

## Summary

|                         |   |  |   |
|-------------------------|---|--|---|
| Program LMI Endorsement | Endorsed: All LMI Criteria Met <input type="checkbox"/> | Endorsed: Some LMI Criteria Met <input type="checkbox"/> | Not LMI Endorsed <input type="checkbox"/> |
|-------------------------|---|--|---|

### Program LMI Endorsement Criteria

|   | Yes <input type="checkbox"/>  | No <input type="checkbox"/> |
|---|---|-----------------------------|
| Supply Gap:                                   | <i>Comments:</i> The OC COE predicates endorsement only for middle-skill occupations. <b>Since this proposed new program includes above middle-skill occupations only, we are unable to evaluate the labor market information endorsement criteria.</b> |                             |
| Living Wage: (Entry-Level, 25 <sup>th</sup> ) | Yes <input type="checkbox"/>  | No <input type="checkbox"/> |
|   | <i>Comments:</i> See comment above.   |                             |
| Education:                                    | Yes <input type="checkbox"/>  | No <input type="checkbox"/> |
|   | <i>Comments:</i> See comment above.   |                             |

### Emerging Occupation(s)

|  | Yes <input checked="" type="checkbox"/>  | No <input type="checkbox"/> |
|--|--|-----------------------------|
|  | <i>Comments:</i> According to IBM, “Artificial intelligence is a field, which combines computer science and robust datasets, to enable problem-solving.” <sup>1</sup> Artificial intelligence is a rapidly emerging field; the effects of artificial intelligence and automation on the labor market, productivity, and job loss continues to be a topic of discussion among researchers and policymakers. However, the intent of this labor market analysis is to better understand the demand for jobs that require artificial intelligence programming languages (such as Python) and methods (such as machine learning, deep learning, and natural language processing). |                             |

The Orange County Center of Excellence for Labor Market Research (OC COE) prepared this report to determine whether there is a supply gap in the Los Angeles/Orange County regional labor market related to two above middle-skill occupations that are most closely related to artificial intelligence:

- Computer Programmers (15-1251)
- Software Developers (15-1252)

Currently, there is no Standard Occupational Classification (SOC) code that is solely for artificial intelligence programming jobs. However, these two occupations utilize artificial programming languages such as Python and methods such as machine learning to analyze large amounts of data and create models that can optimize productivity, sales, maintenance, and more.<sup>2</sup>

<sup>1</sup> "What is Artificial Intelligence (AI)?" IBM - United States, accessed August 2, 2023, <https://www.ibm.com/topics/artificial-intelligence>.

<sup>2</sup> "What is AI?," McKinsey & Company, last modified April 24, 2023, <https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-ai>.

It is important to note that there are currently no middle-skill occupations that are directly related to artificial intelligence programming and typical education requirements for artificial intelligence programming jobs are high. According to the Georgetown Center for Security and Emerging Technology, “four-year college is a common pathway for many AI jobs.” Additionally, technical artificial intelligence roles have a higher percentage of workers that have completed a bachelor’s degree than non-technical roles.<sup>3</sup>

Though artificial intelligence programming jobs typically require at least a bachelor’s degree, community colleges throughout the country are developing artificial intelligence programs. In 2020, Intel launched an artificial intelligence associate degree program in partnership with Maricopa County Community College District (MCCCD) in Arizona.<sup>4</sup> Additionally, Intel and Dell Technologies have partnered with the American Association of Community Colleges (AACC) to create the Artificial Intelligence Incubator Network Initiative, which aims to deliver artificial intelligence learning content and courses to community college students in all 50 states by 2023.<sup>5</sup> Because these programs are relatively new, student employment outcomes are currently unclear.

For these reasons, it is unclear if a community college degree or certificate will be sufficient to obtain artificial intelligence programming jobs. However, the rapidly emerging nature of artificial intelligence and increase in artificial intelligence adoption by firms across all industries continues to expose more workers to artificial intelligence. According to one estimate, nearly 13% of workers were employed at firms that utilized artificial intelligence between 2016 and 2018 and that figure is projected to increase.<sup>6</sup>

The remainder of this report analyzes traditional labor market information for *computer programmers* and *software developers*, the two occupations that are most closely related to artificial intelligence programming. An analysis of online job postings related to artificial intelligence programming is also included to better understand the real-time demand for this emerging area.

The OC COE predicates endorsement only for middle-skill occupations. **Since this proposed new program includes above middle-skill occupations only, we are unable to evaluate the labor market information endorsement criteria.**

Exhibit 1, on the following page, lists the occupational demand, supply, typical entry-level education, and educational attainment for the occupations included in this report.

### Exhibit 1: Labor Market Endorsement Summary

| Occupation (SOC)               | Demand (Annual Openings) | Supply (CC and Non-CC)  | Entry-Level Hourly Earnings (25 <sup>th</sup> Percentile) | Typical Entry-Level Education | Community College Educational Attainment |
|--------------------------------|--------------------------|-------------------------|---|-------------------------------|--|
| Computer Programmers (15-1251) | LA: 245                  | LA: Accounted for Below | OC: \$33.54   | Bachelor's degree             | 20%                                      |

<sup>3</sup> "The U.S. AI Workforce," Center for Security and Emerging Technology, last modified June 9, 2023, <https://cset.georgetown.edu/publication/the-u-s-ai-workforce/>.

<sup>4</sup> "Intel Launches First Artificial Intelligence Associate Degree Program," Intel, last modified June 25, 2020, <https://www.intel.com/content/www/us/en/newsroom/news/artificial-intelligence-associate-degree-program.html#gs.3d68d2>.

<https://www.intel.com/content/www/us/en/newsroom/news/artificial-intelligence-associate-degree-program.html>

<sup>5</sup> "Artificial Intelligence Incubator Network," AACC -, last modified November 7, 2022, <https://www.aacc.nche.edu/programs/workforce-economic-development/artificial-intelligence-incubator-network/>.

<sup>6</sup> "The Impact of Artificial Intelligence on the Future of Workforces in the European Union and the United States of America," The White House, accessed August 2, 2023, <https://www.whitehouse.gov/wp-content/uploads/2022/12/TTC-EC-CEA-AI-Report-12052022-1.pdf>.

| Occupation (SOC)              | Demand (Annual Openings)             | Supply (CC and Non-CC)             | Entry-Level Hourly Earnings (25 <sup>th</sup> Percentile) | Typical Entry-Level Education | Community College Educational Attainment |
|-------------------------------|--------------------------------------|------------------------------------|---|-------------------------------|--|
|                               | OC: 112                              | OC: <i>Accounted for Below</i>     |   |                               |  |
|                               | TTL: 357                             | TTL: <i>Accounted for Below</i>    |   |                               |  |
| Software Developers (15-1252) | LA: 3,480<br>OC: 1,649<br>TTL: 5,128 | LA: 2,346<br>OC: 891<br>TTL: 4,975 | OC: \$50.42   | Bachelor's degree             | 12%                                      |
| <b>Total</b>                  | <b>5,485</b>                         | <b>4,975</b>                       | <b>N/A</b>  | <b>N/A</b>                    | <b>N/A</b>                               |

### Demand:

- The number of jobs related to these artificial intelligence occupations are projected to increase 10% through 2026, equating to 5,485 annual job openings for these artificial intelligence occupations.
- Hourly entry-level wages for these artificial intelligence occupations range from \$33.54 to \$50.42 in Orange County; all annual job openings have entry-level wages above the living wage.
- There were 13,176 online job postings related to artificial intelligence programming over the past 12 months. The highest number of postings were for data scientists, software engineers, machine learning engineers, data engineers, and software development engineers.
- The typical entry-level education for these artificial intelligence occupations is a bachelor's degree.
- Between 12% and 20% of workers in the field have completed some college or an associate degree as their highest level of educational attainment.

### Supply:

- There was an average of 1,470 awards conferred by 28 community colleges in Los Angeles and Orange Counties from 2019 to 2022.
  - Though these community college programs are most closely related to the artificial intelligence occupations in this report, it is important to note that they train for a variety of occupations, including middle-skill occupations. However, these artificial intelligence-related occupations have high education requirements and employers typically require more than a community college education for these occupations. For these reasons, community college supply is overstated
- Non-community college institutions conferred an average of 3,505 awards from 2019 to 2021.
- Orange County community college students that exited other information technology programs in the 2019-20 academic year had a median annual wage of \$26,028 after exiting the program. There was insufficient data to determine the percentage of students that attained the living wage.
- Throughout Orange County, 75% of other information technology students that exited their program in 2018-19 reported that they are working in a job closely related to their field of study.

