Artificial Intelligence

California

Introduction

This report focuses on employment demand for artificial intelligence jobs in California. Artificial Intelligence (AI) is the science and engineering of making intelligent computer programs and machines that exhibit human-like traits such as learning and problem-solving (IBM, 2023). The current applications of AI technology include speech recognition, customer service, computer vision, automated stock trading, and recommendation engines.

Occupations exclusively dedicated to the implantation, development, and maintenance of artificial intelligence and related systems have yet to be identified by the U.S. Bureau of Labor Statistics (BLS) in their Standard Occupational Classification (SOC) system. In this case, the knowledge, skills, and abilities (KSAs) related to artificial intelligence workers are likely assigned to an existing subset of computer, information analysts, database and network administrators, and software developers. To quantify the demand for artificial intelligence workers, this report analyzes online job advertisements (ads) from employers seeking this classification of workers.

The Taxonomy of Programs (TOP), developed by the California Community Colleges Chancellor's Office, does not contain a TOP code that directly provides artificial intelligence training. According to the California Community Colleges Chancellor's Office Curriculum Inventory (COCI), two community colleges in the state currently offer programs that provide training related to artificial intelligence (COCI, 2023).

Artificial Intelligence Summary of Findings

Traditional labor market information is not available for artificial intelligence workers. For this reason, online employer job advertisements are the basis of this report's job demand assessment. Online job ads are helpful in understanding KSAs, education requirements, and other employer hiring preferences; however, the number of job ads does not accurately count job openings. While efforts were made to de-duplicate job ads, employers may list jobs they do not end up filling or use a single ad to hire multiple workers. Therefore, the number of online job ads is neither comparable nor indicative of the number of annual openings for any given occupation. Following is an overview of this report's key findings.

Key Findings:

- Over the past 12 months (April 2022 to March 2023), there were 565 artificial intelligence job ads posted in California. None of these job ads were posted in the Inland Empire/Desert Region.
    - Approximately 91% of employer job ads for artificial intelligence workers were concentrated in two occupations, software developers and data scientists.

- Overall, online job ad salary information reveals that employers in the state are willing to pay these positions $150,010 annually, well above the $45,386 annual ($21.82 hourly) MIT living wage standard.
- Within job ads, approximately 99% of employers sought candidates with a bachelor's degree, while less than 1% sought candidates with an associate degree or high school diploma.
- Approximately 94% of employer job ads with experience requirements sought candidates with more than one year of previous work experience, indicating that employers value artificial intelligence workers with previous work experience.

- Regional community colleges and other regional postsecondary education institutions do not currently provide training programs for artificial intelligence workers.

Job Advertisements

An online job ad search for jobs in artificial intelligence workers was conducted to reveal the employers seeking these workers, including the median job ad duration, earnings information, and in-demand skills. Over the last twelve months, from April 2022 through March 2023, no job ads were posted for artificial intelligence workers in the Inland Empire/Desert Region. This job ad search was expanded to include all artificial intelligence job ads listed over the last 12 months in California, yielding 565 job ads.

Exhibit 1 shows the occupations that employers frequently associate with artificial intelligence work, as well as the number of job ads posted over the last twelve months in the state and the median posting duration. On average, employers kept online job ads for artificial intelligence workers open for 24 days. The average statewide online job is open for 28 days, indicating employers likely experience fewer challenges filling artificial intelligence positions than they do with other jobs. Approximately 91% of artificial intelligence job ads were for software developers and data scientists.

Exhibit 1: Job ads and posting duration, California, April 2022 – March 2023

Occupations	Job Ads	Median Posting Duration (Days)
Software Developers	302	24
Data Scientists	213	24
Database Administrators	10	18
Software Quality Assurance Analysts and Testers	9	35
Computer Systems Analysts	8	47
Information Security Analysts	8	21
Computer Programmers	5	28
Computer Network Architects	4	25
Database Architects	4	21

