A. degree program. Instead, this section provides an overview of the total resources available in the ICS Department, followed by estimates of the proportion of resources allocated to the B.A. program.

Faculty resources

The ICS faculty is a diverse and well qualified group. As indicated by responses in the TechHui forum discussed in the previous section, students recognize and value the strength and the quality of faculty in the department. A brief listing of our faculty and their areas of expertise follows.

Professors

M. Crosby, Ph.D. (Chair)—human-computer interaction, augmented cognition, CS education
D. Chin, Ph.D.—artificial intelligence, natural language processing, user modeling
P. Johnson, Ph.D. (Associate Chair)—renewable energy, software engineering
D. Suthers, Ph.D.—human-computer interaction, computer-supported collaborative learning, technology for education, socio-technical networks and online communities

Associate Professors

E. Biagioni, Ph.D.—networks, systems, languages
K. Binsted, Ph.D.—artificial intelligence, cognitive science, natural language processing
H. Casanova, Ph.D.—high performance computing, distributed systems
G. Poisson, Ph.D.—bioinformatics, computational biology
L. Quiroga, Ph.D. (ICS/LIS)—information retrieval, databases, library systems, website design
N. Reed, Ph.D.—artificial intelligence, autonomous agents
S. Robertson, Ph.D.—human-computer interaction, digital government and digital democracy
J. Stelovsky, Dr.Tech.Sc.—computer-hypermedia, human-computer interaction
S. Still, Ph.D.—statistical mechanics, information theory, machine learning, theoretical biology
K. Sugihara, Dr.Eng—algorithms, distributed computing, visual languages

Assistant Professors

K. Baek, Ph.D.—computer vision, machine learning, bioinformatics
R. Gazan, Ph.D. (ICS/LIS)—social aspects of information technology
C. Ikehara, Ph.D.—biometrics and physiological sensors, adaptive human-computer interfaces
L. Lim, Ph.D.—database systems
J. Patriarche, Ph.D.—applications of computers to medicine

Assistant Specialists
G. Lau—student advising, professional software engineering, computer security
M. Ogawa, Ph.D.—multimedia course design, information science, on-line education

Emeritus Professors
S. Itoya, Ph.D.—database systems, expert systems, logic programming
D. Pager, Ph.D.—compiler theory, theory of computability, artificial intelligence

Two of the faculty above, Dr. Gazan and Dr. Quiroga, hold dual appointments and are assigned half load to ICS and LIS.

The Assistant Specialists hold substantial non-instructional duties. These duties include academic support by coordinating and assisting the Department Chair and Graduate Program Chairs in major initiatives such as distance education, student services, recruitment, financial aid, and placement services. The specialists also coordinate outreach programs and act as liaisons with other campus-wide committees, alumni groups and the community. One specialist manages the many sections of ICS 101 with the help of a large number of student assistants.

The average instructional workload for each faculty member is two courses per semester. Using the Teaching Equivalent Workload Spreadsheet adopted by the College of Natural Sciences, we estimate that our faculty averages 8.82 semester credit hours for coursework (including directed reading courses, thesis advising and guest lecturing) and another 2.10 semester credit hours for additional teaching, for a total of 10.92 semester credit hours. On February 18, 2011 a comprehensive ICS Department Workload Documentation Procedure was approved by faculty.

In addition to teaching, faculty members are expected to participate with industry, agency and community groups. ICS has established relationships with a variety of local and national companies including: Alion Science, B.A.E, Booz Allen Hamilton, Camber, Central Intelligence Agency, DataHouse, Decision Research Corporation, FBI, High Technology Development Corporation, Hoana, Isayko, Infragistics, Orincon/Lockheed Martin, National Security Agency, Progeny Systems, Referentia, SAIC, TREK, and Oceanit. In addition, we are working with Information and Technology Services to establish internships within the UH Mānoa environment.

Research and teaching laboratory resources

In today’s rapidly changing technology environment, ICS must constantly maintain and update its networking and data environment in order to provide up-to-date equipment for students and faculty. The department has developed a number of research labs to support both research and teaching. These include:

The Adaptive Multimodal Interaction (AMI) lab studies user behavior. Typical experiments collect eye movements, pressure grasping, and other physiological input to develop novel and effective interactive systems. Research in the AMI lab produces new

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\[6 \text{http://goo.gl/IGRrr}\]
design principles, user interfaces, multimedia interaction systems, and visualizations of complex information. The website of the AMI lab is at: http://www2.hawaii.edu/~amilab/.

The Bioinformatics (BIL) Lab pursues research in bioinformatics and metagenomics. For example, a recent project studied the diversity and ecology of marine RNA viruses. The website of BIL is at: http://navet.ics.hawaii.edu/~poisson/BIL/index.html

The Collaborative Software Development Lab (CSDL) has performed research and development in a variety of areas including renewable energy technology, software engineering, and computer supported cooperative work. A recent focus of CSDL is the Kukui Cup project, in which 1,000 first year students living on-campus participate in a three week energy challenge. The website of CSDL is at: http://cSDL.ics.hawaii.edu/.

The Concurrency Research Group (CORG) performs research in parallel and distributed computing, computer system simulation, and high-performance computing. For example, CORG is part of an international research consortium developing SimGrid, a toolkit for simulation of distributed applications in heterogeneous distributed environments. The website of CORG is at: http://navet.ics.hawaii.edu/~casanova/corg/index.html

The Hawaii Computer-Human Interaction (HI’CHI) lab focuses on understanding how people use information systems based on human performance data. Current research includes digital government applications and how people use the Internet including, Facebook, to make political decisions. The website of the HI’CHI lab is at: http://Mānoa.hawaii.edu/hichi/.

The Laboratory for Interactive Learning Technologies (LILT) partners with the Department of Education and other local educational agencies to support innovative uses of high technology in education. A recent project, Traces, will develop a theoretical foundation for analysis, a data model, and software tools to trace out the movements, confluences, and transformations of people and ideas in online social networks. The website of LILT is at: http://lilt.ics.hawaii.edu/.

The Machine Learning (ML) group pursues research in machine learning, information theory, statistical mechanics, quantitative finance, robotics, time series analysis, and computational neuroscience. Ongoing projects focus on the theory of interactive learning, optimal predictive coding, the thermodynamics of systems driven far from thermodynamic equilibrium, energy efficient information processing in (silicon) neurons, novel approaches to robust clustering, the effects of regularization on portfolio optimization, the analysis of volcanic features on Io, the analysis of whale songs, document classification, and the development of games for the use in psychophysics research. The website of the ML Group is at: http://www2.hawaii.edu/~sstill/MLL.html.

The Research Center for Information Assurance (RCIA) provides a learning laboratory and test bed for investigations and applications related to the generation, organization, access, preservation, and secure use of digital information. The website of RCIA is at: http://www2.hawaii.edu/~rcia/.

The research and teaching facilities occupied by the ICS Department are primarily located on the 3rd floor of the POST building. This includes office space for all of the faculty and staff as well as a small conference meeting room.
Information technology and fiscal support resources

In addition to the instructional staff, the department has two information technology (IT) specialists. They are responsible for system administration, networking, installation, and maintenance of the department's computer hardware and software infrastructure. The IT specialists also acquire software, hardware, and other products in response to instructional and research needs.

The department also has an administrative and fiscal support person who works with the Department Chair to develop and track an annual department budget with corresponding projections for all forms of revenues including general and extramural funds. This person also provides fiscal support to faculty for grant and contract proposals with funding agencies such as NSF, DARPA, NIH, etc. Timely fiscal status reports are required to meet the needs of the college, department, accreditation bodies and researchers. Prompt and accurate payments of obligations to vendors upon delivery of goods and services are another function of this staff person, as well as fiscal work related to curriculum and instructional needs of the department.

Student advising and financial aid resources

As our TechHui forum responses indicate above, ICS students view our department's advising as a significant strength. Providing focused academic advising helps free the faculty to engage in mentoring relationships with students. ICS undergraduate students are also often employed by the department as student assistants, teaching assistants and laboratory assistants. Recently approximately 17 undergraduate students have been employed as helpers in ICS 101 and about 10 students are engaged in paid REUs (Research Experience for Undergraduates). These activities provide students with both financial resources and real-world work experience. Through general funds and special funds, the department spends approximately $110,000 per year on undergraduate student employment.

We recently received a $100,000 endowment to further develop our cyber security program which directly supports students in the Bachelor of Arts program. The Fred and Annie Chan Scholarship is used to recruit one or two outstanding Hawaii high school students and provide them with a full scholarship each year. Many other scholarships and tuition waivers are provided to students on an annual basis. For past several years, the ICS department has supported high school students in the 6th through 12th grade by providing approximately $1400 to winners of the science fair competition.

We strive to provide internships and industry work experience to our students. The National Survey of Student Engagement (NSSE) has found that students involved in industry and real-world related projects have higher rates of retention and success. They strengthen the relationship between the University and local industry and they provide students with valuable out-of-class experiences. Work experiences have included web application development, usability assessments, software maintenance, XML programming, and penetration testing.

Department financial resources

The last major influx of general funds occurred in 2001 when the Hawaii state legislature directed an allocation of $1M that became a permanent part of the ICS department’s budget. This major investment enabled us to accomplish the following: 1) hire instructors to expand our lower division course offerings, 2) increase the number of teaching
assistants assigned to high enrollment classes, and 3) purchase equipment to support these individuals and the computer labs servicing the students. In general, the funding allowed us to increase the number of sections of high-demand classes, improve the quality of education in each class, and reduce the dropout rate from its undergraduate programs. As a result, we were able to improve the faculty-student ratio of our classes, provide additional course assistance, and provide additional computer laboratory facilities for student use. We believe the net result of this investment was a significant improvement in the student experience and an increase in the retention of students in the ICS program. The ICS department spends approximately $300,000 per year to support operational costs such as:

| Software licensing fees                      | Software purchases                     |
| Lab teaching supplies                        | Office supplies                        |
| Delivery charges, postage, freight           | Contracts, maintenance, service        |
| Facilities repairs, maintenance, modifications | Fees, subscriptions, dues           |
| Printing and publications: program brochures | Recruiting: travel, per diem              |
| Telcom installation, fees, long distance graders | Student help: office,                  |
| Travel for department business               | Laboratory equipment                   |
| Office equipment: computers, shredders       | Shop equipment: drills, cutters         |
| Teaching Supplies and Equipment              | Instructors                             |

**Allocation of resources**

As discussed earlier, it is difficult to account separately for the resources dedicated to the B.A. and B.S. programs. We believe that an allocation based upon student numbers is approximately correct. In the last five years the proportion of undergraduate students in the B.A. program has grown from 15% in 2006 to 28% in 2011.

**Assessment of program efficiency and outcomes**

*In response to E5.201 questions 4 and 6: Is the program efficient, and are the outcomes compatible with objectives? (An assessment of outcomes, productivity, and cost/benefit considerations within the overall context of campus and University “mission” and planning priorities. Include quantitative measures comparing, for example, SSH/faculty, average class size, cost per SSH, cost per major with other programs in the college, on the campus and, as appropriate, similar programs to other UH campuses.)*

This section presents a set of quantitative charts that reveal various aspects of the efficiency of the ICS Department. These charts are based upon the data collected for the administration cost and revenue spreadsheets in Appendix C, which are a required supplement to this document. We intend this section to serve as a useful narrative to the data presented in that Appendix by highlighting various data of interest.
B.A. head count trends

We begin with a simple chart showing the enrollment of B.A. students from 1998 to 2010, taken from the data in Appendix C.

![B.A. Enrollment (Head Count)](image)

Figure 2: B.A. Enrollment (Head Count)

Figure 2 reveals that B.A. enrollment skyrocketed in 2000 as part of the overall "dot com" explosion in our economy, and then decreased sharply in 2002 as part of the "dot bomb" economic correction. Fortunately, interest in computer science as a career has resumed in the past several years, and enrollment in the B.A. has recovered to the point that only the years 2000-2001 showed higher numbers.

