



Labor Market Analysis: 07 – Information Technology

Artificial Intelligence for Business

Associate of Science (A.S.) degree; Certificate requiring 6 to <18 semester units

Los Angeles Center of Excellence, October 2024

Program Endorsement:	Endorsed: All Criteria Met <input type="checkbox"/>	Endorsed: Some Criteria Met <input checked="" type="checkbox"/>	Not Endorsed <input type="checkbox"/>
Program Endorsement Criteria			
Supply Gap:	Yes <input checked="" type="checkbox"/>		No <input type="checkbox"/>
Living Wage: (Entry-Level, 25 th)	Yes <input checked="" type="checkbox"/>		No <input type="checkbox"/>
Education:	Yes <input type="checkbox"/>		No <input checked="" type="checkbox"/>
Emerging Occupation(s)			
	Yes <input checked="" type="checkbox"/>		No <input type="checkbox"/>

SUMMARY

This report analyzes whether local labor market demand is being met by community college programs aligned with the identified target occupations¹ or whether a shortage of workers exists. Labor market demand is measured by annual job openings while education supply is measured by the number of awards (degrees and certificates) conferred on average each year.

Based on the available data, there appears to be a supply gap for the three identified target occupations in the region. While entry-level wages exceed the self-sufficiency standard wage in both Los Angeles and Orange counties, the majority of annual openings for the occupations in this report typically require a bachelor’s degree.

Recommendation: Due to all two of three program endorsement criteria being met, the Los Angeles Center of Excellence for Labor Market Research (LA COE) endorses this proposed program.

Key Findings

Supply Gap

- 6,986 annual job openings are projected in the region through 2028. This number is greater than the three-year average of 5,169 awards conferred by educational institutions in the region.

¹ Middle-skill occupations typically require some postsecondary education, but less than a bachelor’s degree. The COE classifies middle-skill jobs as the following:

- All occupations that require an educational requirement of some college, associate degree or apprenticeship;
- All occupations that require a bachelor’s degree, but also have more than one-third of their existing labor force with an educational attainment of some college or associate degree; or
- All occupations that require a high school diploma or equivalent or no formal education, but also require short- to long-term on-the-job training where multiple community colleges have existing programs.

Living Wage

- All three occupations in this report have entry-level wages **above** Los Angeles County's self-sufficiency standard hourly wage (\$24.03/hour).²

Educational Attainment

- A bachelor's degree is the typical entry-level education for all the target occupations in this report, according to the Bureau of Labor Statistics (BLS).
- The national-level educational attainment data indicates between 13% and 46% of workers in the field have completed an associate degree or less education, while between 54% and 89% hold a bachelor's degree or more education.

Community college supply

- 28 community colleges issued awards related to information technology and/or artificial intelligence in the greater LA/OC region.
- 1,337 awards (degrees and certificates) were conferred on average each year between 2021 and 2023.

Other postsecondary supply

- 37 educational institutions in the LA/OC region have conferred awards in programs related to information technology and/or artificial intelligence over the past three years.
- 3,832 awards were conferred on average each year by other postsecondary institutions throughout the greater LA/OC region between 2020 and 2022.

TARGET OCCUPATIONS

LA COE prepared this report to provide regional labor market and postsecondary supply data related to three target occupations and one emerging occupation. Currently, there is not a standard occupational classification (SOC) code for a middle-skill occupation in the field of artificial intelligence. While the occupations in this report typically require a bachelor's degree and are not traditionally considered middle-skill³, these occupations are most closely aligned with the knowledge, skills, and abilities required for an entry-level job seeker in the emerging field of artificial intelligence. [For full occupation descriptions, please see Appendix.](#)

- **Software Developers (15-1252)**⁴
- **Computer Occupations, All Other (15-1299)**⁵
- **Data Scientists (15-2051)**⁶
 - **Business Intelligence Analysts (15-2051.01)**⁷

² Center for Women's Welfare, University of Washington. (2024). *The self-sufficiency standard for California 2024*. <http://selfsufficiencystandard.org/California>.