# Demand

## Occupational Projections:

Exhibit 2 shows the annual percent change in jobs for these artificial intelligence occupations from 2017 through 2027. Though there was a 7% decline across all occupations from 2019 to 2020 due to the COVID-19 pandemic, employment in these artificial intelligence occupations decreased only 1% in Orange County during the same period. Each year from 2019 to 2021. These artificial intelligence occupations are projected to grow at a slightly higher rate compared to all occupations through 2027.

**Exhibit 2: Annual Percent Change in Jobs for Artificial Intelligence Occupations, 2017-2027**

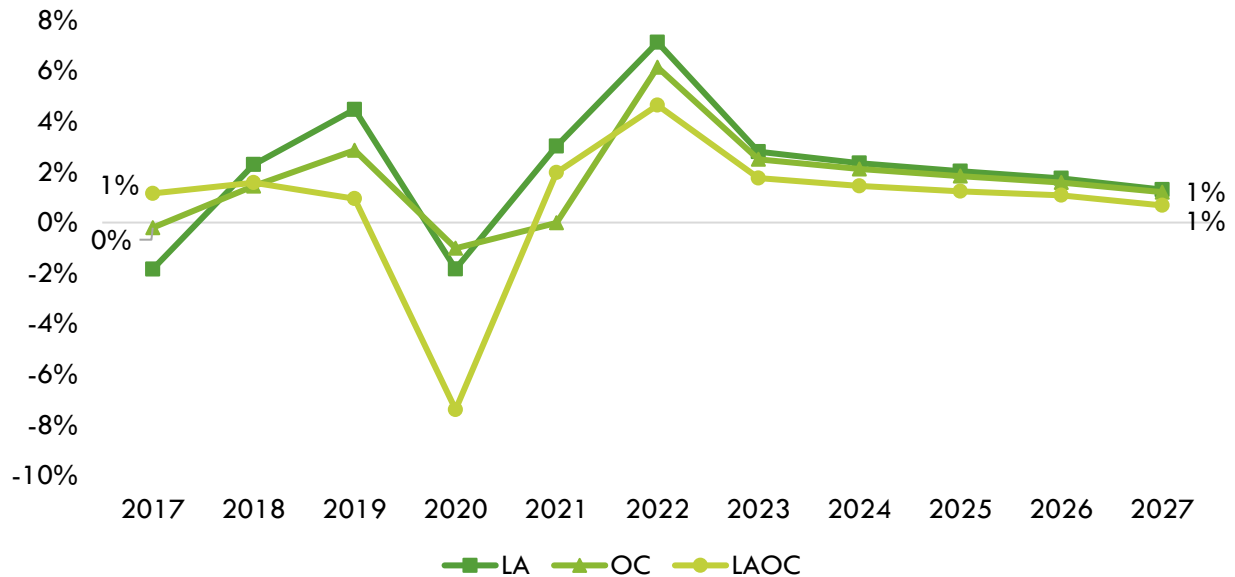


Exhibit 3 shows the five-year occupational demand projections for these artificial intelligence occupations. In Los Angeles/Orange County, the number of jobs related to these occupations is projected to increase by 10% through 2027. There is projected to be 5,485 jobs available annually.

**Exhibit 3: Occupational Demand in Los Angeles and Orange Counties<sup>7</sup>**

| Geography    | 2022 Jobs     | 2027 Jobs     | 2022-2027 Change | 2022-2027 % Change | Annual Openings |
|--------------|---------------|---------------|------------------|--------------------|-----------------|
| Los Angeles  | 40,815        | 45,159        | 4,344            | 11%                | 3,724           |
| Orange       | 19,813        | 21,711        | 1,897            | 10%                | 1,761           |
| <b>Total</b> | <b>60,628</b> | <b>66,870</b> | <b>6,242</b>     | <b>10%</b>         | <b>5,485</b>    |

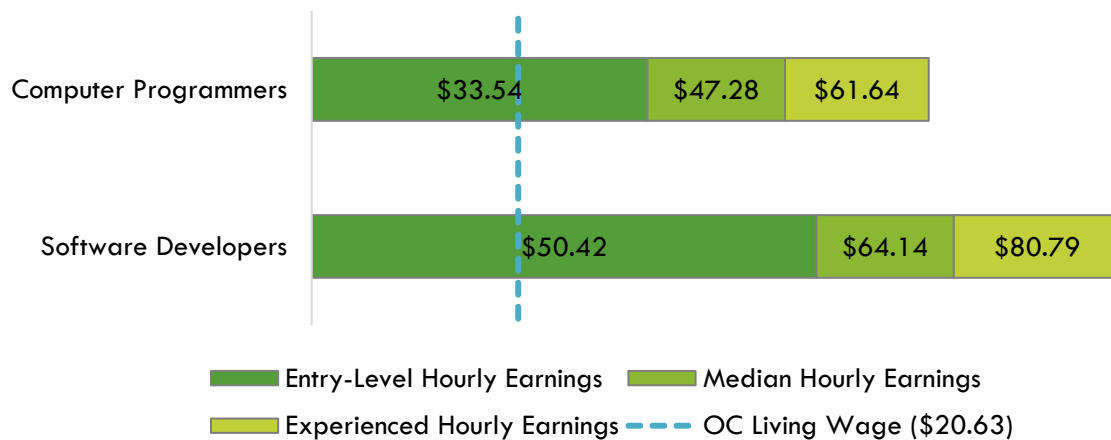
<sup>7</sup> Five-year change represents new job additions to the workforce. Annual openings include new jobs and replacement jobs that result from retirements and separations.

## Wages:

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

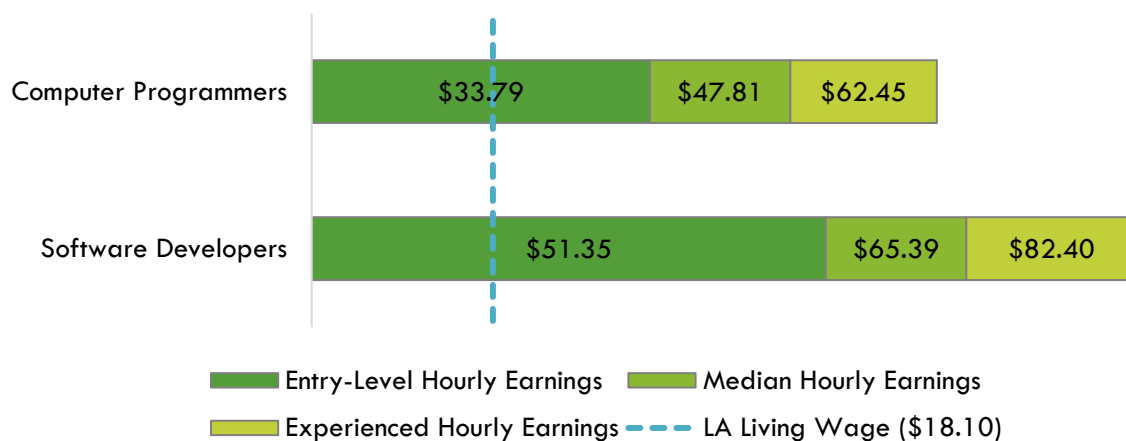
All annual openings for these artificial intelligence occupations have entry-level wages above the living wage for one adult (\$20.63 in Orange County). Typical entry-level hourly wages range between \$33.54 and \$50.42. Orange County's average wages are below the average statewide wage of \$84.87 for these occupations. Exhibit 4 shows the wage range for each of these artificial intelligence occupations in Orange County and how they compare to the regional living wage, sorted from lowest to highest entry-level wage.

Exhibit 4: Wages by Occupation in Orange County



All annual openings for these artificial intelligence occupations have entry-level wages above the living wage for one adult (\$18.10 in Los Angeles County). Typical entry-level hourly wages are in a range between \$33.79 and \$51.35. Los Angeles County's average wages are below the average statewide wage of \$84.87 for these occupations. Exhibit 5 shows the wage range for each of these artificial intelligence occupations in Los Angeles County how they compare to the regional living wage, sorted from lowest to highest entry-level wage.