It is also useful to see B.A. enrollment as a percentage of overall enrollment, as illustrated in Figure 3: This chart shows that the percentage of our undergraduate students enrolled in the B.A. program has risen steadily over time, from 8% in 2002 to 25% in 2010. Similarly, the percentage of undergraduate ICS students who graduated with a B.A. degree rose from 18% in 2002 to 39% in 2010.

![B.A. Students as percentage of undergraduate program](image)

Figure 3: Percentage enrollment in B.A. program over time
Student semester hours

Appendix C also provides information on student semester hours, illustrated in the following chart:

![Student Semester Hours](chart.png)

Figure 4: Student semester hours in the B.A. program

Figure 4 shows the trend in student semester hours (SSH) to be flatter (since 2005) and less dramatic than the enrollment data. In general, SSH reached a peak in 2000 along with the dot.com explosion, then dropped, and for the past several years has been in a relatively stable state. We believe that SSH tends to lag head count, as students can declare themselves in the B.A. program before taking a significant course load. Thus, we predict that SSH will increase in the coming years as a result of the growth in the program enrollment since 2007.

Program cost per SSH

The next chart highlights the total program cost per SSH from Appendix C: Figure 5 reveals that program cost has risen over the past decade, but dropped in the last year. We believe that this reflects the gradual ramping up of services for our B.A. students as the program matured over the past decade. Although this trend is somewhat disconcerting, the next two charts provide some additional context that we believe puts this trend in a favorable light.
Comparison of Cost/SSH (B.A. ICS vs. B.S. EE)

The following chart shows Cost/SSH for the B.A. as well as Cost/SSH for the B.S. degree in Electrical Engineering. The selection of the B.S. in EE as the comparison was suggested by the office of the Vice Chancellor for Academic Affairs, based on similar sizes and time since inception.

Figure 6 shows that the Cost/SSH for the B.A. in ICS is consistently below the Cost/SSH for a comparable program (B.S. in Electrical Engineering). Thus, while our cost/SSH has increased, we are still a relatively "cheap" program compared to Electrical Engineering.
Revenue

Our final excerpt from Appendix C illustrates revenue. Revenue for the B.A. program is estimated based on the proportion of B.A. students in the undergraduate program and the total revenue for the undergraduate program.

![Revenue Graph]

Figure 7: Revenue from the B.A. program

Again, although our Cost/SSH has risen, Figure 7 shows that revenue has remained positive throughout the entire program, and more importantly that revenue has increased significantly during the past four years. Thus, although we are investing more in our students (in terms of Cost/SSH), the net result has been an increase in revenue for the program as a whole. We take this data to indicate that our program is a good investment, both for our students and for the University’s bottom line.

Graduation rates

Figure 1 (on page 8) shows the graduation rates for the B.A. program, which have hovered around one dozen per year for the past five years. There were fewer graduates in 2010 because we had to offer fewer courses due to three faculty deaths in the immediately preceding years. The B.A. program accounts for roughly a quarter to a third of the undergraduate degrees awarded by our department. As is also noted in Figure 1, our overall "throughput" has varied between 15% and 25%.

Assessment of program quality

In response to E5.201 question 5: A qualitative assessment of the program in relation to competing demands for resources by new programs and continuing programs. Accreditation or other external evaluation, student performance [e.g., on external exams], satisfaction, placement and employer satisfaction, awards to faculty and students faculty publication record, evaluation of faculty…

The ICS department has a national and international reputation, and our faculty are regularly awarded grants, fellowships, awards, contracts and commissions. In prior sections of this document, we have presented evidence for the quality of our faculty. In
the introduction, we noted that Wesley Peterson won the Japan Prize for his work on error correcting codes and that Norman Abramson designed an early version of Ethernet. The next section presents a snapshot of recent ICS faculty activities as evidence of the quality of our work.

Faculty research activities

*Digital democracy*

Professor Scott Robertson and his students have developed projects to understand the way participation in public debate and deliberation is influenced by emergent social media such as Facebook. The research includes user-centered design of enhancements to search engine tools, laboratory studies of how potential voters browse, and longitudinal studies through at least three election cycles. This research has been funded by multiple NSF grants totaling over $1.3M.

*Artificial intelligence (AI) and medicine*

Professor Julia Patriarche and her students have developed a system for the detection of change in serial magnetic resonance imaging studies of brain tumor patients. The system is a multi-level AI system, which demonstrates how such systems can augment patient care by performing routine tasks and thus elevating the role of the clinician to the more interesting and less routine parts of patient care. Dr. Patriarche's work has resulted in a diagnostic system that has been adopted as a standard part of patient care for brain tumor patients at the Mayo Clinic. This research has been funded by multiple grants from the National Institute of Health and has resulted in two patent applications.

*Socio-technical network analysis*

Professor Dan Suthers and his students are studying the new emergent forms of socio-technical systems enabled by modern communication and information technologies. A recent project called Traces provides a theoretical foundation for analysis, a data model, and software tools to trace out the movements, confluences, and transformations of people and ideas in online social networks. Professor Suther's recent research is funded by the National Science Foundation for approximately $400K.

*Data management*

Professor Lipyeow Lim and his students have developed efficient algorithms for evaluating XPath queries on XML data that exploit the multi-core parallelism available in modern processors resulting in performance improvements of up to an order of magnitude. Other students have also designed query processing algorithms for mobile devices (e.g. i-Phones, android phones) that optimize the energy efficiency in such devices in order to improve battery life. A recent project investigates using the streaming paradigm to forecast wind profiles for the purpose of wind energy monitoring and management. This project has been funded by an IBM innovation award.

*Biometrics*

Professors Martha Crosby and Curtis Ikehara have been applying biometrics to study cognitive overload in specific situations. In 2007, they received patent No. US 7,245,218 B2 for an “Input Device to Continually Detect Biometrics.” This patent was granted for a method and system that uses surface finger pressures to identify the biometric characteristics of a user from a computer input device (such as a mouse).
User modeling

Professor David Chin and his students perform research to create models of user to improve information systems. A recent project involves a prototype agent-based simulation system that will allow analysis of the long-term effects of policy on culture, and to predict the effects of cultural change on the level of violence in various localities. The goal is to better predict which policy alternatives are likely to minimize long-term violence. Professor Chin’s recent research has been funded by a variety of grants totaling over $1M.

Space exploration

Professor Kim Binsted manages a NASA-funded 4-month simulated space-exploration mission using an environment on the Big Island. Six crewmembers will live in a habitat for four months, while researchers study their diet, psychology, teamwork, etc. ICS graduate students will work on automated tools for data collection, as well as on advanced communication strategies for long-term space missions. In addition, Professors Binsted and Rich Gazan are applying computational methods to the search for life in the universe, funded by a 5-year, $8M NASA Astrobiology Institute grant. They work with a cross-disciplinary team at UH including researchers from Astronomy, SOEST, Physics and Chemistry, and NASA researchers nationwide, using information-theoretic clustering methods to relate the work of researchers in diverse fields, and to model the galactic habitable zone.

Quantitative Finance

Professor Susanne Still and her collaborators have argued that portfolio optimization must be regularized for large portfolios, such as those of banks and insurance companies. They have shown that regularization gets rid of an intrinsic instability that is otherwise present in portfolio optimization. They are studying the effects of regularization on investment strategies and on market dynamics, with the goal of finding mechanisms that could help prevent future crashes.

High performance computing

Professor Henri Casanova and his students have developed a novel method for sharing computing resources among competing users. This approach, called Dynamic Fractional Resource Scheduling, makes both theoretical and practical advances and outperforms state-of-the-art techniques by orders of magnitude. Among its benefits are a higher level of user satisfaction, a quantifiable and optimized measure of fairness among users, and enhanced resource economy both in terms of hardware and electrical power expense. This research has been funded by multiple grants from the National Science Foundation totaling over $500K.

Wireless networking and security

Professor Edo Biagioni and his students have developed a seamless voting system that lets voters vote from home, verify that their vote has been counted, yet remain anonymous. Another project involves a virtual machine system that detects attacks on the operating system. In embedded systems, a student designed a wireless system that can track buses, similar in function but different in technical details from the system that TheBus is currently using.
Studio-based learning

Professor Martha Crosby and her students perform research in studio-based learning, an innovative paradigm for science education that adapts concepts from architectural education including "design crits". Professor Crosby’s recent research has been funded by multiple grants from the National Science Foundation.

Broadening Participation in Computing (BPC)

Working with Chaminade University (CU) and the University of Hawai’i at Hilo (UHH), Professor Martha Crosby is part of a NSF Broadening Participation in Computing (BPC) alliance grant for planning and developing the infrastructure for serving higher education institutions in the Pacific region with significant Native Hawaiian (NH) and Pacific Island (PI) student populations. CU and UHH are two of the three NH-serving institutions in Hawai’i.

Collaborative Research in Computer Security Education

Since 2006, Professor Martha Crosby has collaborated with The George Washington University (GW), a DHS/NSA designated Center of Academic Excellence in Information Assurance Education and Research (CAE/IAE and CAE/IAE-R), in Project PISCES (Partnership in Securing Cyberspace through Education and Service) to expand computer security and information assurance (CSIA) education opportunities to potential successful CSIA applicants from ICS. In 2011 Professor Crosby built on this partnership and received a NSF Collaborative Research grant to make this educational perspective available to ICS students. This research has been funded by multiple grants from the National Science Foundation totaling over $6M.

STEM education

Professors Violet Harada and Dan Suthers are principal investigators of the Hawai’i Networked Learning Communities (HNLC) Initiative, which is a partnership of the Hawai’i Department of Education and the University of Hawai’i to improve science, mathematics and technology learning in K-12 rural schools. It directly supports the effort to form a seamless connection between UH and the State DOE. This initiative has been funded by grants from the Department of Education totaling over $1M.

Renewable energy and sustainability

Professor Philip Johnson and his students perform research on consumer-facing energy analysis and visualization that results in open source technology and empirical data to guide policy making. For example, they designed and implemented "The Quest for the Kukui Cup", an energy challenge for all 1,000 first year students living in the Hale Aloha residence halls. The project involves novel information technology, pedagogy, and game design techniques designed to raise student awareness of the energy challenges facing Hawaii, help them to learn how to use energy more efficiently, and connect them with organizations and curriculum if they decide to pursue energy studies at the University. Professor Johnson’s recent research is funded by grants from the National Science Foundation totaling over $400K.

Bioinformatics

Professors Guylaine Poisson and Kyungim Baek are Director and Associate Director for the Bioinformatics cores of the COBRE Pacific Center for Emerging Infectious Diseases Research and the INBRE Hawaii State Research and Education Partnership programs.
They work with their students on research projects that include metagenome analysis, prediction of phosphorylation sites in proteins, and population clustering using human SNPs (single nucleotide polymorphism) data. As Directors of the Bioinformatics cores, Professors Poisson and Baek manage research funds from multiple grants from the National Institute of Health totaling around $1.8M.

**Machine Learning**

Professor Susanne Still has developed a new approach to interactive learning. Her theoretical work has spawned a number of applications in machine learning and robotics. Her students are using this approach to implement curiosity driven learning and exploration in robotics, to understand human learning and behavior in simplified scenarios, such as computer games, and for devising intelligent agents which are to be embedded into computer games. Professor Still and her collaborators have developed a novel robust clustering algorithm, and they have improved the state-of-the-art in cluster analysis methods. Her students are applying these methods to document classification, whale song analysis, and, in collaboration with researchers at NASA, to problems in geophysics and planetary sciences.

**Computer vision**

Professor Kyungim Baek and her students designed and implemented a traffic density estimator which provides traffic monitoring information by analyzing images from Hawaii state traffic cameras. Other students implemented a wrist pose estimator for robotic surgical instrument that helps human-robot interaction in a minimally invasive robotic surgery environment.

**Software Visualization**

Professor Jan Stelovsky and his students developed a visualization tool embedded within a popular software development environment. This tool allows a programmer to view algorithm execution in a textbook-like graphical fashion. When the resulting video is replayed, the programmer can switch between a variety of different visualizations. The tool was successfully used in introductory ICS courses to help students understand the behavior of typical algorithms.