³ The COE classifies middle-skill jobs as the following:

- All occupations that require an educational requirement of some college, associate degree or apprenticeship;
- All occupations that require a bachelor's degree, but also have more than one-third of their existing labor force with an educational attainment of some college or associate degree; or
- All occupations that require a high school diploma or equivalent or no formal education, but also require short- to long-term on-the-job training where multiple community colleges have existing programs.

⁴ [Software Developers, Quality Assurance Analysts, and Testers \(bls.gov\)](#)

⁵ [Computer Occupations, All Other \(bls.gov\)](#)

⁶ [Data Scientists \(bls.gov\)](#)

⁷ [Business Intelligence Analysts \(O*NET OnLine\)](#)

OCCUPATIONAL DEMAND

Exhibit 1 shows the five-year occupational demand projections for the target occupations in this report related to artificial intelligence. In the greater Los Angeles/Orange County region, the number of jobs related to these occupations is projected to increase by 8% through 2028. There will be nearly 7,000 job openings per year through 2028 due to job growth and replacements. It is important to note that the *computer occupations, all other (15-1299)* SOC code includes a variety of emerging computer occupations and not solely artificial intelligence-related occupations. Therefore, the data in Exhibit 1 is likely overstated for occupations related to artificial intelligence. The majority of jobs in 2023 for these middle-skill artificial intelligence occupations (69%) were located in Los Angeles County.

Exhibit 1: Current employment and occupational demand, Los Angeles and Orange counties⁸

Geography	2023 Jobs	2028 Jobs	2023-2028 Change	2023-2028 % Change	Annual Openings
Los Angeles	64,883	70,381	5,498	8%	4,874
Orange	29,233	31,374	2,141	7%	2,112
Total	94,116	101,754	7,639	8%	6,986

Detailed Occupation Data

Exhibit 2 displays the current employment and projected occupational demand for each of the target occupations in Los Angeles County. Positive scores for automation resilience⁹ reflect a lower-than-average threat of the occupation(s) being replaced by automation, while negative scores reflect a greater-than-average risk of automation. The average percentage of workers aged 55+ across all occupations in the Los Angeles/Orange County region is 26%; occupations with a larger share of workers aged 55 and older typically have greater replacement needs to offset the amount of impending retirements. On average, 81% of workers across all occupations in California are employed full-time.

Exhibit 2: Detailed employment and occupational demand, Los Angeles County¹⁰

Occupation	2023 Jobs	2028 Jobs	5-Yr % Change	Annual Openings	Auto-mation Resilience	% Aged 55 and older	% Full Time Workers
Software Developers	40,388	44,513	10%	3,062	19.8	14%	99%
Computer Occupations, All Other	18,069	18,584	3%	1,241	14.5	19%	90%

⁸ Five-year change represents new job additions to the workforce. Annual openings include new jobs and replacement jobs that result from retirements and separations.

⁹ Automation risk is calculated based on the percentage of time spent on high-risk compared to low-risk work, the number of high-risk jobs in compatible occupations, and the overall industry automation risk.

¹⁰ Five-year change represents new job additions to the workforce. Annual openings include new jobs and replacement jobs that result from retirements and separations.

Occupation	2023 Jobs	2028 Jobs	5-Yr % Change	Annual Openings	Auto-mation Resilience	% Aged 55 and older	% Full Time Workers
Data Scientists	6,426	7,283	13%	572	16.6	14%	Data Unavail.
Total	64,883	70,381	8%	4,874	-	-	-

WAGES

The labor market endorsement in this report considers the entry-level hourly wages for these target occupations related to artificial intelligence in Los Angeles County as they relate to the county's self-sufficiency standard wage. Orange County wages are included below in order to provide a complete analysis of the greater Los Angeles/Orange County region.

Los Angeles County

All three occupations have entry-level wages above the self-sufficiency standard wage for one adult (\$24.03 in Los Angeles County). Typical entry-level hourly wages are in a range between \$29.46 and \$58.84. (Exhibit 3). Experienced workers can expect to earn wages between \$71.26 and \$84.39.