Exhibit 5: Wages by Occupation in Los Angeles County



## Job Postings:

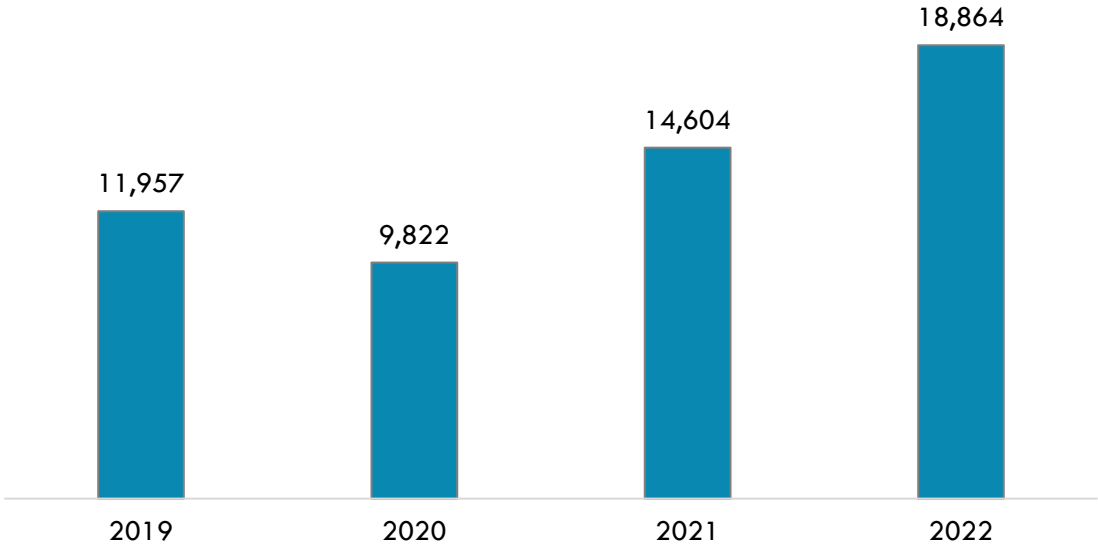
**Important Online Job Postings Data Note:** Online job postings data is sourced from Lightcast, a labor market analytics firm that scrapes, collects, and organizes data from online job boards such as LinkedIn, Indeed, Glassdoor, Monster, GovernmentJobs.com, and thousands more. Lightcast uses natural language processing (NLP) to determine the related company, industry, occupation, and other information for each job posting. However, NLP has limitations that include understanding contextual words of phrases; determining differences in words that can be used as nouns, verbs, and/or adjectives; and misspellings or grammatical errors.<sup>8</sup> For these reasons, job postings could be assigned to the wrong employer, industry, or occupation within Lightcast’s database.

Additionally, there are several limitations when analyzing job postings. A single job posting may not represent a single job opening, as employers may be creating a pool of candidates for future openings or hiring for multiple positions with a single posting. Additionally, not all jobs are posted online, and jobs may be filled through other methods such as internal promotion, word-of-mouth advertising, physical job boards, or a variety of other channels.

This section analyzes online job postings that requested skills related to artificial intelligence programming. These skills include artificial intelligence, artificial intelligence development, artificial intelligence systems, generative artificial intelligence, machine learning, deep learning, and deep learning methods. Though Python is a common programming language for artificial intelligence applications, it was not included because it has several other uses that are not specific to artificial intelligence programming and would overstate the number of job postings.

Exhibit 6 shows the number of online job postings related to artificial intelligence programming skills from 2019 to 2022. Following a decrease in online job postings in 2020 due to the COVID-19 Pandemic, artificial intelligence online job postings increased in 2021 and 2022.

**Exhibit 6: Number of Artificial Intelligence Job Postings, 2019-2022**



There were 13,176 online job postings related to artificial intelligence programming skills listed in the past 12 months. Exhibit 7 shows the number of job postings by job title. The top job title was data scientists, followed by software engineers, machine learning engineers, and data engineers.

<sup>8</sup> K. R. Chowdhary, *Fundamentals of Artificial Intelligence* (Basingstoke: Springer Nature, 2020), <https://link.springer.com/book/10.1007/978-81-322-3972-7>.

### Exhibit 7: Number of Job Postings by Title (n=13,176)

| Occupation                     | Job Postings | Percentage of Job Postings |
|--------------------------------|--------------|----------------------------|
| Data Scientists                | 683          | 5%                         |
| Software Engineers             | 291          | 2%                         |
| Machine Learning Engineers     | 257          | 2%                         |
| Data Engineers                 | 214          | 2%                         |
| Software Development Engineers | 116          | 1%                         |
| Data Analysts                  | 109          | 1%                         |
| Postdoctoral Scientists        | 106          | 1%                         |
| Bioinformaticians              | 105          | 1%                         |
| Data Software Engineers        | 79           | 1%                         |
| Principal Software Engineers   | 62           | 0.5%                       |

The top employers that requested artificial intelligence skills in the region, by number of job postings, are shown in Exhibit 8.

### Exhibit 8: Top Employers by Number of Job Postings (n=13,176)

| Employer                  | Job Postings | Percentage of Job Postings |
|---------------------------|--------------|----------------------------|
| Boeing                    | 461          | 3%                         |
| Cedars-Sinai              | 403          | 3%                         |
| Amazon                    | 389          | 3%                         |
| Deloitte                  | 262          | 2%                         |
| CyberCoders               | 205          | 2%                         |
| Disney                    | 202          | 2%                         |
| University of California  | 202          | 2%                         |
| Motion Recruitment        | 176          | 1%                         |
| The Aerospace Corporation | 160          | 1%                         |
| Robert Half               | 159          | 1%                         |

The top specialized, soft, and computer skills listed by those most frequently mentioned in job postings (denoted in parentheses) are shown in Exhibit 9. Due to the small number of job postings that requested a high school diploma or associate degree, the COE was unable to conduct an analysis of skills by requested education level.

### Exhibit 9: Top Skills by Number of Job Postings (n=13,176)

| Top Specialized Skills                | Top Soft Skills        | Top Computer Skills                   |
|---------------------------------------|------------------------|---------------------------------------|
| Machine Learning (9,418)              | Communications (5,719) | Python (Programming Language) (5,801) |
| Artificial Intelligence (7,500)       | Research (3,861)       | SQL (Programming Language) (3,166)    |
| Python (Programming Language) (5,801) | Leadership (3,386)     | Amazon Web Services (2,471)           |
| Computer Science (5,297)              | Management (3,104)     | R (Programming Language) (2,287)      |
| Data Science (3,313)                  | Mathematics (2,756)    | C++ (Programming Language) (2,275)    |

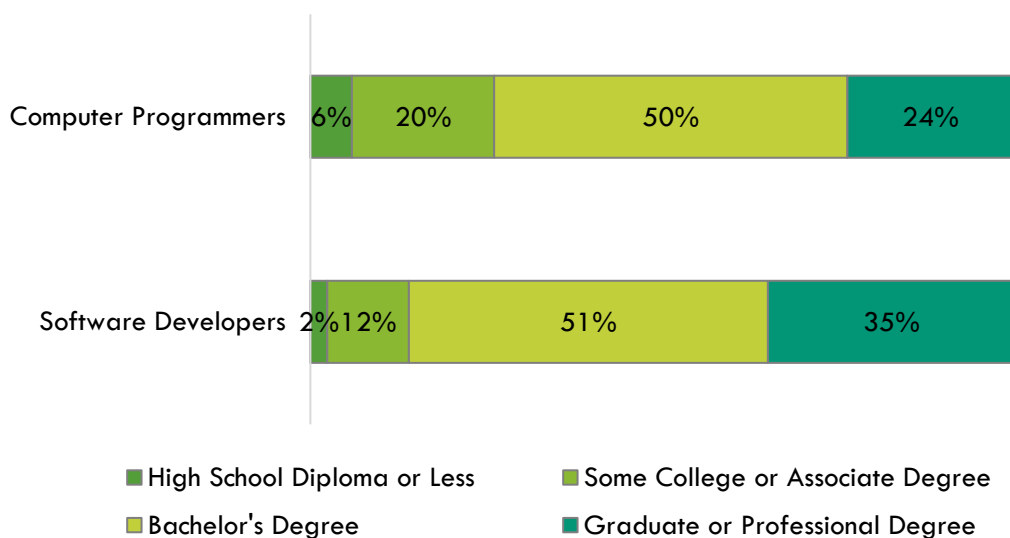
| Top Specialized Skills             | Top Soft Skills         | Top Computer Skills                              |
|------------------------------------|-------------------------|--|
| SQL (Programming Language) (3,165) | Innovation (2,401)      | Java (Programming Language) (2,118)              |
| Data Analysis (2,942)              | Operations (2,378)      | C (Programming Language) (1,326)                 |
| Algorithms (2,737)                 | Problem Solving (2,356) | Microsoft Azure (1,318)                          |
| Amazon Web Services (2,471)        | Writing (2,130)         | Apache Spark (1,223)                             |
| Software Engineering (2,466)       | Presentations (2,043)   | Tableau (Business Intelligence Software) (1,181) |

### Educational Attainment:

The Bureau of Labor Statistics (BLS) lists a bachelor’s degree as the typical entry-level education for these artificial intelligence occupations. Additionally, the national-level educational attainment data indicates between 12% and 20% of workers in the field have completed some college or an associate degree as their highest level of education. The vast majority of workers in these occupations have completed a bachelor’s, master’s, or doctoral degree as their highest level of education. Exhibit 9 shows the educational attainment for each occupation, sorted by highest community college educational attainment to lowest.

