







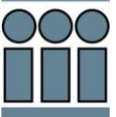


Artificial Intelligence Occupations

Labor Market Analysis: San Diego County

September 2023

Summary

NEW PROGRAM RECOMMENDATION?	EVIDENCE OF A SUPPLY GAP?	AT OR ABOVE THE LIVING WAGE?	EXPECTED EDUCATION FOR MAJORITY OF OCCUPATIONS ANALYZED
 Proceed with Caution	 	 	<input type="checkbox"/> Doctorate Degree <input type="checkbox"/> Master's Degree <input checked="" type="checkbox"/> Bachelor's Degree <input type="checkbox"/> Apprenticeship <input type="checkbox"/> Associate Degree <input type="checkbox"/> Some College or Certificate <input type="checkbox"/> HS Diploma or Equivalent <input type="checkbox"/> Less Than a HS Diploma
SUPPORT FOR PROGRAM MODIFICATION?	NUMBER OF INSTITUTIONS THAT PROVIDE TRAINING	NUMBER OF ANNUAL JOB OPENINGS	
 	MEDIUM 	HIGH 	

This brief provides labor market information about *Artificial Intelligence Occupations* to assist the San Diego & Imperial Counties Community Colleges with program development and strategic planning. According to available labor market information, there is no single occupation for “artificial intelligence.” However, occupations with the most online job postings for this skill are “Computer Occupations, All Other,” “Data Scientists,” “Managers, All Other,” “Marketing Managers,” and “Software Developers.” These occupations are collectively referred to as *Artificial Intelligence Occupations* in this brief. This brief recommends that the San Diego & Imperial Counties Community Colleges proceed with caution in developing a new program because **employers require a minimum of a bachelor’s degree for these occupations (e.g., 97 percent of job postings list a bachelor’s degree or higher)**. Consequently, existing programs for artificial intelligence in San Diego County award a bachelor’s degree or master’s degree. Should the regional community colleges proceed with a new certificate program, for example, the target student market should be individuals with bachelor’s degrees or incumbent workers in the occupations listed above. There is a labor market supply gap and entry-level wages are above the living wage, however.

Introduction

According to available labor market information, there is no single occupation for “artificial intelligence.” However, occupations with the most online job postings for this skill are “Computer Occupations, All Other,” “Data Scientists,” “Managers, All Other,” “Marketing Managers,” and “Software Developers.” Therefore, this report provides labor market information in San Diego County for the following occupational codes in the Standard Occupational Classification (SOC)¹ system:

- **Computer Occupations, All Other** (SOC 15-1299): All computer occupations not listed separately.
- **Data Scientists** (SOC 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.
- **Managers, All Other** (SOC 11-9199): All managers not listed separately.
- **Marketing Managers** (SOC 11-2021): Plan, direct, or coordinate marketing policies and programs, such as determining the demand for products and services offered by a firm and its competitors, and identify potential customers. Develop pricing strategies with the goal of maximizing the firm’s profits or share of the market while ensuring the firm’s customers are satisfied. Oversee product development or monitor trends that indicate the need for new products and services.
- **Software Developers** (SOC 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.

For the purpose of this report, these occupations are referred to as *Artificial Intelligence Occupations*.

¹ The Standard Occupational Classification (SOC) system is used by federal statistical agencies to classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data. [bls.gov/soc/](https://www.bls.gov/soc/).

Projected Occupational Demand

Between 2022 and 2027, *Artificial Intelligence Occupations* are projected to increase by 5,190 net jobs or 11 percent (Exhibit 1a). Employers in San Diego County will need to hire 4,671 workers annually to fill new jobs and backfill jobs due to attrition caused by turnover and retirement, for example.