Exhibit 3: Earnings for occupations in Los Angeles County

Occupation	Entry-Level Hourly Earnings (25 th Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75 th Percentile)	Median Annual Earnings*
Software Developers	\$58.84	\$74.13	\$84.39	\$154,200
Computer Occupations, All Other	\$29.46	\$48.10	\$71.26	\$100,000
Data Scientists	\$38.55	\$60.29	\$78.48	\$125,400

*Rounded to the nearest \$100

Orange County

All three occupations have entry-level wages above the self-sufficiency standard wage for one adult (\$27.13 in Orange County). Typical entry-level hourly wages are in a range between \$28.35 and \$57.29 (Exhibit 4). Experienced workers can expect to earn wages between \$68.49 and \$82.08.

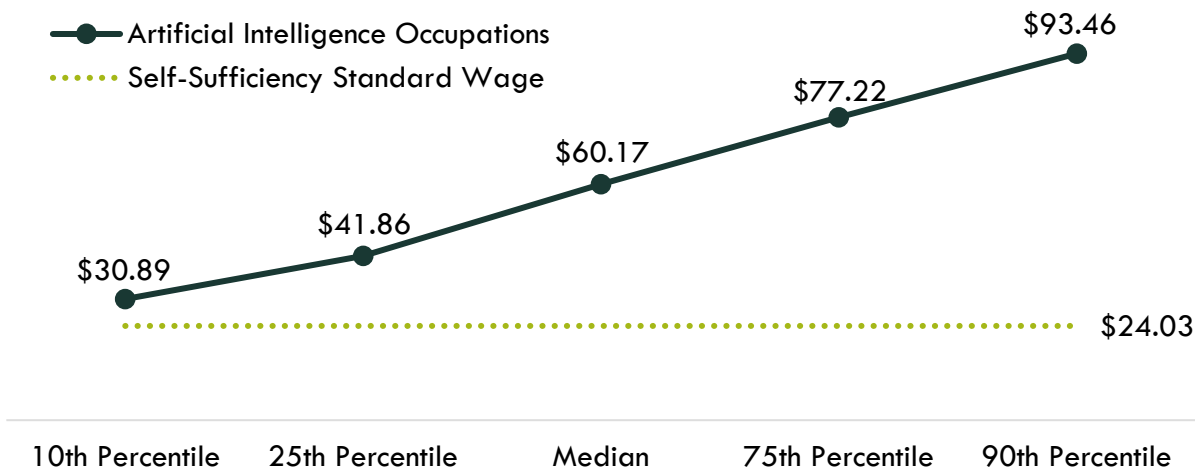
Exhibit 4: Earnings for occupations in Orange County

Occupation	Entry-Level Hourly Earnings (25 th Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75 th Percentile)	Median Annual Earnings*
Software Developers	\$57.29	\$72.12	\$82.08	\$150,000
Computer Occupations, All Other	\$28.35	\$46.26	\$68.49	\$96,200
Data Scientists	\$37.03	\$57.85	\$75.26	\$120,300

*Rounded to the nearest \$100

Across the greater Los Angeles and Orange County region, the average entry-level hourly earnings for the occupations in this report are \$41.86; this is above the living wage for a single adult in Los Angeles County (\$24.03). Exhibit 5 shows the average hourly wage for the occupations in this report, for entry-level to experienced workers.

