

# HAWAI'I IT WORKFORCE NEEDS REPORT

November 2021

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# **EXECUTIVE SUMMARY**

This report aims to understand Hawai'i companies' information technology (IT) workforce needs and how well Hawai'i meets those needs. The results will inform education and training programs, including K-12, UH credit and noncredit programs, and statewide programs. In this way, more Hawai'i students and residents can be employable in IT-related fields in Hawai'i.

The report is intended to serve as a starting point for further discussion by stakeholders who together can help ensure Hawai'i is preparing our own future-focused IT talent pipeline, and supporting workforce diversification and an innovation economy.

## OVERVIEW OF IT WORKFORCE IN HAWAI'I

In 2020, the IT sector in Hawai'i was responsible for 12,740 jobs, 3,834 hires, and 894 average annual openings. In 2018, the industry had contributed \$2.037 billion, or 2.2 percent, to Hawai'i's total nominal Gross Domestic Products<sup>1</sup> (GDP).<sup>2</sup> The average tech industry hourly wage in Hawai'i is \$39.92<sup>3</sup>, 157 percent higher than the \$15.53 ALICE Individual Living Wage.<sup>4</sup>

The US Bureau of Labor Statistics (BLS) data has shown that computer and technology occupations are promising career fields. Related employment is projected to increase 13 percent nationally between 2020 to 2030. In Hawai'i, the total employment forecast for the computer and mathematics occupation group, from 2018-2028, is an increase of 7%.

The largest number of IT positions by industry in Hawai'i are within the NAICS 541 Professional, Scientific, and Technical Services. This category includes technology companies and consulting companies that provide services to the Department of Defense. Overall, of companies posting for IT positions, 48% are technology companies or have military contracts, 25% are non-technology companies that rely heavily on technology such as banks and healthcare providers and the remaining 27% are educational institutions, non-profits, and government.

<sup>&</sup>lt;sup>1</sup> The gross domestic product (GDP) in a region is the monetary value of all goods and services produced within the geographic area of the region in a particular period of time. It is the broadest quantitative measure of a region's total economic activity. DBEDT.

<sup>&</sup>lt;sup>2</sup> Hawai'i Economic Structure Analysis Using the Industry Level Gross Domestic Product Data, State of Hawai'i Department of Business, Economic Development and Tourism (DBEDT), July 2019.

<sup>&</sup>lt;sup>3</sup> Workforce Availability Report, Emsi Q4 2021 Dataset, November 2021, University of Hawai'i Community Colleges, <u>www.economicmodeling.com</u>

<sup>&</sup>lt;sup>4</sup> ALICE in Hawai'i: A Financial Hardship Study, 2020 Hawai'i Report, Aloha United Way, <u>ALICE Project – Hawaii</u> (<u>unitedforalice.org</u>)

<sup>&</sup>lt;sup>5.</sup> The State of Hawai'i 's Department of Business, Economic Development and Tourism (DBEDT) Hawai'i Defense Economy (HDE) Strengths-Weaknesses-Opportunities-Threats (SWOT) Analysis Report and Action Plan

The Hawai'i Defense Economy SWOT Analysis Report<sup>5</sup> estimates that Defense-related contract awards in NAICS 5415 (Computer Systems Design and Related Services) was close to \$128 million in 2020. This level is estimated to support 1,700 jobs (not all of them IT) and contribute \$240 million in economic impact to the Hawai'i economy.

## **IN-DEMAND OCCUPATIONS**

The four IT occupations with the largest number of employees are Computer Systems Analysts, Software Developers & Quality Assurance Engineers/Analysts and Testers, Computer User Support Specialists, and Network and Computer Systems Administrators. These are the occupations that are common within most industries. Other IT positions are more concentrated within specific industries.

## **FASTEST GROWING OCCUPATIONS**

The top three fastest-growing IT occupations in Hawai'i from 2018 to 2028 are projected to be: Information Security Analysts with 60 new positions (+33%); Computer and Information Research Scientists with 20 new jobs (+25%); and Software Developer and Software Quality Testers with 220 new positions (+15%). This last category is projected to have the largest increase in jobs, followed by Computer User Support Specialists with 110 (+12%) more jobs<sup>6</sup>

Executives identified cloud computing, cybersecurity, and data analysis together with data analytics as the skills that are increasing in demand.

## SUPPLY AND DEMAND

The demand for IT employees in Hawai'i exceeds the number of available IT individuals seeking jobs in the industry. In 2020 there were approximately 894 job openings (including retirements and new positions) within the category of Computer and Mathematical occupations in Hawai'i.<sup>7</sup> There were about 775 program completions from Hawai'i higher educational institutions in Comprehensive Instructional Programs (CIPs) that included IT-related skills in the same year. If the skills gained in the completed programs matched the skills required in the job openings, that still leaves a gap of 111 unfilled positions. This gap is a rough estimate, but it is consistent with the number of unique IT job postings exceeding the number of IT job applications.

In addition, insights from interviews and analysis of Emsi data identify a high churn level within the Computer and Mathematical occupations in Hawai'i of about 30%.<sup>8</sup> These are individuals moving from one position to another within these occupations. An employer observed that the competition for experienced IT workers is very competitive locally and employees will leave a position for the same position with better pay.

<sup>&</sup>lt;sup>6</sup> HireNet Hawai'i, calculations by SMS Research, the estimation and projection data only include non-confidential data.

<sup>&</sup>lt;sup>7</sup> Workforce Availability Report, Emsi Q4 2021 Dataset, November 2021, University of Hawai'i Community Colleges, www.economicmodeling.com

<sup>&</sup>lt;sup>8</sup> Occupation Table, 17 Computer and Mathematical Occupations in Hawai'i, Emsi Q2 2021 dataset, June 2021, University of Hawai'i Community Colleges.

## SKILLS AND CREDENTIALS

- Ideal employees have a mix of technical skills, credentials, and professional skills.
- The five most employer sought technical skills between January and April 2021 were Computer Science, Operating Systems, Cyber Security, Information Systems, and Python.
- The three certifications included most in job postings were IAT Level II Cert., CompTIA Security+, and Certified Information Systems Security Professional.
- Communications, management, operations, troubleshooting, and leadership were the most frequent professional skills in job postings. With professional skills, new employees should have the ability to apply their technical skills to the challenges within a worksite and be a member of a working group. Work experience and internships are valued as a way of acquiring and demonstrating professional skills. Often a bachelor's degree is used as proxy for professional skills.
  - There is a high level of competition for internships. An example provided through an interview said there were over 80 applications for 15 internships.

## WAGES

The 2020 ALICE Report for Hawai'i provided a survival level hourly wage for an individual at \$15.53, and an hourly stability wage at \$25.49<sup>9</sup> in 2018. Of the fourteen tech-specific occupations in the Workforce Availability report, thirteen had median income levels above the hourly stability wage and the one was above the survival level hourly wage.<sup>10</sup>

<sup>&</sup>lt;sup>9</sup> Workforce Availability Report, Emsi Q4 2021 Dataset, November 2021, University of Hawai'i Community Colleges, www.economicmodeling.com

<sup>&</sup>lt;sup>11.</sup> ALICE in Hawai'i: A Financial Hardship Study, 2020 Hawai'i Report, Aloha United Way, <u>ALICE Project – Hawaii</u> (unitedforalice.org)

## RECOMMENDATIONS

- Improve the alignment between educators and employers: Improve the alignment and communications between IT workforce employers and educational institutions. The IT field is evolving rapidly. Only by maintaining a connection between the two, can students be better prepared to fulfill the job requirements of the future.
- Increase career awareness opportunities: Involve industry partners in career awareness and work-based learning (guest speakers, workplace visits, career fairs) to introduce IT occupations to Hawai'i students at a younger age. These actions will increase the likelihood of more students in higher education majoring in IT-related fields. Within higher education institutions, career counseling can make students more aware that different IT occupations have specific technical skills and certifications requirements.
- Increase training opportunities to improve professional skills: Engage industry partners to provide more on-the-job training opportunities, including internships and apprenticeship programs. Training opportunities help students acquire professional skills, including solid communications skills, critical thinking, problem-solving, and flexibility. These skills provide managers with the confidence that an employee can apply the technical skills they have learned to the work environment. Often employers perceive that these skills are only acquired by graduating with a bachelor's degree or having work experience. The challenge is to scale the work experiences that provide on-the-job training that make IT students employable.
- <u>Review minimum qualifications for entry-level jobs</u>: Employers should consider reviewing the screening criteria for entry-level IT positions. A bachelor's degree may not be necessary for some positions when skills have been gained through training or work experience.
- <u>Improve data collection</u>: Improve the tracking and reporting of data related to IT courses, certifications, and where students go when they leave an educational institution. This data will support better evaluation of programs and contribute to better planning for the future. Improve data that goes into projecting the number of future IT jobs for the State.

# HAWAI'I IT WORKFORCE NEEDS REPORT

# **OVERVIEW**

The US Bureau of Labor Statistics (BLS) data has shown that computer and technology occupations are a promising career field, with projected employment set to increase 13 percent between 2020 to 2030. However, in Hawai'i, the total employment forecast for the computer and mathematics occupation group, from 2018-2028, is an increase of only 7.13%.<sup>11</sup>

Information Technology (IT) employers in the state cover a diverse range of organizations such as IT and technology companies, the military and their contractors, and even non-IT companies, such as healthcare and financial institutions. This range is reflected in the variety of industries that employ IT workers. Predictably, the industry with the most IT employees in 2018 was the professional, scientific, and technical services field, followed by management of companies and enterprises, and educational services. For most IT positions in Hawaii, average median salaries for IT positions are above the ALICE livable wage for singles. Many IT occupations exceed the ALICE livable wage level for families. IT positions provide another opportunity for Hawaii residents to earn a livable wage and remain in Hawaii.

