Information & Computer Science

2020
ANNUAL REVIEW OF PROGRAM DATA

LEEWARD COMMUNITY COLLEGE

UNIVERSITY OF HAWAII
1. Program or Unit Description

ICS Program Mission Statement
The Information and Computer Science program is committed to providing an intellectually challenging curriculum that prepares graduates to understand the fundamental concepts in computer science and the practices, values and demands of the related professions.

Program Description
The information and computer science program plays two different roles, it is both a transfer program (AS-NS in Information and Communication Technology), as well as a Career and Technical Education (CTE) program.

The curriculum leading to an Associate in Science degree in Information and Computer Science is designed to prepare individuals for employment as technical assistants to professional and administrative personnel using computers. Students may choose one area of specialty: Network Support Specialist, Information Security Specialist, or Software Developer Specialist. Skills in writing, speech, social science, global issues, and mathematics complete the preparation for employment. The program can be completed entirely via using various distance education modalities of delivery.

The core program requirements are designed to facilitate transfer to the baccalaureate programs in Information and Computer Sciences at UH Manoa, the Bachelor of Science degree in Computer Science at UH Hilo, the Bachelor of Applied Sciences degree in Applied Business and Information Technology at UH Maui College, and the Bachelor of Applied Sciences in Information Security and Assurance at UH West Oahu. Leeward CC graduates are able to continue working towards a four-year degree while working in the industry.

The ICS Program has been articulated by Program Coordinating Council continuously for the past two decades. The most recent agreement is dated September 2017 among all the community colleges of the UH system and UH Maui College. Our core courses remain aligned with UH Manoa, UH West Oahu and UH Hilo requirements, as well as nationally with curriculum guidelines approved by the Association for Computing Machinery (ACM).

The ICS program is recognized by the National Security Agency as a Center of Academic Excellence – 2 Year (CAE-2Y) in Cybersecurity. The application process vetted our program against national guidelines for cybersecurity programs.

2. Analysis of the Program/Unit

The demand indicator shows a slight increase in state and county computer science jobs. The demand for computer science and IT professionals is rising at a fast pace. Every business that uses
computers and has computers in their premises needs a team of IT professionals to safeguard the integrity of the hardware, software and data. Computer science professionals are required in every field including agriculture, education, health care, manufacturing, transportation, tourism and more. The US military is seeking a trained workforce in cybersecurity and other information technology professionals. Both computers and computer professionals have become ubiquitous commodities. The need for professionals in computer fields is so evident and so important that money and time from varied sources has been allocated to support these fields across the nation and here at the University of Hawaii system. The UHCCs C3T4 grant for cybersecurity which ended in 2017 allotted over half a million dollars to support computer security education across the UH campuses. We continue to self-support and upgrade the equipment purchased under that grant for our computer science program at Leeward CC. The ICS consortium and other STEM initiatives are now in place to coordinate the efforts from the different campuses to serve students given the increasing demand for the courses that we offer. The ICS discipline purchased new servers to maintain the NetLab system. We are planning to purchase two additional servers in the next year. STEM resources from the past two years are listed here: http://www.hawaii.edu/offices/aa/stem/stem-resources/.

Over seven years ago, the then University of Hawaii Chief Information Technology officer David Lassner gathered every computer science, computer engineering and IT program throughout the UH System for regular meetings with us and representatives from the US military. Our cybersecurity group has solidified and it is now under the leadership of The UH Chief Security officer, Jodi Ito. The NSA and industry representatives continue to be present during our meetings. Aware of the need for computer security specialists, sources external to the University of Hawaii system help us better tailor our educational programs to grow their future employees. In regards to job availability for our students, the CIP code selection limits the number of jobs that may be associated with our graduates’ abilities to find a job. Our current CIP code is quite narrow, however fields as forensics, cybersecurity, information assurance, programming, database management and helpdesk troubleshooting are not included in it. OPPA is aware that this continues to be an issue, and not just in our campus but in other campuses as well. According to a report handed to us during our ICT consortium meeting organized by the STEM education office at UH Manoa, the ‘T’ in STEM is the one with the most growth from all the STEM disciplines. The UH System STEM Education office has a page with links to resources of jobs: http://www.hawaii.edu/offices/aa/stem/resources/. The number of students transferring to the Bachelor degree programs at UH Manoa and the BAS in Information Security at UHWO have steadily increased. Leeward is the biggest partner into the NSA/DHS certified National Center of Academic Excellence in Cyber Defense Education at UHWO in 2020. Over the past year, Leeward also created a transfer pathway into the BAS in Advanced Business and Information Technology at UH Maui College. The articulation agreements are set in place in a way that students that transfer with a degree from Leeward CC have many advantages, among them, there is no need for a transcript evaluation; students are automatically accepted as juniors in the bachelor degree programs at our four-year institutions.