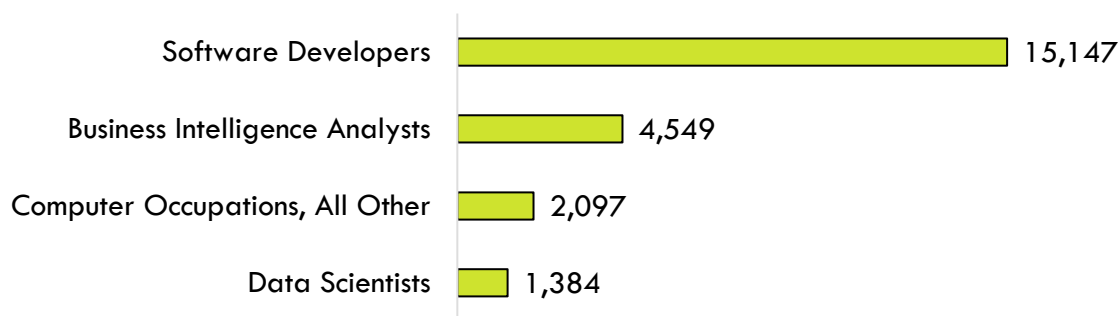
Exhibit 5: Average hourly earnings for artificial intelligence occupations, Los Angeles and Orange counties



JOB POSTINGS

There were 23,177 online job postings related to the target occupation in this report listed in the past 12 months in Los Angeles and Orange counties. Exhibit 6 displays the number of job postings by occupation. The majority of job postings (65%) were for *software developers*, followed by *business intelligence analyst* (20%) and *computer occupations, all other* (9%).

Exhibit 6: Job postings by occupation (last 12 months), Los Angeles and Orange counties



Job postings were analyzed for the most common job titles, skills, and employers associated with the target occupations in this report (Exhibit 7).

Exhibit 7: Most commonly requested job titles, skills and employers in job postings, Los Angeles and Orange counties

Top Job Titles	Top Skills	Top Employers
<ul style="list-style-type: none"> • Software engineers • Data analysts • Data scientists • Principal software engineers • Solutions architects • Embedded software engineers • Software developers 	<ul style="list-style-type: none"> • Computer science • Python (programming language) • SQL (programming language) • Software engineering • Software development • Agile methodology • Amazon Web Services 	<ul style="list-style-type: none"> • Amazon • Deloitte • Disney • Raytheon Technologies • Northrop Grumman • Accenture • Motion Recruitment • Insight Global • University of California

Of these 23,177 online job postings, **1,380 listed artificial intelligence as a specialized skill.** These 1,380 job postings were analyzed for the most common job titles, skills, and employers associated with artificial intelligence skills (Exhibit 8).

Exhibit 8: Most commonly requested job titles, skills and employers in targeted job postings listing artificial intelligence as a specialized skill, Los Angeles and Orange counties

Top Job Titles	Top Skills	Top Employers
<ul style="list-style-type: none"> • Data scientists • Software engineers • Machine learning engineers • Solutions architects • Principal software engineers • Artificial intelligence engineers 	<ul style="list-style-type: none"> • Artificial intelligence • Machine learning • Python (programming language) • Computer science • Software engineering • Amazon Web Services • SQL (programming language) 	<ul style="list-style-type: none"> • Amazon • Accenture • Boeing • Motion Recruitment • The Aerospace Corporation • PricewaterhouseCoopers • Deloitte

In the greater Los Angeles/Orange County region, 63% of the target job postings listed a minimum educational requirement. Exhibit 9 details the number and percentage of job postings by educational level.

Exhibit 9: Education levels requested in job postings for occupations related to artificial intelligence, Los Angeles and Orange counties

Education Level	Job Postings	% of Job Postings
Bachelor's degree	13,240	91%

Education Level	Job Postings	% of Job Postings
Associate degree	619	4%
High school diploma or vocational training	738	5%

EDUCATIONAL ATTAINMENT

The Bureau of Labor Statistics (BLS) lists a bachelor's degree as the typical entry-level education for each of the occupations in this report (Exhibit 10). The national-level educational attainment data indicates between 13% and 46% of workers in the field have completed an associate degree or less education, while between 54% and 89% hold a bachelor's degree or more education. The Bureau of Labor Statistics (BLS) lists the following typical entry-level education levels for the occupations in this report:

Exhibit 10: Entry-level education preferred by employers nationally, Bureau of Labor Statistics

Occupation	Education Level
Software Developers	Bachelor's degree
Computer Occupations, All Other	Bachelor's degree
Data Scientists	Bachelor's degree

EDUCATIONAL SUPPLY

Community College Supply

Exhibit 11 shows the annual and three-year average number of awards conferred by community colleges in programs that have historically trained for the occupations of interest. The colleges with the most completions in the region are Orange Cost, Mt. San Antonio, and Santa Monica.