Overall, the employment statistics for computer and mathematical occupations in Hawai'i show that in 2020, there were a total of 12,740 jobs, 3,834 hires, 894 average annual openings, and a turnover rate of 30 percent. In 2018, the IT sector had contributed \$2.037 billion, or 2.2 percent, to Hawai'i's total nominal Gross Domestic Products<sup>12</sup> (GDP).<sup>13</sup> Despite not contributing as much nominal GDP as the real estate, accommodation, and retail industry, it had the highest annual real GDP<sup>14</sup> growth rate among all sectors between 2001 and 2018 at 4.9 percent. As an economic driver that covers a wide range of industries, IT has become a significant component propelling the prosperity of Hawai'i. Nevertheless, IT is a dynamic industry that changes quickly. Ensuring that our state workforce has an adequate and efficient education in IT will guarantee continued growth for Hawai'i's economy.

# OBJECTIVE

The primary objective of this project is to provide recommendations that lead to more Hawai'i students and residents being employed in IT-related fields with Hawai'i companies.

We will look at both the demand and supply sides of the IT workforce: the employers seeking to hire IT staff and skills required, compared with what applicants are providing and training/certifications provided by the University of Hawai'i System, particularly the Community Colleges (UHCC). Specifically, we look at the courses and skillsets UHCCs and University of Hawaii Manoa are offering students in preparation for their IT career together with the current and

<sup>&</sup>lt;sup>11</sup> HireNet Hawai'i

<sup>&</sup>lt;sup>12</sup> The gross domestic product (GDP) in a region is the monetary value of all goods and services produced within the geographic area of the region in a particular period of time. It is the broadest quantitative measure of a region's total economic activity. DBEDT.

<sup>&</sup>lt;sup>13</sup> Hawaii Economic Structure Analysis Using the Industry Level Gross Domestic Product Data, State of Hawai'i Department of Business, Economic Development and Tourism (DBEDT), July 2019.

<sup>&</sup>lt;sup>14</sup> Real gross domestic product is the inflation-adjusted value of the goods and services produced by labor and property located in the United States. Federal Reserve Bank of St. Louis.

future demand for those skillsets on the IT job market. Interviews and a survey of Chief Executive Officers and Chief Information Officers supplement the data gathered and contribute to an indepth understanding of the challenges in finding quality IT employees and recommendations for the future.

# DATA SOURCES

In this project, we utilize several data sources to investigate the current IT job market.

I. Economic Modeling Specialist International (Emsi) II. HireNet Hawai'i III. Hawai'i Career Explorer IV. O\*NET OnLine V. UHCCs' Data

EMSI provides more granular data than the traditional labor market information sources such as the Bureau of Labor Statistics (BLS) and the US Census Bureau. HireNet Hawai'i has the most current labor information on jobs, wages, unemployment, occupation-related data available in Hawai'i, and projections. It will serve as the backbone of this analysis. Career Explorer was developed and maintained by UHCCs. It provides the information of hiring companies and the job market trends and projections for each IT occupation. O\*NET OnLine serves as another reference source on the reported job titles and median annual wage for each occupation. UHCCs data contain the IT curriculum information. Each of these data sources complements one another in this analysis.

In addition to the secondary data above, two methods of primary data collection were undertaken:

VI. An IT workforce survey of Hawai'i employers was conducted by SMS. A link to the survey was sent to employers by the CIO Council, the Chamber of Commerce Hawai'i, the IT Workforce Advisory Committee, Broadband Hui, Society for Human Resource Management Hawai'i Chapter (SHRM), DLIR Workforce Development Division, Hawai'i Lodging and Tourism Association Hospitality IT Council. Seventy-five completed surveys were received representing a mix of industries: Information Technology (20%), Finance & Insurance (17%), Professional, Scientific & Technical Services (15%), Utilities & Real Estate (12%), Transportation & Warehousing (12%), Non-profit (8%), Healthcare & Social Assistance (9%), Educational Services (5%), and Food and Hospitality (1%).

VII. SMS conducted Executive Interviews with Chief Executive Offices and Chief Information Officers about their challenges in hiring IT employees and recommendations on ensuring an adequate number of qualified employees for the future.

# APPROACH

According to HireNet Hawai'i, the IT sector falls under the computer and mathematical occupations group. This group has 34 different occupations, of which 28 of them are related to the IT sector.<sup>15</sup> Each IT occupation may be further broken down into 5 to 11 job titles. We focus on IT occupations that are more popular<sup>16</sup> in Hawai'i and are projected to grow substantially in the future.

The list of selected IT occupations is presented in Table 1. The Standard Occupational Classification Codes (SOC)<sup>17</sup> and the associated occupation descriptions can be found in Appendix A at the back of this report.

IT Occupations	Unique Postings in 12 months
Computer User Support Specialists	2,555
Software Developers and Software Quality Assurance Analysts and Testers	2,508
Network and Computer Systems Administrators	2,288
Computer Occupations, All Other	2,150
Information Security Analysts	1,593
Computer Systems Analysts	1,098
Web Developers and Digital Interface Designers	935
Computer and Information Research Scientists	309
Computer Programmers	275
Computer Network Architects	212
Database Administrators and Architects	124
Computer Network Support Specialists	66

#### Table 1. Selected List of IT Occupations

Source: Hawai'i Career Explorer

<sup>&</sup>lt;sup>15</sup> HireNet Hawai'i

<sup>&</sup>lt;sup>16</sup> The popularity is determined based on the number of unique postings over the past 12 months on Hawai'i Career Explorer

<sup>&</sup>lt;sup>17</sup> According to the U.S. Bureau of Labor Statistics, the Standard Occupational Classification (SOC) system is a federal statistical standard used by federal agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data.

Note: Software Developers and Software Quality Assurance Analyst and Testers will be further broken down into Software Developers (System Software), Software Developers (Applications), and Software Quality Assurance/Engineer whenever possible.

# DATA ANALYSIS

We begin the analysis by looking at the demand side of the current IT workforce. Information technology covers a wide range of industries. These industries may or may not be genuinely related to IT. That means even companies not primarily IT-focused are also looking to fill in the technology positions for their business needs.

## Number of Technology and Non-technology Companies

Hawai'i Career Explorer provides a list of companies that are hiring for different technology positions in 2021. We collected the list of companies and further classified them into one of the following categories:

- (1) Primarily IT companies,
- (2) Primarily non-IT companies,
- (3) Military,
- (4) Companies (Military Contractors), and
- (5) Federal / State / Other

The primarily IT companies refer to companies that focus on providing IT services, products, or solutions to their clients. Mainly non-IT companies offer services to their clients, such as financial institutions, healthcare or insurance companies. Military primarily refers to the United States Department of Defense, including civilian employees of the Department of Defense. Companies (military contractors) refer to companies awarded one or more military contracts. Lastly, federal/state/other refer to Federal Departments, State Departments, and other associations.

Some companies may fall into more than one of these categories. They include multiple industries that provide both IT and non-IT services to the public and the government. One good example would be Amazon.com, Inc.; its products and services include e-commerce services, digital cloud computing, and artificial intelligence technology.<sup>18</sup> A single classification may not include all company types but will provide close estimates on how many different types of companies are hiring the technology positions.

<sup>&</sup>lt;sup>18</sup> "Amazon.com, Inc. - Form-10K". NASDAQ. December 31, 2018



# Figure 1. Number of Technology and Non-Technology Companies (2019 Q4 to 2020 Q3) Hiring IT Positions

Source: Hawai'i Career Explorer, 2021 (Accessed on 9/9/2021)

Figure 1 summarizes the number of technology and non-technology companies that hire to fill different technology positions. The time frame for the job postings advertised by these companies is estimated to be between 2019 Q4 and 2020 Q3. Since a company may hire more than one technology position, the list of companies was de-duplicated. Each company is unique and only shows up one time. Overall, 480 unique companies are looking to fill different types of technology positions. Approximately 44 percent (212) of these companies are primarily non-IT companies. Close to 30 percent of these companies (138) are predominantly considered IT companies. Companies serving as military contractors make up 18 percent (86) of all companies. Less than 10 percent of these entities that look to hire the technology positions are from the Federal and State departments or other associations.

At first, it appears that the primarily non-IT companies are hiring more technology positions than the IT companies. However, companies being awarded military contracts are usually highly specialized in IT. If we combine primary IT companies with military contractors, about 47 percent of all companies (224) that look to hire these technology positions are, indeed, primarily IT companies.

## Annual Turnover and Average Annual Openings

Based on Emsi data, there appears to be a lot of movement of employees in computer occupations in Hawai'i based on Table 2. For example, Web Developers had a 43 percent turnover rate in 2020 with 125 separations and 136 hires. On average, there are 20 annual openings in this SOC due to both retirements and an increase in positions.

Not surprisingly, the occupations with the largest number of jobs had more hires and average annual openings: Software Developers & Software Quality Assurance Analysts and Testers; Computer User Support Specialists; Computer Systems Analysts; Network & Computer Systems Administrators; and Computer Occupations, All Other. These occupations are in higher demand based on the number of hired employees and average annual openings. Individuals interviewed believe that once employees get work experience, they frequently leave for a higher-paying position. These positions may also include working virtually for a company on the Continent while living in Hawaii.