Our ICS program health indicators for demand, efficiency and effectiveness are all healthy. Demand for our ICS courses continues to grow showing full-time enrollment growing from 183 to
202 in the last year. SSH in all program classes increased from 5,475 to 6,069 the past year. The total number of classes taught increased from 100 to 113. Program efficiency indicators remained healthy and steady over the past year. There was a slight dip in fill rate dropping from 90.6% to 87.8% over the past year. The number of majors to FTE BOR appointed faculty also dipped slightly from 46 to 43. Program effectiveness indicators also are healthy. There was a large increase in the number of unduplicated degrees and certificates awarded. An analysis with other UHCCs which offer IT degrees indicates that Leeward awards more than double the number of degrees than any other institution.

One of the six Perkins IV core indicators, our program meets 2P1 Completion by 1.5 points. We fall a small amount short on each of the other indicators. We fall short on Student Placement and Nontraditional Completion due to large numbers of our students who transfer to four-year programs before completing our degree.

Mike Bauer travels every year to the NCWIT (National Center for Women in Information Technology) summit where he learns how to better support, recruit and retain minorities in computer science and other STEM fields. Although with the COVID pandemic, Mike attended a virtual event this year. Mike Bauer also travels to ACM SIGCSE (Association for Computing Machinery’s Special Interest Group in Computer Science Education) Technical Symposium on Computer Science Education with the same goal. Although, it too, was replaced by a virtual event.

The Hub is our on-campus student help desk. It provides valuable experience for computer science students in hardware troubleshooting and maintenance. The hub has helped many students that had problems with their computers. This makes students feel supported while promoting our program. Students realize that the skills obtained in the computer science program are useful and it may influence their decision to join our program. The Hub is a tool we use to recruit and retain students. Aside from the experience that our students acquired by helping other students, we have saved our Leeward students a great amount of money. Considering that computer service companies charge an average of $100 per hour just to diagnose a problem, this past year we saved our students $58,500 just in diagnosing a computer problem without considering the time it takes to actually fix the issue. This amount dropped from the previous year due to sharply reduced services brought on by the COVID pandemic. Faculty from Kapiolani Community College have visited the Hub to plan to implement it on their campus. In our last accreditation team visit, The Hub was recognized as one of seven commendations Leeward CC received.

The art of productive teaching at a community college demands that we tailor our course offerings and pedagogies to our student population. Demand from students for more online courses to complete their education continues to grow. The C3T4 grant enabled us to purchase NetLab. NetLab is a virtual environment that enables our students to acquire hands-on experience in network set up and troubleshooting from home. Without NetLab, at least nine of our courses could not successfully be offered completely online which will require students to be present on campus. Aside from this we would have to purchase physical equipment to allow every student to participate within the allotted class time. NetLab is very important for the ICS program and for students to acquire their learning outcomes as described in the following sections. Thanks to NetLab and other
initiatives, our number of online classes grew from 30 in 2019 to 38 in 2020. The number of students served in online classes grew from 547 to 664.

3. Program Student Learning Outcomes or Unit/Service Outcomes

ICS Program Outcomes
- Demonstrate computing literacy.
- Describe the functions and interrelationships of the building blocks of an operating system.
- Solve problems, develop algorithms, and write object-oriented computer programs in at least two programming languages.
- Apply mathematics to solve computing problems.
- Effectively communicate in written and oral form, a system solution its documentation, and its implementation.
- Use project management tools to manage information systems development projects.
- Work effectively as part of a group/team.
- Design a relational database with proper documentation
- Demonstrate proficiency in computer maintenance and networking.
- Software Developer Specialist: Develop a foundation in computer programming, data structures and discrete mathematics.
- Network Support Specialist: Apply computer-networking principles to build and troubleshoot networks.
- Information Security Specialist: Apply the tools and techniques of information security to secure physical and digital information.