Exhibit 1a: Number of Jobs for Artificial Intelligence Occupations (2012-2027)²

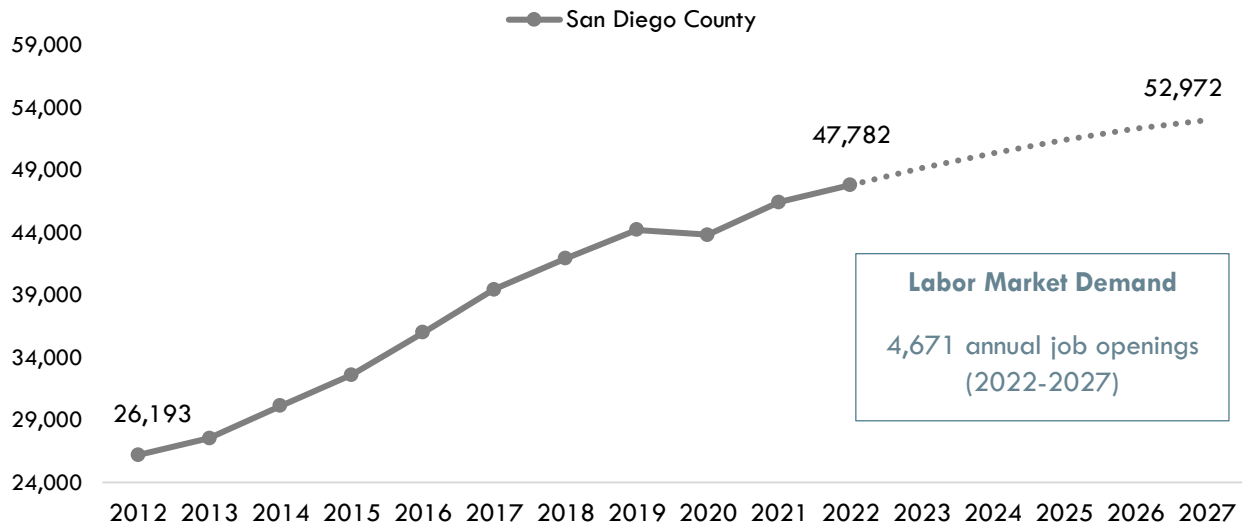


Exhibit 1b disaggregates the projected number of jobs change by occupation. “Software Developers” are projected to have the most labor market demand between 2022 and 2027, with 1,818 annual job openings.

Exhibit 1b: Number of Jobs for Artificial Intelligence Occupations in San Diego County (2022-2027)³

Occupational Title	2022 Jobs	2027 Jobs	2022 - 2027 Net Jobs Change	2022-2027 % Net Jobs Change	Annual Job Openings (Demand)
Software Developers	17,636	20,478	2,842	16%	1,818
Managers, All Other	14,783	15,846	1,063	7%	1,404
Computer Occupations, All Other	10,308	10,999	691	7%	893
Marketing Managers	3,489	3,775	286	8%	373
Data Scientists	1,566	1,874	308	20%	183
Total	47,782	52,972	5,190	11%	4,671

² Lightcast 2023.03; QCEW, Non-QCEW, Self-Employed.

³ Lightcast 2023.03; QCEW, Non-QCEW, Self-Employed.

Earnings

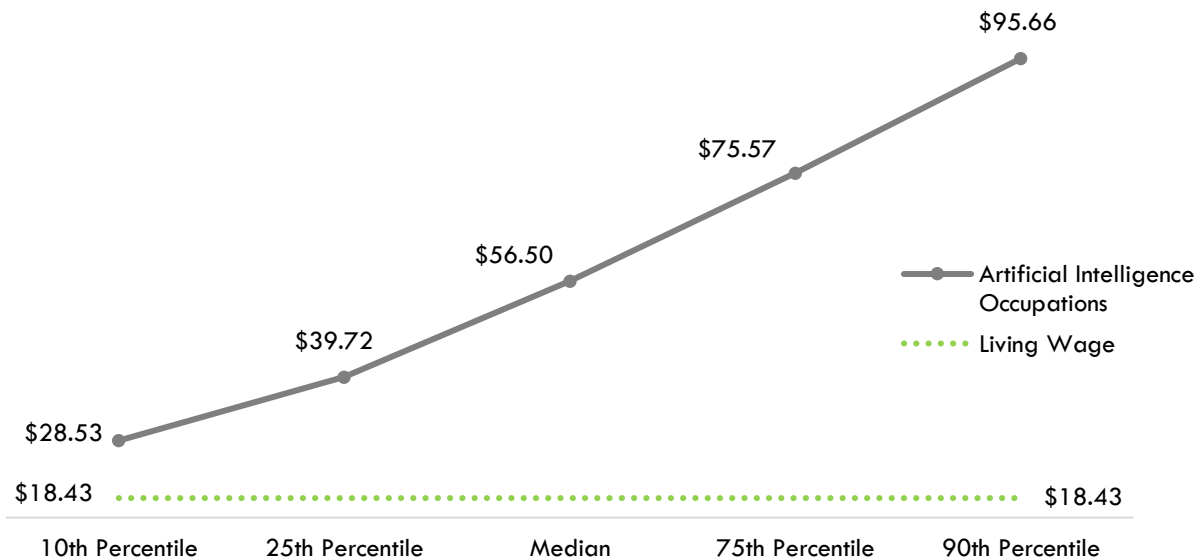
Exhibit 2a disaggregates hourly earnings by occupation. The entry-level hourly earnings for *Artificial Intelligence Occupations* range from \$29.88 to \$49.17.