Exhibit 11: Regional community college awards (certificates and degrees), 2021-2023

TOP Code	Program	College	2020-21 Awards	2021-22 Awards	2022-23 Awards	3-Year Average
0701.00	Information Technology, General	East LA	4	30	18	17
		Glendale	3	17	16	12
		LA Harbor	1	2	-	1
		LA Mission	1	4	3	3
		LA Southwest	2	12	1	5
		Long Beach	106	88	73	89
		Mt San Antonio	49	23	12	28
		Santa Monica	1	-	-	0
		West LA	-	6	4	3
		LA Subtotal		167	182	127

TOP Code	Program	College	2020-21 Awards	2021-22 Awards	2022-23 Awards	3-Year Average
		Santa Ana	3	9	25	12
		OC Subtotal	3	9	25	12
		Supply Subtotal/Average	170	191	152	171
0702.00	Computer Information Systems	Citrus	4	6	2	4
		Compton	-	12	4	5
		East LA	23	11	23	19
		El Camino	11	28	19	19
		Glendale	6	8	11	8
		LA City	4	3	4	4
		LA Harbor	-	1	2	1
		LA Mission	1	1	-	1
		LA Southwest	-	21	20	14
		LA Trade-Tech	15	17	35	22
		Long Beach	3	-	6	3
		Mt San Antonio	6	68	41	38
		Rio Hondo	6	15	14	12
		Santa Monica	-	-	2	1
		West LA	9	14	8	10
		LA Subtotal	88	205	191	161
		Coastline	-	2	7	3
		Fullerton	31	49	48	43
		Irvine	-	-	1	0
		Orange Coast	-	1	-	0
		Saddleback	1	-	1	1
Santa Ana	16	18	8	14		
Santiago Canyon	1	1	5	2		
OC Subtotal	49	71	70	63		
		Supply Subtotal/Average	137	276	261	225
0706.00	Computer Science (transfer)	Cerritos	35	33	26	31
		Citrus	27	44	57	43
		El Camino	31	32	21	28
		Glendale	7	16	14	12
		LA City	10	13	11	11
		LA Mission	6	3	3	4
		LA Southwest	2	-	-	1

TOP Code	Program	College	2020-21 Awards	2021-22 Awards	2022-23 Awards	3-Year Average
		Long Beach	30	27	25	27
		Rio Hondo	-	2	9	4
		Santa Monica	73	86	64	74
		West LA	1	3	7	4
		LA Subtotal	222	259	237	239
		Cypress	3	7	16	9
		Golden West	1	5	2	3
		Irvine	48	62	55	55
		Orange Coast	66	66	-	44
		Saddleback	29	33	38	33
		Santa Ana	21	28	28	26
		Santiago Canyon	7	8	19	11
		OC Subtotal	175	209	158	181
		Supply Subtotal/Average	397	468	395	420
0707.00	Computer Software Development	LA City	-	1	-	0
		LA Harbor	-	2	2	1
		LA Mission	-	2	-	1
		LA Pierce	4	7	7	6
		Santa Monica	1	1	2	1
		West LA	-	6	1	2
		LA Subtotal	5	19	12	12
		Golden West	6	4	1	4
		Orange Coast	2	-	-	1
		Saddleback	10	15	16	14
		OC Subtotal	18	19	17	18
		Supply Subtotal/Average	23	38	29	30
0707.10	Computer Programming	Cerritos	3	7	2	4
		Citrus	3	9	7	6
		East LA	1	-	1	1
		LA City	8	10	19	12
		LA Harbor	2	4	6	4
		LA Mission	7	7	6	7
		LA Pierce	5	5	7	6
		LA Southwest	2	2	3	2
		LA Valley	13	8	15	12