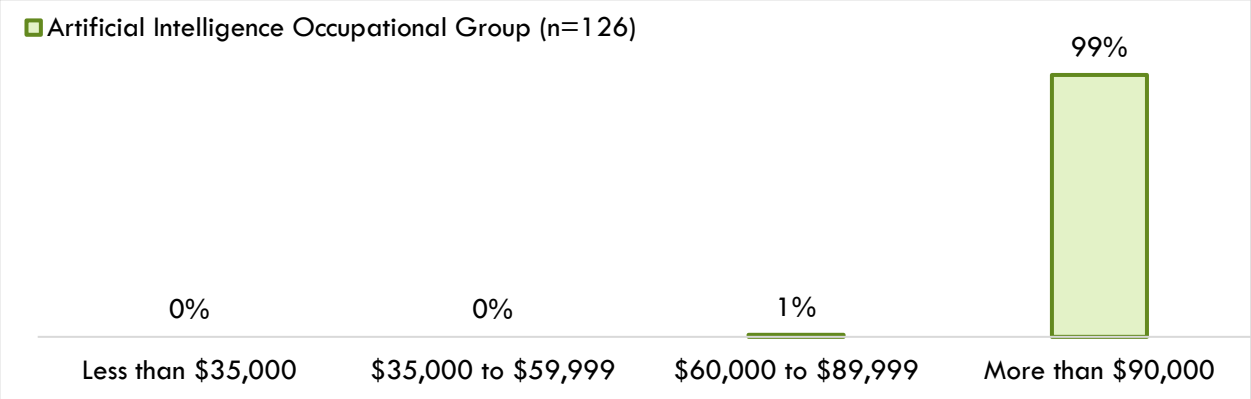
Occupations	Job Ads	Median Posting Duration (Days)
Network and Computer Systems Administrators	2	31
Total	**565**	**24**

Source: Lightcast 2023.1

Advertised Salary from Online Job Ads

Exhibit 2 displays the online advertised salaries for the artificial intelligence occupational group over the last 12 months. Online job ad salary information reveals that employers in the state are willing to pay artificial intelligence workers an annual salary of $150,010 or $72.12 per hour, well above the $21.82 hourly living wage standard. Consider the salary information with caution since only 22% (126 of 565) of online job ads for this occupational group provided salary information.

Exhibit 2. Online advertised salaries for the artificial intelligence occupational group, California, April 2022 – March 2023



Source: Lightcast 2023.1

Job Titles, Employers, Skills, Education, and Work Experience

Exhibit 3 displays the job titles most frequently requested for artificial intelligence worker jobs over the last 12 months in the state. Job titles may provide insight into the types of positions held by artificial intelligence workers. The job title most frequently associated with artificial intelligence workers in California over the last 12 months was data scientist, followed by machine learning software engineer.

Exhibit 3: Job titles most frequently requested for artificial intelligence workers, California, April 2022 – March 2023

Job Titles	Job Ads
Data Scientists	87
Machine Learning Software Engineers	81
Machine Learning Engineers	45
Software Engineers	32

Job Titles	Job Ads
Data Science Managers	17
Infrastructure Software Engineers	14
Computer Vision Software Engineers	13
Lead Data Scientists	13
Cloud Software Engineers	11
Artificial Intelligence Architects	11
All other job titles	*241*
Total	**565**

Source: Lightcast 2023.1

Exhibit 4 displays the employers that posted the most job ads for artificial intelligence workers during the last 12 months. Showing employer names provides insight into where students may find employment after completing a program. Google posted the most job ads for artificial intelligence workers over the last 12 months in the state.

Exhibit 4: Employers posting the most job ads for artificial intelligence jobs, California, April 2022 – March 2023

Top Employers	Jobs Ads
Google	80
TuSimple	71
Deloitte	42
Nvidia	34
Acxiom	26
Dun & Bradstreet	16
Booz Allen Hamilton	14
Amazon	11
AMD	10
All other employers	*261*
Total	**565**

Source: Lightcast 2023.1

Exhibit 5 lists a sample of specialized, employability, and software and programming skills employers seek when looking for artificial intelligence workers. Specialized skills are occupation-specific skills that employers request for industry or job competency. Employability skills are foundational skills that transcend industries and occupations; this category is often referred to as "soft skills." The skills requested in job ads may be utilized to guide curriculum development. The programming language Python was included in approximately 64% of employer job ads, indicating that this skill is important for artificial intelligence workers.