Of the 71% of the cumulative job postings that requested artificial intelligence skills and that listed a minimum education requirement in Los Angeles/Orange County, 95% (8,877) requested a bachelor’s, master’s, or doctoral degree and only 5% (436) requested a high school diploma, vocational training, or an associate degree.

Exhibit 9: National-level Educational Attainment for Occupations





# Educational Supply

## Community College Supply:

Exhibit 10 shows the three-year average number of awards conferred by community colleges in the related TOP codes: Electronic Game Design (0614.20), Information Technology, General (0701.00), Computer Information Systems (0702.00), Computer Software Development (0707.00), Computer Programming (0707.10), Database Design and Administration (0707.20), Computer Systems Analysis (0707.30), Computer Infrastructure and Support (0708.00), and Computer Networking (0708.10). The colleges with the most completions are Mt. San Antonio, Orange Coast, and Long Beach. Over the past 12 months, there were no other related program recommendation requests from regional community colleges.

Though these programs are most closely related to the artificial intelligence occupations in this report, it is important to note that they train for a variety of occupations, including middle-skill occupations such as *computer network support specialists*, *computer network architects*, and *computer user support specialists*. However, the artificial intelligence-related occupations in this report have high education requirements and employers typically require more than a community college education for these occupations. For these reasons, community college supply is overstated.

**Exhibit 10: Regional Community College Awards (Certificates and Degrees), 2019-2022**

| TOP Code                       | Program                         | College            | 2019-2020 Awards | 2020-2021 Awards | 2021-2022 Awards | 3-Year Award Average |
|--------------------------------|---------------------------------|--------------------|------------------|------------------|------------------|----------------------|
| 0614.20                        | Electronic Game Design          | Pasadena           | 1                | 1                | 5                | 3                    |
|                                |                                 | <b>LA Subtotal</b> | <b>1</b>         | <b>1</b>         | <b>5</b>         | <b>3</b>             |
|                                |                                 | Golden West        | 2                | 0                | 0                | 0                    |
|                                |                                 | <b>OC Subtotal</b> | <b>2</b>         | <b>0</b>         | <b>0</b>         | <b>0</b>             |
| <b>Supply Subtotal/Average</b> |                                 |                    | <b>3</b>         | <b>1</b>         | <b>5</b>         | <b>3</b>             |
| 0701.00                        | Information Technology, General | East LA            | 10               | 4                | 30               | 15                   |
|                                |                                 | Glendale           | 0                | 3                | 17               | 7                    |
|                                |                                 | LA Harbor          | 0                | 1                | 2                | 1                    |
|                                |                                 | LA Mission         | 3                | 1                | 4                | 3                    |
|                                |                                 | LA Southwest       | 0                | 2                | 12               | 5                    |
|                                |                                 | Long Beach         | 64               | 106              | 88               | 85                   |
|                                |                                 | Mt San Antonio     | 90               | 49               | 23               | 53                   |
|                                |                                 | Santa Monica       | 0                | 1                | 0                | 0                    |
|                                |                                 | West LA            | 5                | 0                | 6                | 4                    |
|                                |                                 | <b>LA Subtotal</b> | <b>172</b>       | <b>167</b>       | <b>182</b>       | <b>173</b>           |
|                                |                                 | Santa Ana          | 0                | 3                | 9                | 4                    |
|                                |                                 | <b>OC Subtotal</b> | <b>0</b>         | <b>3</b>         | <b>9</b>         | <b>4</b>             |
| <b>Supply Subtotal/Average</b> |                                 |                    | <b>172</b>       | <b>170</b>       | <b>191</b>       | <b>177</b>           |
| 0702.00                        | Computer Information Systems    | Citrus             | 8                | 4                | 6                | 6                    |
|                                |                                 | Compton            | 0                | 0                | 12               | 4                    |
|                                |                                 | East LA            | 15               | 23               | 11               | 16                   |

| TOP Code | Program                       | College                        | 2019-2020 Awards | 2020-2021 Awards | 2021-2022 Awards | 3-Year Award Average |
|----------|-------------------------------|--------------------------------|------------------|------------------|------------------|----------------------|
|          |                               | El Camino                      | 21               | 11               | 28               | 20                   |
|          |                               | Glendale                       | 5                | 6                | 8                | 6                    |
|          |                               | LA City                        | 1                | 4                | 3                | 3                    |
|          |                               | LA Harbor                      | 0                | 0                | 1                | 0                    |
|          |                               | LA Mission                     | 1                | 1                | 1                | 1                    |
|          |                               | LA Southwest                   | 0                | 0                | 21               | 7                    |
|          |                               | LA Trade                       | 20               | 15               | 17               | 17                   |
|          |                               | Long Beach                     | 0                | 3                | 0                | 1                    |
|          |                               | Mt San Antonio                 | 79               | 6                | 68               | 51                   |
|          |                               | Rio Hondo                      | 10               | 6                | 15               | 11                   |
|          |                               | West LA                        | 10               | 9                | 14               | 11                   |
|          |                               | <b>LA Subtotal</b>             | <b>170</b>       | <b>88</b>        | <b>205</b>       | <b>154</b>           |
|          |                               | Coastline                      | 0                | 0                | 2                | 0                    |
|          |                               | Cypress                        | 4                | 0                | 0                | 1                    |
|          |                               | Fullerton                      | 11               | 31               | 49               | 30                   |
|          |                               | Irvine                         | 2                | 0                | 0                | 1                    |
|          |                               | Orange Coast                   | 2                | 0                | 1                | 1                    |
|          |                               | Saddleback                     | 0                | 1                | 0                | 0                    |
|          |                               | Santa Ana                      | 2                | 16               | 18               | 12                   |
|          |                               | Santiago Canyon                | 4                | 1                | 1                | 2                    |
|          |                               | <b>OC Subtotal</b>             | <b>25</b>        | <b>49</b>        | <b>71</b>        | <b>47</b>            |
|          |                               | <b>Supply Subtotal/Average</b> | <b>195</b>       | <b>137</b>       | <b>276</b>       | <b>201</b>           |
| 0707.00  | Computer Software Development | LA City                        | 0                | 0                | 1                | 0                    |
|          |                               | LA Harbor                      | 0                | 0                | 2                | 1                    |
|          |                               | LA Mission                     | 0                | 0                | 2                | 1                    |
|          |                               | LA Pierce                      | 0                | 4                | 7                | 4                    |
|          |                               | Santa Monica                   | 0                | 1                | 1                | 1                    |
|          |                               | West LA                        | 0                | 0                | 6                | 2                    |
|          |                               | <b>LA Subtotal</b>             | <b>0</b>         | <b>5</b>         | <b>19</b>        | <b>9</b>             |
|          |                               | Cypress                        | 1                | 0                | 0                | 0                    |
|          |                               | Golden West                    | 2                | 6                | 4                | 4                    |
|          |                               | Orange Coast                   | 2                | 2                | 0                | 2                    |
|          |                               | Saddleback                     | 3                | 10               | 15               | 10                   |
|          |                               | <b>OC Subtotal</b>             | <b>8</b>         | <b>18</b>        | <b>19</b>        | <b>16</b>            |
|          |                               | <b>Supply Subtotal/Average</b> | <b>8</b>         | <b>23</b>        | <b>38</b>        | <b>25</b>            |
| 0707.10  | Computer Programming          | Cerritos                       | 2                | 3                | 7                | 4                    |
|          |                               | Citrus                         | 1                | 3                | 9                | 4                    |