SOC	Description	2020 lobs	2020 Hires	2020	2020 Turnover	Avg. Annual
000	Description	2020 0003	202011103	Separations	Rate	Openings
15-1257	Web Developers and Digital Interface Designers	288	136	125	43%	20
15-1251	Computer Programmers	515	145	211	41%	29
15-2098	Data Scientists and Mathematical Science Occupations, All Other	89	40	31	35%	10
<mark>15-1256</mark>	Software Developers and Software Quality Assurance Analysts and Testers	1,793	817	623	35%	148
15-1241	Computer Network Architects	440	116	148	34%	25
<mark>15-1232</mark>	Computer User Support Specialists	1,645	589	540	33%	114
15-1231	Computer Network Support Specialists	772	209	244	32%	51
<mark>15-1244</mark>	Network and Computer Systems Administrators	1,462	370	433	30%	86
15-1245	Database Administrators and Architects	306	91	88	29%	21
15-1211	Computer Systems Analysts	1,992	518	571	29%	129
15-1212	Information Security Analysts	557	184	150	27%	47
15-2031	Operations Research Analysts	226	59	52	23%	19
15-1299	Computer Occupations, All Other	2,265	463	480	21%	159
15-2041	Statisticians	187	56	39	21%	19
15-1221	Computer and Information Research Scientists	97	20	18	19%	7

#### Table 2. Computer and Mathematical Occupations in Hawai'i Emsi Q2 2021 Data Set<sup>19</sup>

Source: Emsi occupation employment data are based on final Emsi industry data and final Emsi staffing patterns. State data from Hawai'i Department of Labor and Industrial Relations, Research and Statistics Office.

# Average Number of Job Postings in Hawai'i (April to May, July to August 2021)

HireNet Hawai'i provides the number of job openings for the IT occupations in Hawai'i. We collected the job openings data from April through May and July through August 2021 to demonstrate how many positions may be available during a given period. On average, there were 535 and 395 IT job openings between April through May and July through August, respectively. Among all IT occupations, Computer User Support Specialists had the highest percent of job openings in these four months (~16% to 17%). Software Developers, Applications also had a consistent percent of job openings (~11% to 12%). Note that throughout this report, two time periods were selected to draw a sampling of HireNet data. Often the data was consistent, sometimes not, which reflects the fluctuations in job postings.

<sup>&</sup>lt;sup>19</sup> University of Hawai'i Community Colleges, Occupation Table Report, Computer and Mathematical Occupations in Hawai'i, June 2021, Emsi Q2 2021 Data Set.

	Apr - May (Average Number of Job		Jul - Aug (Average Number of Job	
IT Occupations	Openings)	Percent	<b>Openings</b> )	Percent
Computer User Support Specialists	85	16%	68	17%
Network and Computer Systems Administrators	38	7%	65	16%
Computer Systems Analysts	31	6%	47	12%
Software Developers, Applications	62	12%	45	11%
Computer and Information Systems Managers	28	5%	40	10%
Computer Network Architects	33	6%	30	7%
Computer Programmers	68	13%	28	7%
Information Security Analysts	40	7%	21	5%
Computer and Information Research Scientists	30	6%	14	4%
Software Developers, Systems Software	65	12%	11	3%
Software Quality Assurance Engineers/Analysts and				
Testers	19	3%	9	2%
Computer Network Support Specialists	12	2%	8	2%
Database Administrators	12	2%	7	2%
Web Developers	4	1%	3	1%
Computer Occupations, All Other	2	0%	2	0%
Computer Hardware Engineers	9	2%	1	0%
Total	535	100%	395	100%

Table 3. Average	e Number of Job	Openings in Hawaiʻi (	(April to Ma	v. Julv to A	ugust. 2021)
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Source: HireNet Hawai'i

On the other hand, the percent of job openings for the Network and Computer Systems Administrators, Computer Systems Analysts, Computer and Information Systems Managers, Computer programmers, and Software Developers, Systems Software were higher in one month and lower in the other month. One possibility is that these occupations are in much higher demand and these positions usually get filled up quickly as soon as the jobs posted. However, we need more data to support this hypothesis.

# **Future IT Occupation Projections**

Understanding the future growth patterns of IT occupations is essential for educational institutions to maximize efficiency in allocating courses and resources to students. According to HireNet Hawai'i, the number of Software Developers and Software Quality Testers jobs was among the highest of all IT occupational jobs at 1,460 (23%). Computer User Support Specialists jobs were at about 930 (15%), followed by 920 Network and Computer System Administrators jobs (14%) and 910 Computer System Analysts jobs (14%).

In contrast, Computer and Information Research Scientists, Information Security Analysts, Web Developers, Digital Interface Designers, and Computer Network Architects had the least number of jobs in 2018. They only accounted for approximately one to three percent of all IT jobs in Hawai'i, respectively. All results are based on non-confidential data only.

Input from interviews identifies information security and Cybersecurity as positions that will be most in greater demand in the future. While relatively small in number based on the public data, these fields are already challenged to find qualified employees, and employers are often recruiting employees from the Continent.





Source: HireNet Hawai'i

Note: The estimation and projection data only show non-confidential data

# Fastest Growing IT Occupations

The question that follows naturally is, which of these will be the fastest-growing IT occupations by 2028? According to the State of Hawai'i Occupational Projections, the top three fastest-growing IT occupations are projected to be, (1) Information Security Analysts at +33 percent, (2) Computer and Information Research Scientists at +25 percent, and (3) Software Developer and Software Quality Testers at +15 percent. This is consistent with projections provided in interviews.

Interestingly, the number of Computer Programmers jobs is expected to decline -10 percent by 2028. But we should reemphasize that these job projections are based on non-confidential data only. There is a possibility that some of these occupations may be growing much faster than expected due to unreported data.

	2018 (Estimated # of Jobs)	2028 (# of Job Projections)	Difference	% Change
Information Security Analysts	180	240	60	33.3%
Computer and Information Research Scientists	80	100	20	25.0%
Software Developer and Software Quality Testers	1,460	1,680	220	15.1%
Web Developer & Digital Interface Designers	200	230	30	15.0%
Computer Network Architects	200	230	30	15.0%
Computer User Support Specialists	930	1,040	110	11.8%
Computer System Analysts	910	1,000	90	9.9%
Database Admin & Architects	310	340	30	9.7%
Computer Occupation, All Other	240	260	20	8.3%
Network & Computer System Administrator	920	990	70	7.6%
Computer Network Support Specialists	560	590	30	5.4%
Computer Programmers	390	350	-40	-10.3%

#### **Table 4. Fastest Growing IT Occupations**

Source: HireNet Hawai'i

Note: The estimation and projection data only include non-confidential data

# **Occupations Hardest to Fill**

The number of jobs is projected to grow for almost all IT occupations. However, some are more difficult to fill than others. Table 4 below presents a snapshot of the supply (number of candidates) and demand (number of job openings) for each occupation between May and September. The supply and demand ratio (S/D ratio) is calculated as:

 $S/D Ratio = \frac{Number of Candidates}{Number of Job Openings}$ 

If the ratio is less than one, then it means that there are fewer candidates available per job opening. Conversely, if the ratio is greater than one, more candidates are available per job opening. The S/D ratio is equal to one if the number of candidates and the number of job openings are the same. The median S/D ratio across three months evaluated which IT occupations are consistently more difficult to fill.

Among all IT occupations, Computer Network Architects is the most challenging occupation to fill. It has a median S/D ratio of 0.20 over the data collection period. This means that only one candidate is available for every five job openings. The second hardest-to-fill occupation is the Computer System Analysts with a median S/D ratio of 0.42. Software Developers have a median S/D ratio of 0.46, close to one candidate for every two job openings.

#### Table 5. Positions Hardest to Fill

		5/18/2021			7/21/2021			9/8/2021		Median
IT Occupations	Supply	Demand	S/D Ratio	Supply	Demand	S/D Ratio	Supply	Demand	S/D Ratio	S/D Ratio
Computer Network Architects	4	34	0.12	5	23	0.22	7	35	0.20	0.20
Computer System Analysts	19	42	0.45	16	38	0.42	18	61	0.30	0.42
Software Developers:	46	102	0.45	40	23	1.74	46	100	0.46	0.46
Software Developers, Applications	32	72	0.44	27	13	2.08	31	79	0.39	N/A
Software Developers, Systems Software	14	30	0.47	13	10	1.30	13	9	1.44	N/A
Software Quality Assurance Engineers and Testers	N/A	N/A	N/A	N/A	N/A	N/A	2	12	0.17	N/A
Computer Programmers	19	25	0.76	17	27	0.63	18	27	0.67	0.67
Computer and Information Research Scientist	11	17	0.65	9	10	0.90	10	14	0.71	0.71
Network and Computer System Administrators	55	63	0.87	46	55	0.84	42	74	0.57	0.84
Computer User Support Specialists	75	65	1.15	61	32	1.91	62	91	0.68	1.15
Information Security Analysts	34	28	1.21	26	14	1.86	31	33	0.94	1.21
Computer Network Support Specialist	22	6	3.67	13	6	2.17	14	7	2.00	2.17
Database Administrators and Architects	25	10	2.50	18	4	4.50	15	4	3.75	3.75
Web Developer and Digital Interface Design	25	5	5.00	17	2	8.50	21	5	4.20	5.00
Computer Occupations, All Other	14	2	7.00	10	1	10.00	9	4	2.25	7.00
TOTAL	349	399	0.87	278	235	1.18	293	455	0.64	0.87

Source: HireNet Hawai'i

Job Source: Online advertised jobs data

Candidate Source: Individuals with active résumés in the workforce system

Note: Cells highlighted in red indicate relatively low S/D ratios and blue color represents high S/D ratios

On the other hand, Database Administrators and Architects, Web Developer and Digital Interface Designers, and Computer Occupations, All Other appear to be the top three occupations easiest to fill. The median S/D ratios of these three occupations are all greater than one, with the highest ratio being 7. This suggests that more candidates are available than the number of job openings for these occupations in the job market. Overall, the median S/D ratio of the IT occupations is 0.87, which implies that the demand for the IT labor force is slightly higher than the supply. It must be remembered that while candidates may apply for a position not all will be qualified for that position.