Associate in Science Degree, Information & Computer Science

Core Requirements 27 credits
ICS 101 Digital Tools for the Information World (3)
ICS 110M or ICS 110P Introduction to Programming (3)
ICS 111 Introduction to Computer Science I (3)
ICS 125 Personal Computer Maintenance and Repair (3)
ICS 129 Introduction to Databases (3)
ICS 171 Introduction to Computer Security (3)
ICS 184 Introduction to Networking (3)
ICS 240 Operating Systems (3)
ICS 270 Systems Analysis (3)

General Education Requirements 21 credits
One DS Course (3)
ENG 100 Composition I (3)
ENG 225 or ENG 209 Technical Writing (3) or Business Writing (3)
SP 151 or SP 251 Personal and Public Speech (3) Principles of Effective Public Speaking (3)
ICS 170 Ethics for the Digital World (3)
One FG Course (3)
ICS 141 or MATH 103 or MATH 135 Discrete Mathematics for Computer Science (3) or College Algebra (3) or Precalculus: Elementary Functions (3)

Electives 3 credits any college course 100 or higher (3)

**Specialization 9 credits Select One Specialization Below**

**Specialization: Network Support Specialist**
ICS 215 Introduction to Scripting (3)
ICS 273 Network Design and Administration (3)
ICS 274 Advanced Network Design and Administration (3)

**Specialization: Information Security Specialist**
ICS 215 Introduction to Scripting (3)
ICS 281 Ethical Hacking (3)
ICS 282 Computer Forensics (3)

**Specialization: Software Developer Specialist**
ICS 211 Introduction to Computer Science II (3)
ICS 212 or ICS 215 Program Structure (3) or Introduction to Scripting (3)
ICS 241 Discrete Mathematics for Computer Science II (3)

**ICS AS Degree Summary:**
- ICS Core Courses 27 credits
- Specialization Courses 9 credits
- General Education Courses 21 credits
- Electives 3 credits
- Total Credits 60 credits

**Certificate of Achievement in ICS**
The Certificate of Achievement in Information and Computer Science is designed to provide the student with entry-level skills or job upgrading for positions under direct supervision in computer support, cabling and basic networking, office application support, and database management.

**First Semester**
ICS 101 Digital Tools for the Information World (3)
ICS 110M or ICS 110P Introduction to Programming (3)
ICS 129 Introduction to Databases (3)
ENG 100 Composition I (3)
MATH 103 or MATH 135 or higher or ICS 141 College Algebra (3) Precalc: Elementary Functions (3) Discrete Math for Computer Sci I (3)

**Second Semester**
ICS 111 Introduction to Computer Science I (3)
ICS 125 Personal Computer Maintenance and Repair (3)
ICS 170 Ethics for the Digital World (3)
ICS 184 Introduction to Networking (3)
SP 151 or SP 251 Personal and Public Speech (3) Principles of Effective Public Speaking (3)
Total Credits 30

Upon completion of the Certificate of Achievement in ICS, the student will be able to:

- Demonstrate computing literacy.
- Solve problems, develop algorithms and write object-oriented computer programs in a programming language.
- Design and a relational database with proper documentation.
- Demonstrate proficiency in computer maintenance and networking.

**Certificate of Achievement in Information Security**
The Certificate of Achievement in Information Security is designed to provide the student with the preparation needed to take the exams for several industry certifications.