Exhibit 2a: Hourly Earnings for Artificial Intelligence Occupations in San Diego County⁴

Occupational Title	Entry-Level Hourly Earnings (25 th Percentile)	Median Hourly Earnings	Experienced Hourly Earnings (75 th Percentile)
Software Developers	\$49.17	\$62.87	\$79.30
Marketing Managers	\$46.38	\$64.64	\$90.89
Data Scientists	\$38.26	\$52.59	\$67.51
Managers, All Other	\$34.93	\$55.39	\$78.49
Computer Occupations, All Other	\$29.88	\$47.02	\$61.69

On average, the entry-level hourly earnings for *Artificial Intelligence Occupations* are \$39.72; this is more than the living wage for a single adult in San Diego County, which is \$18.43 per hour (Exhibit 2b).⁵

Exhibit 2b: Average Hourly Earnings⁶ for Artificial Intelligence Occupations in San Diego County⁷



⁴ Lightcast 2023.03; QCEW, Non-QCEW, Self-Employed.

⁵ "Family Needs Calculator (formerly the California Family Needs Calculator)," Insight: Center for Community Economic Development, last updated 2021. insightccd.org/family-needs-calculator.

⁶ 10th and 25th percentiles could be considered entry-level wages, and 75th and 90th percentiles could be considered experienced wages for individuals who may have been in the occupation longer, received more training than others, etc.

⁷ Lightcast 2023.03; QCEW, Non-QCEW, Self-Employed.

Educational Supply

Educational supply for an occupation can be estimated by analyzing the number of awards in related Taxonomy of Programs (TOP) or Classification of Instructional Programs (CIP) codes.⁸ There are six TOP codes and nine CIP codes related to *Artificial Intelligence Occupations* (Exhibit 3).

Exhibit 3: Related TOP and CIP Codes for Artificial Intelligence Occupations⁹

TOP or CIP Code	TOP or CIP Program Title
TOP 0509.00	Marketing and Distribution
TOP 0509.70	E-Commerce (Business emphasis)
TOP 0707.00	Computer Software Development
TOP 0707.10	Computer Programming
TOP 0707.20	Database Design and Administration
TOP 0707.30	Computer Systems Analysis
CIP 11.0102	Artificial Intelligence
CIP 11.0501	Computer Systems Analysis/Analyst
CIP 11.0802	Data Modeling/Warehousing and Database Administration
CIP 14.0903	Computer Software Engineering
CIP 30.7001	Data Science, General
CIP 30.7101	Data Analytics, General
CIP 30.7102	Business Analytics
CIP 30.7103	Data Visualization
CIP 52.1401	Marketing/Marketing Management, General
CIP 52.1404	Digital Marketing

⁸ TOP data comes from the California Community Colleges Chancellor's Office MIS Data Mart (datamart.cccco.edu) and CIP data comes from the Integrated Postsecondary Education Data System (nces.ed.gov/ipeds/use-the-data).

⁹ This brief uses a conservative estimate of program supply and only calculates awards from the TOP codes in Exhibit 3.

According to TOP data, six community colleges supply the region with awards for these occupations: Grossmont College, MiraCosta College, Palomar College, San Diego College of Continuing Education, San Diego Mesa, and Southwestern College. According to CIP data, six non-community-college institutions supply the region with awards: Ashford University, California State University-San Marcos, Point Loma Nazarene University, San Diego State University, Southern States University, and University of San Diego (Exhibit 4).

Though these programs are most closely related to *Artificial Intelligence Occupations*, it is important to note that they train for a variety of occupations. Additionally, employers typically require at least a bachelor’s degree for these positions; therefore, programs that train for more than an associate degree are marked below.