## In-Demand Technical Skills, Professional Skills, and Certificates

This section will look at the technical skills (tools and technologies), professional skills, and the types of certificates that are most in-demand in the current IT job market.

## **Technical Skills (Tools and Technologies)**

Technical skills are practical skill sets required to complete some specific tasks. In the context of IT, technical skills typically refer to the knowledge and experience of using a set of tools and technologies. Possessing adequate technical skills that align with the job market needs is especially important to IT candidates while job searching.

We utilize the EMSI data to examine the top 10 technical skills asked in the job postings between January and April and June and July 2021. These top 10 technical skills were selected and reported based on the frequencies of the skills that appeared in job postings.

The top 10 most sought technical skills between June and July were Computer Science, Agile Methodology, Technology Solutions, Automation, Operating Systems, Python, Amazon Web Services (AWS), Software Development, Java, and Structured Query Language (SQL).





#### Source: Emsi Data

The Emsi data shows that some technical skills were sought more often than others. For instance, the skills of Computer Science, Agile Methodology, Automation, Operating Systems, Python, and Structured Query Language (SQL) have consistently appeared in job postings for the past six months. Computer Science and Operations Systems may be more foundational skills for many occupations, while other skills may be more position dependent.

## **Certifications**

Earning a certification is an effective way to prove that one meets the minimum standard of competence in performing a specific task or analysis. It adds value and increases employers' confidence during the hiring process because a certificate indicates job competency.

January to	April 2021	June to July 2021		
Certificates	Job Postings	Certificates	Job Postings	
Certified Information				
Systems Security	181	IAT Level II Cert	255	
Professional				
Cisco Certified Network	1 / 1		254	
Associate	141	CompTIA Security+	234	
Cisco Certified Network		Certified Information		
Associate (CCNA)	80	Systems Security	146	
Security		Professional		
		Cisco Certified		
Certified Ethical Hacker	63	Network Associate	112	
		(CCNA)		
Certified Information	58	GIAC Cortifications	94	
System Auditor (CISA)	58	GIAC Certifications	54	

#### Table 6. Top 5 Certifications Asked in Job Postings by Period

Source: EMSI Data

Table 5 presents the top 5 certificates listed most frequently in job postings from January to April and June to July 2021. Certified Information Systems Security Professional and Cisco Certified Network Associate (CCNA) were two certificate qualifications continuously sought by employers for the past six months. Of all certificates, both IAT Level II Certificate (255) and CompTIA Security+ (254) showed up in more than 250 job postings, outweighing the third most frequent certification—Certified Information Systems Security Professional (181) by more than 70 times.

## **Professional Skills**

Professional or "soft skills" are as critical as technical skills to employers. Unlike technical skills that can be acquired via school or job-training programs, professional skills are generally more universal, less well-defined. They may require a much longer time to develop and are more experience-based. Because of that, personal skills are more likely to be acquired through experience at work rather than at school.

Figure 4 shows employers' top 10 professional skills in job postings between January to April and June to July 2021. As in the case of technical skills, these top 10 personal skills were selected and reported according to their frequencies appeared in job postings. Of the top 10 professional skills, communications, management, and operations ranked highest in terms of frequencies appeared in job postings for both periods. Close to 30 to 40 percent of job postings included these three professional skills as job requirements.

Troubleshooting and leadership skills are the following most important professional skills that employers are seeking from job candidates. These two skills were seen in approximately onefourth to one-fifth of job postings. The remaining top 10 professional skills are planning, problemsolving, information technology, infrastructure, innovation, and integration.





Source: Emsi data

Employers face a significant challenge because new employees often have the needed technical skills but cannot apply these skills to actual work tasks and work well within a team. Employers are spending time and resources to train new employees in the professional skills noted earlier. Professional skills are primarily acquired through work experience, and for new students through internships, apprenticeships, and capstone projects.

Based on the Employer Survey, there are too few companies offering internships due to insufficient resources to manage the administration of internships and staff time to train interns. Employers report that demand for internships exceeds the number of positions available.

## Vacant Positions and Profiles of Workforce

In this section, we utilize the Emsi data and examine the vacant positions together with the workforce profiles. Our goal is to evaluate if the workforce profiles match the skills used by these positions. First, we look at the tools and technologies that these occupations typically use. Based on HireNet Hawai'i's data, the top 5 tools and technologies used by each occupation are summarized in Table 6 below.

Occupations	Top 5 Tools and Technologies Used
Software Developers, Applications	<ul> <li>C#</li> <li>Structured Query Language (SQL)</li> <li>JavaScript</li> <li>HyperText Markup Language (HTML)</li> <li>C++</li> </ul>
Software Developers, Systems Software	<ul> <li>Windows Server</li> <li>VMware</li> <li>Domain Name Server (DNS)</li> <li>Structured Query Language (SQL)</li> <li>Microsoft SQL Server</li> </ul>
Computer User Support Specialists	<ul> <li>Microsoft Office</li> <li>Help desk software</li> <li>Display screens</li> <li>Structured Query Language (SQL)</li> <li>Workstations</li> </ul>
Computer Systems Analysts	<ul> <li>Structured Query Language (SQL)</li> <li>Microsoft Office</li> <li>C#</li> <li>UNIX</li> <li>Microsoft SQL Server</li> </ul>
Network and Computer Systems Administrators	<ul> <li>Vmware</li> <li>Windows Server</li> <li>UNIX</li> <li>Structured Query Language (SQL)</li> <li>PowerShell</li> </ul>
Computer Network Support Specialists	<ul> <li>VMware</li> <li>Internet Protocol Security</li> <li>Open Shortest Path First</li> <li>Personal Computer</li> <li>Load Balancers</li> </ul>
Computer Programmers	<ul> <li>Structured Query Language (SQL)</li> <li>C#</li> <li>Programming languages</li> <li>Windows Server</li> <li>Python</li> </ul>
Database Administrators	<ul> <li>Structured Query Language (SQL),</li> <li>Microsoft SQL Server,</li> <li>Windows Server</li> <li>Microsoft Excel</li> <li>Microsoft Internet Information Service</li> </ul>

## Table 6. IT Occupations and Top 5 Tools and Technologies Used

Occupations	Top 5 Tools and Technologies Used
Computer Occupations, All Other	<ul> <li>Structured Query Language (SQL)</li> <li>Microsoft Office</li> <li>Python</li> <li>HyperText Markup Language (HTML)</li> <li>Tableau</li> </ul>
Information Security Analysts	<ul> <li>Python,</li> <li>Microsoft Office</li> <li>PowerShell</li> <li>Field Computer</li> <li>Wireshark</li> </ul>
Computer Network Architects	<ul> <li>Enhanced Interior Gateway Routing Protocol</li> <li>Open Shortcut Path First</li> <li>Internet Protocol Security</li> <li>Tcpdump software</li> <li>Deployment software</li> </ul>
Web Developers and Digital Interface Designers	<ul> <li>HyperText Markup Language (HTML)</li> <li>JavaScript</li> <li>Programming languages</li> <li>Node.js</li> <li>Tableau</li> </ul>
Computer and Information Research Scientists	<ul> <li>Python</li> <li>Structured Query Language (SQL)</li> <li>Tableau</li> <li>MongoDB</li> <li>NoSQL</li> </ul>
Software Quality Assurance Engineers / Analysts and Testers	<ul> <li>Structured Query Language (SQL),</li> <li>FitNesse</li> <li>Selenium</li> <li>GitHub</li> <li>Microsoft Azure</li> </ul>

Source: HireNet Hawai'i

Next, we will look at the unique job postings from January to April and June to July to see which occupations were hiring extensively. Figure 5 shows the positions of Network and Computer Systems Administrators, Computer User Support Specialists, Information Security Analysts, Software Developers, all other Computer Occupations, and Computer Systems Analysts had the highest percentage of job postings. Some of the tools and technologies that these occupations use include Structured Query Language (SQL), C#, C++, JavaScript, Windows Servers, VMware, Domain Name Servers (DNS), UNIX, PowerShell, Python, HyperText Markup Language (HTML), Microsoft Office, and Tableau, etc.



Figure 5A. Current Job Vacancy vs. Profiles

#### Figure 5B. Current Job Vacancy vs. Profiles



We move one step forward to examine if the workforce profiles align with these skills. There were 7 to 8 percent of the workforce listed SQL in their profiles. Another four percent of the workforce listed Python in their skill sets. Six percent of the workforce has experience in system administration, which is related to configuration, upkeeping, and operating computer servers. Approximately 3 percent of the workforce listed automation in their profiles. Automation involves understanding and using various programming languages such as JavaScript, Python, Java, C#, C++, Ruby, and PHP.

While there are opportunities to reduce the gaps between job skills and profile skills, it does appear that our workforce profiles align with the skills required by these positions overall.