TOP Code	Program	College	2020-21 Awards	2021-22 Awards	2022-23 Awards	3-Year Average
		Long Beach	3	7	4	5
		Mt San Antonio	83	125	65	91
		Pasadena	23	23	37	28
		Santa Monica	65	71	55	64
		LA Subtotal	218	278	227	241
		Coastline	-	1	2	1
		Cypress	6	5	5	5
		Fullerton	24	28	32	28
		Orange Coast	206	160	250	205
		Santiago Canyon	2	2	3	2
		OC Subtotal	238	196	292	242
		Supply Subtotal/Average	456	474	519	483
0799.00	Other Information Technology	LA Harbor	-	1	-	0
		Mt San Antonio	4	12	1	6
		LA Subtotal	4	13	1	6
		Orange Coast	1	-	-	0
		Santa Ana	-	-	5	2
		OC Subtotal	1	-	5	2
		Supply Subtotal/Average	5	13	6	8
		Supply Total/Average	1,188	1,460	1,362	1,337

Other Postsecondary Supply

For a comprehensive regional supply analysis, it is important to consider the supply from other institutions in the region that provide training programs for the target occupations in this report. Exhibit 12 shows the number of awards conferred by these institutions in relevant programs. Due to different data collection periods, the most recent data is from 2020 to 2022. Between 2020 and 2022, other postsecondary college institutions in the region conferred an average of 3,832 bachelor's and sub-baccalaureate awards. Sub-baccalaureate awards include associate degrees, postsecondary awards, and other academic awards that typically take fewer than four years to complete. The majority of awards in Exhibit 12 (94%) are bachelor's degrees (3,587 awards).

Exhibit 12: Other regional postsecondary awards, 2020-2022

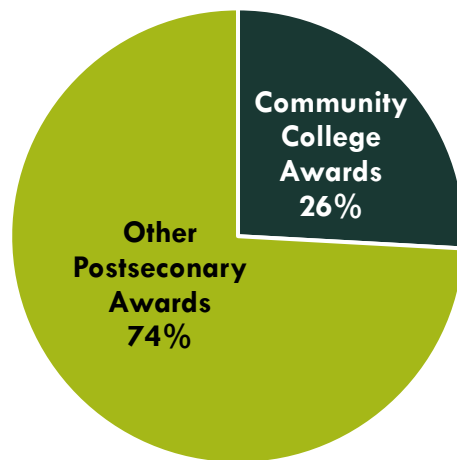
CIP Code	Program	Postsecondary Institution	2019-20 Awards	2020-21 Awards	2021-22 Awards	3-Year Average
11.0101	Computer and Information	Azusa Pacific University	21	25	5	17
		Chapman University	16	20	25	20

CIP Code	Program	Postsecondary Institution	2019-20 Awards	2020-21 Awards	2021-22 Awards	3-Year Average
	Sciences, General	LA Pacific College	6	2	2	3
		Loyola Marymount Univ.	27	44	51	41
		Pitzer College	-	1	-	0
		UC-Irvine	-	1	-	0
		University of La Verne	23	36	20	26
		University of Massachusetts Global	30	36	37	34
		Univ. of the People	203	292	478	324
11.0103	Information Technology	Brand College	13	17	18	16
		CA Intercontinental Univ.	2	-	-	1
		CSU-Dominguez Hills	4	10	17	10
		CSU-Los Angeles	134	111	90	112
		CSU-Northridge	29	51	45	42
		Platt College-Anaheim	15	17	12	15
		Platt College-LA	12	6	3	7
		University of La Verne	2	3	15	7
		University of Massachusetts Global	-	-	1	0
		Westcliff University	-	-	1	0
11.0199	Computer and Information Sciences, Other	CSU-Dominguez Hills	63	55	54	57
		CSU-Northridge	73	99	78	83
11.0201	Computer Programming/ Programmer, General	ABCO Technology	46	34	14	31
		Platt College-Anaheim	4	-	-	1
11.0701	Computer Science	Azusa Pacific University	-	-	9	3
		Biola University	18	18	15	17
		CA Intercontinental Univ.	72	83	77	77
		CSPU-Pomona	238	270	202	237
		CSU-Dominguez Hills	57	66	82	68
		CSU-Fullerton	259	307	325	297
		CSU-Long Beach	220	221	254	232
		CSU-Los Angeles	119	152	148	140
		CSU-Northridge	160	214	251	208
		Chapman University	30	45	50	42
Claremont McKenna College	25	17	13	18		