**Undergraduate education**

Professor M.B. Ogawa supervises a variety of research projects related to undergraduate education. As one example, four undergraduate students were semi-finalists in the 2009 ImagiNations Competition sponsored by Walt Disney Corporation. These students designed a mobile device to enhance the experience of Walt Disney park goers with live data feeds to determine ride wait times, GPS mapping, and historical information about the park. This is part of an overall research program on student learning that has been funded by multiple grants totaling over $500K.

**Human computer interaction**

While the ICS faculty prides itself on providing a diversity of research interests and activities to its students and the community, the focus area of human computer interaction (HCI) encompasses such a substantial number of ICS faculty interests that it deserves special mention. Professors Scott Robertson, Martha Crosby, Dan Suthers, David Chin, Rich Gazan, Curtis Ikehara, Jan Stelovsky, and Philip Johnson have all published research in HCI related conferences and journals. When viewed in aggregate,
HCI is an area in which the ICS faculty have achieved a special level of national and international recognition.

Faculty productivity: external funding and refereed publications

Figure 8 provides a perspective on faculty productivity based upon the aggregate value of external funding that ICS faculty have been awarded as PIs or co-PIs, along with the number of refereed publications that ICS faculty have authored or co-authored.

![Chart showing external funding and refereed publications by ICS faculty](image)

Figure 8: External funding and refereed publications by ICS faculty

Figure 8 shows that aggregate external funding in which ICS faculty were directly involved varied between $3M and $5.5M during this six year period, and the number of refereed publications by ICS faculty varied between 35 and 45 per year.

For a listing of recent faculty extramural funding awards, please see Appendix F. For faculty publications, please see Appendix G.

Curriculum quality

We now turn from our faculty to a discussion of the quality of our curriculum.

Encouraged by the provisional approval of a B.A. in Information and Computer Sciences, the approval of a Minor in Computer Science and WASC approval for distance delivery of its bachelor and master programs, we have introduced major curricular changes and articulation agreements with UH-Hilo, Maui College and the Community Colleges for most of our 100 and 200 level courses.

There has been considerable discussion regarding the need to provide increased access to "information technology" (IT), "computer science", "programming" and other related general concepts. "The First Two" Project attempted to meet this need. Using funds from the state government, we established a learning and support environment to directly impact the first two years of course work in ICS. This includes ICS 111 and 211 (Introduction to Computer Science I & II), ICS 212 (Program Structure), ICS 141 & 241 (Discrete Mathematics I & II), and ICS 311 (Data Structures & Algorithms). Although the changes in these foundational ICS courses are incremental, it is a key part of a long
term effort to revamp the upper division undergraduate courses to reflect the latest changes in the Association for Computing Machinery (ACM) 2008 computer science curriculum. The ultimate goal is to provide a significantly more supportive and successful environment for those students enrolled in ICS 111, ICS 211, ICS 212, ICS 141, ICS 241, and ICS 311. These courses represent the basic concepts and skills that frame computer science and "informatics". They also provide opportunities for application of technology to other fields. The program does not differentiate between students in regular day, extended, summer, or ALN courses.

We have also been exploring different teaching methodologies that use active learning techniques. In 2007, we began testing how using a studio-based learning (SBL) methodology could improve learning outcomes in computer courses. This project was initially funded with a grant from NSF and was to address the dual challenge of retaining computer science students, and broadening access to computing education, by building a community of educators and researchers using a novel studio-based instructional model in introductory computing education courses. Adopted from architectural education, this instructional model emphasizes learning activities in which students (a) construct personally-meaningful representations of the algorithms and programming concepts under study, and then (b) present those representations to their instructors and peers for feedback and discussion within the context of so-called "design crits."

We also teamed with George Washington University on Project PISCES (Partnership in Securing Cyberspace through Education and Service). This program provides opportunities for students with diverse backgrounds to become Computer Security and Information Assurance (CSIA) professionals and help protect the safety and security of our nation’s information infrastructure. It does this by combining scholarships, university courses in computer security and information assurance, internships, laboratories, and government service, and appropriate monitoring and evaluation for these students. A major new thrust of the project is to include students from the ICS department at the University of Hawaii at Mānoa (UHM) to provide potential successful CSIA applicants.

**Initiatives related to student quality**

Recently we have begun a series of initiatives to improve and award student quality. The following table describes some of our recent activities.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Project Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incoming</td>
<td>ICS Science Fair Awards - Five $200 awards for a computer science project. One for the best project from each class level from 8th grade, freshman, sophomore, junior and senior. Status: Ongoing from 2009.</td>
</tr>
<tr>
<td>Incoming</td>
<td>Fred and Annie Chan Scholarship for incoming Freshmen. First, this requires organizing a publicity campaign to students, counselors and parents. Second, collection and organizations of applicants. Third, the assembly of a selection committee. Finally, implementation and follow-up with the recipient. Status: Ongoing from 2008.</td>
</tr>
<tr>
<td>Incoming</td>
<td>ICS Minor promotion – This is a promotion to recruit more undergraduates to minor in ICS. It requires the printing and disbursement of over 500 flyers on the ICS minor program. Status: Ongoing from 2007.</td>
</tr>
<tr>
<td>Undergrad</td>
<td>ICS 290 - Computer Science Careers: An exploration of the specialties of computer science – Spring 2009. A class designed to provide students with information to help define and achieve their goals in computer science. Status: Ongoing from 2010.</td>
</tr>
<tr>
<td>Incoming, Undergrad &amp; Grad</td>
<td>Bachelor’s packet, thanking graduates for selecting our department, informing them of alumni services and requesting that they send thank you notes to their high school mentors. The thank you notes increase awareness of the ICS program and will hopefully motivate more high school mentors to send their best students to our department. Status: Ongoing since 2008.</td>
</tr>
<tr>
<td>Undergrad</td>
<td>Promotion to encourage high end undergraduates to take graduate courses before graduating. This will provide high end students with a transcript that stands out and increase confidence in their academic ability. This requires organizing a publicity campaign to students. Status: Ongoing since Fall 2009.</td>
</tr>
<tr>
<td>Undergrad &amp; Grad</td>
<td>ICS Software Engineering Competition for undergraduate students (where a graduate student may mentor undergraduates). First, this requires coordinating with the faculty on the notification and incentive systems to increase student participation. Second, conducting the competition and awarding of the winners. Status: Competition held Fall 2009.</td>
</tr>
<tr>
<td>Undergrad</td>
<td>Promoting the hiring of lower division CS students by commercial CS organizations as entry level help. This will provide students who cannot do CS work with the experience of working in a CS environment. Status: Started 2011.</td>
</tr>
<tr>
<td>Undergraduate &amp; Graduate</td>
<td>Graduation and awards ceremony. Status: Spring 2011 graduates completed</td>
</tr>
<tr>
<td>Undergraduate &amp; Graduate</td>
<td>Short Skill Set Classes - Creating special non-credit classes to fill-out the specific skill sets requested by the local computer companies. Status: Organizing in progress – currently communicating with local companies.</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>GRE Award – This award is encourages high performing undergraduate computer science majors to prepare for graduate school. A full-time undergraduate ICS student who takes the Graduate Record Exam (GRE) and scores above the 80% percentile for two categories can apply for a $200 award. A student can only receive this award once. Status: Organizing in progress.</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>Help promote the department of Information and Computer Sciences at the university open house, high school counselors meeting, and high school events. Since 2007.</td>
</tr>
<tr>
<td>Undergrad &amp; Grad</td>
<td>ICS 40th Alumni Lunch with alumni, faculty and their best students. Status: Completed 2008</td>
</tr>
</tbody>
</table>

The large number of local and mainland companies that recruit our graduates attests to the success of our academic programs. Federal agencies like the FBI and CIA also show a strong interest in our majors. Graduates from the ICS program go on to graduate study (30%), obtain positions in the computer field (50%), obtain positions in government (10%) and form their own startup businesses (10%). (Figures are approximate.) Here are two testimonials from local companies:

"We have hired ICS graduates at Referentia and have found them to be well qualified and ready to work. I believe the B.A. program provides the opportunity for students to add domain specialization and diversity into their education. Students that can apply their skills to a particular domain and problem are extremely valuable in our local high tech industry." -- Aaron Kagawa, Software Engineer, Referentia, Inc.

"Professor Johnson, I’ve communicated to you in the past about offering internships to your ICS students. We recently brought on board another one of your students into our internship program. We also have on our staff three former graduates from your program. We found graduates from your program to be universally sound in development techniques, have a solid background in Java, are hard workers, have a
strong desire to enhance and refine their skills and possess excellent communication skills." --- Steve Mizokawa, Vice President, eWorld Enterprise Solutions.

Assessment of appropriateness of program objectives

In response to E5.201 question 7: Are program objectives still appropriate functions of the college and University? (Relationship to University mission and development plans, evidence of continuing need for the program, projections of employment opportunities for graduates, etc.)

ICS Mission

The following section addresses how the mission statements for the Department of Information and Computer Sciences support the larger missions of the University of Hawaii at Mānoa, the University of Hawaii system, the state of Hawaii, and the overall national picture.

The mission of the Department of Information and Computer Sciences is to nurture a world-class community of students and faculty dedicated to innovative scientific and information-related research and education for the benefit of the participants, Hawaii, the United States, and the world. A goal of the ICS program is to prepare students to be research and development leaders in computer science and computer technology. To this end, the program is a catalyst and a resource for shaping the future of the broad discipline of computer science. The faculty embraces the mutual interdependence of research and teaching to achieve excellence in both. As part of its mission the program brings the latest research findings into courses and actively involves students in research endeavors of the faculty. The program also provides leadership in the application of high technology to improve the educational experience.

Alignment with the UH Mānoa strategic plan

The final draft of Achieving Our Destiny, the University of Hawaii at Mānoa 2011–2015 Strategic Plan has been released, and central to the UHM mission statement is to "support innovations in education, health care, social development, culture and arts, earth, space, and ocean sciences, sustainable land management, and technological advancement." In its broad-based research, teaching and professional networks, the ICS department is a catalyst for innovation in each of these areas.

Alignment with the UH System strategic plan

The University of Hawaii System strategic plan approved by the Board of Regents has the following goals for the system:

- Educational Effectiveness and Student Success
- A Learning, Research, and Service Network
- A Model Local, Regional, and Global University
- Investment in Faculty, Staff, Students, and Their Environment
- Resources and Stewardship

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The ICS department's mission statement closely aligns with the first goal of educational effectiveness and student success. Furthermore, the department helps to provide the university system with a strong learning, research, and service network.

Alignment with the State of Hawaii

At the state level, Governor Neil Abercrombie's Technology and Information platform states the need for human capital and education in the area of technology, specifically:

"The fuel of an innovation economy is our human capacity to learn and create. Everyone can contribute. Education at all levels is the fundamental investment we will make to improve our economy. Industry and public education must work very closely to support each other and ensure highly skilled employees are being prepared at the same rate that high skill jobs are being created."

The need for education in technical fields is further underscored by Office of Department of Business, Economic Development and Tourism's report on Hawaii's Technology. This report includes a summary of employment trends, reproduced in Appendix D. Our degree programs directly address the highlighted occupations. Focusing on just these occupations, the Bureau is projecting an increase of more than 50% that would result in over 1.4 million new positions.

In a U.S. Department of Commerce, Office of Technology Policy report entitled "The Digital Workforce: Building Infotech Skills at the Speed of Innovation" (June 1999) Alan Greenspan said, "The rapid acceleration of computer and telecommunications technologies is a major reason for the appreciable increase in our productivity in this expansion, and is likely to continue to be a significant force in expanding standards of living into the twenty-first century." This bodes well for the increasing use of information technology and for the strategic role that the ICS Department might play in delivering high-quality teaching and research at UHM.

Alignment with international needs

The globalization of society makes this need the same as that for the national needs. The central role of information technology in almost all aspects of higher education is expected to increase dramatically for the foreseeable future. Areas such as bioinformatics, medical informatics, business informatics, and educational informatics argue for the increasing need for our interdisciplinary B.A. program.
Appendix A: ICS course descriptions

ICS 111 Introduction to Computer Science I (4) Overview of computer science, writing programs. AY2011 enrollment: 222.