**Exhibit 4: Number of Awards (Certificates and Degrees) Conferred by Postsecondary Institutions
(Program Year 2019-20 through Program Year 2020-21 Average)**

TOP6 or CIP Code	TOP6 or CIP Program Title	3-Yr Annual Average CC Awards (PY19-20 to PY21-22)	Other Institutions 2-Yr Annual Average Awards (PY19-20 to PY20-21)	Total Average Supply (PY19-20 to PY21-22)
0509.00	Marketing and Distribution	36	0	36
	• Grossmont	7	0	
	• MiraCosta	20	0	
	• San Diego College of Cont. Ed.	0	0	
	• San Diego Mesa	5	0	
	• Southwestern	4	0	
0509.70	E-Commerce (Business emphasis)	2	0	2
	• Southwestern	2	0	
0707.00	Computer Software Development	44	0	44
	• Grossmont	1	0	
	• MiraCosta	14	0	
	• Palomar	7	0	
	• San Diego College of Cont. Ed.	22	0	
0707.10	Computer Programming	39	0	39
	• Grossmont	23	0	

TOP6 or CIP Code	TOP6 or CIP Program Title	3-Yr Annual Average CC Awards (PY19-20 to PY21-22)	Other Institutions 2-Yr Annual Average Awards (PY19-20 to PY20-21)	Total Average Supply (PY19-20 to PY21-22)
	• MiraCosta	8	0	
	• Palomar	5	0	
	• Southwestern	3	0	
0707.30	Computer Systems Analysis	197	0	197
	• San Diego College of Cont. Ed.	197	0	
11.0802	Data Modeling/Warehousing and Database Administration ¹⁰	0	1	1
	• San Diego State University*	0	1	
14.0903	Computer Software Engineering ¹¹	0	21	21
	• Ashford University*	0	10	
	• California State University-San Marcos*	0	5	
	• San Diego State University***	0	6	
30.7001	Data Science, General	0	0	0
	• Point Loma Nazarene University*	0	0	
30.7102	Business Analytics ¹²	0	13	13
	• University of San Diego**	0	13	
52.1401	Marketing/Marketing Management, General	0	175	175
	• Point Loma Nazarene University	0	29	
	• Southern States University	0	29	
	• University of San Diego	0	117	
			Total	528

*Bachelor's Degree Program

**Master's Degree Program

***Post Baccalaureate Degree

¹⁰ Lightcast 2023.03; Program Overview. 11.0802 Data Modeling/Warehousing and Database Administration. 2020 & 2021 Completions. San Diego County.

¹¹ Lightcast 2023.03; Program Overview. 14.0903 Computer Software Engineering. 2020 & 2021 Completions. San Diego County.

¹² Lightcast 2023.03; Program Overview. 30.7102 Business Analytics. 2020 & 2021 Completions. San Diego County.

Demand vs. Supply

Comparing labor demand (annual openings) with labor supply¹³ suggests that there is a **supply gap** for these occupations in San Diego County, with **4,671** annual openings and **528** awards. Comparatively, there are **60,118** annual openings in California and **3,593** awards, suggesting that there is also a **supply gap** across the state¹⁴ (Exhibit 5).

Exhibit 5: Labor Demand (Annual Openings) Compared with Labor Supply (Average Annual Awards)

	Demand (Annual Openings)	Supply¹⁵ (Total Annual Average Supply)	Supply Gap or Oversupply
San Diego	4,671	528	4,143
California	60,118	3,593	56,525

Please note: This is a basic analysis of supply and demand of labor. The data does not include workers currently in the labor force who could fill these positions or workers who are not captured by publicly available data. This data should be used to discuss the potential gaps or oversupply of workers; however, it should not be the only basis for determining whether or not a program should be developed.

¹³ Labor supply can be found from two different sources: Lightcast or the California Community Colleges Chancellor's Office MIS Data Mart. Lightcast uses CIP codes while MIS uses TOP codes. Different coding systems result in differences in the supply numbers.