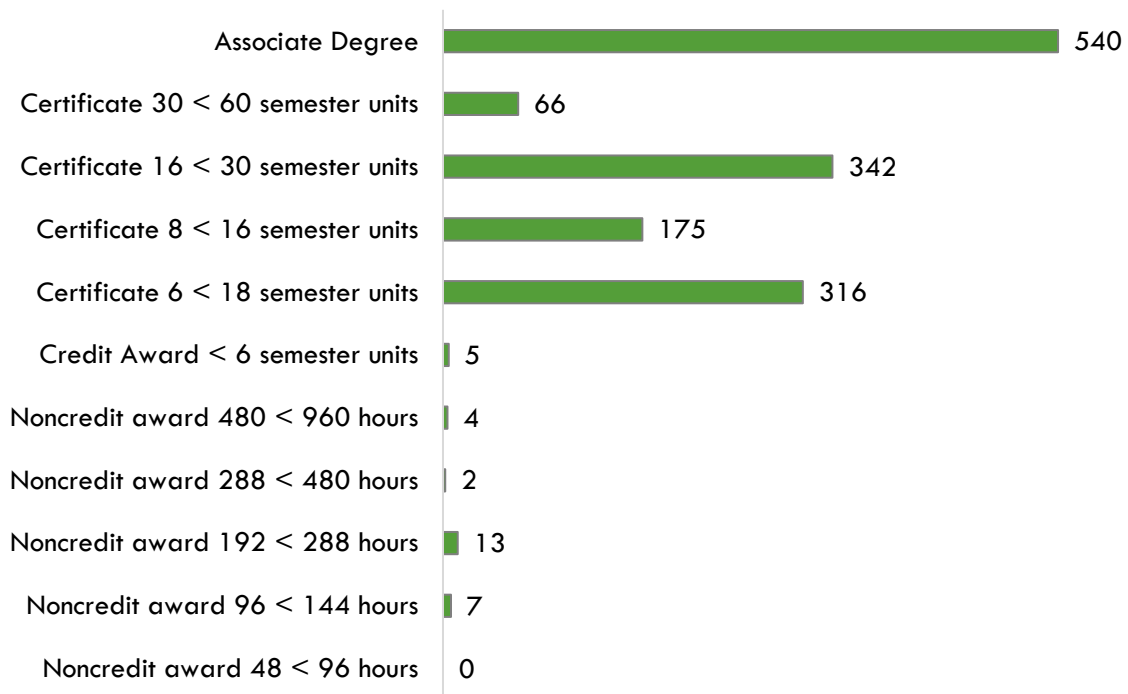
| TOP Code                       | Program                            | College            | 2019-2020 Awards | 2020-2021 Awards | 2021-2022 Awards | 3-Year Award Average |
|--------------------------------|------------------------------------|--------------------|------------------|------------------|------------------|----------------------|
|                                |                                    | East LA            | 4                | 1                | 0                | 2                    |
|                                |                                    | Glendale           | 3                | 0                | 0                | 1                    |
|                                |                                    | LA City            | 6                | 8                | 10               | 8                    |
|                                |                                    | LA Harbor          | 0                | 2                | 4                | 2                    |
|                                |                                    | LA Mission         | 4                | 7                | 7                | 7                    |
|                                |                                    | LA Pierce          | 4                | 5                | 5                | 4                    |
|                                |                                    | LA Southwest       | 1                | 2                | 2                | 2                    |
|                                |                                    | LA Valley          | 6                | 13               | 8                | 9                    |
|                                |                                    | Long Beach         | 5                | 3                | 7                | 5                    |
|                                |                                    | Mt San Antonio     | 114              | 83               | 125              | 107                  |
|                                |                                    | Pasadena           | 21               | 23               | 23               | 22                   |
|                                |                                    | Santa Monica       | 46               | 65               | 71               | 61                   |
|                                |                                    | <b>LA Subtotal</b> | <b>217</b>       | <b>218</b>       | <b>278</b>       | <b>238</b>           |
|                                |                                    | Coastline          | 0                | 0                | 1                | 0                    |
|                                |                                    | Cypress            | 20               | 6                | 5                | 11                   |
|                                |                                    | Fullerton          | 28               | 24               | 28               | 27                   |
|                                |                                    | Irvine             | 4                | 0                | 0                | 1                    |
|                                |                                    | Orange Coast       | 157              | 206              | 160              | 175                  |
|                                |                                    | Santa Ana          | 1                | 0                | 0                | 0                    |
|                                |                                    | Santiago Canyon    | 3                | 2                | 2                | 2                    |
|                                |                                    | <b>OC Subtotal</b> | <b>213</b>       | <b>238</b>       | <b>196</b>       | <b>216</b>           |
| <b>Supply Subtotal/Average</b> |                                    |                    | <b>430</b>       | <b>456</b>       | <b>474</b>       | <b>454</b>           |
| 0707.20                        | Database Design and Administration | Citrus             | 1                | 0                | 1                | 1                    |
|                                |                                    | Long Beach         | 1                | 13               | 11               | 8                    |
|                                |                                    | Mt San Antonio     | 12               | 8                | 16               | 12                   |
|                                |                                    | Pasadena           | 4                | 24               | 14               | 14                   |
|                                |                                    | Santa Monica       | 5                | 2                | 4                | 3                    |
|                                |                                    | <b>LA Subtotal</b> | <b>23</b>        | <b>47</b>        | <b>46</b>        | <b>38</b>            |
|                                |                                    | Santa Ana          | 8                | 2                | 2                | 4                    |
|                                |                                    | <b>OC Subtotal</b> | <b>8</b>         | <b>2</b>         | <b>2</b>         | <b>4</b>             |
| <b>Supply Subtotal/Average</b> |                                    |                    | <b>31</b>        | <b>49</b>        | <b>48</b>        | <b>42</b>            |
| 0707.30                        | Computer Systems Analysis          | Cerritos           | 3                | 0                | 5                | 2                    |
|                                |                                    | East LA            | 1                | 0                | 0                | 0                    |
|                                |                                    | LA City            | 0                | 1                | 6                | 2                    |
|                                |                                    | LA Harbor          | 0                | 1                | 1                | 1                    |
|                                |                                    | LA Mission         | 1                | 1                | 1                | 1                    |
|                                |                                    | LA Pierce          | 0                | 6                | 5                | 4                    |

| TOP Code | Program                             | College                        | 2019-2020 Awards | 2020-2021 Awards | 2021-2022 Awards | 3-Year Award Average |
|----------|-------------------------------------|--------------------------------|------------------|------------------|------------------|----------------------|
|          |                                     | Mt San Antonio                 | 0                | 0                | 9                | 3                    |
|          |                                     | Rio Hondo                      | 0                | 0                | 3                | 1                    |
|          |                                     | <b>LA Subtotal</b>             | <b>5</b>         | <b>9</b>         | <b>30</b>        | <b>14</b>            |
|          |                                     | -                              | -                | -                | -                | -                    |
|          |                                     | <b>OC Subtotal</b>             | <b>-</b>         | <b>-</b>         | <b>-</b>         | <b>-</b>             |
|          |                                     | <b>Supply Subtotal/Average</b> | <b>5</b>         | <b>9</b>         | <b>30</b>        | <b>14</b>            |
| 0708.00  | Computer Infrastructure and Support | Cerritos                       | 4                | 4                | 9                | 5                    |
|          |                                     | East LA                        | 0                | 0                | 3                | 1                    |
|          |                                     | El Camino                      | 0                | 0                | 5                | 2                    |
|          |                                     | Glendale                       | 3                | 4                | 11               | 6                    |
|          |                                     | LA City                        | 3                | 5                | 12               | 6                    |
|          |                                     | LA Harbor                      | 1                | 1                | 2                | 1                    |
|          |                                     | LA Mission                     | 12               | 17               | 32               | 20                   |
|          |                                     | LA Valley                      | 2                | 4                | 3                | 3                    |
|          |                                     | Long Beach                     | 8                | 8                | 2                | 6                    |
|          |                                     | Mt San Antonio                 | 24               | 24               | 36               | 28                   |
|          |                                     | Pasadena                       | 1                | 24               | 8                | 11                   |
|          |                                     | Rio Hondo                      | 10               | 11               | 19               | 13                   |
|          |                                     | West LA                        | 15               | 16               | 7                | 13                   |
|          |                                     | <b>LA Subtotal</b>             | <b>83</b>        | <b>118</b>       | <b>149</b>       | <b>115</b>           |
|          |                                     | Coastline                      | 46               | 73               | 91               | 70                   |
|          |                                     | Cypress                        | 3                | 1                | 1                | 1                    |
|          |                                     | Orange Coast                   | 7                | 5                | 7                | 6                    |
|          |                                     | Saddleback                     | 0                | 3                | 13               | 5                    |
|          |                                     | Santa Ana                      | 0                | 27               | 14               | 13                   |
|          |                                     | <b>OC Subtotal</b>             | <b>56</b>        | <b>109</b>       | <b>126</b>       | <b>95</b>            |
|          |                                     | <b>Supply Subtotal/Average</b> | <b>139</b>       | <b>227</b>       | <b>275</b>       | <b>210</b>           |
| 0708.00  | Computer Infrastructure and Support | Cerritos                       | 9                | 8                | 6                | 8                    |
|          |                                     | Glendale                       | 3                | 0                | 2                | 1                    |
|          |                                     | LA City                        | 0                | 4                | 8                | 4                    |
|          |                                     | LA Pierce                      | 20               | 12               | 19               | 16                   |
|          |                                     | Long Beach                     | 47               | 48               | 52               | 49                   |
|          |                                     | Mt San Antonio                 | 11               | 4                | 25               | 13                   |
|          |                                     | Rio Hondo                      | 7                | 2                | 5                | 5                    |
|          |                                     | West LA                        | 48               | 58               | 24               | 43                   |
|          |                                     | <b>LA Subtotal</b>             | <b>145</b>       | <b>136</b>       | <b>141</b>       | <b>139</b>           |
|          |                                     | Coastline                      | 59               | 92               | 49               | 67                   |