ICS 141 Discrete Mathematics for Computer Science I (3) Logic, sets, functions, matrices, algorithmic concepts, mathematical reasoning, recursion, counting techniques, probability theory. AY 2011 enrollment: 155

ICS 211 Introduction to Computer Science II (3) Algorithms and their complexity, introduction to software engineering, data structures, searching and sorting algorithms, numerical errors. AY 2011 enrollment: 72

ICS 212 Program Structure (3) Program organization paradigms, programming environments, implementation of a module from specifications, the C and C++ programming languages. AY 2011 enrollment: 46

ICS 215 Introduction to Scripting (3) Introduction to scripting languages for the integration of applications and systems. Scripting in operating systems, web pages, server-side application integration, regular expressions, event handling, input validation, selection, repetition, parameter passing, Perl, JavaScript, and PHP. AY 2011 enrollment: 16

ICS 241 Discrete Mathematics for Computer Science II (3) Program correctness, recurrence relations and their solutions, divide and conquer relations, relations and their properties, graph theory, trees and their applications, Boolean algebra, introduction to formal languages and automata theory. AY 2011 enrollment: 67

ICS 290 Computer Science Careers: An Exploration of the Specialties of Computer Science (1) Exploration of the specialties of computer science. AY 2011 enrollment: 7

ICS 311 Algorithms (3) Design and correctness of algorithms, including divide-and-conquer, greedy and dynamic programming methods. Complexity analyses using recurrence relations, probabilistic methods, and NP-completeness. Applications to order statistics, disjoint sets, B-trees and balanced trees, graphs, network flows, and string matching. AY 2011 enrollment: 67

ICS 312 Machine-Level and Systems Programming (3) Machine organization, machine instructions, addressing modes, assembler language, subroutine linkage, linking to higher-level languages, interface to operating systems, introduction to assemblers, loaders and compilers. AY 2011 enrollment: 24

ICS 313 Programming Language Theory (3) Syntax, semantics, control structures, variable binding and scopes, data and control abstractions. Programming in functional (LISP) and logic (Prolog) programming styles. AY 2011 enrollment: 63

ICS 314 Software Engineering I (3) System specification, modeling and analysis, prototyping, hierarchal design, program design methods, cost estimation, project management, computer-aided software design. Team-oriented software-design project. AY 2011 enrollment: 25 (taught as 413).

ICS 315 Web Design and Management (3) Web design principles, XML and HTML, tables, forms, and frames, multimedia objects, security, scripting for web applications, web servers, commercial aspects, new technology. AY 2010 enrollment: 10.
ICS 321 Data Storage and Retrieval (3) Data storage devices, timing and capacity, programming for files, hashed and indexed files, introduction to relational database systems. AY 2011 enrollment: 90

ICS 331 Logic Design and Microprocessors (4) (1 3-hr Lab) Basic machine architecture, microprocessors, bus organization, circuit elements, logic circuit analysis and design, microcomputer system design. AY 2011 enrollment: 35

ICS 332 Operating Systems (3) Operating system concepts and structure, processes and threads, CPU scheduling, memory management, scheduling, file systems, interprocess communication, virtualization, popular operating systems. AY 2011 enrollment: Not taught.

ICS 351 Network Design and Management (3) Overview of the internet and its capabilities; introduction to HTTP, TCP/IP, ethernet, and wireless 802.11; routers, switches, and NAT; network and wireless security; practical experience in designing and implementing networks. AY 2011 enrollment: 14

ICS 361 Introduction to Artificial Programming (3) Introduction to the theory of Artificial Intelligence and the practical application of AI techniques in Functional (Common LISP and/or Scheme) and Logic (Prolog) programming languages. Students gain practical experience through programming assignments and projects. AY 2011 enrollment: Not taught.

ICS 390 Computing Ethics for Lab Assistants (3) A lecture/discussion/internship on ethical issues and instructional techniques for students assisting a laboratory section of ICS 101. The class uses multiple significant writing and oral presentation activities to help students learn course content. AY 2011 enrollment: 17

ICS 414 Software Engineering II (3) Continuation of 413. Project management, quality, and productivity control, testing and validation, team management. Team-oriented software-implementation project. Pre: 413. AY 2011 enrollment: 15

ICS 415 Introduction to Programming for the Web (3) Introduction to emerging technologies for construction of World Wide Web (WWW)- based software. Covers programming and scripting languages used for the creation of WWW sites and client-server programming. Students will complete a medium-sized software project that uses languages and concepts discussed in class. AY 2011 enrollment: Not taught.

ICS 419 The Science, Psychology and Philosophy of Systems Design (3) Scientific, psychological and philosophical bases of systems design, including a survey of human-factors and ergonomic standards; the nature of innovation and creativity as it relates to systems design. Web-enhanced course. AY 2011 enrollment: 9


ICS 423 Computer Security (3) Legal, ethical and technology issues in computer access, confidentiality, authentication, privacy and intellectual property. AY 2011 enrollment: Not taught.

ICS 424 Application Frameworks (3) Experience producing applications with at least two different applications frameworks. A-F only. AY 2011 enrollment: Not taught.


ICS 441 Theory of Computation (3) Grammars, sequential machines, equivalence, minimalization, analysis and synthesis, regular expressions, computability, unsolvability, Gödel's theorem, Turing machines. AY 2011 enrollment: 5.

ICS 451 Data Networks (3) Network analysis, architecture, digital signal analysis and design; circuit switching, packet switching, packet broadcasting; protocols and standards; local area networks; satellite networks; ALOHA channels; examples. AY 2011 enrollment: 24.

ICS 452 Software Design for Robotics (3) Sensors, actuators, signal processing, paradigms of robotic software design, introduction to machine learning, introduction to computer vision, and robot-to-human interaction. A-F only. Pre: two ICS 300-level courses or consent. AY 2011 enrollment: Not taught.


ICS 464 Human Computer Interaction I (3) Application of concepts and methodologies of human factors, psychology and software engineering to address ergonomic, cognitive, and social factors in the design and evaluation of human-computer systems. AY 2011 enrollment: 22


ICS 466 Design for Mobile Devices (3) Lecture introducing design issues, programming languages, operating systems and mark-up languages for internet-enabled mobile devices, such as cell phones and PDAs. AY 2011 enrollment: 21.
ICS 469 Cognitive Science (3) Introduces basic concepts, central problems, and methods from cognitive science. Identifies contributions from disciplines such as cognitive psychology, linguistics, artificial intelligence, philosophy, and neuroscience. AY 2011 enrollment: 15.

ICS 475 Introduction to Bioinformatics Sequences and Genomes Analysis (3) Introduction to bioinformatics to computer sciences students by focusing on how computer sciences techniques can be used for the storage, analysis, prediction and simulation of biological sequences (DNA, RNA and proteins). AY 2011 enrollment: 16.

ICS 476 Bioinformatics Algorithms and Tool Development (3) Study of commonly used bioinformatics’ algorithms, with an emphasis on string, tree, and graph algorithms. Presentation of probabilistic and clustering methods. Implementation of the studied algorithms and design of applications. AY 2011 enrollment: Not taught.

ICS 481 Introduction to Computer Graphics (3) Fundamentals of computer graphics including graphics hardware, representation, manipulation, and display of two- and three-dimensional objects, use of commercial software. AY 2011 enrollment: Not taught.

ICS 483 Computer Vision (3) Introductory course in computer vision. Topics include image formation, image processing and filtering, edge detection, texture analysis and synthesis, binocular stereo, segmentation, tracking, object recognition and applications. AY 2011 enrollment: Not taught.
### Appendix B: B.A. sample schedule

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<td>HSL 102</td>
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<td>DB</td>
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<tr>
<td><strong>Total</strong></td>
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**Total credits after 8 semesters**: 125

*Cr = credit hours for course(s); A = A&S credits; N = non-introductory A&S credits*
## Appendix C: Head counts, student semester hours, and costs

### Table: Direct and Incremental Program Costs Without Fringe

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### Table: Direct and Incremental Program Costs With Fringe

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<td>$131,310</td>
<td>$220,230</td>
<td>$328,920</td>
<td>$216,230</td>
<td>$199,950</td>
<td>$293,750</td>
<td>$219,800</td>
</tr>
</tbody>
</table>

### Table: Revenue

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1,291,146</td>
<td>$1,420,304</td>
<td>$1,415,804</td>
<td>$1,351,420</td>
<td>$1,415,844</td>
<td>$1,263,154</td>
<td>$1,115,724</td>
<td>$1,093,102</td>
</tr>
<tr>
<td></td>
<td>118</td>
<td>128</td>
<td>126</td>
<td>126</td>
<td>126</td>
<td>126</td>
<td>126</td>
<td>126</td>
</tr>
<tr>
<td></td>
<td>$1,291,146</td>
<td>$1,420,304</td>
<td>$1,415,804</td>
<td>$1,351,420</td>
<td>$1,415,844</td>
<td>$1,263,154</td>
<td>$1,115,724</td>
<td>$1,093,102</td>
</tr>
</tbody>
</table>

### Table: J. Net Cost (Revenue)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$555</td>
<td>$1,287,354</td>
<td>$1,192,744</td>
<td>$1,134,180</td>
<td>$1,195,844</td>
<td>$1,163,204</td>
<td>$814,634</td>
<td>$379,782</td>
</tr>
</tbody>
</table>

### Figure C.1: Costs & Revenues Spreadsheet, 1998 - 2005

### Figure C.2: Costs & Revenues Spreadsheet, 2006 - 2011

---

38
**Academic Program Cost and Revenues Template: Provisional to Established**

**ENTER VALUES IN HIGHLIGHTED CELLS ONLY**

**CAMPUS/Program**

**MANOULA Info Comp Sciences**

**ENTER ACADEMIC YEAR (e.g., 2004-05)**

**Provisional Years (double click to show all provisional years)**

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
</table>

**Students & SSH**

A. Headcount Enrollments (Fall)
   - Fall
   - Program
   - Student
   - Total

B. Annual SSH
   - Fall
   - Program
   - Student
   - Total

**Direct and Incremental Program Costs Without Fringe**

C. Instructional Cost without Fringe
   - C1. Number of FTES of FT Faculty/Lecturers
   - C2. Number of FTES of PT Faculty/Lecturers

D. Other Personnel Costs
   - D1. Number (FTES) of PT Faculty/Lecturers
   - D2. Number (FTES) of PT Researchers

E. Unique Program Costs

F. Total Direct and Incremental Costs

**Revenue**

G. Tuition
   - Tuition rate per credit

H. Other

I. Total Revenue

J. Net Cost (Revenue)

**Program Cost per SSH With Fringe**

K. Instructional Cost with Fringe/SSH
   - K1. Total Salary FT Faculty/Lecturers
   - K2. Cost including Fringe of K1
   - K3. Total Salary PT Lecturers
   - K4. Cost including Fringe of K3

L. Support Cost/SSH
   - L1. Support Cost/SSH
   - L2. Support Cost/SSH
   - L3. Support Cost/SSH
   - L4. Support Cost/SSH
   - L5. Support Cost/SSH
   - L6. Support Cost/SSH
   - L7. Support Cost/SSH

M. Total Program Cost/SSH

N. Total Campus Expenditure/SSH

**Instruction Cost with Fringe per SSH**

K. Instructional Cost/SSH

**Program used for comparison:**

- SIS in Electrical Engineering

---

**Figure C.3: Costs and Revenues Spreadsheet, 2011 - 2016 (Projected)**
## Appendix D: Employment trends

Italicized occupations below are those which might be appropriate for our B.A. graduates.