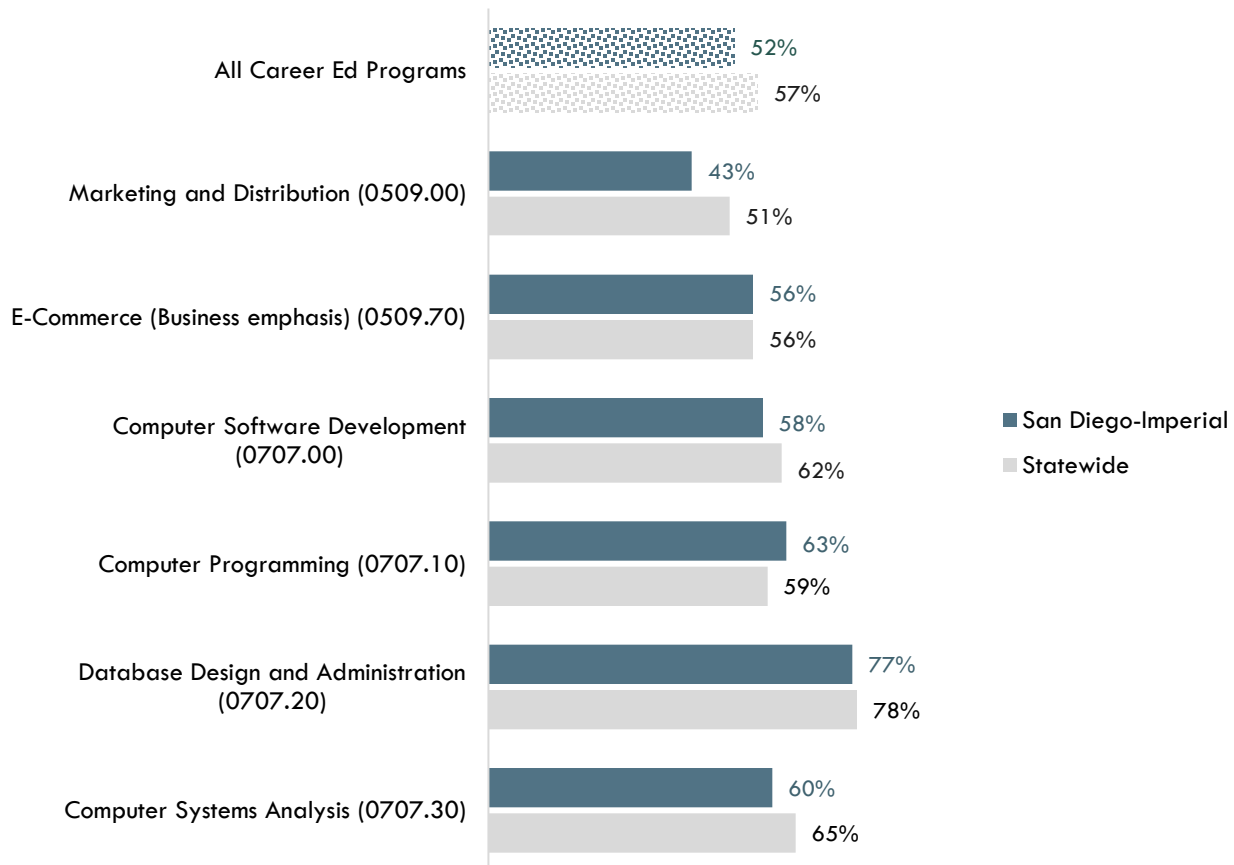
¹⁴ "Supply and Demand," Centers of Excellence Student Outcomes, <https://coecc.net/our-resources/>.

¹⁵ Awards included: associate degree; award <1 year; award 1<2 years; and postsecondary awards.

Student Outcomes and Regional Comparisons

According to the California Community Colleges LaunchBoard, 43 to 77 percent of students in the San Diego-Imperial region earned a living wage after completing a program related to *Artificial Intelligence Occupations*, compared 51 to 78 percent statewide and 57 percent of students in Career Education programs in general across the state (Exhibit 6a).¹⁶

Exhibit 6a: Percentage of Students Who Earned a Living Wage by Program, PY2020-21¹⁷