| TOP Code | Program | College                        | 2019-2020 Awards | 2020-2021 Awards | 2021-2022 Awards | 3-Year Award Average |
|----------|---------|--------------------------------|------------------|------------------|------------------|----------------------|
|          |         | Cypress                        | 95               | 61               | 71               | 76                   |
|          |         | Fullerton                      | 0                | 1                | 0                | 0                    |
|          |         | Irvine                         | 21               | 10               | 18               | 16                   |
|          |         | Saddleback                     | 21               | 19               | 15               | 19                   |
|          |         | Santa Ana                      | 12               | 23               | 45               | 27                   |
|          |         | <b>OC Subtotal</b>             | <b>208</b>       | <b>206</b>       | <b>198</b>       | <b>205</b>           |
|          |         | <b>Supply Subtotal/Average</b> | <b>353</b>       | <b>342</b>       | <b>339</b>       | <b>344</b>           |
|          |         | <b>Supply Subtotal/Average</b> | <b>1,336</b>     | <b>1,414</b>     | <b>1,676</b>     | <b>1,470</b>         |

Exhibit 11 shows the annual average community college awards by type from 2018-19 through 2020-21. The plurality of the awards are for associate degrees, followed by certificates between 16 and less than 30 semester units.

### Exhibit 11: Annual Average Community College Awards by Type, 2018-2021



### Community College Student Outcomes:

Exhibit 12 shows the Strong Workforce Program (SWP) metrics for other information technology programs in Rancho Santiago Community College District (RSCCD), the Orange County Region, and California. Of the 69 other information technology students in the 2020-21 academic year, 28% (19) attended a RSCCD college. Due to a low number of students in these programs, there is insufficient data to determine other outcomes for RSCCD students.

Orange County students that exited other information programs in the 2018-19 academic year had lower median annual earnings (\$26,028) compared to all other information programs students throughout the state (\$41,390).

### Exhibit 12: Other Information Technology (0799.00) Strong Workforce Program Metrics, 2020-21<sup>9</sup>

| SWP Metric  | RSCCD             | OC Region         | California |
|---|-------------------|-------------------|------------|
| SWP Students  | 19                | 69                | 1,852      |
| SWP Students Who Earned 9 or More Career Education Units in the District in a Single Year | Insufficient Data | 29%               | 29%        |
| SWP Students Who Completed a Noncredit CTE or Workforce Preparation Course                | Insufficient Data | Insufficient Data | 95%        |
| SWP Students Who Earned a Degree or Certificate or Attained Apprenticeship Journey Status | Insufficient Data | Insufficient Data | 355        |
| SWP Students Who Transferred to a Four-Year Postsecondary Institution (2019-20)           | Insufficient Data | Insufficient Data | 53         |
| SWP Students with a Job Closely Related to Their Field of Study (2018-19)                 | Insufficient Data | 75%               | 65%        |
| Median Annual Earnings for SWP Exiting Students (2019-20)                                 | Insufficient Data | \$26,028          | \$41,390   |
| Median Change in Earnings for SWP Exiting Students (2019-20)                              | Insufficient Data | Insufficient Data | 14%        |
| SWP Exiting Students Who Attained the Living Wage (2019-20)                               | Insufficient Data | Insufficient Data | 55%        |

### Non-Community College Supply:

For a comprehensive regional supply analysis, it is also important to consider the supply from other institutions in the region that provide training programs for these artificial intelligence occupations. Exhibit 13 shows the annual and three-year average number of awards conferred by these institutions in the related Classification of Instructional Programs (CIP) Codes: Computer and Information Sciences, General (11.0101), Information Technology (11.0103), Computer Programming/Programmer, General (11.0201), Computer Science (11.0701), and Computer/Computer Systems Technology/Technician (15.1202). Due to different data collection periods, the most recent two-year period of available data is from 2019 to 2021. Currently, only two years of data are currently available due to changes in the CIP Taxonomy. Between 2019 and 2021, four-year colleges in the region conferred an average of 3,505 awards annually in related training programs.

### Exhibit 13: Regional Non-Community College Awards, 2017-2020

| CIP Code | Program                                    | College                     | 2019-2020 Awards | 2020-2021 Awards | 2-Year Award Average |
|----------|--|-----------------------------|------------------|------------------|----------------------|
| 11.0101  | Computer and Information Sciences, General | Azusa Pacific University    | 21               | 25               | 23                   |
|          |  | Chapman University          | 18               | 23               | 20                   |
|          |  | Los Angeles Pacific College | 6                | 2                | 4                    |

<sup>9</sup> All SWP metrics are for 2020-21 unless otherwise noted.

| CIP Code                       | Program                                   | College  | 2019-2020 Awards | 2020-2021 Awards | 2-Year Award Average |
|--------------------------------|---|--|------------------|------------------|----------------------|
|                                |   | Loyola Marymount University                    | 27               | 45               | 36                   |
|                                |   | Mount Saint Mary's University                  | 0                | 0                | 0                    |
|                                |   | Pacific States University                      | 0                | 0                | 0                    |
|                                |   | Pitzer College                                 | 0                | 1                | 0                    |
|                                |   | The Master's University and Seminary           | 11               | 5                | 8                    |
|                                |   | University of California-Irvine                | 0                | 1                | 0                    |
|                                |   | University of La Verne                         | 23               | 36               | 30                   |
|                                |   | University of Massachusetts Global             | 30               | 36               | 33                   |
|                                |   | University of the People                       | 203              | 292              | 248                  |
|                                |   | Westcliff University                           | 0                | 0                | 0                    |
|                                |   | <b>Supply Subtotal/Average</b>                 |                  |                  | <b>339</b>           |
| 11.0103                        | Information Technology                    | Bethesda University                            | 0                | 0                | 0                    |
|                                |   | Brand College                                  | 13               | 17               | 15                   |
|                                |   | California Intercontinental University         | 2                | 0                | 1                    |
|                                |   | California State University-Dominguez Hills    | 4                | 10               | 7                    |
|                                |   | California State University-Los Angeles        | 166              | 116              | 141                  |
|                                |   | California State University-Northridge         | 29               | 51               | 40                   |
|                                |   | Platt College-Anaheim                          | 15               | 17               | 16                   |
|                                |   | Platt College-Los Angeles                      | 12               | 6                | 9                    |
|                                |   | University of La Verne                         | 2                | 3                | 2                    |
|                                |   | Westcliff University                           | 0                | 0                | 0                    |
|                                |   | <b>Supply Subtotal/Average</b>                 |                  |                  | <b>243</b>           |
| 11.0201                        | Computer Programming/ Programmer, General | ABCO Technology                                | 46               | 34               | 40                   |
|                                |   | Platt College-Anaheim                          | 4                | 0                | 2                    |
| <b>Supply Subtotal/Average</b> |   |  | <b>243</b>       | <b>220</b>       | <b>231</b>           |
| 11.0701                        | Computer Science                          | Biola University                               | 18               | 19               | 18                   |
|                                |   | California Institute of Technology             | 72               | 83               | 78                   |
|                                |   | California State Polytechnic University-Pomona | 238              | 270              | 254                  |