CIP Code	Program	Postsecondary Institution	2019-20 Awards	2020-21 Awards	2021-22 Awards	3-Year Average
		Concordia Univ.-Irvine	-	-	3	1
		Harvey Mudd College	47	48	48	48
		Occidental College	14	14	31	20
		Pitzer College	9	5	10	8
		Pomona College	34	33	49	39
		Scripps College	11	4	6	7
		Southern California Institute of Technology	10	7	5	7
		UC-Irvine	794	805	729	776
		UCLA	287	345	348	327
		USC	247	293	287	276
11.0804	Modeling, Virtual Environments and Simulation	ABC Adult School	-	-	1	0
		UC-Irvine	61	70	62	64
		USC	27	45	32	35
11.0899	Computer Software and Media Applications, Other	Art Center College of Design	20	14	21	18
		CA Institute of the Arts	7	1	6	5
		Learnet Academy	10	9	2	7
11.9999	Computer and Information Sciences and Support Services, Other	Woodbury University	-	1	-	0
15.1202	Computer/Computer Systems Technology/Technician	Learnet Academy	4	2	2	3
30.3001	Computational Science	Chapman University	-	-	1	0
30.3101	Human Computer Interaction	Woodbury University	4	2	2	3
Supply Total/Average			3,507	3,951	4,037	3,832

Exhibit 12 shows the proportion of community college awards conferred in the greater Los Angeles/Orange County region compared to the number of other postsecondary awards for the programs in this report. The majority of awards conferred in these programs are awarded by other institutions in the greater Los Angeles/Orange County region.

Exhibit 12: Percentage of community college awards compared to other postsecondary institution awards in the Los Angeles/Orange County region



APPENDIX: OCCUPATION DESCRIPTIONS

LA COE prepared this report to provide regional labor market supply and demand data related to these target occupations:

- **Software Developers (15-1252)** 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.¹¹
- **Computer Occupations, All Other (15-1299)** All computer occupations not listed separately.¹²
- **Data Scientists (15-2051)** Develop and implement a set of techniques or analytics applications to transform raw data into meaningful information using data-oriented programming languages and visualization software. Apply data mining, data modeling, natural language processing, and machine learning to extract and analyze information from large structured and unstructured datasets. Visualize, interpret, and report data findings. May create dynamic data reports.¹³
 - **Business Intelligence Analysts (15-2051.01)** Produce financial and market intelligence by querying data repositories and generating periodic reports. Devise methods for identifying data patterns and trends in available information sources.¹⁴

¹¹ [Software Developers, Quality Assurance Analysts, and Testers \(bls.gov\)](https://www.bls.gov)

¹² [Computer Occupations, All Other \(bls.gov\)](https://www.bls.gov)

¹³ [Data Scientists \(bls.gov\)](https://www.bls.gov)

¹⁴ [Business Intelligence Analysts \(onetonline.org\)](https://www.onetonline.org)

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POWERED BY



DATA SOURCES

- O*NET Online
- Lightcast (formerly Emsi)
- Bureau of Labor Statistics (BLS)
- California Employment Development Department, Labor Market Information Division, OES
- California Community Colleges Chancellor's Office Management Information Systems (MIS)
- Self-Sufficiency Standard at the Center for Women's Welfare, University of Washington
- Chancellor's Office Curriculum Inventory (COCI 2.0)

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