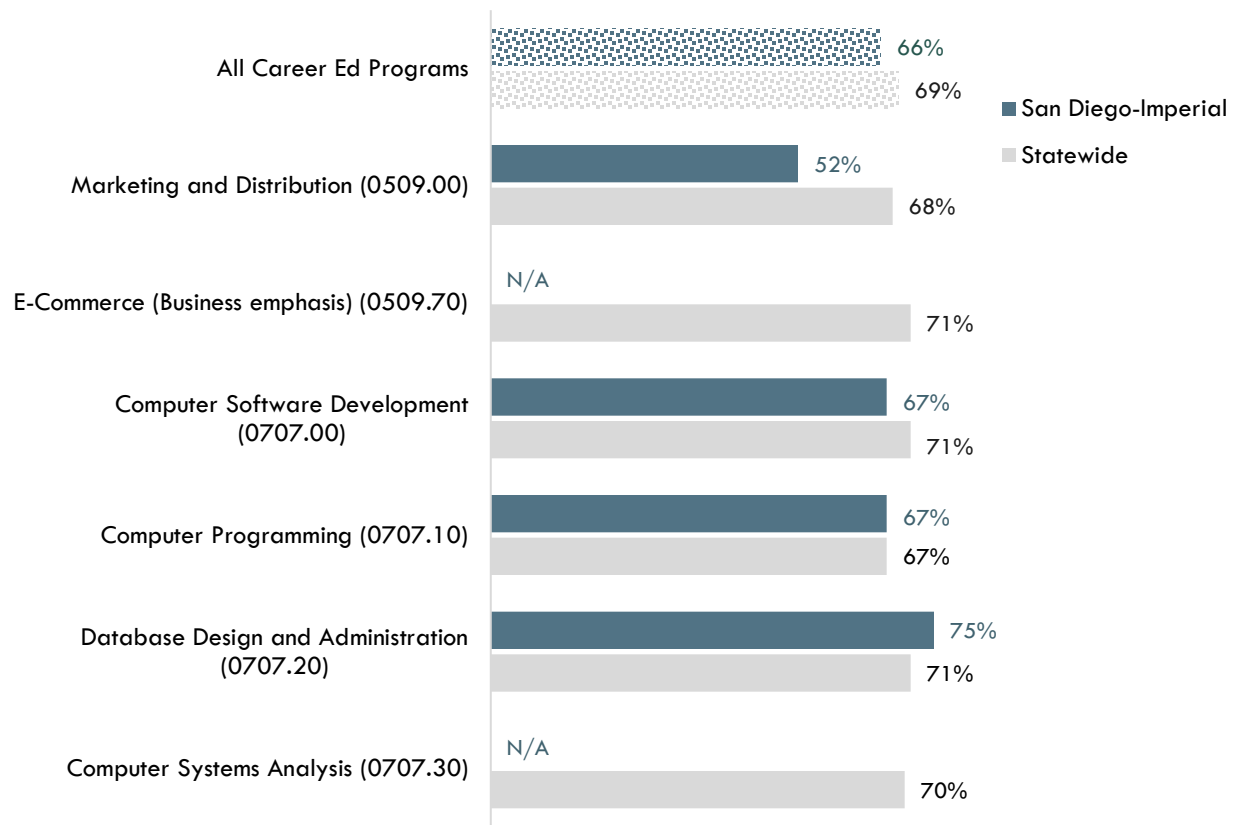
"N/A" indicates insufficient data

¹⁶ "California Community Colleges Strong Workforce Program," California Community Colleges, calpassplus.org/LaunchBoard/SWP.aspx.

¹⁷ Most recent year with available data is Program Year 2020-21. Among completers and skills builders who exited, the percentage of students who attained a living wage.

According to the California Community Colleges LaunchBoard, 52 to 75 percent of students in the San Diego-Imperial region obtained a job closely related to their field of study after completing a program related to *Artificial Intelligence Occupations*, compared to 67 to 71 percent statewide and 69 percent of students in Career Education programs in general across the state (Exhibit 6b).¹⁸

Exhibit 6b: Percentage of Students in a Job Closely Related to Field of Study by Program, PY2019-20¹⁹



"N/A" indicates insufficient data

¹⁸ "California Community Colleges Strong Workforce Program," California Community Colleges, calpassplus.org/LaunchBoard/SWP.aspx.

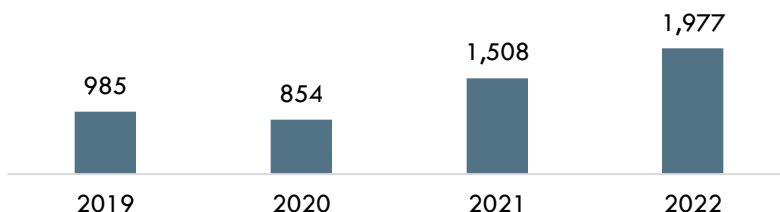
¹⁹ Most recent year with available data is Program Year 2019-20. Percentage of Students in a Job Closely Related to Field of Study: Among students who responded to the CTEOS, the percentage reporting employment in the same or similar field as their program of study.

Online Job Postings

This report analyzes not only historical and projected (traditional LMI) data, but also recent data from online job postings (real-time LMI). Online job postings may provide additional insight about recent changes in the labor market that are not captured by historical data. While *Artificial Intelligence Occupations* include “Computer Occupations, All Other,” “Data Scientists,” “Managers, All Other,” “Marketing Managers,” and “Software Developers,” employers do not typically use these formal occupational titles when recruiting for artificial intelligence positions. As a result, this section explores online job postings that include the skill “Artificial Intelligence,”²⁰ which employers commonly use to hire for these roles.