<table>
<thead>
<tr>
<th>Fastest Growing Jobs</th>
<th>Employment change</th>
<th>Number (thousands)</th>
<th>Percent Increase</th>
<th>Most significant source of education or training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupation</td>
<td>2000-2010</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Computer software engineers, applications</strong></td>
<td></td>
<td>380</td>
<td>100</td>
<td><em>Bachelor’s degree</em></td>
</tr>
<tr>
<td>Computer support specialists</td>
<td></td>
<td>490</td>
<td>97</td>
<td><em>Associate degree</em></td>
</tr>
<tr>
<td><strong>Computer software engineers, systems software</strong></td>
<td></td>
<td>284</td>
<td>90</td>
<td><em>Bachelor’s degree</em></td>
</tr>
<tr>
<td><strong>Network and computer systems administrators</strong></td>
<td></td>
<td>187</td>
<td>82</td>
<td><em>Bachelor’s degree</em></td>
</tr>
<tr>
<td><strong>Network systems and data communications analysts</strong></td>
<td></td>
<td>92</td>
<td>77</td>
<td><em>Bachelor’s degree</em></td>
</tr>
<tr>
<td>Desktop publishers</td>
<td></td>
<td>25</td>
<td>67</td>
<td><em>Postsecondary vocational award</em></td>
</tr>
<tr>
<td><strong>Database administrators</strong></td>
<td></td>
<td>70</td>
<td>66</td>
<td><em>Bachelor’s degree</em></td>
</tr>
<tr>
<td>Personal and home care aides</td>
<td></td>
<td>258</td>
<td>62</td>
<td><em>Short-term on-the-job training</em></td>
</tr>
<tr>
<td><strong>Computer systems analysts</strong></td>
<td></td>
<td>258</td>
<td>60</td>
<td><em>Bachelor’s degree</em></td>
</tr>
<tr>
<td>Medical assistants</td>
<td></td>
<td>187</td>
<td>57</td>
<td><em>Moderate-term on-the-job training</em></td>
</tr>
<tr>
<td>Social and human service assistants</td>
<td></td>
<td>147</td>
<td>54</td>
<td><em>Moderate-term on-the-job training</em></td>
</tr>
<tr>
<td>Physician assistants</td>
<td></td>
<td>31</td>
<td>53</td>
<td><em>Bachelor’s degree</em></td>
</tr>
<tr>
<td>Medical records and health information technicians</td>
<td></td>
<td>66</td>
<td>49</td>
<td><em>Moderate-term on-the-job training</em></td>
</tr>
<tr>
<td>Computer and information systems managers</td>
<td></td>
<td>150</td>
<td>48</td>
<td><em>Bachelor’s degree, plus work experience</em></td>
</tr>
<tr>
<td>Home health aides</td>
<td></td>
<td>291</td>
<td>47</td>
<td><em>Short-term on-the-job training</em></td>
</tr>
<tr>
<td>Physical therapist aides</td>
<td></td>
<td>17</td>
<td>46</td>
<td><em>Short-term on-the-job training</em></td>
</tr>
<tr>
<td>Occupational therapist aides</td>
<td></td>
<td>4</td>
<td>45</td>
<td><em>Short-term on-the-job training</em></td>
</tr>
<tr>
<td>Profession</td>
<td>Hours</td>
<td>Duration</td>
<td>Training</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------</td>
<td>----------</td>
<td>------------------------------</td>
<td></td>
</tr>
<tr>
<td>Physical therapist assistants</td>
<td>20</td>
<td>45</td>
<td>Associate degree</td>
<td></td>
</tr>
<tr>
<td>Audiologists</td>
<td>6</td>
<td>45</td>
<td>Master's degree</td>
<td></td>
</tr>
<tr>
<td>Fitness trainers and aerobics instructors</td>
<td>64</td>
<td>40</td>
<td>Postsecondary vocational award</td>
<td></td>
</tr>
<tr>
<td>Computer and information scientists, research</td>
<td>11</td>
<td>40</td>
<td>Doctoral degree</td>
<td></td>
</tr>
</tbody>
</table>
Appendix E: Distance education courses and enrollments

<table>
<thead>
<tr>
<th>Semester</th>
<th>Classes</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2004</td>
<td>4</td>
<td>37</td>
</tr>
<tr>
<td>Spr 2005</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>Fall 2005</td>
<td>3</td>
<td>44</td>
</tr>
<tr>
<td>Spr 2006</td>
<td>4</td>
<td>29</td>
</tr>
<tr>
<td>Fall 2006</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Spr 2007</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Fall 2007</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Spr 2008</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>Fall 2008</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Spr 2009</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>Fall 2009</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Spr 2010</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Fall 2010</td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>Spr 2011</td>
<td>5</td>
<td>125</td>
</tr>
<tr>
<td>Fall 2011</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>Average</td>
<td>4</td>
<td>28</td>
</tr>
</tbody>
</table>
Appendix F: Faculty extramural funding

This section provides a listing of extramural funding awards with ICS faculty participation as Principal or co-Principal Investigator during the past five years.

Kim Binsted, co-PI, Effects or retronasal smelling, variety, and choice on appetite and satiety, NASA, 2011, $395,000.

Kim Binsted, co-PI, UH-NASA Astrobiology Institute, NASA, 2008, $7,824,000.


David Chin, co-PI, Coherence-Based Modeling of Cultural Change and Political Violence, National Science Foundation, 2007, $1,074,754.

David Chin, PI, Agent-based modeling for PMRF Intent Analysis, SAIC, 2006, $186,638.

Martha Crosby, PI, Teaching Strategic, Operational, and Defensive Cyber-security to the Next Generation from Sea to Shining Sea, National Science Foundation, 2011, $86,438.


Rich Gazan and Kim Binsted, co-PIs, Water and Habitable Worlds, NASA, 2009, $8,000,000.

Curtis Ikehara, co-PI, Center for Ohana and Self-Management of Chronic Illnesses in Hawaii, National Institutes of Health, 2008, $300,000.


Curtis Ikehara, co-PI, Magnetic Levitation Systems for Human Interaction, National Science Foundation, 2006, $95,248.


Philip Johnson, PI, Innovative Information Architectures for the Smart Grid, National Science Foundation, 2009, $397,000.

Michael-Brian Ogawa, co-PI, Pathways to excellence and achievement in research and learning, IMLS, 2009, $249,917.

Michael-Brian Ogawa, co-PI, Examining the link between informal social networks and innovation: Using netometrics to quantify the value of distributed hierarchical networks, National Science Foundation, 2007, $199,766.

Guylaine Poisson and Kyungim Baek, co-PIs, COBRE Pacific Center for Emerging Infectious Diseases Research, National Institutes of Health, 2010, $11,000,000.

Guylaine Poisson and Stephen Itoga, co-PIs, INBRE II, National Institutes of Health, 2010, $9,000,000.


Scott Robertson, co-PI, Digital Deliberation: Search and deciding how to vote, National Science Foundation, 2006, $400,000.

Scott Robertson, PI, Social search and deliberation in digital political information and collaboration domains, National Science Foundation, 2011, $948,537.

Dan Suthers, co-PI, Traces: Understanding distributed socio-technical systems, National Science Foundation, 2009, $382,421.

Dan Suthers, co-PI, HiMax Research and Development, 2006, $1,034,927.
Appendix G: Faculty publications

The following links provide access to the publications associated with our faculty.

Kyungim Baek, http://www2.hawaii.edu/~kyungim/research.html
Kim Binsted, http://www2.hawaii.edu/~binsted/papers/Publications.html
David Chin, http://www2.hawaii.edu/~chin/chin_vita.pdf
Curtis Ikehara, http://www2.hawaii.edu/~cikehara/
Lipyeow Lim, http://www2.hawaii.edu/~lipyeow/#publications
Julia Patriarche, http://www2.hawaii.edu/~julia4/PatriarcheCV.pdf
Luz Quiroga, http://www2.hawaii.edu/~lquiroga/LuzMQuirogaVita.htm
Nancy Reed, http://www2.hawaii.edu/~nreed/nreed-cv.pdf
Scott Robertson, http://manoa.hawaii.edu/hichi/pubs.html
Susanne Still, http://www2.hawaii.edu/~sstill/pubs.html
Dan Suthers, http://liit.ics.hawaii.edu/?page_id=42
Appendix H: Assessing teamwork, communication, and critical review skills

Overview

Studio-based learning (SBL) endeavors to build students' skills in communication, teamwork, and critical review. The department attempts to directly measure these skills. We record student teams engaging in a team problem-solving activity relevant to the course at two points in the course: during the first week of the course, and again during the last week of the course. Multiple experts review the recordings (or transcripts of the recordings), rating the activity against structured rubrics designed to assess teamwork, communication, and critical review skills. Similar to our pre/post assessment strategy for learning and attitude changes, this assessment strategy is designed to measure changes in three “soft” skills that SBL is purported to promote.

Steps

1. Devise a challenging problem that is both relevant to your course and appropriate for a team to work on collaboratively. The problem should be nontrivial, have no clear solutions, and a rich design space. For example, in a human-computer interaction or software engineering course, the problem might involve the design of a new software application for a particular client or domain in need of one. In an algorithms course, the problem might involve the design of algorithms and data structures for a non-trivial problem. In a databases course, the problem might involve the design of a database schema for a complex set of business rules.

2. Devise a deficient solution to a different problem for a team to critique collaboratively. The problem you solve should be similar in spirit and difficulty to the problem you devised in step (1). You should deliberately seed the solution with errors of different types and degrees of severity. For example, if you provide a code solution to a software design problem, you might include errors of the following types: (a) logic errors that lead to incorrect output; (b) potential for division by zero; (c) "off by one" errors in iteration; (d) redundant code that could be made into a single function; (e) a case in which a different design pattern could make the code simpler and easier to maintain; (f) poor variable name choices; and (g) poor or missing comments.

3. Group students into teams. The target team size is four to five. Try to match students of equivalent abilities, so that there is a better chance that a single student won't dominate the activity. If the team is mixed-gender, it is best if at least two women are on the team.

4. Capture student teams' problem-solving and critiquing activities. Here, we have two choices: Either have students work on the problem asynchronously through a web-based collaboration environment (for an example of this, see http://soa.asee.org/paper/conference/paper-view.cfm?id=9065), or have students work on the problem face-to-face. If they work on it asynchronously, their dialog will be automatically captured. If they work on the problem face-to-face, we will need to (a) record their problem-solving activity using either audio or videotape, and (b) set a time limit of 40 minutes for their interaction.

5. Transcribe student teams' problem-solving activities. If we had students solve the problem face-to-face, we may need to transcribe the recording that we made, so that it
can be easily analyzed. However, a transcription may not be necessary, as it would also be possible for the expert raters to view or listen to the recording directly.

6. **Have a team of 2 to 3 experts review the transcriptions, recordings, or online dialog.** Below is both a protocol that the expert assessors can follow, and a provisional rubric that they could use for the assessment.

**Review Protocol**

6a. Read and discuss professional skill definitions and criteria below with your rating group.

6b. Skim the student work without making written comments to get a sense for how well the student group addressed the professional skills.

6c. Review the student work again, marking specific passages where the team exhibited certain professional skills—for example, “Outcome (d).” A given passage may exhibit more than one skill simultaneously.

6d. Circle specific descriptors in the criteria below that express how well the student work as a whole exhibits a given skill.

6e. Note the rationale for the ratings in the comment boxes. For example, “The team identified a list of stakeholders but did not consider stakeholder perspectives, so I gave them a 3 on Outcome (f).”

**Rubric**

**Outcome I (ABET Outcome d): Ability to function effectively on teams to accomplish a common goal.** Students work as a team to address the problem by acknowledging and building on each other’s ideas. Students collaboratively build an understanding of the issues involved and possible approaches to the problem. Students clearly frame the problem or issue and begin the process of resolution.

<table>
<thead>
<tr>
<th>1 - Absent</th>
<th>2 - Emerging</th>
<th>3 - Developing</th>
<th>4 - Competent</th>
<th>5 - Effective</th>
<th>6 - Mastering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students do not interact with each other in ways that promote better understanding of the problem. One person dominates or some team members are shut out.</td>
<td>Students attempt to consider the problem at multiple levels and perspectives. Students may lack the skill to fully balance everyone’s input or to actively support/clarify each other’s ideas.</td>
<td>Students demonstrate the ability to effectively conceptualize the problem by probing it at multiple levels and from multiple perspectives. Students encourage participation and actively help each other to clarify ideas.</td>
<td>Students attempt to reach consensus but have some difficulty in developing an approach that incorporates everyone’s perspectives equitably.</td>
<td>Students work together to reach a consensus before clearly framing the challenge and developing appropriate, concrete approaches to resolve the problem.</td>
<td></td>
</tr>
</tbody>
</table>
### Outcome II (ABET Outcome f): Ability to communicate effectively with a range of audiences.