# **Employers by Industry and IT Positions**

Organizations in almost every industry require at least some IT assistance. However, some occupations are more in demand across industries than others. Using Hirenet and Bureau of Labor Statistics, we identified occupations that are in demand by many industries and those that relate more to specific industries. As shown in Table 7, Computer User Support Specialists, Network and Computer Systems Administrators, and Computer Systems Analysts are occupations within eight or more industries. While positions such as Computer and Information Research Scientist and Computer Network Architect have more limited options within just two sectors: the Professional, Scientific and Technical Services and Internet Service Providers, Web Search Portals, and Data Processing Services. This analysis confirms the finding that different industries have different needs for IT workforce qualifications.

	<u> </u>			<u> </u>							
Distribution of IT Employees by SOC and Industry Industry Title (NAICS Code)	Total	Computer User Support Specialists Employment	Network and Computer Systems Administrators	Computer Systems Analysts	Computer and Information Research Scientist	Computer Network Architects	Computer Programmers	Information Security Analyst	Computer Network Support Specialist	Computer Occupations, All Other	Number of Rep. Units
Professional, Scientific, and Technical Services (541)	42.6%	20.4%	44.6%	45.1%	100.0%	90.0%	64.1%	72.2%	21.4%	45.8%	4959
Management of Companies and Enterprises (551)	15.6%	25.8%	9.8%	16.5%			10.3%	11.1%	21.4%	12.5%	465
Educational Services (611)	12.9%	24.7%	19.6%				7.7%		12.5%	25.0%	844
Administrative and Support Services (561)	7.7%	9.7%	3.3%	7.7%				16.7%	17.9%	8.3%	2725
Telecommunications (517)	3.6%		3.3%				7.7%		17.9%		164
Hospitals (622)	3.6%		6.5%	5.5%					8.9%		33
Insurance Carriers and Related Activities (524)	2.3%	2.2%		8.8%							627
Ambulatory Health Care Services (621)	2.3%	6.5%	2.2%							8.3%	3175
Utilities (221)	2.0%		2.2%	7.7%							93
Internet Service Providers, Web Search Portals, and											
Data Processing Services (518)	2.0%		3.3%			10.0%	10.3%				126
Credit Intermediation and Related Activities (522)	1.6%	2.2%		5.5%							739
Publishing Industries (except Internet) (511)	0.7%			3.3%							211
Accommodations (721)	0.7%		3.3%								475
Merchant Wholesalers, Durable Goods (423)	0.5%	2.2%									939
Merchant Wholesalers, Nondurable Goods (424)	0.5%	2.2%									843
Social Assistance (624)	0.5%	2.2%									1006
Repair and Maintenance (811)	0.5%	2.2%									814
Air Transportation (481)	0.5%		2.2%								75

#### Table 7: IT Occupations (SOC) by Industry (NAICS)

Source: HireNet and Bureau of Labor Statistics.

As noted earlier, the largest employers and the majority of the technology firms and Department of Defense IT contractors are in the Professional, Scientific and Technical Services, and their IT workforce consists of the broadest range of occupations.

# **Education/Training Programs and Current Job Needs**

Providing high-quality education and training to students are the goals and mission of the UH System. This section will compare the credentials, certifications, and tools offered by UHCCs and UHM compared with current in-demand job market needs.

Seven out of 10 UHCCs are currently offering students IT-related degrees and certificates. For instance, the Honolulu Community College (HCC) offers students not only an associate degree in science but also a bachelor's degree in Applied Science or Information Security and Assurance as well as certificates in specialized areas. The same is true for Kapi'olani Community College; it offers students an associate degree in science and a series of certificates related to the information security agreement. Table 7 summarizes all the IT-related degrees, certificates, credentials, and tools offered by each campus.

School	Program / Area	Degree/Certificates	Certifications/Technical Skills
Hawai'i	Information	AS Information Technology	Unix/Linux
Community	rechnology	CA Information Technology	Structured Query Language
College		CO Information Security and Assurance	Windows Operating System
		CO Computer Support	OSI Reference Model
			Advanced object-oriented programming     tashniques
			Craphical Loar Interface and Networking
			Graphical Oser Interface and Networking     Entity Polationship Diagrams
Hopolulu	Computing Security	AS Computing Security and Natworking Technology	Computer Technician Au
Community	and Networking	AS computing, Security and Networking Technology     ADC Computing, Security and Networking Technology	Computer rechnician A+     Ciaco Cortified Network Associate
College	Technology	Arc computing, Security and Networking Technology     CA Information Accurates. Notworking and Telecommunications	GISCO Certified Network Associate     Microsoft Cortified Professional
Conogo	roomology		Cisco Cortified Networking Professional
			Linux+     V/Mware Certified Professional
Kani'olani	Information	• AS Information Technology	Microsoft SQL Server
Community	Technology	AS Information Technology     AS Natural Sciences Information and Communication Technology	Cybersecurity
College	roomology	APC Information Technology	Help Desk
		CA Information Security and Assurance	Programming
		CA Information Technology	Database Administration
		CO Database Administration	Microsoft Access
		CO Help Desk	Oracle
		CO Information Security and Assurance	Front-end graphical user
		CO Programming	· · · · · · · · · · · · · · · · · · ·
Kaua'i	Electronics	AS Electronics Technology	Cisco
Community	Technology	CA Electronics Technology	Cisco CCNA Security
College		<ul> <li>CA Network Administrator and Security Certificate</li> </ul>	Linux
		CO Cisco I	Circuit Analysis
		CO Cisco II	
		CO Computer Support	
		CO Network Security	
		CO Programming	
Leeward	Information and	AS Information and Computer Science	• A+
Community	Computer Science	AS Natural Sciences Information and Communication Technology	Networks+
College		ASC Information and Computer Science	Security+
		CA Information and Computer Science	CCNA
		CA Information Security	Certified Ethical Hacker
		CO Basic Logic & Programming Level 1	Linux+
		CO Basic Logic & Programming Level 2	Network Support

#### Table 8. Summary of IT Degrees, Certifications, Credentials, and Tools Offered by University of Hawai'i System

UH Maui College	Electronics and Computer Engineering Technology	<ul> <li>CO Help Desk</li> <li>CO Information Security Specialist</li> <li>CO Network Support Specialist</li> <li>CO Software Developer</li> <li>BAS Business and Information Technology</li> <li>AS Electronic and Computer Engineering Technology</li> <li>AS Natural Sciences Information and Communication Technology</li> <li>CA Electronic and Computer Technology</li> </ul>	<ul> <li>Information Security</li> <li>Software Development</li> <li>Programming</li> <li>Help Desk</li> <li>Information and Computer Science</li> <li>Digital computer technology</li> <li>Mathematics</li> <li>Circuit analysis</li> </ul>
Windward	Natural Science:	<ul> <li>CA Information Security Specialist</li> <li>CO Information Security Specialist</li> <li>AS Natural Sciences Information and Communication Technology</li> </ul>	<ul> <li>Data Science &amp; Machine Learning</li> <li>Basic ethical hacking</li> </ul>
Community College	Information and Communication Technology	<ul><li>CO Information Security Specialist</li><li>CO Web Support</li></ul>	<ul><li>Website Development</li><li>Computer Forensics</li></ul>
UH Manoa	Information and Computer Sciences	<ul> <li>BS Computer Science General Track Data Science Track Security Science Track</li> <li>BA Information and Computer Sciences</li> </ul>	<ul> <li>Computer Science</li> <li>Java</li> <li>Database Systems</li> <li>Operating Systems</li> <li>Network Design &amp; Management</li> <li>Programming Language Theory</li> <li>Machine and Systems Programming</li> <li>Algorithm</li> <li>Data Security and Crypto</li> <li>Computer Systems Security</li> <li>Security and Trust I/ II Information Assurance</li> <li>Data Science Fundamentals</li> <li>Software Engineering</li> <li>Special Topics in Security</li> <li>Data Networks</li> <li>Logic Design and Micro</li> <li>Big Data Analytics</li> <li>Machine Learning Fundamentals</li> <li>Data Visualization</li> </ul>

Source: UHCCs, UH Manoa

Note: Shaded items are on the list of Top In-Demand certifications and technical skills in the IT job market (See Tables 8A and 8B).

Tables 9A and 9B are lists of in-demand certificates and technical skills currently needed in the job market. Utilizing Table 8 above, we indicate whether UHCCs and UHM offer them.

The UHCCs offer numerous certification programs for IT students; however, not all certifications are equally in demand. Of the 14 in-demand certificates, seven of them are offered at UHCCs. For instance, the UHCCs do not offer IAT Level II Certificate, one of the highly sought certificates in the past two to three months.

There are in-demand certificates not necessarily designed for students looking for entry-level positions. These certifications require years of experience and expertise in a specific area to acquire (ex. Certified Information Security Manager).

The UHCC and UHM are teaching students technical skills that align with the needs of the job markets (see Table 9B). Thirteen out of the top 15 in-demand technical skills are included in the curriculum. There may be three in-demand technical skills missing in the current curriculum, however, the UHCCs appear to have provided adequate education to their IT students overall.

In interviews, the UHCCs provide foundational certifications and skills, and the 4-year UHM delivers the professional and higher-order skills.