There was an average of 1,331 online job postings per year for “Artificial Intelligence” in San Diego County between 2019 and 2022 (Exhibit 7). Please note that online job postings do **not** equal labor market demand; demand is represented by annual job openings (see Exhibit 1b). While this brief includes online job postings data to help with curriculum development, the community colleges should note that this type of data is impacted by several variables: employers may post a position multiple times to increase the pool of applicants; a job posting can remain posted after a business decides not to fill a position; or an employer may use one posting to fill multiple positions, for example.

Exhibit 7: Number of Online Job Postings with “Artificial Intelligence” Skill in San Diego County (2019-2022)²¹



While labor market demand cannot be determined for “Artificial Intelligence” roles, the COE estimates that approximately 3.3 percent of the occupations in San Diego County and 3.5 percent in California require the skill “Artificial Intelligence,” based on the percentage of online job postings that listed “Artificial Intelligence” (Exhibit 8). Based on this information, there is an estimated labor market demand of 163 and 2,104 annual job openings for “Artificial Intelligence” in San Diego County and California, respectively (Exhibit 9).

²⁰ . “Artificial Intelligence” skills include “Artificial Intelligence “Artificial General Intelligence,” “Generative Artificial Intelligence,” “Artificial Intelligence Systems,” “Applications of Artificial Intelligence,” “Artificial Intelligence Development,” “AIOps (Artificial Intelligence For IT Operations),” and “Artificial Intelligence Markup Language (AIML).”

²¹ Lightcast; “Job Posting Analytics.” 2018-2022.

Exhibit 8. Online Job Postings for Selected SOC Codes and “Artificial Intelligence” Skill (January 2020 - December 2022)²²

	Online Job Postings (San Diego)	Online Job Postings (California)
Occupations listed in Exhibit 5	132,003	1,365,279
Occupations listed in Exhibit 5 and filtered by "artificial intelligence" skills	4,339	48,395
% of online job postings with skills and job titles above	3.3%	3.5%

Exhibit 9. Number of Annual Job Openings (Labor Market Demand) by SOC Code, 2022-2027²³

SOC Code	Occupational Title	Average Annual Job Openings		Estimated Annual Job Openings for “Artificial Intelligence”²⁴	
		San Diego	California	San Diego	California
15-1252	Software Developers	1,818	27,228	64	953
11-9199	Managers, All Other	1,404	15,759	49	552
15-1299	Computer Occupations, All Other	893	9,013	31	315
11-2021	Marketing Managers	373	5,792	13	203
15-2051	Data Scientists	183	2,326	6	81
	Total	4,671	60,118	163	2,104

²² Lightcast. 2023.3 – QCEW Employees, Non-QCEW Employees, and Self-Employed data set. “Job Postings Analytics” for selected SOC codes. Numbers in the exhibit reflect “unique postings” or de-duplicated online job postings. “Artificial Intelligence” skills include “Artificial Intelligence “Artificial General Intelligence,” “Generative Artificial Intelligence,” “Artificial Intelligence Systems,” “Applications of Artificial Intelligence,” “Artificial Intelligence Development,” “AIOps (Artificial Intelligence For IT Operations),” and “Artificial Intelligence Markup Language (AIML).”

²³ Lightcast. 2023.3 – QCEW Employees, Non-QCEW Employees, and Self-Employed data set. Numbers in the “Estimated Annual Job Openings for “Artificial Intelligence” reflect the 3.5% (% of online job postings with ‘artificial intelligence’ skill) multiplied against the average annual job openings for each occupation.

Top Employers

Between January 1, 2020 and December 31, 2022, the top five employers in San Diego County for *Artificial Intelligence Occupations* were [Qualcomm](#), [TuSimple](#), [General Atomics](#), [Deloitte](#), and [Intuit](#) based on online job postings (Exhibit 10).

Exhibit 10: Top Employers for “Artificial Intelligence” Skill in San Diego County²⁵

Top Employers	
<ul style="list-style-type: none">• Qualcomm• TuSimple• General Atomics• Deloitte• Intuit	<ul style="list-style-type: none">• Leidos• CyberCoders• Accenture• ResMed• Shield Ai

Education, Skills, and Certifications

Artificial Intelligence Occupations have a national educational attainment of a [bachelor’s degree](#) (Exhibit 11a).