Students value and integrate the diverse perspectives of stakeholders and other potential audiences beyond the student team. They discuss how they will communicate with stakeholders (e.g., employees, administrators, the public, etc.).

<table>
<thead>
<tr>
<th>1 - Absent</th>
<th>2 - Emerging</th>
<th>3 - Developing</th>
<th>4 - Competent</th>
<th>5 - Effective</th>
<th>6 - Mastering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students do not consider the perspectives of multiple stakeholders.</td>
<td>Students acknowledge that there are other stakeholders but do not always create adequate strategies for addressing these perspectives.</td>
<td>Students thoughtfully consider perspectives of diverse stakeholders and discuss how they might be addressed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Students fail to recognize the ways in which the diverse perspectives of stakeholders will impact communication.</td>
<td>Students consider the diverse perspectives of stakeholders but may be somewhat naive in their approach to communicating with them.</td>
<td>Students acknowledge the challenge of communicating with stakeholders who hold diverse perspectives. They work together and/or seek outside expertise in determining the best approach for communicating with target audiences.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Comments:

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### Outcome III (unique to SBL project): Ability to comprehend, identify issues with, and constructively review technical solutions at multiple levels of abstraction.

Students demonstrate grasp of peers' technical solutions (e.g., software designs) and provide constructive feedback that both identifies the solutions' strengths/weaknesses and suggests viable ways to improve the solutions.

<table>
<thead>
<tr>
<th>1 - Absent</th>
<th>2 - Emerging</th>
<th>3 - Developing</th>
<th>4 - Competent</th>
<th>5 - Effective</th>
<th>6 - Mastering</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Identification of issues with solutions) Students fail to show an understanding of peers' solutions to the problem; little or no attempt is made to understand peers'</td>
<td>Students show some understanding of peers' proposed solutions to the problem; they ask relevant questions to provide a basis for analyzing solutions</td>
<td>Students grasp peers' proposed solutions; they ask relevant and even insightful questions, perhaps with follow-up questions, that provide a sound basis for</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

48
<table>
<thead>
<tr>
<th>(Expression of issues with solutions) Students fail to express strengths and weaknesses in their peers’ solutions in a constructive or precise way (e.g., “your variable names are great/suck!” or “this interface is nice/ugly”), or they fail to express relevant issues</th>
<th>Students express relevant strengths and weaknesses in their peers’ solutions in a constructive and precise way (e.g., “Your variable names aren’t suggestive” or “your interface has a poor color scheme”)</th>
<th>Students express key strengths and weaknesses in their peers’ solutions. Students justify their observations. Students’ communication is helpful and respectful (e.g., “Using a name like x for a sum impacts the readability of your code” or “your interface’s red/blue color scheme will make it difficult for color-blind individuals to use”).</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Expression of ways to improve solutions, a.k.a., “constructive feedback” ) Students fail to express ways to improve peers’ technical solutions.</td>
<td>Students provide some feedback on how to improve peers; technical solutions; feedback may be superficial or of little help to peers (“Change x to sum” or “consider making your variable names more suggestive.”) Feedback may not be grounded in a sound rationale.</td>
<td>Students provide constructive feedback on how to improve peers’ technical solutions (e.g., “change x to sum and consider changing all of your other variable names to make them match their role.”). Students’ feedback is based on a sound rationale. Students’ communication is helpful and respectful.</td>
</tr>
</tbody>
</table>
Appendix I: Program Assessment Reports

Fall 2011 Assessment Report
Department: Information & Computer Science
Program: Computer Science (BS), Info & Comp Sci (BA)
Level: Bachelor’s

1) Below are your program student learning outcomes (SLOs). Please update as needed.
   (a) Students can apply knowledge of computing and mathematics appropriate to the discipline
   (b) Students can analyze a problem, and identify and define the computing requirements appropriate to its solution
   (c) Students can design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
   (d) Students can function effectively on teams to accomplish a common goal
   (e) Students have an understanding of professional, ethical, legal, security and social issues and responsibilities
   (f) Students can communicate effectively with a range of audiences
   (g) Students can analyze the local and global impact of computing on individuals, organizations, and society
   (h) Students can recognize the need for and an ability to engage in continuing professional development
   (i) Students can use current techniques, skills, and tools necessary for computing practice.
   (j) An ability to use and apply current technical concepts and practices in the core information technologies. [BA IT only]
   (k) An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems. [BA IT only]
   (l) An ability to effectively integrate IT-based solutions into the user environment. [BA IT only]
   (m) An understanding of best practices and standards and their application. [BA IT only]
   (n) An ability to assist in the creation of an effective project plan. [BA IT only]

2) Your program’s SLOs are published as follows. Please update as needed.
   Department Website URL:
   Student Handbook URL, if available Online:
   Information Sheet, Flyer, or Brochure URL, if available Online:
   UH M Catalog. Page Number:
   Course Syllabi. URL, if available online:
   Other:
   Other:

3) Below is the link(s) to your program’s curriculum map(s). If we do not have your curriculum map,
   please upload it as a PDF.
   Curriculum Map File(s) from 2011:
   File #1 (10/12/2011)
   File #2 (10/12/2011)
   1 of 3 5/14/2012 8:45 AM
   File #3 (10/12/2011)

4) For your program, the percentage of courses that have course SLOs explicitly stated on the syllabus,
a website, or other publicly available document is as follows. Please update as needed.
   100%
   81-99%
   51-80%
   1-50%
   0%

5) For the period June 1, 2010 to September 30, 2011: State the assessment question(s) and/or assessment goals. Include the SLOs that were targeted, if applicable.
   Develop a new curriculum map based on the updated undergraduate curriculum.
   How does the inclusion of recitation sessions impact student achievement in ICS 141 and ICS 241?
   SLO: A, & B
6) State the type(s) of evidence gathered to answer the assessment question and/or meet the assessment goals that were given in Question #5.
Alignment of curriculum to SLOs: The Department collected the minutes from the Curriculum Committee to identify the changes necessary for the curriculum map. Curriculum and SLOs were re-aligned based on modifications to the curriculum. The curriculum was modified in spring 2011 and implemented in fall 2011. The Department believes the modification to the curriculum to be pedagogically advantageous and to lower students' time to degree completion. Based on the modifications in process, the Department will revisit this assessment question when the implementation has had time to mature.
ICS 141 and 241: The Department collected final course grades from students enrolled in ICS 141 or 241 prior to the inclusion of recitation sessions. The Department also collected final course grades after the implementation to determine if recitation sessions improved student learning. Student interviews were also conducted to determine reasons for the findings.
7) State how many persons submitted evidence that was evaluated. If applicable, please include the sampling technique used.
Nine faculty members submitted evidence (four for ICS 141 and five for ICS 241).
141: 4
241: 5
8) Who interpreted or analyzed the evidence that was collected? (Check all that apply.)
Course instructor(s)
Faculty committee
Ad hoc faculty group
Department chairperson
Persons or organization outside the university
Faculty advisor
Advisors (student support services)
Students (graduate or undergraduate)
Dean/Director
2 of 3 5/14/2012 8:45 AM
9) How did they evaluate, analyze, or interpret the evidence? (Check all that apply.)
Used a rubric or scoring guide
Scored exams/tests/quizzes
Used professional judgment (no rubric or scoring guide used)
Compiled survey results
Used qualitative methods on interview, focus group, open-ended response data
External organization/person analyzed data (e.g., external organization administered and scored the nursing licensing exam)
10) For the assessment question(s) and/or assessment goal(s) stated in Question #5: Summarize the actual results.
Alignment of curriculum to SLOs: See attached revised curriculum map for the undergraduate programs.
ICS 141: The overall GPA of students who enrolled in ICS 141 prior to the implementation of recitation sessions was 2.14. After recitation sessions were implemented, the overall GPA of the students improved to 2.34.
ICS 241: The overall GPA of students who enrolled in ICS 241 prior to the implementation of recitation sessions was 2.44. After recitation sessions were implemented, the overall GPA of the students declined to 2.29. Since these results for ICS 141 demonstrated an improvement and ICS 241 demonstrated a decline, the faculty
committee interviewed students who were enrolled in these courses to identify possible reasons for the improvement and decline. In ICS 141, students mentioned the direct relationship between content covered in the ICS 141 class and the recitation sessions. In ICS 241, the students mentioned a difference in teaching methods in the class and recitation sessions.

11) State how the program used the results or plans to use the results. Please be specific.
ICS 141, 241: The Department will bring these findings to the next curriculum committee meeting to determine possible methods to better align the recitation sessions with the in-class sessions. The Department will also implement a student representative role for undergraduate students to participate in curriculum committee meetings to allow for a feedback loop to improve curriculum and instruction.
Alignment of curriculum to SLOs: The new curriculum map will be used by faculty advisors when advising students through the B.A. and B.S. programs.

12) Beyond the results, were there additional conclusions or discoveries?
This can include insights about assessment procedures, teaching and learning, program aspects and so on.

13) Other important information.
Please note: If the program did not engage in assessment, please explain. If the program created an assessment plan for next year, please give an overview.
3 of 3 5/14/2012 8:45 AM

Fall 2010 Assessment Report

Department: Information & Computer Science
Program: Computer Science (BS), Info & Comp Sci (BA)
Level: Bachelor's

1) Below are the program student learning outcomes submitted last year. Please add/delete/modify as needed.

(a) Students can apply knowledge of computing and mathematics appropriate to the discipline
(b) Students can analyze a problem, and identify and define the computing requirements appropriate to its solution
(c) Students can design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
(d) Students can function effectively on teams to accomplish a common goal
(e) Students have an understanding of professional, ethical, legal, security and social issues and responsibilities
(f) Students can communicate effectively with a range of audiences
(g) Students can analyze the local and global impact of computing on individuals, organizations, and society
(h) Students can recognize the need for and an ability to engage in continuing professional development
(i) Students can use current techniques, skills, and tools necessary for computing practice.
(j) An ability to use and apply current technical concepts and practices in the core information technologies. [BA IT only]
(k) An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems. [BA IT only]
(l) An ability to effectively integrate IT-based solutions into the user environment. [BA IT only]
(m) An understanding of best practices and standards and their application. [BA IT only]
(n) An ability to assist in the creation of an effective project plan. [BA IT only]

2) As of last year, your program’s SLOs were published as follows. Please update as needed.
Department Website URL:
Student Handbook URL, if available Online:
3) Below is the link to your program's curriculum map (if submitted in 2009). If it has changed or if we do not have your program's curriculum map, please upload it as a PDF.

1 of 3 5/14/2012 8:47 AM
Curriculum Map File(s) from 2009:
File (11/24/2009)

4) The percentage of courses in 2009 that had course SLOs explicitly stated on the syllabus, a website, or other publicly available document is indicated below. Please update as needed.

100%
81-99%
51-80%
1-50%
0%

5) State the assessment question(s) and/or goals of the assessment activity. Include the SLOs that were targeted, if applicable.

The ICS Department assessed and studied SLOs that are covered in the introductory computer science courses (ICS 111, 141, 211, and 241). The SLOs covered were a, b, d, h, i, j, and m.
The ICS Department wanted to determine the most effective method to teach introductory Information and Computer Science courses, as they serve as a basis for all subsequent coursework.
The ICS Department also reviewed the SLOs and curriculum maps and began addressing the following:
1. Alignment of curriculum to SLOs.
2. Students' time to completion of degree.

6) State the type(s) of evidence gathered.