| CIP Code                       | Program   | College                                     | 2019-2020 Awards | 2020-2021 Awards | 2-Year Award Average |
|--------------------------------|---|---|------------------|------------------|----------------------|
|                                |   | California State University-Dominguez Hills | 57               | 66               | 62                   |
|                                |   | California State University-Fullerton       | 264              | 308              | 286                  |
|                                |   | California State University-Long Beach      | 220              | 221              | 220                  |
|                                |   | California State University-Los Angeles     | 119              | 152              | 136                  |
|                                |   | California State University-Northridge      | 160              | 214              | 187                  |
|                                |   | Chapman University                          | 30               | 45               | 38                   |
|                                |   | Claremont McKenna College                   | 35               | 17               | 26                   |
|                                |   | Harvey Mudd College                         | 47               | 48               | 48                   |
|                                |   | Occidental College                          | 18               | 18               | 18                   |
|                                |   | Pitzer College                              | 10               | 5                | 8                    |
|                                |   | Pomona College                              | 34               | 33               | 34                   |
|                                |   | Scripps College                             | 11               | 5                | 8                    |
|                                |   | Southern California Institute of Technology | 10               | 7                | 8                    |
|                                |   | The Master's University and Seminary        | 0                | 0                | 0                    |
|                                |   | University of California-Irvine             | 805              | 822              | 814                  |
|                                |   | University of California-Los Angeles        | 287              | 342              | 314                  |
|                                |   | University of Southern California           | 247              | 293              | 270                  |
| <b>Supply Subtotal/Average</b> |   |   | <b>2,682</b>     | <b>2,968</b>     | <b>2,827</b>         |
| 15.1202                        | Computer/Computer Systems Technology/Technician | Learnet Academy Inc                         | 4                | 2                | 3                    |
|                                |   | University of La Verne                      | 0                | 0                | 0                    |
| <b>Supply Subtotal/Average</b> |   |   | <b>4</b>         | <b>2</b>         | <b>3</b>             |
| <b>Supply Total/Average</b>    |   |   | <b>3,318</b>     | <b>3,690</b>     | <b>3,505</b>         |



## Regional Demographics

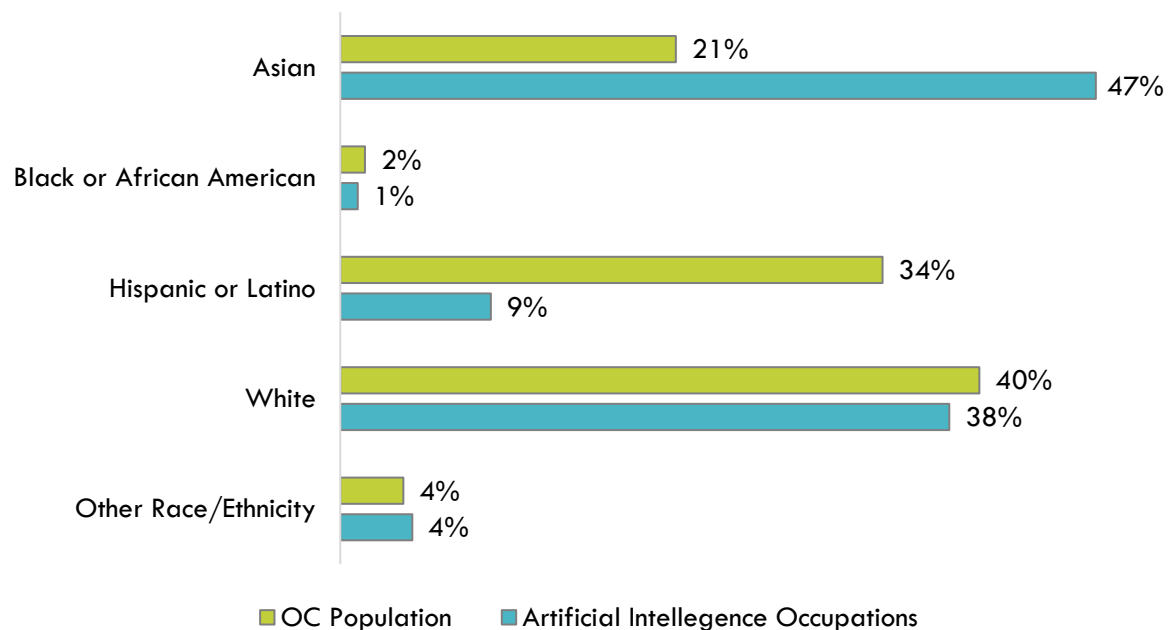
This section analyzes demographic data for Orange County community college students enrolled in other information technology programs compared to the OC population, as well occupational data, for the purpose of identifying potential diversity and equity issues that can be addressed by community college programs.

Due to the low number of students enrolled in other information technology programs throughout the region, detailed demographic data is not available. Therefore, the following sections do not include community college student demographic data.

### Ethnicity:

Exhibit 14 shows the ethnicity of the overall Orange County population, as well as the two artificial intelligence occupations included in this report. Notably, 47% of workers employed in these artificial intelligence occupations are Asian, which is significantly higher than the population (21%). Conversely, only 9% of workers in these occupations are Hispanic or Latino, which is significantly lower than the population (34%).

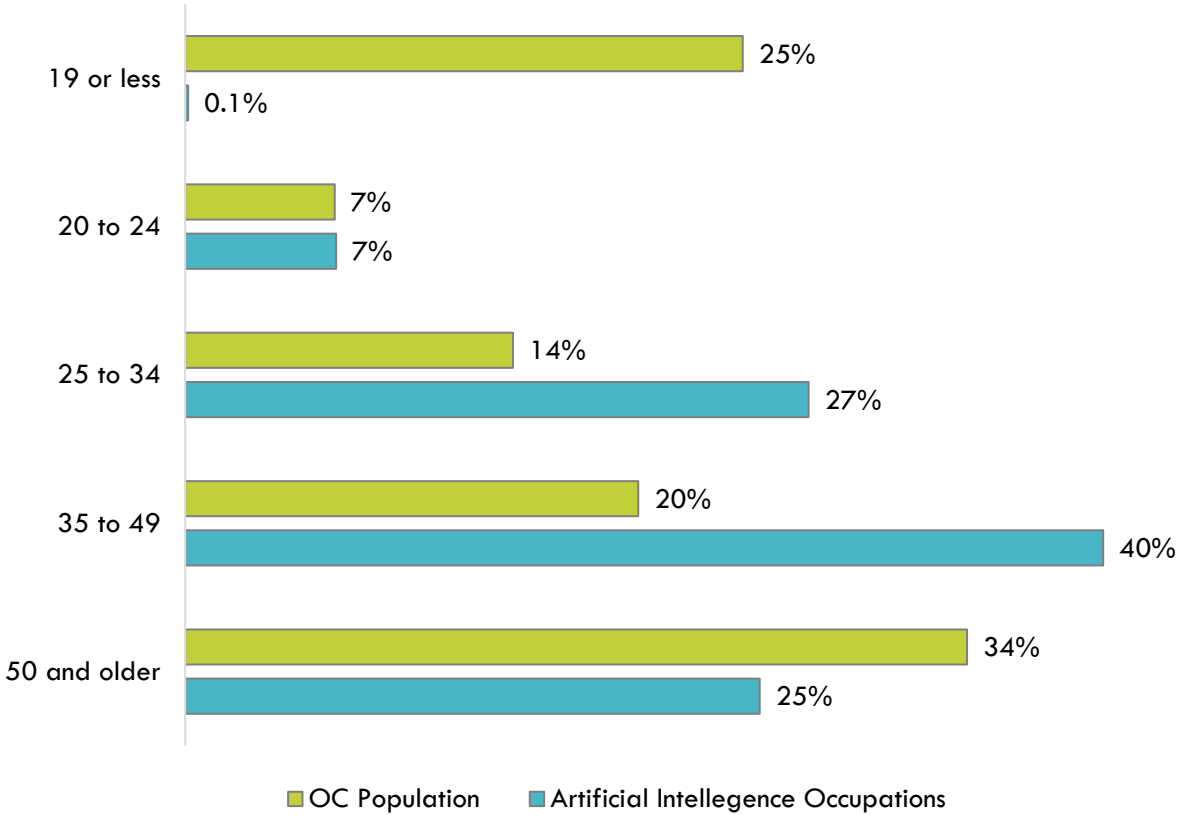
Exhibit 14: Program and County Demographics by Ethnicity



## Age:

Exhibit 14 shows the age of the overall Orange County population, as well as the two artificial intelligence occupations included in this report. The plurality (40%) of workers in these artificial intelligence occupations are 35 to 49, which is double the population (20%).