Most In-demand Certificates in IT Job Market	Offered by UHCCs?
IAT Level II Cert	
CompTIA+	V
CompTIA Security+	$\checkmark$
Certified Information Systems Security Professional	$\overline{\mathbf{A}}$
Cisco Certified Network Associate (CCNA)	V
GIAC Certifications	
Cisco Certified Network Associate (CCNA) Security	V
Certified Ethical Hacker	$\checkmark$
Certified Information System Auditor (CISA)	
Project Management Professional Certification	
Certified Information Security Manager	
Certified Internal Auditor	
Cisco Certified Network Associate (CCNA) Routing and Switching	
Microsoft Certified Systems Administrator	$\mathbf{\nabla}$
Less In-demand Certificates in IT Job Market	Offered by UHCCs?
International Information System Security Certification Consortium (ISC) <sup>2</sup>	
Cisco Professional	$\square$
IAAPA Certification	

 Table 9A. UHCC Offered Certifications vs. In-demand Certifications

Source: Emsi Data, HireNet Hawai'i, UHCCs' data, IT survey

Top In-demand Technical Skills in IT Job Market	Offered by UHCCs?	Offered by UH Manoa
Computer Science	${\bf \boxtimes}$	V
Agile Methodology		V
Technology Solutions		V
Automation	$\checkmark$	V
Python	$\checkmark$	V
Operating Systems	V	V
Amazon Web Services	V	
Structured Query Language (SQL)	V	V
Java	V	V
Software Development	V	V
Information Systems	V	V
Cyber Security	V	V
Linux	V	V
System Administration	$\checkmark$	V
Technical Support	$\checkmark$	

#### Table 9B. UHCCs' and UHM Offered Technical Skills vs. In-demand Technical Skills

Source: Emsi Data, UHCC data, IT Survey, UH Manoa data

A UHCC report on the Classification of Instructional Programs codes (CIP) and Emsi data on program completions shows the positive trends over the past five years (Figure 6). This data includes statewide higher education institutions. The majority of these completions are associate and bachelor's degree programs.

The growth is in the more general CIPs of Computer Science and Computer & Information Services. Overall the trends have been stable with some increase in Management Information Systems. (Appendix C has the specific CIP codes and actual numbers). Note that this figure includes codes outside of the standard CIP 11 codes because IT skills are being integrated into "non-standard" programs. This presents another challenge for data tracking to include these additional codes and for higher education institutions to ensure that the CIPs accurately reflect the content of their program.



#### Figure 6: Higher Education IT-Related Program Completions Trend<sup>20</sup>

# **Relationship of Programs to IT Occupations**

So how do program completions relate to SOC occupations? The National Center for Educational Statistics developed a crosswalk between CIP and SOC codes based on respective skills descriptions. The following Sankey shows the relationships between the CIP codes above and SOC codes nationally. The number of different links shows the complexity of the IT workforce. The broader programs like Computer Science and Computer & Information Science, General have the greatest number of connections, as noted by the length of the color bar for those two programs.

This figure does not identify the best CIP programs for each SOC, just the links based on skills identified. However, SOCs identified as growing in the future such as Information Security Analyst has four connections: two general categories of Computer Science and Information Technology, and two more specific programs – Computer and Information Security and Computer Systems Networking and Telecommunications. Unfortunately, Computer and Information Systems Security showed only 16 program completions in Figure 6 and a declining trend. This is a challenge for higher education institutions to create a curriculum that meets the larger demand for occupations like Computer User Support Services and the more specialized but growing occupations in Cybersecurity.

<sup>&</sup>lt;sup>20</sup> University of Hawai'i Community Colleges, Workforce Availability, November 2021, Using Emsi Q4 2021 dataset.

When using SOC and CIP codes it becomes clearer that occupation and program descriptions should be reviewed regularly. This ensures that what is being taught is accurately reflected in the CIP descriptions. Improved accuracy for both sets of codes will enable employers to better classify jobs within their companies, and for the census to gather more accurate employment data.

Another data challenge to develop crosswalks between IT occupations and programs are the interdisciplinary positions such as Robotics that combine Computer Science with Engineering. This SOC is not under the standard 15 listings; therefore Computer Science does not show up as a link unless specifically added.



#### Figure 7: Crosswalk between SOC (left column) and CIP (right column) codes

#### Is a bachelor's degree necessary?

According to the US Census, educational attainment refers to the highest level of education that an individual has completed. Employers often see educational attainment as part of the job competency indicator to distinguish graduates. This section will investigate whether earning a bachelor's degree is necessary for the IT industry. Considering the situation may vary across different IT occupations, we will review each IT occupation separately. The data used here were obtained from HireNet Hawai'i and Career Explorer. HireNet Hawai'i provides the minimum education requirements for advertised jobs. In contrast, Hawai'i Career Explorer delivers the highest level of education that an individual has achieved at the time of employment. The latter data allows us to compare what type of graduate employers typically hire. These two data sets may not be referring to the same group of candidates. Still, they are both looking at a specific IT occupation.

Based on the analyses of education requirements in job postings compared to actual degree attainment, we conclude that the job market may not necessarily ask for a bachelor's degree as minimum requirements; however, recipients of a bachelor's degree appear to be more likely to be hired.. Of the 12 IT occupations discussed above, only one occupation—Computer Network Support Specialists had a smaller percent of bachelor's degree holders than the job market requested. The rest of the IT occupations are dominated mainly by employees with a bachelor's degree. Some of the professions may even prefer hiring masters or doctorate holders.



#### Figure 8A: Education Level at Time of Employment by Occupation



Figure 8B: Minimum Education Requirement on Advertised Jobs by Occupation

For example, Computer and Information Research Scientists had the highest percent of people holding a degree higher than an associate degree (90%) upon employment. The percent of Computer and Information Research Scientists who reported having a master's degree at the time of employment is 35 percent, slightly higher than those who held a bachelor's degree (34%). Another 21 percent had a doctorate. However, 60 percent of all job postings did not specify any educational requirements.

Close to half of the Database Admin and Architects reported having a bachelor's degree (47%). One-fourth of them earned a master's degree at the time of employment. Another 20 percent possessed an associate degree.

Despite 25 percent of advertised jobs listed high school diplomas and associate degrees as the minimum requirements for all other computer occupations, about 44 percent of workers reported that they indeed had a bachelor's degree. One-fourth of them even held a master's degree, while more than one-fifth of these workers had an associate degree (27%).

However, there were some exceptions. While 57 percent of the advertised Computer Network Support Specialist's jobs required a minimum of a bachelor's degree, only 37 percent of the specialists reported having a bachelor's degree. Another 41 percent of them had an associate degree.

A more detailed analysis by each occupation and a detailed breakdown of education requirements can be found in Appendix B.

In interviews, work experience was more important than having a degree because it indicated professional skills. However, as noted earlier, in the absence of work experience, a bachelor's degree was often used as a proxy for professional skills. Therefore, while a bachelor's degree may not be required in job postings, it may help individuals clear the initial screening process when seeking a job.

## **Options for Higher Education Institutions**

Given the complexity of IT workforce supply and demand, it will be challenging for higher education institutions to know where to focus. Figure 9A shows the occupations with the largest number of jobs in Hawai'i, the average number of annual job openings and expected growth rate. In addition, the technical skills most often required in job postings are shown and those that are available within the UH System are highlighted. Computer User Specialist and Network and Computer Systems Administrators occupations are more likely to accept individuals with an associate degree. These positions may represent a good opportunity for graduates from community colleges.

Figure 9A also shows some of the data challenges that arise when looking closer at IT occupations. The three Software Developer categories shows three jobs with unique qualifications that are being posted under one SOC code. It is therefore unclear which job has the highest numbers and higher growth rate.

Occupation	<ul> <li>2028 Projected # of Jobs</li> <li>Average # of Annual Openings</li> <li>Growth Rate</li> <li>Median Hourly Wage (State)<sup>21</sup></li> </ul>	Top Five Certifications/Technical Skills/ Highlights offered within UH System
Software Developers, Applications	<ul> <li>1,680 Jobs</li> <li>148 Openings</li> <li>15% Growth Rate</li> <li>\$52.95 **</li> </ul>	<ul> <li>C#</li> <li>Structured Query Language (SQL)</li> <li>JavaScript</li> <li>HyperText Markup Language (HTML)</li> <li>C++</li> </ul>
Software Developers, Systems Software		<ul> <li>Windows Server</li> <li>VMware</li> <li>Domain Name Server (DNS)</li> <li>Structured Query Language (SQL)</li> <li>Microsoft SQL Server</li> </ul>
Software Quality Assurance Engineers/ Analysts and Testers		<ul> <li>Structured Query Language (SQL),</li> <li>FitNesse</li> <li>Selenium</li> <li>GitHub</li> <li>Microsoft Azure</li> </ul>
Computer User Support Specialists	<ul> <li>1,040 Jobs</li> <li>114 Openings</li> <li>12% Growth Rate</li> <li>\$25.33*</li> </ul>	<ul> <li>Microsoft Office</li> <li>Help desk software</li> <li>Display screens</li> <li>Structured Query Language (SQL)</li> <li>Workstations</li> </ul>

#### Figure 9A: Occupations with the largest Number of Jobs

<sup>&</sup>lt;sup>21</sup> State of Hawai'i Occupational Projects. One \* means wage level is above ALICE Individual livable wage threshold, Two \*\* means that the average wage is above the ALICD Family Livable wage threshold.

Computer Systems Analysts	<ul> <li>1,000 Jobs</li> <li>129 Openings</li> <li>10% Growth Rate</li> <li>\$45.06**</li> </ul>	Structured Query Language (SQL)     Microsoft Office     C#     UNIX     Microsoft SQL Server
Network and Computer Systems Administrators	<ul> <li>99 Jobs</li> <li>86 Openings</li> <li>8% Growth Rate</li> <li>\$40.77*</li> </ul>	<ul> <li>Vmware</li> <li>Windows Server</li> <li>UNIX</li> <li>Structured Query Language (SQL)</li> <li>PowerShell</li> </ul>

Another option for educational institutions to focus on is occupations with a higher projected growth rate from 2018 – 2028 (Figure 9B). The total number of jobs is smaller than those in Figure 9A. Still, the median hourly wage is higher in most of the categories. Interviews confirm Information Security positions such as Cybersecurity are projected to grow significantly in the future. Other functions identified as needed include Cloud Computing, Data Analysis together with Data Analytics.

