Labor Market Analysis: 0707.00 – Computer Software Development
Applied Artificial Intelligence – Certificate requiring 16 to <30 units

Los Angeles Center of Excellence, May 2024

Program Endorsement:	Endorsed: All Criteria Met ☐	Endorsed: Some Criteria Met ☒	Not Endorsed ☐

Program Endorsement Criteria		
Supply Gap:	Yes ☑	No ☐
Living Wage: (Entry-Level, 25th)	Yes ☑	No ☐
Education:	Yes ☐	No ☑
Emerging Occupation(s)		
	Yes ☑	No ☐

SUMMARY

This report analyzes whether local labor market demand is being met by community college programs aligned with the identified artificial intelligence-related occupations[1] 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.

According to Harvard Business Review, artificial intelligence (AI) can support business needs through automating business processes, gaining insight though data analysis and mining, and by engaging with customers and employees.[2] A 2023 article highlights the multitude of ways that PepsiCo is utilizing AI on a daily basis to create new products and flavors, determine which stores are selling the most of specific products, and to optimize product placement.[3] Since this field of technology is constantly evolving, the Standard Occupational Classification (SOC) system has yet to classify artificial intelligence occupations. Therefore, this report utilizes real-time job posting information from employer job advertisements to approximate demand for artificial intelligence-related jobs, as well as SOC codes that employ the skills necessary for artificial intelligence.

Based on the available data, there appears to be a supply gap for the three identified occupations in the region. While entry-level wages exceed the self-sufficiency standard wage in both Los Angeles and Orange counties, the Bureau of Labor Statistics (BLS) lists a bachelor's degree as the typical entry-level education.

[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.

[2] Harvard Business Review: https://hbr.org/2018/01/artificial-intelligence-for-the-real-world

[3] https://www.axios.com/2023/04/06/pepsico-artificial-intelligence-kanioura

<u>Recommendation:</u> Due to 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

- 7,718 annual job openings are projected in the region through 2027. This number is greater than the three-year average of 5,169 awards conferred by educational institutions in the region.
    - Over the past 12 months in the LA/OC region, there were 3,012 online job postings for the three occupations in this report that also listed "artificial intelligence", "machine learning", "natural language" and/or "large language" as a specialized skill.

Living Wage

- All three occupations have entry-level wages **<u>above</u>** Los Angeles County's self-sufficiency standard hourly wage ($18.10/hour).[4]

Educational Attainment

- A bachelor's degree is the typical entry-level education for these artificial intelligence-related occupations according to the Bureau of Labor Statistics (BLS).
- 13%-46% of workers in the field have completed an associate degree or less education, according to national educational attainment data.

Community college supply

- 28 community colleges issued awards related to artificial intelligence in the greater LA/OC region.
- 1,337 awards (degrees and certificates) were conferred on average each year between 2020 and 2023.

Other postsecondary supply

- 37 educational institutions in the LA/OC region offer programs related to artificial intelligence.
- 3,832 awards were conferred on average each year by other postsecondary institutions throughout the greater LA/OC region.

TARGET OCCUPATIONS

The LA COE prepared this report to provide regional labor market and postsecondary supply data for three occupations related to artificial intelligence. Although the occupations in this report typically require a bachelor's degree, these SOC codes employ the skills necessary for artificial intelligence. For full occupation descriptions, please see Appendix.

- ***Software Developers* (15-1252)**[5]

[4] Self-Sufficiency Standard wage data was pulled from The Self-Sufficiency Standard Tool for California. For more information, visit: http://selfsufficiencystandard.org/california.

[5] Software Developers, Quality Assurance Analysts, and Testers U.S. Bureau of Labor Statistics (bls.gov)

- ***Computer Occupations, All Other* (15-1299)**[6]
- ***Data Scientists* (15-2051)**[7]

OCCUPATIONAL DEMAND

Exhibit 1 shows the five-year occupational demand projections for these occupations 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 13% through 2027. There will be more than 7,700 job openings per year through 2027 due to job growth and replacements. The majority of jobs in 2022 for these occupations related to artificial intelligence (69%) were located in Los Angeles County.

Exhibit 1: Current employment and occupational demand, Los Angeles and Orange counties[8]

Geography	2022 Jobs	2027 Jobs	2022-2027 Change	2022-2027 % Change	Annual Openings
Los Angeles	61,767	70,355	8,588	14%	5,438
Orange	28,223	31,310	3,087	11%	2,280
Total	**89,990**	**101,665**	**11,675**	**13%**	**7,718**

Detailed Occupation Data

Exhibit 2 displays the current employment and projected occupational demand for each of the target occupations in Los Angeles County. The percentage of workers aged 55+ and automation index is included in order visualize upcoming replacement demand for these occupations. The occupations in this report have a lower-than-average risk of automation, as well as a smaller share of older workers in the field.