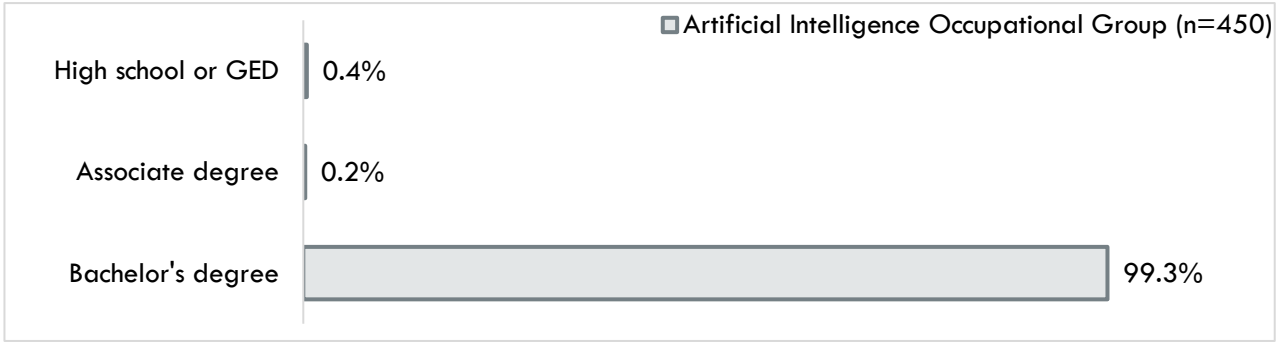
Exhibit 5: Sample of in-demand skills from employer job ads for artificial intelligence workers, California, April 2022 – March 2023, (n=565)

Specialized Skills	Employability Skills	Software and Programming Skills
• Machine Learning • Deep Learning • Artificial Intelligence • Computer Science • Software Engineering • Data Science • Software Development	• Research • Communication Skills • Mathematics • Planning • Forecasting • Innovation • Troubleshooting (Problem-Solving)	• Python • TensorFlow • C++ • PyTorch • SQL • AWS • Apache Spark • Scikit-learn • R

Source: Lightcast 2023.1

Exhibit 6 displays the minimum advertised education requirements for artificial intelligence workers. Nearly all employer job ads (99.3%) for artificial intelligence workers sought candidates with a bachelor's degree.

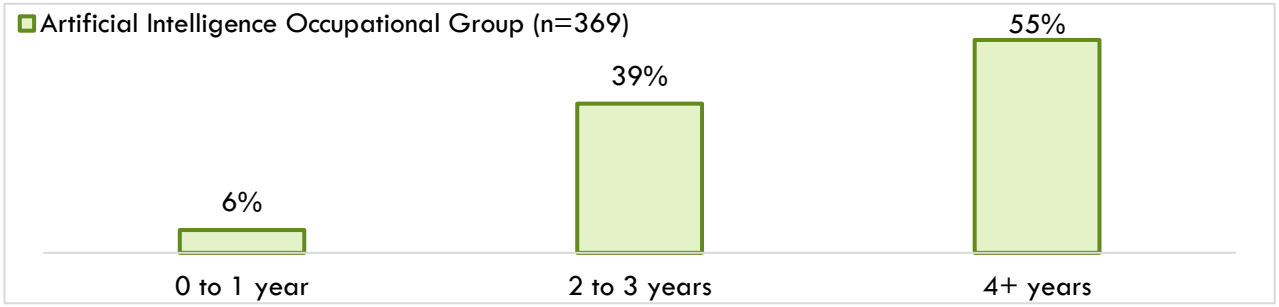
Exhibit 6: Minimum advertised education requirements for artificial intelligence workers, California, April 2022 – March 2023



Source: Lightcast 2023.1

Exhibit 7 displays the real-time work experience requirements from employer job ads. Approximately 35% of employer job ads did not include work experience requirements in job ads for artificial intelligence workers. Approximately 94% of employer job ads with experience requirements sought candidates with more than one year of previous work experience, indicating that employers value artificial intelligence workers with previous work experience.

Exhibit 7: Real-time work experience requirements, California, April 2022 – March 2023



Source: Lightcast 2023.1

Training Programs

The Taxonomy of Programs does not contain a program code for artificial intelligence training programs. According to the Chancellor's Office Curriculum Inventory (COCI), only two community colleges in California currently offer programs related to artificial intelligence. Mt. San Antonio College offers Artificial Intelligence in Business programs, and Las Positas College offers an Artificial Intelligence program. These programs were developed recently, and program outcome information is not available for artificial intelligence programs statewide. The following is the program description and program outcomes for Las Positas College's artificial intelligence program, and it may be helpful for program development.