**First Semester**
ICS 101 Digital Tools for the Information World (3)
ICS 111 Introduction to Computer Science I (3)
ICS 170 Ethics for the Digital World (3)
ICS 171 Introduction to Computer Security (3)
ICS 184 Introduction to Networking (3)

**Second Semester**
ICS 129 Introduction to Databases (3)
ICS 215 Introduction to Scripting (3)
ICS 240 Operating Systems (3)
ICS 281 Ethical Hacking (3)
ICS 282 Computer Forensics (3)

Total Credits 30

Upon completion of the Certificate of Achievement in Information Security, the student will be able to:

- Solve problems, develop algorithms and write object-oriented computer programs using a programming language.
• Design a relational database with proper documentation.
• Demonstrate proficiency in computer maintenance and networking.
• Exhibit proper use of an operating system.
• Apply the tools and techniques of information security to secure physical and digital information.

Courses Leading to Industry Certifications
Industry certifications must be taken in specialized testing centers. The ICS department is exploring the possibility of making Leeward Community College a CompTIA testing center.
http://home.pearsonvue.com/For-test-centers.aspx

• A+ (ICS 125)

CompTIA A+ is a vendor neutral computer support certification that is trusted around the world. It validates essential knowledge and skills needed to support computer users within an organization including hardware, networking, mobile devices, operating systems, troubleshooting, virtualization, security and operational procedures. This certification is earned by passing two exams.  https://www.comptia.org/certifications/a#overview

• Network+ (ICS 184)

CompTIA Network+ is a vendor neutral networking certification that is trusted around the world. It validates the essential knowledge and skills needed to confidently design, configure, manage and troubleshoot any wired and wireless devices. CompTIA Network+ certified individuals are in-demand worldwide.
https://certification.comptia.org/certifications/network

• Security + (ICS 171)

CompTIA Security+ is the certification globally trusted to validate foundational, vendor-neutral IT security knowledge and skills. As a benchmark for best practices in IT security, this certification covers the essential principles for network security and risk management – making it an important stepping stone of an IT security career.
https://certification.comptia.org/certifications/security

• Linux+ (ICS 240)

CompTIA Linux+ Powered by LPI certifies foundational skills and knowledge of Linux. With Linux being the central operating system for much of the world’s IT infrastructure, Linux+ is an essential credential for individuals working in IT, especially those on the path of a Web and software development career.
https://certification.comptia.org/certifications/linux

• CEH (ICS 281)
This course will significantly benefit security officers, auditors, security professionals, site administrators, and anyone who is concerned about the integrity of the network infrastructure.
http://www.globalknowledge.com/training/course.asp?pageid=9&courseid=20241&catid=191&country=United+States

- **EnCE (ICS 282)**

  The EnCase® Certified Examiner (EnCE®) program certifies both public and private sector professionals in the use of Guidance Software's EnCase® computer forensic software. EnCE® certification acknowledges that professionals have mastered computer investigation methodology as well as the use of EnCase® software during complex computer examinations. Recognized by both the law enforcement and corporate communities as a symbol of in-depth computer forensics knowledge, EnCE certification illustrates that an investigator is a skilled computer examiner.
  https://www.guidancesoftware.com/training/Pages/ence-certification-program.aspx

**A) Evidence of Industry Validation**

Industry certifications are a great boost to IT personnel salaries. Whereas some places look for college credit, most of the look for industry certifications as a form of validation that future employees have the necessary experience and skills to perform the assigned tasks at work. Many students must decide whether to spend their time studying to obtain industry certifications or to get college credit. Our approach blends these two options into college courses that prepare them to take industry certifications.

**B) Expected Level of Achievement**

For success at least 70% of the student should perform at least 70% of a given task correctly. Success in industry certification exams is measured differently. Some exams require at least 90% in order for a student to pass. Students are notified about these facts in the classroom.

**C) Courses Assessed**

The following courses were assessed during the past year. This concludes the assessment cycle that we set for our ICS program which requires that all course SLOs in all program courses are assessed at least every 2 years. This allows for all the previously mapped PLOs to be assessed along with the course SLOs

- ICS 111 Introduction to Computer Science I
- ICS 125 Personal Computer Maintenance and Repair
- ICS 129 Introduction to Databases
- ICS 171 Introduction to Computer Security
- ICS 211 Introduction to Computer Science II
D) Assessment Strategy/Instrument

NetLab is an important tool in many of our classes. NetLab is a virtual environment that provides students with the hands-on experience required in the industry. NetLab also allows students access from home therefore making it easier for students to fit these hands-on training sessions into their busy schedule. NetLab is also an instrumental part of many of our courses assignments as well as an assessment tool.