Exhibit 11a: National Educational Attainment for *Artificial Intelligence Occupations*²⁶

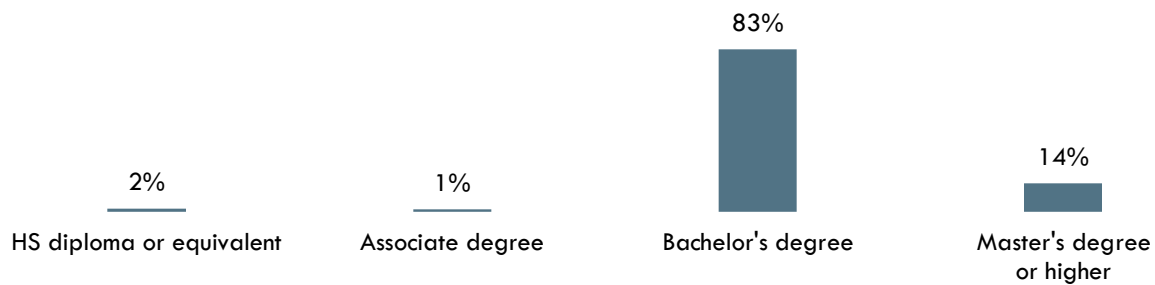
Occupational Title	Typical Entry-Level Education
Computer Occupations, All Other	Bachelor's degree
Data Scientists	Bachelor's degree
Managers, All Other	Bachelor's degree
Marketing Managers	Bachelor's degree
Software Developers	Bachelor's degree

²⁵ Lightcast; “Job Posting Analytics.” 2020-2022.

²⁶ Lightcast 2023.03; QCEW, Non-QCEW, Self-Employed.

Based on online job postings between January 1, 2020 and December 31, 2022 in San Diego County, employers posted a **bachelor's degree** as the most requested educational requirement for *Artificial Intelligence Occupations* (Exhibit 11b).²⁷

Exhibit 11b: Educational Requirements in Online Job Postings for Artificial Intelligence Occupations in San Diego County²⁸



*May not total 100 percent due to rounding

Exhibit 12 lists the top specialized, soft, and software skills that appeared in online job postings between January 1, 2020 and December 31, 2022.

Exhibit 12: Top Skills in Online Job Postings with “Artificial Intelligence” in San Diego County²⁹

Specialized Skills	Soft Skills	Software Skills
<ul style="list-style-type: none"> Artificial Intelligence Machine Learning Computer Science Software Engineering Software Development Algorithms Data Science Agile Methodology Automation Deep Learning Data Analysis Scalability Product Management Debugging Marketing 	<ul style="list-style-type: none"> Communications Management Leadership Research Innovation Operations Planning Problem Solving Writing Presentations Customer Service Mathematics Sales Influencing Skills Forecasting 	<ul style="list-style-type: none"> Python C++ Amazon Web Services Java SQL C JavaScript Linux Application Programming Interface TensorFlow Microsoft Azure Docker R Kubernetes Git

²⁷ Lightcast; “Job Posting Analytics.” 2020-2022.

²⁸ “Educational Attainment for Workers 25 Years and Older by Detailed Occupation,” Bureau of Labor Statistics, last modified April 9, 2021. bls.gov/emp/tables/educational-attainment.htm.

²⁹ Lightcast; “Job Posting Analytics.” 2020-2022.

Exhibit 13 lists the top certifications that appeared in online job postings between January 1, 2020 and December 31, 2022.

Exhibit 13: Top Certifications in Online Job Postings with “Artificial Intelligence” in San Diego County³⁰

Top Certifications in Online Job Postings

1. Security Clearance
 2. Master Of Business Administration (MBA)
 3. Secret Clearance
 4. Top Secret-Sensitive Compartmented Information (TS/SCI Clearance)
 5. CompTIA Security+
 6. Certified Information Systems Security Professional
 7. Project Management Professional Certification
 8. DoD Information Assurance Certification And Accreditation Process (DIACAP)
 9. IAT Level II Certification
 10. Enterprise Desktop Administrator (Microsoft Certified IT Professional)
 11. Agile Certification
 12. GIAC Certifications
 13. Microsoft Azure Certification
 14. IAT Level III Certification
 15. CompTIA Linux+
-

³⁰ Lightcast; “Job Posting Analytics.” 2020-2022.

Prepared by:

Tina Ngo Bartel, Director (tngobartel@miracosta.edu)

John Edwards, Research Analyst (jedwards@miracosta.edu)

San Diego & Imperial Center of Excellence

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