Exhibit 2: Current employment, projected occupational demand, percentage of workers aged 55+, Los Angeles County[9]

Occupation	2022 Jobs	2027 Jobs	5-Yr % Change	Annual Openings	% Aged 55 and older*	Auto-mation Index**	% Full Time Workers ***
Software Developers	38,270	44,454	16%	3,433	14%	80.2	99%
Computer Occupations, All Other	17,826	18,674	5%	1,307	19%	85.5	90%
Data Scientists	5,672	7,227	27%	698	14%	83.4	92%
Total	**61,767**	**70,355**	**14%**	**5,438**	**-**	**-**	**-**

[6] Computer Occupations, All Other (bls.gov)
[7] Data Scientists U.S. Bureau of Labor Statistics (bls.gov)
[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] Ibid.

*The average percentage of workers aged 55 and older across all occupations in the greater LA/OC region is 27%. These occupations have a smaller share of older workers, which typically indicates fewer replacements needs to offset the amount of impending retirements.
**The automation index captures an occupation's risk of being affected by automation with a base of 100. An automation index greater than 100 indicates a higher-than average risk of automation; less than 100 indicates a lower-than-average risk.
***In California, 81% of workers are employed full-time.

WAGES

The labor market endorsement in this report considers the entry-level hourly wages for these 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 ($18.10 in Los Angeles County). Typical entry-level hourly wages are in a range between $29.46 and $58.80. (Exhibit 3). Experienced workers can expect to earn wages between $71.29 and $84.36.

Exhibit 3: Earnings for occupations in Los Angeles County

Occupation	Entry-Level Hourly Earnings (25th Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75th Percentile)	Median Annual Earnings*
Software Developers	$58.80	$74.09	$84.36	$154,100
Computer Occupations, All Other	$29.46	$48.11	$71.29	$100,100
Data Scientists	$38.56	$60.31	$78.51	$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 ($20.63 in Orange County). Typical entry-level hourly wages are in a range between $28.27 and $57.29 (Exhibit 4). Experienced workers can expect to earn wages between $68.39 and $82.14.

Exhibit 4: Earnings for occupations in Orange County

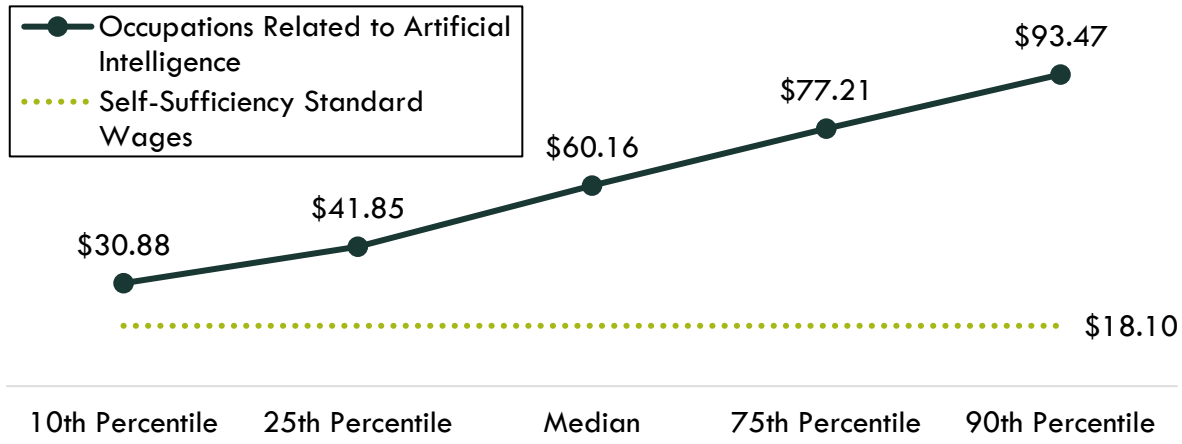
Occupation	Entry-Level Hourly Earnings (25th Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75th Percentile)	Median Annual Earnings*
Software Developers	$57.29	$72.16	$82.14	$150,100
Computer Occupations, All Other	$28.27	$46.17	$68.39	$96,000
Data Scientists	$36.98	$57.79	$75.19	$120,200

*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 $41.85; this is above the living wage for one single

adult in Los Angeles County ($18.10). 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 occupations related to artificial intelligence, Los Angeles and Orange counties



JOB POSTINGS

Over the past 12 months in the region, there were 3,012 online job postings for the three occupations in this report that also listed "artificial intelligence", "machine learning", "natural language" and/or "large language" as specialized skills. Exhibit 6 displays the number of job postings by occupation. The majority of job postings (46%) were for software developers, followed by data scientists (35%) and computer occupations, all other (19%).

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
• Data scientists • Software engineers • Machine learning engineers • DevSecOps engineers	• Machine learning • Python (programming language) • Artificial intelligence • Computer science	• Boeing • Motion Recruitment* • Amazon • Snap Inc.