Courses that use NetLab

- ICS 125 Personal Computer Maintenance and Repair
- ICS 171 Introduction to Computer Security
- ICS 184 Introduction to Networking
- ICS 240 Operating Systems
- ICS 273 Network Design and Administration
- ICS 274 Advanced Network Routing and Optimization
- ICS 281 Ethical Hacking
- ICS 282 Computer Forensics

E) Results of Program Assessment

As of the end of the Spring 2020, all ICS program courses have been assessed except for ICS 170 Ethics for the Digital World and ICS 184 Introduction to Networking. We will prioritize completion of assessment of those courses in the next year. It is important to mention that all our lecturers helped the ICS program with SLO assessment. As described in the program description, we are short on full-time tenured faculty. There are some courses that are taught only by lecturers. They have graciously helped us with assessment.

The courses which were staffed solely by lecturers:

- ICS 212 Program Structure
- ICS 215 Introduction to Scripting
- ICS 240 Operating Systems
- ICS 270 Systems Analysis
- ICS 273 Network Design and Administration
- ICS 274 Advanced Network Routing and Optimization

As of now and as evidenced by data, our program has successfully assessed all the program learning outcomes. The SLOs mapped into the PLOs have achieved the required 70% mastery in at least 70% of the students in each course. In many instances we rely in technology tools for course and program assessment. For example, Blackboard Collaborate is a very effective tool to assess teamwork in online courses. We rely heavily on NetLab to assist with assessment.
4. Action Plan

Keeping Leeward CC’s mission statement in mind; We are striving to help more students obtain their goals, which in this case is to graduate and obtain an AS in ICS. Many students are limited to taking classes online due to family and job responsibilities. We will continue to offer our AS in ICS degree entirely online. All new courses developed will be required to have an online offering available for students. ICS faculty will use the distance education guidelines to develop high-quality online courses. ICS faculty will have their online courses assessed by peers with online experiences, including those from other disciplines. ICS faculty members Michael Bauer and Petersen Gross have completed online training from Quality Matters to build better online courses. Michael Bauer is also a certified peer reviewer for Quality Matters. Aside from that, ICS faculty have grown the offerings of hybrid courses. These courses allow students to work on their own using material posted online but to also have a weekly meeting with the instructor to better support learning and to interact with their classmates in person.

In response to UH System Initiatives and industry trends. The ICS program will introduce new courses in data science, virtualization, cloud security and computer science principles. The new courses will provide important skills for IT professionals. In addition, we will introduce a new cloud security specialization within our AS in ICS degree. A certificate in cloud security will also be available. We will also form a Business and Industry Leadership Team to obtain feedback for continual improvement and adaptability to industry trends.

Our program meets Perkins indicator 2P1: Completion. Our program awarded twice the number of degrees and significantly more certificate than IT programs at other UH Community Colleges. Class scheduling was conducted in a thoughtful manner which provided groups of courses in subsequent time periods which are taken by the same groups of students. This improved our completion rate and will continue to be used in the next year.

Our program fell slightly short of meeting Perkins indicator 1P1: Technical Skills Attainment. Our goal was 94.75 and actual level 92.05. During the past year, William Albritton and Michael Bauer met with a program alumnus to develop a pipeline for our students to obtain industry certifications. We were able to grant eight students with a voucher to take a certification exam. We will expand the program next year to provide the opportunity for more students to earn industry recognized certifications.

Our program fell short of meeting Perkins indicator 3P1: Student Retention or Transfer. Our goal was 86 and actual level 82.66. We have well-developed pathways into baccalaureate programs at UH Manoa and UH West Oahu. We developed a pathway with UH Maui College this past year and expect to see fruit from that effort in next year’s data. Several of our students take selected classes at Leeward to retrain or update job skills without seeking our AS degree. We have a series of targeted Certificate of Competences which provide these students with the desired training. Unfortunately, these short certificates do not count toward attainment of Perkins Indicators.