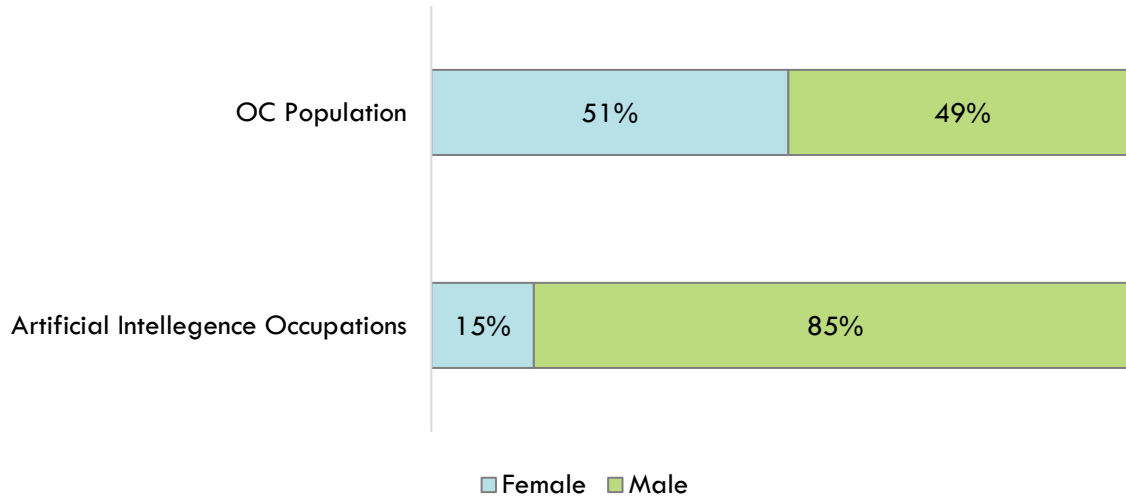
Exhibit 14: Program and County Demographics by Age



## Sex:

Exhibit 15 shows the sex of the overall Orange County population as well as these artificial intelligence occupations. Though the population is split nearly evenly between women and men, 85% of workers in these artificial intelligence occupations are men.

Exhibit 15: Program and County Demographics by Sex



## Appendix A: Methodology

The OC COE prepared this report by analyzing data from occupations and education programs. Occupational data is derived from Lightcast, a labor market analytics firm that consolidates data from the California Employment Development Department (EDD), U.S. Bureau of Labor Statistics (BLS) and other government agencies. Program supply data is drawn from two systems: Taxonomy of Programs (TOP) and Classification of Instructional Programs (CIP).

Using a TOP-SOC crosswalk, the OC COE identified middle-skill jobs for which programs within these TOP codes train. Middle-skill jobs include:

- 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.

The OC COE determined labor market supply for an occupation or SOC code by analyzing the number of program completers or awards in a related TOP or CIP code. The COE developed a “supply table” with this information, which is the source of the program supply data for this report. TOP code data comes from the California Community Colleges Chancellor's Office MIS Data Mart ([datamart.cccco.edu](http://datamart.cccco.edu)) and CIP code data comes from the Integrated Postsecondary Education Data System ([nces.ed.gov/ipeds/use-the-data](http://nces.ed.gov/ipeds/use-the-data)), also known as IPEDS. TOP is a system of numerical codes used at the state level to collect and report information on California community college programs and courses throughout the state that have similar outcomes. CIP codes are a taxonomy of academic disciplines at institutions of higher education in the United States and Canada. Institutions outside of the California Community College system do not use TOP codes in their reporting systems.

Data included in this analysis represent the labor market demand for relevant positions most closely related to the proposed program as expressed by the requesting college in consultation with the OC COE. Traditional labor market information was used to show current and projected employment based on data trends, as well as annual average awards granted by regional community colleges. Real-time labor market information captures job post advertisements for occupations relevant to the field of study which can signal demand and show what employers are looking for in potential employees, but is not a perfect measure of the quantity of open positions.

All representations have been produced from primary research and/or secondary review of publicly and/or privately available data and/or research reports. The most recent data available at the time of the analysis was examined; however, data sets are updated regularly and may not be consistent with previous reports. Efforts have been made to qualify and validate the accuracy of the data and findings; however, neither the Centers of Excellence for Labor Market Research (COE), COE host district, nor California Community Colleges Chancellor's Office are responsible for the applications or decisions made by individuals and/or organizations based on this study or its recommendations.

## Appendix B: Data Sources

| Data Type   | Source  |
|---|---|
| Occupational Projections, Wages, and Job Postings   | <p>Traditional labor market information data is sourced from Lightcast, a labor market analytics firm. Lightcast occupational employment data are based on final Lightcast industry data and final Lightcast staffing patterns. Wage estimates are based on Occupational Employment Statistics and the American Community Survey. For more information, see <a href="https://lightcast.io/">https://lightcast.io/</a></p>   |
| Living Wage   | <p>The living wage is derived from the Insight Center’s California Family Needs Calculator, which measures the income necessary for an individual of family to afford basic expenses. The data assesses the cost of housing, food, child care, health care, transportation, and taxes. For more information, see: <a href="https://insightccd.org/family-needs-calculator/">https://insightccd.org/family-needs-calculator/</a></p> <p>The living wage for one adult in Orange County is \$20.63 per hour (\$42,910.40 annually). This figure is used by the CCCCCO to calculate the percentage of students that attained the regional living wage.</p> |
| Typical Education and Training Requirements, and Educational Attainment                       | <p>The Bureau of Labor Statistics (BLS) provides information about education and training requirements for hundreds of occupations. BLS uses a system to assign categories for entry-level education, work experience in a related occupation, and typical on-the-job training to each occupation for which BLS publishes projections data. For more information, see <a href="https://www.bls.gov/emp/documentation/education/tech.htm">https://www.bls.gov/emp/documentation/education/tech.htm</a></p>   |
| Emerging Occupation Descriptions, Additional Education Requirements, and Employer Preferences | <p>The O*NET database includes information on skills, abilities, knowledges, work activities, and interests associated with occupations. For more information, see <a href="https://www.onetonline.org/help/online/">https://www.onetonline.org/help/online/</a></p>  |
| Educational Supply  | <p>The CCCCCO Data Mart provides information about students, courses, student services, outcomes and faculty and staff. For more information, see: <a href="https://datamart.cccco.edu">https://datamart.cccco.edu</a></p> <p>The National Center for Education Statistics (NCES) Integrated Postsecondary Integrated Data System (IPEDS) collects data on the number of postsecondary awards earned (completions). For more information, see <a href="https://nces.ed.gov/ipeds/use-the-data/survey-components/7/completions">https://nces.ed.gov/ipeds/use-the-data/survey-components/7/completions</a></p>   |
| Student Metrics and Demographics  | <p>LaunchBoard, a statewide data system supported by the California Community Colleges Chancellor's Office and hosted by Cal-PASS Plus, provides data on progress, success, employment, and earnings outcomes for California community college students. For more information, see: <a href="https://www.calpassplus.org/LaunchBoard/Home.aspx">https://www.calpassplus.org/LaunchBoard/Home.aspx</a></p>   |

| Data Type                              | Source   |
|--|--|
| Population and Occupation Demographics | <p>The Census Bureau's American Community Survey (ACS) is the premier source for detailed population and housing information. For more information, see: <a href="https://www.census.gov/programs-surveys/acs">https://www.census.gov/programs-surveys/acs</a></p> <p>Data is sourced from IPUMS USA, a database providing access to ACS and other Census Bureau data products. For more information, see: <a href="https://usa.ipums.org/usa/about.shtml">https://usa.ipums.org/usa/about.shtml</a></p> |

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