Top Job Titles	Top Skills	Top Employers
• Systems engineers • Data analysts • Expert software engineers	• Software engineering • Data science • SQL (programming language)	• The Aerospace Corporation • Disney • PricewaterhouseCoopers

*Staffing company

In the greater Los Angeles/Orange County region, 75% of the related job postings listed a minimum educational requirement. The number and percentage of job postings by educational level appear in exhibit 8.

Exhibit 8: 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	2,096	93%
Associate degree	100	4%
High school diploma or vocational training	49	2%

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 9). The national-level data indicates 13% of software developers and data scientists in the field have completed an associate degree or less education as their highest level of educational attainment. However, 46% of computer occupations, all other have completed an associate degree or less education as their highest level of educational attainment. The Bureau of Labor Statistics (BLS) lists the following typical entry-level education levels for the occupations in this report:

Exhibit 9: 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 10 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 Coast, Mt. San Antonio, and Santa Monica.

Exhibit 10: Regional community college awards (certificates and degrees), 2020-2023

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**	**159**
		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

TOP Code	Program	College	2020-21 Awards	2021-22 Awards	2022-23 Awards	3-Year Average
		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
		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
		Cypress	3	7	16	9
		Golden West	1	5	2	3
		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

TOP Code	Program	College	2020-21 Awards	2021-22 Awards	2022-23 Awards	3-Year Average
		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
		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 occupations related to artificial intelligence. Exhibit 11 shows the number of awards conferred by these institutions in relevant programs. Due to different data collection periods, the most recent data is from 2019 to 2022. Between 2019 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 11 are bachelor's degrees (3,587 awards), followed by sub-baccalaureate awards (244 awards).

Exhibit 11: Other regional postsecondary awards, 2019-2022

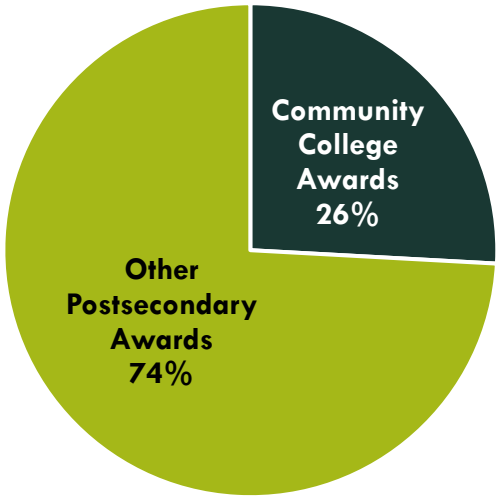
CIP Code	Program	Postsecondary Institution	2019-20 Awards	2020-21 Awards	2021-22 Awards	3-Year Average
11.0101	Computer and Information Sciences, General	Azusa Pacific Univ.	21	25	5	17
		Chapman Univ.	16	20	25	20
		LA Pacific College	6	2	2	3
		Loyola Marymount Univ.	27	44	51	41
		Pitzer College	-	1	-	0
		UC-Irvine	-	1	-	0
		Univ. of La Verne	23	36	20	26
		Univ. of Mass. 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
		Univ. of La Verne	2	3	15	7
		Univ. of Mass. 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

CIP Code	Program	Postsecondary Institution	2019-20 Awards	2020-21 Awards	2021-22 Awards	3-Year Average
11.0701	Computer Science	Azusa Pacific Univ.	-	-	9	3
		Biola University	18	18	15	17
		CA Institute of Tech.	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 Univ.	30	45	50	42
		Claremont McKenna College	25	17	13	18
		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 CA Institute of Technology	10	7	5	7
		UC-Irvine	794	805	729	776
		UC-Los Angeles	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 Univ.	-	1	-	0
15.1202	Computer/ Computer Systems	Learnet Academy	4	2	2	3

CIP Code	Program	Postsecondary Institution	2019-20 Awards	2020-21 Awards	2021-22 Awards	3-Year Average
	Technology/ Technician					
30.3001	Computational Science	Chapman Univ.	-	-	1	0
30.3101	Human Computer Interaction	Woodbury Univ.	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.[10]

- ***Computer Occupations, All Other* (15-1299)** All computer occupations not listed separately.[11]
- ***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.[12]

Contact information:
Luke Meyer, Director

Los Angeles Center of Excellence

Lmeyer7@mtsac.edu

If for any reason this document is not accessible or if you have specific needs for readability, please contact us and we will do our utmost to accommodate you with a modified version.

C·O·E
CENTERS OF EXCELLENCE
FOR LABOR MARKET RESEARCH

POWERED BY
California Community Colleges

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)

[10] Software Developers, Quality Assurance Analysts, and Testers (bls.gov)
[11] Computer Occupations, All Other (bls.gov)
[12] Data Scientists (bls.gov)