Our program fell short of meeting Perkins indicator 4P1: Student Placement. Our goal was 66.75 and actual level 58.21. Michael Bauer, William Albritton and Daniel Cordial are working toward
developing a Business and Industry Leadership Team (BILT) to advise our program and create internships and placements for our students. We are planning our initial meeting of the BILT in Spring 2021.

Our program fell short of meeting Perkins indicators 5P1: Nontraditional Participation and 5P2: Nontraditional Completion. Michael Bauer will continue to engage the resources of NCWIT and the ACM to recruit and retain women in our ICS program. The program is working in collaboration with Alu Like on a grant to fund opportunities for Native Hawaiians, including Native Hawaiian women. We hope to obtain funding to support participation in cybersecurity exercises, additional industry certifications, provide resources to our students and to provide additional professional development opportunities.

5. Resource Implications

A) ICS Faculty Position

The ICS program currently has six full time tenure-track faculty. Two of them cannot get overloads because they have release time to serve the college. Aside from having a lighter teaching load, they cannot get overload. This decreases the classes that may be taught in two different ways. From the remaining four ICS full time faculty members, three are willing to work overload. The ICS program has up to twelve lecturers teaching during any given semester. Some of them can only teach a limited range or courses or for a limited number of credits. Even with these limitations, four lecturers have completely full loads of five classes per semester. Some of them teach a sixth class.

The only full-time lecturer with the skills to teach almost any course in the ICS curriculum is Edward Meyer. Ed teaches a wide repertoire of courses which greatly supports the ICS program. Ed developed one new course for the ICS program and has assisted with curriculum development for five other courses. We need to continue to work toward funding a full-time position for Edward Meyer.

B) Industry Certification for ICS Faculty

Our full-time ICS faculty seek professional development leading to industry certification. The faculty would like to take ICS industry certification exams. The costs range from about $200 to $800, depending on the exam for the certification. The CAE2Y certification for Leeward CC requires that at least one instructor have a Security+ certification or higher. At the present time only one ICS faculty has earned Security+. The requirement could change in the future, so that more instructors might need these certifications. Also, it's best not to rely on only one instructor who has the required certification. Studying for and taking these industry exams will help instructors to keep up to date with changes in computer technologies. The estimated cost to obtain certification for ICS faculty is $1,200 to $4,800 (6 * $200 to $800).
C) NetLab Maintenance

NetLab is very important for the ICS program. It provides students with the opportunity to access virtual equipment and to perform hands on activities from home. The virtual equipment provided by NetLab, if it were real will be worth up to $100,000 and will be confined to the classroom. Whereas NetLab provides the same service for a fraction of the cost and makes it available 24/7 from anywhere access to the Internet is available.

We need to continue to sustain the NetLab through service agreements and software licenses. Support for the NetLab requires $3,000.00 per year for software licenses. We also need to budget for periodic server replacements for NetLab. We replaced one server this year. We would like to replace two additional servers in the next year at a cost of approximately $40,000. NetLab helps the ICS program to assess several SLOs in the following courses:

- ICS125 Personal Computer Maintenance and Repair
- ICS171 Introduction to Computer Security
- ICS184 Introduction to Networking
- ICS240 Operating Systems
- ICS273 Network Design and Administration
- ICS274 Advance Network Routing Optimization
- ICS281 Ethical Hacking
- ICS282 Computer Forensics

Aside from allowing us to assess SLOs in the above-mentioned courses, NetLab allows the ICS program to offer the same courses online. Without NetLab, students would have to come to our campus to use computer equipment during available hours to obtain hands-on skills. This would weed out many students that currently have full time jobs. NetLab is available to students 24 hours a day.

D) The Hub Support

In order to maintain the Hub, we need the current space and hire student workers to manage it. Ideally some of the ICS lecturer’s offices will be transferred to the Hub. That will help alleviate the currently overpopulated computer science faculty area. The cost for student workers the Hub 40 hours per week at $11.65 per hour is $7,456 per 16-week semester.

ICS student tutors need to be hired to support our programming classes. The cost for student tutors 10 hours per week at $11.65 is $1,864 per 16-week semester.

☐ I am NOT requesting additional resources for my program/unit.