ICS 111 and 211: The ICS Department collected pre- and post-test scores for students in introductory programming courses, ICS 111 and ICS 211. The ICS Department also collected survey data from the students, which included demographic and qualitative data.
ICS 141 and 241: The Department collected final course grades from students enrolled in ICS 141 prior to the inclusion of recitation sessions. The Department will collect final course grades after the implementation to determine if recitation sessions improved student learning.
Alignment of curriculum to SLOs: Curriculum to SLOs are updated based on discipline needs.
Students' time to degree completion: The Department is in the process of modifying the curriculum to be pedagogically advantageous and to lower students' time to degree completion. Based on the modifications in process, the Department will revisit this assessment question when the implementation has had time to mature.

7) Who interpreted or analyzed the evidence that was collected?

Course instructor(s)
Faculty committee
Ad hoc faculty group
Department chairperson
Persons or organization outside the university
Faculty advisor
Advisors (student support services)
8) How did they evaluate, analyze, or interpret the evidence?
Used a rubric or scoring guide
Scored exams/tests/quizzes
Used professional judgment (no rubric or scoring guide used)
Compiled survey results
Used qualitative methods on interview, focus group, open-ended response data
External organization/person analyzed data (e.g., external organization administered and scored the nursing licensing exam)

9) State how many persons submitted evidence that was evaluated.
If applicable, please include the sampling technique used.

10) Summarize the actual results.
ICS 111, 211: The intervention used in instruction provided in ICS 111 and 211 increased learning and achievement for beginning ICS students. Therefore, the Department is considering this method of instruction for other upper division courses.
ICS 141, 241: No results are available at this time. The Department will have results in the next annual assessment.
Alignment of curriculum to SLOs: No results available at this time.
Students’ time to degree completion: No results at this time. The Department will revisit this assessment question when the implementation has had time to mature.

11) How did your program use the results? --or-- Explain planned use of results.
Please be specific.
ICS 111 and 211: The results were available for faculty to review. The results were also discussed by the assessment committee.
ICS 141 and 241: A faculty discussion will occur when results are available.
Alignment of curriculum to SLOs: No results available at this time.
Students’ time to degree completion: No results at this time. A faculty discussion will occur when results are available.

12) Beyond the results, were there additional conclusions or discoveries? This can include insights about assessment procedures, teaching and learning, program aspects and so on.

13) Other important information:

Fall 2009 Assessment Report

Department: Information & Computer Science
Program: Computer Science (BS), Info & Comp Sci (BA)
Level: Bachelor's

1) List your program's student learning outcomes (SLOs).
(a) Students can apply knowledge of computing and mathematics appropriate to the discipline
(b) Students can analyze a problem, and identify and define the computing requirements appropriate to its solution
(c) Students can design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
(d) Students can function effectively on teams to accomplish a common goal
(e) Students have an understanding of professional, ethical, legal, security and social issues and responsibilities
(f) Students can communicate effectively with a range of audiences
(g) Students can analyze the local and global impact of computing on individuals, organizations, and society
(h) Students can recognize the need for and an ability to engage in continuing professional development
(i) Students can use current techniques, skills, and tools necessary for computing practice.
(j) An ability to use and apply current technical concepts and practices in the core information technologies. [BA IT only]
(k) An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems. [BA IT only]
(l) An ability to effectively integrate IT-based solutions into the user environment. [BA IT only]
(m) An understanding of best practices and standards and their application. [BA IT only]
(n) An ability to assist in the creation of an effective project plan. [BA IT only]

2) Where are your program's SLOs published?
Department Website URL:
Student Handbook URL, if available Online:
Information Sheet, Flyer, or Brochure URL, if available Online:
UHM Catalog. Page Number:
Course Syllabi. URL, if available online:
Other:
Other:

3) Upload your program's current curriculum map(s) as a PDF.
Curriculum Map File(s) from 2009:
File (11/24/2009)
1 of 3 5/14/2012 8:48 AM

4) What percentage of courses have the course SLOs explicitly stated on the course syllabus, department website, or other publicly available document? (Check one)
100%
81-99%
51-80%
1-50%
0%

5) State the SLO(s) that was Assessed, Targeted, or Studied
The ICS Department assessed and studied the SLOs that are covered in the introductory computer science courses (ICS 111 and 211).
The student learning outcomes covered in ICS 111 and 211 are b, d, h, i, j, and m.

6) State the Assessment Question(s) and/or Goal(s) of Assessment Activity
The ICS Department wanted to determine the most effective method to teach introductory Information and Computer Science courses,
as they serve as the basis for all subsequent coursework.

7) State the Type(s) of Evidence Gathered
The ICS Department collected pre-test and post-test scores of students in introductory programming courses, ICS 111 and ICS 211.
The ICS Department also collected survey data from the students, which included demographic and qualitative data.

8) State How the Evidence was Interpreted, Evaluated, or Analyzed
The pre- and post-test scores were compared to determine the best instructional method for introductory Computer Science courses.
Qualitative data were also collected to gain insight into the students' learning process. The data were analyzed by teaching assistants
and faculty.

9) State How Many Pieces of Evidence Were Collected
Data were collected from all students who were enrolled in ICS 111 (58 students) and 211 (35 students) in the spring 2009 semester.

10) Summarize the Actual Results
The ICS Department determined that the intervention used in instruction provided in ICS 111 and 211 increased learning and
achievement for beginning Information and Computer Science students. Therefore, the ICS Department believes that
this method of
instruction may applicable to other ICS courses to improve student learning and achievement.

11) Briefly Describe the Distribution and Discussion of Results
The results were available for ICS faculty to review. The results were discussed by the ICS Assessment Committee.

12) **Describe Conclusions and Discoveries**
The ICS Department concluded that the method of instruction that was studied increased student learning and achievement based on the student learning outcomes. Therefore, the ICS Department believes that the intervention should be discussed at future faculty meetings to determine which courses could integrate this method of instruction.

13) **Use of Results/Program Modifications: State How the Program Used the Results --or-- Explain Planned Use of Results**
The ICS Department is planning to use the results to determine if the investigated method of instruction is viable for other ICS courses. We plan to discuss this opportunity at future faculty meetings to determine where and how it can be integrated.

14) **Reflect on the Assessment Process**
2 of 3 5/14/2012 8:48 AM
The assessment process was enlightening to the ICS Department, as we were able to identify an instructional method that can improve student learning. We also found the creation of the curriculum maps to be very useful and intend to use them in future curriculum committee meetings when reviewing new course proposals. Next time, we believe that we would like to start on the assessment process earlier, as it is time consuming, but is well worth the effort.

15) **Other Important Information**
No approved distance learning undergraduate programs.

16) **FOR DISTANCE PROGRAMS ONLY: Explain how your program/department has adapted its assessment of student learning in the on-campus program to assess student learning in the distance education program.**

17) **FOR DISTANCE PROGRAMS ONLY: Summarize the actual student learning assessment results that compare the achievement of students in the on-campus program to students in the distance education program.**

# Appendix J: Curriculum Map for Student Learning Objectives

**Information and Computer Sciences B.S. Undergraduate Degree Program Curriculum Map**

<table>
<thead>
<tr>
<th>SLO A</th>
<th>SLO B</th>
<th>SLO C</th>
<th>SLO D</th>
<th>SLO E</th>
<th>SLO F</th>
<th>SLO G</th>
<th>SLO H</th>
<th>SLO I</th>
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<td>I</td>
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<td>I</td>
<td>I</td>
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<td>361</td>
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<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
</tbody>
</table>

5 ICS or other approved courses at the 400 level or above.

| 414 | M | M | M | M | M | M | R | M | M |
| 415 | M | M | M | M | M | M | M | M | M |
| 419 | M | M | M | M | M | M | M | M | M |
| 421 | M | M | M | M | M | M | M | M | M |
| 425 | M | M | M | M | M | M | M | M | M |
| 426 | M | M | M | M | M | M | M | M | M |
| 431 | M | M | M | M | M | M | M | M | M |
| 432 | M | M | M | M | M | M | M | M | M |
| 435 | M | M | M | M | M | M | M | M | M |
| 441 | M | M | M | M | M | M | M | M | M |
| 442 | M | M | M | M | M | M | M | M | M |
| 451 | M | M | M | M | M | M | M | M | M |
| 452 | M | M | M | M | M | M | M | M | M |
| 461 | M | M | M | M | M | M | M | M | M |
| 464 | M | M | M | M | M | M | M | M | M |
| 465 | M | M | M | M | M | M | M | M | M |
| 466 | M | M | M | M | M | M | M | M | M |
| 469 | M | M | M | M | M | M | M | M | M |
| 471 | M | M | M | M | M | M | M | M | M |
| 475 | M | M | M | M | M | M | M | M | M |
| 476 | M | M | M | M | M | M | M | M | M |
| 481 | M | M | M | M | M | M | M | M | M |
| 483 | M | M | M | M | M | M | M | M | M |
| 491 | M | M | M | M | M | M | M | M | M |

(Computers in Medicine)

| 499 | Ethics Req. | M |
|     | Oral Req.    | M |
Appendix K: ICS Program Review (March 2008)
University of Hawai‘i at Manoa
Program Review - Information and Computer Sciences
March 2008

GENERAL OVERVIEW

This review is based on an examination of the Department of Information and Computer Sciences 2002 Self-Study Review, its Assessment Report 2004-2005, updated faculty CVs, meetings with Assistant Chair David Chin, Assistant Faculty Specialist Gerald Lau, information available through the University of Hawai‘i at Manoa Institutional Research Office, Management and Planning Support Folder (http://www.hawaii.edu/iro/), the University of Hawai‘i STAR enrollment data, and two brochures produced by the ICS Department, Information and advice for Computer Science Majors and Minors, and Department of Information and Computer Sciences, and the ICS Department home page.

Relevance: The ICS mission statement appears to be aligned with that of Manoa. It reads:

The mission of the Information and Computer Sciences Department is to nurture a world-class community of students and faculty dedicated to innovative scientific and information-related research and education for the benefit of the participants, Hawaii, the United States, and the world.

Computer Science Mission -- The mission of the Computer Science program is to prepare students to be research and development leaders in computer science and computer technology. To this end, the program is a catalyst and a resource for shaping the future of the broad discipline of computer science. The faculty embraces the mutual interdependence of research and teaching to achieve excellence in both. As part of its mission the program brings the latest research findings into courses and actively involves students in research endeavors of the faculty. The program also provides leadership in the application of high technology to improve the educational experience.

The ICS Department has a productive research record, clear educational objectives for each of its degrees, successful economic contributions, and is certainly involved in technological development. Its faculty have been involved in developing information enterprises, hold technological patents, and have engaged with the community in several ways. Although the faculty have a number of accomplishments, the self-report provides no national or international comparisons with comparable programs.

7 Although the ICS Department merged with the School of Library and Information Studies in 1997, this review excludes the program in Library and Information Science (LIS). The LIS Masters in Library and Information Science (MLISc) is separately accredited by the American Library Association.
Since Fall 2002, through Fall 2007, ICS has seen a drop in enrollments of approximately 50% in its BS and MS programs as a result of the dot-com collapse in the computer industry in the early 2000s. The following table shows enrollments in ICS programs and its joint Communication and Information Sciences (CIS) interdisciplinary PhD program.

<table>
<thead>
<tr>
<th>Level</th>
<th>Program</th>
<th>No. of Majors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2002</td>
</tr>
<tr>
<td>Undergraduate</td>
<td>BA in ICS</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>BS in CS</td>
<td>616</td>
</tr>
<tr>
<td>Graduate</td>
<td>MS in ICS</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>PhD in CS</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>PhD in CIS</td>
<td>43</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>779</td>
</tr>
</tbody>
</table>

The lowering enrollments in the BS and MS reflect a nationwide trend in the field. The PhD program has increased in size and the BA and PhD in CI/ICS have remained relatively stable.

CURRICULUM

The curriculum follows the standards set by the Association of Computing Machinery which prepares recommendations for the curriculum of benchmark institutions for computer science. The Department has a thoughtfully-designed program for its students. Each degree program has a set of student learning outcomes (Assessment Report 2004-2005) with a mapping of course topics to student learning outcomes. An example of the student learning outcomes and curriculum map for the Bachelor of Arts program is presented in Appendix I.