Occupation	<ul> <li>2028 Projected # of Jobs</li> <li>Annual Openings</li> <li>Growth Rate</li> <li>Median Hourly Wage</li> </ul>	Top Five Certifications/Technical Skills/ Highlights offered within UH System
Information Security Analysts	<ul> <li>240 Jobs</li> <li>47 Openings</li> <li>33% Growth Rate</li> <li>\$49.80**</li> </ul>	<ul> <li>Python,</li> <li>Microsoft Office</li> <li>PowerShell</li> <li>Field Computer</li> <li>Wireshark</li> </ul>
Computer and Information Research Scientists	<ul> <li>100 Jobs</li> <li>7 Openings</li> <li>25% Growth Rate</li> <li>\$72.67**</li> </ul>	<ul> <li>Python</li> <li>Structured Query Language (SQL)</li> <li>Tableau</li> <li>MongoDB</li> <li>NoSQL</li> </ul>
Computer Network Architects	<ul> <li>230 Jobs</li> <li>25 Openings</li> <li>15% Growth Rate</li> <li>\$56.14**</li> </ul>	<ul> <li>Enhanced Interior Gateway Routing Protocol</li> <li>Open Shortcut Path First</li> <li>Internet Protocol Security</li> <li>Tcpdump software</li> <li>Deployment software</li> </ul>
Web Developers and Digital Interface Designers	<ul> <li>230 Jobs</li> <li>20 Openings</li> <li>15% Growth Rate</li> <li>\$37.12*</li> </ul>	<ul> <li>HyperText Markup Language (HTML)</li> <li>JavaScript</li> <li>Programming languages</li> <li>Node.js</li> <li>Tableau</li> </ul>

#### Figure 9B: Occupations with Fastest Expected Growth

# STRENGTHS, WEAKNESSES, OPPORTUNITIES, AND THREATS SUMMARY

The following is a summary of issues gathered from data analysis, interviews, and the employer survey.

Strengths	Weaknesses
<ul> <li>More IT positions available relative to supply.</li> <li>Medium income levels for IT jobs are above ALICE individual level and close to ALICE family living wages.</li> <li>UHCC and UHM offer most of the in-demand technical skills</li> <li>The trend for program completions is positive for general CIPs, but flat for CIPs that will be in greater demand in the future.</li> <li>Many IT Employers are willing to interact with students via presentations, internships, mock interviews.</li> <li>At the K-12 level, A Computer Science Landscape Report of Hawai'i Public Schools (2017-2020), recommendations are beginning to be implemented that will result in more students interested in IT in the future.</li> </ul>	<ul> <li>The types of IT occupations needed differs by industry. Likewise, the Technical Skills and Certifications required may be different.</li> <li>There are too few applicants for most IT positions.</li> <li>Student qualifications for IT positions are frequently not consistent with employer needs and expectations. Especially true for Professional Skills.</li> <li>While a bachelor's degree is not always in a job posting, most of the students hired have a degree.</li> <li>Unclear if the level of counseling for IT students at UHCCs is sufficient given the range of occupations and industries.</li> <li>Too few ways for students to gain work experience to build professional skills.</li> <li>Employers are not as aware of the type and quality of UHCC IT programs.</li> </ul>
<ul> <li>Opportunities</li> <li>Companies prefer to hire local whenever possible.</li> <li>Jobs are expected to grow in Cyber Security, Data Analytics, Cloud Computing, and Al.</li> <li>IT jobs are part of every industry.</li> <li>Entry-level positions are available for most IT positions but may require different certifications or technical skills.</li> </ul>	<ul> <li>Threats</li> <li>Higher salaries and lower living costs outside of Hawai'i are attracting experienced IT employees to leave for the Continent.</li> <li>Availability of qualified Continent and foreign IT workers to connect virtually to Hawai'i companies at lower hourly rates.</li> <li>IT skillsets required are changing rapidly, especially for the higher paying positions. This</li> </ul>
<ul> <li>Many IT courses programs are being offered within the UH System.</li> </ul>	<ul> <li>requires educational institutions to stay connected and current with what the industry needs.</li> <li>Some employers require a bachelor's degree when work experience or similar may better meet their needs.</li> </ul>

# RECOMMENDATIONS

To provide Hawai'i-based employers with the qualified IT workforce they need and provide the opportunity to earn livable wage job; the following are the major recommendations developed during this process.

1. Improve the alignment and communications between IT workforce employers and educational institutions. The IT field is evolving rapidly, as reflected in the technical and credential skills required of new employees. Only by maintaining a connection between the two, can students be better prepared to fulfill the job requirements of the future.

#### a. Higher Education Institutions

- i. System-wide consider the best strategies to meet the needs of Hawaii employers.
- ii. Develop and maintain ongoing communications with IT employers. Update the curriculum as needed to provide students with the skills required by the evolving IT industries.
  - 1. As the curriculum is fine-tuned ensure that CIP codes accurately reflect the skills being taught.
- iii. Ensure that IT employers are aware of the technical skills and credentials that students from your institution possess upon graduation. This may include meet-and-greet events post-COVID.
- iv. Ensure the institutions' website postings about the IT curriculum are updated regularly and accurately reflect what is taught.
- v. UHCC provides additional career counseling for students prior to and after registration to help them identify an appropriate path to achieve their goals. Consider a Career Fair before registration.
  - 1. Identify a funding source for scholarships to be available for students to complete certifications that are in demand by employers.

#### b. Businesses/Employers

i. Be willing to engage with educational institutions and students actively.

#### c. Public-Private Partnerships

- i. Consider an IT Sector Partnership that can provide a structure to convene industry, education, and public sector leaders to address shared priorities such as developing on-the-job training programs or work based learning opportunities.
- 2. Introduce IT occupations to Hawai'i students at an earlier age to better understand the opportunities and skills required.

#### a. Middle and High Schools

- i. Provide early introductions to IT, what it is, why it is essential, how they can participate now and in the future. "A Computer Science Concierge Report of Hawai'i Public Schools" provides an excellent road map.
- ii. Offer professional development for teachers so they can better support and encourage students.
- iii. Support STEM education programs.
- iv. Encourage students to apply for programming boot camps.
- b. Businesses/Employers

- i. Provide work-based learning support to students, from a mix of industries focusing on the endless options within IT. This may include being a guest speaker, sponsoring job site visits, etc.)
- 3. Help students acquire and demonstrate professional skills, including good communications, critical thinking, learning quickly, and being flexible. These are precious skills to employers but are less tangible and more challenging to document. Often employers perceive that these skills are only acquired by graduating with a bachelor's degree or having work experience.

#### a. Community Colleges and High Schools

- i. Require students to do presentations in class to make them more comfortable speaking up and explaining their approach to solving a problem. Whenever possible, provide "real world" problems for students to address via the skills they have learned.
- ii. Integrate case studies into the curriculum that require student teams to think through problem-solving, make and defend recommendations, respond to and offer critiques.
- iii. Consider requiring a capstone project that includes applying what students have learned to real-world challenges.
- iv. Work with businesses to identify options for offering internships, for example, having the company provide the technical knowledge and the school/college handle the administrative aspects of the program.
- v. Encourage students to participate in internships.

#### b. Businesses/Employers

- i. Provide more internships/apprenticeships for high school and community college students.
- ii. Consider offering on-the-job training where appropriate.
- iii. Invest in training and career counseling to entry-level IT employees that provide the skills they may lack initially and lead to a career path within your organization.

#### c. Other Entities

- i. Develop other opportunities for students to gain work experience in IT.
- ii. Develop a program that coordinates and administers internships that makes it easier for companies to provide internships and for students to understand the types of internships available.
- 4. Review the screening criteria for IT positions. A bachelor's degree may not be necessary when work experience or similar are demonstrated in a resume.

#### a. Businesses/Employers

- i. Ensure that human resources recruitment staff clearly understand the technical, credentials, and professional skills required for IT positions and the possible tradeoffs for high potential candidates.
- ii. Consider options in place of a requirement for a bachelor's degree, particularly for entry-level jobs.

5. Improve tracking and reporting related to IT courses, certifications, and where students go when leaving an educational institution. This data will support better evaluation of programs and contribute to better planning for the future.

#### a. Educational Institutions

- i. UHCC include the number of students who receive certifications and the type of certifications.
  - **1.** Develop a means to track what UHCC students do after they graduate or leave.

#### b. State of Hawai'i

i. Identify options for improving the accuracy of the job count for IT positions. Include Department of Defense positions if possible.

# **APPENDIX A**

# A. Standard Occupational Classification (SOC) System<sup>22</sup>

**Computer and Information Research Scientists (15-1221)** – Conduct research into fundamental computer and information science as theorists, designers, or inventors. Develop solutions to problems in the field of computer hardware and software.

**Computer Network Architects (15-1241)** – Design and implement computer and information networks, such as local area networks (LAN), wide area networks (WAN), intranets, extranets, and other data communications networks. Perform network modeling, analysis, and planning, including analysis of capacity needs for network infrastructures. May also design network and computer security measures. May research and recommend network and data communications hardware and software. Excludes Information Security Analysts (15-1212), Computer Network Support Specialists (15-1231), and Network and Computer Systems Administrators (15-1244).