> *The Las Positas Computer Science program offers courses that lead to a Certificate of Achievement in Artificial Intelligence. The certificate prepares students for direct job entry into areas such as artificial intelligence programming, machine learning engineering, and business intelligence development. This certificate also prepares students with the theoretical knowledge of artificial knowledge to ensure quick adaptation to emerging artificial intelligence technologies. Artificial intelligence programmer, machine learning engineer, data scientist, and business intelligence developer. Upon completion of the Certificate of Achievement in Artificial Intelligence, students will be able to analyze a problem, determine which artificial intelligence algorithms are viable, and develop an appropriate solution. Upon completion of the Certificate of Achievement in Artificial Intelligence, students will be able to use existing artificial intelligence and machine learning programming libraries on a data set to create a valid model that justifies their design decisions (Las Positas College, 2023).*

The National Center for Education Statistics (NCES) Classification of Instruction Programs (CIP), the program taxonomy for public and private universities, does not contain a program that provides training for artificial intelligence workers (IPEDS, 2023). Regional educational institutions do not prepare students for employment as artificial intelligence workers.

Contact
Michael Goss
Paul Vaccher
Centers of Excellence, Inland Empire/Desert Region
michael.goss@chaffey.edu
May 2023

References

California Community Colleges Chancellor's Office. (2023). *Chancellor's Office Curriculum Inventory (COCI), version 3.0*. Retrieved from https://coci2.ccctechcenter.org/programs

Carnevale, A. P., Jayasundera, T., & Repnikov, D. (n.d.). Understanding Online Job Ads Data. Retrieved from https://cew.georgetown.edu/wp-content/uploads/2014/11/OCLM.Tech_.Web_.pdf

Glasmeier, A. K. (2023). Massachusetts Institute of Technology. Living Wage Calculator. *Living Wage Calculation for California*. Retrieved from https://livingwage.mit.edu/states/06

IBM. (2023). *What is Artificial Intelligence (AI)?* Retrieved from https://www.ibm.com/topics/artificial-intelligence

Las Positas College. (2023). Degrees & Certificates. *Artificial Intelligence Certificate of Achievement*. Retrieved https://www.laspositascollege.edu/degrees/computer-science/artificial-intelligence-certificateofachievement.php

Lightcast. (2023). *Datarun 2023.1*. Retrieved from https://www.economicmodeling.com/

National Center for Education Statistics (NCES). The Classification of Instructional Programs (CIP). (2023). What is the CIP? Retrieved from https://nces.ed.gov/ipeds/cipcode/default.aspx?y=56

Appendix: Methodology

Job ad data is limited to the information provided by employers and the ability of artificial intelligence search engines to identify this information. Additionally, preliminary calculations by Georgetown Center on Education and the Workforce found that "just 30 to 40 percent of openings for candidates with some college or an associate degree, and only 40 to 60 percent of openings for high school diploma holders appear online" (Carnevale et al., 2014). Online job ads often do not reveal employers' hiring intentions; it is unknown if employers plan to hire one or multiple workers from a single online job ad or collect resumes for future hiring needs.

Appendix: Job Advertisement Search Parameters

Area Filter:

- California
- Riverside-San Bernardino-Ontario MSA

Occupation Filter:

- Computer Systems Analysts (15-1211)
- Information Security Analysts (15-1212)
- Computer Network Architects (15-1241)
- Database Administrators (15-1242)
- Database Architects (15-1243)
- Network and Computer Systems Administrators (15-1244)
- Computer Programmers (15-1251)
- Software Developers (15-1252)
- Software Quality Assurance Analysts and Testers (15-1253)

- Data Scientists (15-2051)

Education Filter:

- High school or GED
- Associate degree
- Bachelor's degree
- Education Not Listed

Skill Filter:

- Artificial Intelligence
- Machine Learning
- Deep Learning

Keyword Filter:

- Artificial Intelligence
- Machine Learning
- Deep Learning