It is not clear which particular courses map onto this structure. However, the Department asserts that students in the undergraduate ICS program, for example, work with an ICS faculty advisor to develop a course proposal explaining how the ICS upper division courses and those in their area of concentration form a coherent plan of study. This proposal is then approved by an undergraduate advisor prior to the student taking courses towards this degree.

The Department has explicit educational objectives for its degrees. These are presented in Appendix II. Additionally, the Department has presented an assessment system in its Assessment Report 2004-2005. As an example of that system across programs, a summary of the approach for the Master of Science in Information and Computer Sciences is presented in Appendix III. The Department notes that it uses the data collected to continuously evaluate the program. The assessment results are taken by two standing ICS committees (curriculum and infrastructure). The Curriculum
Committee considers academic recommendations in modifying existing courses and introducing new curricula.

The Department has recently introduced two new options in BA level program. The first is a BA in ICS with an information technology (IT) focus. It places less emphasis on programming and more emphasis on using computer systems. Four new courses in this area have been added and there are plans to develop this area into a new degree. The second new option is a BA in ICS with a bioinformatics focus. It emphasizes both computer science and biology.

STUDENTS

For the undergraduate program, students who are admitted into the Colleges of Arts and Sciences are eligible to declare ICS as a major. For the graduate programs, the Department enforces admission criteria related to GRE scores and GPA in previous computer science courses. The graduate program chairs verify the minimum GPA for eligibility of all graduate students. Students in the MS and PhD programs may be admitted conditionally depending upon background. These students may need foundation courses in ICS if they come from other natural sciences or majors. For example, students with prior majors in mathematics or biology may need foundation courses in computer science.

The Department has a five page brochure Information and Advice for Computer Science Majors and Minors which describes the course requirements for both the BA and BS programs. This information is consistent with the UHM catalog and the program's website. All tenured and tenure track faculty participate in advising students. Undergraduate majors are free to select their own advisors.

FACULTY

The faculty consists of 22 permanent positions, with 21 of the 22 being on the Graduate Faculty. Faculty publish in a number of different journals as well as in international conference proceedings. See Appendix IV for sample journals. Faculty are quite productive in their research, and indicate a depth and breadth of areas of expertise. The 2002 self-study review notes that in the seven years prior, the faculty had a combined average of 13.3 articles published in refereed journals (sole author and co-author), and an examination of current CVs reflects a similar record of publication since that self-study.

The faculty use the UHM CAFÉ system for teaching evaluation purposes.

DISTANCE DELIVERED PROGRAMS

The Department of ICS states that it is committed to expanding access to the University through distance learning. It is focusing on Asynchronous Learning Network (ALN) media for learning. The asynchronous classes have no class meetings. The M.S. degree in ICS is offered entirely online. Currently one can take both undergraduate and graduate courses via ALN. However, the undergraduate degrees require many non-ICS courses that are not currently available online, so this program is not offered entirely online. Admissions and graduation requirements are identical in the online programs
and the on-campus degree programs. The same faculty are involved in distance courses as are involved in on-campus programs. Students learn the material anytime, anywhere by reading books, handouts, or Web pages and interacting with other students and the instructor via electronic media. This work enables ICS to serve a range of students who cannot attend campus-based classes, whether due to scheduling conflicts such as job or childcare responsibilities, or because they are residents of neighbor islands or living outside of Hawai‘i.

CENTERS OR INSTITUTES

The Department does not yet have an established center or institute, though it has applied to establish a Center for Excellence to address computer security. There are a number of research labs which foster direct research. These are listed in Appendix V.

PROGRAM ACHIEVEMENTS

The Department participates with the Gear-Up program to encourage and assist high school students in Hawai‘i to attend college. The Department has worked with Farrington and other high schools in accomplishing their technical education. The Department also frequently works with Kapiolani Community College. The Hawai‘i Networked Learning Communities (HNLC) began in 1999 as a partnership between the Hawai‘i DOE and the Department of Information and Computer Sciences. It was initiated through National Science Foundation planning and implementation grants, HNLC has grown into a program of professional development reaching 40 rural schools and focusing on standards-focused, assessment-driven, place-based inquiry learning in science, math and technology. Its web site (hnlc.org), was built by the UH/ICS team in part to support the professional development program with discussions and a resource database that enable geographically separated rural teachers to stay in touch with each other and their mentors and share resources.

SUPPORT FUNDING AND FACILITIES

Faculty from the Department have obtained several grants from such sources as the National Science Foundation, DARPA, Quantum Leap Interactive, Microsoft, Office of Naval Research, IBM, the University of Hawaii, Hawaii Technology Development Venture, NEC, Tripler Army Medical Center, and Harold K.L. Castle Foundation. These external grants are used in part for student support.

Although the Department is housed in the relatively new Pacific Ocean Science & Technology (POST) Building, the Assistant Chair indicates a severe shortage of space. Faculty are doubled up in offices and the building has an insufficient capacity to vent the heated air generated by the computers in the Department labs and facilities.

CONCLUSIONS AND RECOMMENDATIONS

A primary issue for the Department to address is that of decreasing majors in the BS and MS program. The Department needs to examine its area foci to determine how to establish a niche that will attract new students. The refocusing onto bioinformatics and IT may be in the right direction. However, it should be monitored and studied thoroughly.
(I will leave additional conclusions and recommendations until the on-site review is completed).
Appendix I: Addenda

Bachelor of Arts in Information and Computer Sciences

Student Learning Outcomes Student will be proficient to:

1. Use current technology concepts and practices in software development, computer networking, database, and web related technologies;
2. Manage all aspects of solving computer-based problems involving requirements analysis, design, implementation, and project management;
3. Participate in collaborative team orientated activities;
4. Communicate effectively using modern technologies that require oral, written and web media;
5. Apply their computer skills to their area of interest.

Curriculum Map for Student Learning Outcomes

The ICS curriculum for Bachelor of Arts program maps course topics to the student learning outcomes. These topics include:

a. Programming
   1. Writing programs
   2. Program structure and organization
   3. Algorithm correctness
   4. Language syntax
   5. Automata theory

b. Data Structures
   1. Data storage
   2. Timing and capacity
   3. Programming for files
   4. Hash and index files
   5. Relational database systems

c. Machine-level and Systems Programming
   1. Machine organization
   2. Addressing modes
   3. Machine instructions
   4. Assembler language
   5. Subroutine linkages
   6. Higher level language linking
   7. Basic loader, assembler and compiler theory

d. Mathematics
   1. Logic
   2. Sets, functions and matrices
   3. Mathematical reasoning
   4. Counting
   5. Probability theory
   6. Program correctness
   7. Recurrence relationships
   8. Boolean algebra
   9. Automata theory
Appendix II: Department Objectives

In the baccalaureate programs, students will be able to:
- Use current technical concepts and practices in software development, computer networking, databases, and web related technologies,
- Manage all aspects of solving computer-based problems involving requirements analysis, design, implementation, and project management,
- Participate in collaborative team oriented activities,
- Communicate effectively using modern technologies, using oral, written, and web media.

In the post baccalaureate programs, students will be able to:
- Perform all activities expected of our baccalaureate graduates,
- Apply more sophisticated analyses in more detail to specialized technical areas,
- Work more independently on project management and problem solving activities.

Appendix III: ICS Assessment System

Data are collected from Master of Information and Computer Sciences majors.

a. Written examinations that assess the student's understanding of the theoretical concepts in computers and information sciences.

b. Class assignments allow students to apply computer concepts and theories to practice and solve specific computer-based problems.

c. Students are involved in group projects where their ability to work collaboratively can be assessed.

d. Through course presentations students are assessed in their ability to present and explain topics in the information and computer sciences fields.

e. Research in their focus area results in a capstone project used for their thesis or Plan B project.

f. The department plans to develop an exit survey to be administered to students when they exit the program. This survey will be given to students when they have their Goldenrod form signed by an ICS advisor.

Assessment of student progress is accomplished by:

a. The graduate student must meet with the Masters Program Chair during the first semester to determine her or his program objective.

b. A degree plan must be filed after completion of the first 12 credit hours of courses. For Plan A (thesis) candidates, a proposal of the courses the student intends to take are reviewed to insure a coherent plan of study. Students who file a Plan B program must review their course options and project with the Graduate Chair.

c. Research in two "capstone" courses is required for this degree. Under Plan A, the successful completion of their thesis and successful submission to Graduate Division is required, while for Plan B, the final project must be approved by a supervising faculty member.

d. Written examinations that assess the student's understanding of the theoretical concepts in computers and information sciences.

e. Class assignments allow students to apply computer concepts and
theories to practice, and solve specific computer-based problems.
f. Students are involved in group projects where their ability to work collaboratively can be assessed.

The Department notes that it uses the data collected to continuously evaluate the program. The assessment results are taken by two standing ICS committees (curriculum and infrastructure). The Curriculum Committee considers academic recommendations in modifying existing courses and introducing new curricula. For the Master of Science in Information and Computer Sciences, for example, they provide the following:

From the data currently collected, the ICS faculty review the results to make informed decisions concerning the curriculum and administration of the program. These reviews have resulted in changes to the curriculum and administration of the program in the following areas:
a. The data collected is used to advise, and counsel students in addressing their academic and career concerns.
b. The ICS program is constantly developing new topics that enable students to select courses in their particular areas of interest. This allows the student to establish a subject emphasis in their preparation towards their Master’s research project.
c. The Department has made administrative changes and hired a Faculty Specialist who works on both the ICS and LIS programs to address student issues such as student data management.
Appendix IV: Journal venues for faculty publication

IEEE Transactions
Machine Vision and Applications
Computer Vision and Image Understanding
Videre
Interacting with Computers
The Visual Computer
Theory in Biosciences
Evolution
American Naturalist
Nature
Genetics
Ecology
International Journal of High Performance Computing Applications
International Journal of Parallel Programming
International Journal of Foundations of Computer Science
Journal of New Generation Computing on Grid Systems for Life Science
Parallel Computing
Artificial Intelligence Review

International Journal of Instructional Media
Computers and Education
Journal of the Learning Sciences
Knowledge-Based Systems
IEEE Software
Journal of Empirical Software Engineering
Journal of Control and Cybernetics
The Information Systems Journal
Nucleic Acids Research
Information Processing and Management
Journal of Simulation Practice and Theory
Journal of Experimental and Theoretical Artificial Intelligence

Research and Practice in Technology Enhanced Learning
International Journal of Computer-Supported Collaborative Learning
Journal of Artificial Intelligence in Education
Journal of the Learning Sciences
Computers & Education
Interactive Learning Environments
Appendix V: ICS Research Labs

Adaptive Multimodal Interaction Laboratory (AMIL) – This lab studies user data such as eye movements, pressure grasping, and other physiological input to develop novel and effective interactive systems.

Bioinformatics Laboratory (BIL) – BIL uses tools and techniques from mathematics, statistics, and computer science to analyze molecular biological information such as DNA, RNA and protein sequences, that generated by various genome sequencing projects.

Collaborative Software development Laboratory (CSDL) – CSDL develops tools and technologies to better support the way groups of programmers design, implement, test and distribute high quality software.

Computational Vision Research Laboratory (CVRL) – CVRL research focuses on understanding the complex task of interpreting the world from visual information, which combines various fields of study including computer science, mathematics, neuroscience and perceptual psychology.

Concurrency Research Group (CORG) – CORG is developing simulation models, algorithms, and systems for parallel and distributed computing platforms and applications.

Innovative Computation Laboratory (ICL) – ICL has as its focus research and development of computer systems and applications that are not constrained by commonplace hardware and software, leading to the design of new dynamic programming optimization tools, simulation software, and reconfigurable computer architecture.

Laboratory for Interactive Learning Technologies (LILT) – LILT conducts research in human-computer interaction, the learning sciences, and artificial intelligence, focused on designing software to enhance individual and collaborative learning processes.

Machine Learning Laboratory (MLL) – The MLL studies models of learning, develops new learning algorithms, and new methods for the analysis of large data sets.