**Computer Network Support Specialists (15-1231)** – Analyze, test, troubleshoot, and evaluate existing network systems, such as local area networks (LAN), wide area networks (WAN), cloud networks, servers, and other data communications networks. Perform network maintenance to ensure networks operate correctly with minimal interruption. Excludes Computer Network Architects (15-1241) and Network and Computer Systems Administrators (15-1244)

**Computer Occupations, All Other (15-1299)** – All computer occupations not listed separately. Excludes Computer and Information Systems Managers (11-3021), Computer Hardware Engineers (17-2061), Electrical and Electronics Engineers (17-2070), Computer Science Teachers, Postsecondary (25-1021), Special Effects Artists and Animators (27-1014), Graphic Designers (27-1024), Health Information Technologists and Medical Registrars (29-9021), and Computer, Automated Teller, and Office Machine Repairers (49-2011).

**Computer Programmers (15-1231)** – Create, modify, and test the code and scripts that allow computer applications to run. Work from specifications drawn up by software and web developers or other individuals. May develop and write computer programs to store, locate, and retrieve specific documents, data, and information.

**Computer System Analysts (15-1211)** – Analyze science, engineering, business, and other data processing problems to develop and implement solutions to complex applications problems, system administration issues, or network concerns. Perform systems management and integration functions, improve existing computer systems, and review computer system capabilities, workflow, and schedule limitations. May analyze or recommend commercially available software.

<sup>&</sup>lt;sup>22</sup> Hawai'i Career Explorer

**Computer Users Support Specialists (15-1232)** – Provide technical assistance to computer users. Answer questions or resolve computer problems for clients in person, via telephone, or electronically. May provide assistance concerning the use of computer hardware and software, including printing, installation, word processing, electronic mail, and operating systems. Excludes Network and Computer Systems Administrators (15-1244).

**Database Administrators and Architects (15-1245)** – Administer, test, and implement computer databases, applying knowledge of database management systems. Coordinate changes to computer databases. Identify, investigate, and resolve database performance issues, database capacity, and database scalability. May plan, coordinate, and implement security measures to safeguard computer databases. Design strategies for enterprise databases, data warehouse systems, and multidimensional networks. Set standards for database operations, programming, query processes, and security. Model, design, and construct large relational databases or data warehouses. Create and optimize data models for warehouse infrastructure and workflow. Integrate new systems with existing warehouse structure and refine system performance and functionality.

**Information Security Analysts (15-1212)** – Plan, implement, upgrade, or monitor security measures for the protection of computer networks and information. Assess system vulnerabilities for security risks and propose and implement risk mitigation strategies. May ensure appropriate security controls are in place that will safeguard digital files and vital electronic infrastructure. May respond to computer security breaches and viruses. Excludes Computer Network Architects (15-1241).

**Network and Computer Systems Administrators (15-1244)** – Install, configure, and maintain an organizations local area network (LAN), wide area network (WAN), data communications network, operating systems, and physical and virtual servers. Perform system monitoring and verify the integrity and availability of hardware, network, and server resources and systems. Review system and application logs and verify completion of scheduled jobs, including system backups. Analyze network and server resource consumption and control user access. Install and upgrade software and maintain software licenses. May assist in network modeling, analysis, planning, and coordination between network and data communications hardware and software. Excludes Information Security Analysts (15-1212), Computer Network Support Specialists (15-1231), and Computer User Support Specialists (15-1232).

**Software Developers and Software Quality Assurance Analysts and Testers (15-1256)** – Research, design, and develop computer and network software or specialized utility programs. Analyze user needs and develop software solutions, applying principles and techniques of computer science, engineering, and mathematical analysis. Update software or enhance existing software capabilities. May work with computer hardware engineers to integrate hardware and software systems and develop specifications and performance requirements. May maintain databases within an application area, working individually or coordinating database development as part of a team. Develop and execute software tests to identify software problems and their causes. Test system modifications to prepare for implementation. Document software and application defects using a bug tracking system and report defects to software or web developers. Create and maintain databases of known defects. May participate in software design reviews to provide input on functional requirements, operational characteristics, product designs, and schedules.

**Web Developers and Digital Interface Designers (15-1257)** – Develop and implement websites, web applications, application databases, and interactive web interfaces. Evaluate code to ensure that it is properly structured, meets industry standards, and is compatible with browsers and devices. Optimize website performance, scalability, and server-side code and processes. May develop website infrastructure and integrate websites with other computer applications. Design digital user interfaces or websites. Develop and test layouts, interfaces, functionality, and navigation menus to ensure compatibility and usability across browsers or devices. May use web framework applications as well as client-side code and processes. May evaluate web design following web and accessibility standards and may analyze web use metrics and optimize the human-computer interaction and maximize the usability of digital devices, websites, and software with a focus on aesthetics and design. May create graphics used in websites and manage website content and links. Excludes Special Effects Artists and Animators (27-1014) and Graphic Designers (27-1024).

# **APPENDIX B**



Figure 10A. Software Developers (Application, Systems Software, Quality Assurance Testers)

Of all advertised Software Developer jobs, close to half of them (49%) listed no minimum education requirements. Slightly more than one-fourth of them required a bachelor's degree and 17 percent required as high as a doctorate degree.

When looking at educational attainment at the time of employment, however, more than half of the workers had a bachelor's degree (52%) and as much as 30% of them had a master's degree.





Approximately 60 percent of advertised jobs for Computer User Support Specialists had no specific job requirements. Another 12 percent had no minimum education requirement. Only 21 percent listed a bachelor's degree as a minimum education requirement.

Compared to the Software Developers, the education attainment for Computer User Support Specialists is not as high. The majority of workers had an associate degree (41%), while only 37 percent had a bachelor's degree.





For the Network and Computer System Administrators' positions, over 70 percent of advertised jobs did not specify a minimum education requirement. Only 20 percent of them required a bachelor's degree.

About 42 percent of Network and Computer System Administrators, however, reported that they had a bachelor's degree at the time of employment. Another 40 percent had an associate degree.





As in the case with other IT occupations, the majority of advertised jobs did not specify a minimum education requirement (67%). Slightly more than one-fourth of them required a bachelor's degree.

As many as 46 percent of Computer System Analysts reported that they had a bachelor's degree at the time of employment. Close to 25 percent of them even reported having a master's degree, while 21 percent had an associate degree.



Figure 10E. Computer Network Support Specialists

While 57 percent of the advertised Computer Network Support Specialist's jobs required a minimum of a bachelor's degree, only 37 percent of the specialists reported having a bachelor's degree. Another 41 percent of them had an associate degree.





About 51 percent of computer programmers had a bachelor's degree, even though only 21 percent of the advertised jobs required a bachelor's degree. As many as 21% of programmers held a master's degree.





Close to half of the Database Admin and Architects reported having a bachelor's degree (47%). One-fourth of them earned a master's degree at the time of employment. Another 20 percent possessed an associate degree.



Figure 10H. Computer Occupation, All Other

Despite 25 percent of advertised jobs listed high school diplomas and associate degrees as the minimum requirements for all other computer occupations, about 44 percent of workers reported that they indeed had a bachelor's degree. One-fourth of them even held a master's degree, while more than one-fifth of these workers had an associate degree (27%).





Approximately 54 percent of workers who worked as web developers and digital interface designers held a bachelor's degree, which is more than double the advertised jobs that listed bachelor's degree as minimum requirements. Even though there was 11 percent of advertised jobs listed no minimum requirement, the actual web developers who did not have formal education is only about 1 percent.





More than 92 percent of Computer Network Architects held a degree higher than a high school diploma or equivalent. Of these 92 percent of Computer Network Architects, 39 percent of them reported holding a bachelor's degree. Approximately the same percentage of them had an associate degree (37%).





About 30 percent of advertised Information Security Analysts jobs required a bachelor's degree. However, the percent of analysts who hold a bachelor's degree is 42 percent at the time of employment, which is much higher than what was asked on the job market.





Computer and Information Research Scientists had the highest percent of people holding a degree higher than an associate degree (90%). The percent of Computer and Information Research Scientists who reported having a master's degree at the time of employment is 35 percent, slightly higher than those who held a bachelor's degree (34%). Another 21 percent even held a doctorate degree. The skewed higher education level suggests that this occupation may be more challenging and intense than any other IT occupation discussed above (i.e., a bachelor's degree may not be sufficient for certain Computer and Information Research Scientist positions).

# **APPENDIX C**

CIP Code	Program	2016	2017	2018	2019	2020
11.0701	Computer Science	108	107	122	121	143
11.0101	Computer & Information Sciences General	59	86	93	100	112
11.0103	Information Technology	72	123	87	110	99
10.0304	Animation, Interactive Technology, Video Graphics and Special Effects	50	29	44	43	88
11.0901	Computer Systems Networking and Telecommunications	83	94	79	91	87
52.1201	Management Information Systems, General	38	41	58	61	62
11.0801	Web Page, Digital/Multimedia and Information Resources Design	31	23	36	51	42
14.0901	Computer Engineering, General	26	26	24	30	34
50.0409	Graphic Design	24	17	18	28	25
51.0707	Health Information/Medical Records Technology/Technician	16	46	51	33	24
11.0401	Information Science/Studies	65	22	19	17	23
15.1202	Computer/Computer System Technology/Technician	18	23	17	15	20
11.1003	Computer and Information Systems Security/Auditing/Information Assurance	36	36	39	24	16
		626	673	687	724	775