HIGHER EDUCATION COORDINATING COMMISSION

**Proposal for a New Academic Program**

**Institution: Portland State University**

**College/School: College of Liberal Arts and Sciences**

**Department/Program Name: Applied Linguistics**

**Degree and Program Title: B.S. in Linguistics & Computer Science**

## 1. Program Description

a. Proposed Classification of Instructional Programs (CIP) number.

30.4801 Linguistics and Computer Science

b. Brief overview (1-2 paragraphs) of the proposed program, including its disciplinary foundations and connections; program objectives; programmatic focus; degree, certificate, minor, and concentrations offered.

The BS in Linguistics & Computer Science combines existing courses from the Department of Applied Linguistics, the College of Arts and Sciences, and the Department of Computer Science, the Maseeh College of Engineering and Computer Science, in a new program that will allow students to acquire highly marketable skills without double majoring in linguistics and computer science. The program is composed of a total of 108 credits drawn from existing courses in linguistics, computer science, and mathematics. This program will be housed in the Department of Applied Linguistics in the College of Liberal Arts & Sciences (CLAS). The proposal has been reviewed and approved in CLAS by Dean Todd Rosenstiel and Senior Associate Dean for Academic Affairs Matt Carlson. In addition, Dean Joseph Bull of the Maseeh College of Engineering and Computer Science (MCECS) has reviewed and indicated support for the program[1]. We will only offer a BS degree option in Linguistics & Computer Science because given the list of foundational linguistics, computer science, and math courses needed to obtain marketable skills, there will not be room in the curriculum for two years of foreign language courses required for a BA degree.

c. Course of study – proposed curriculum, including course numbers, titles, and credit hours.

The B.S. in Linguistics & Computer Science is designed to provide students with the background for work in the field of computational linguistics or natural language processing. It focuses on the relationship between computer and human language and computational techniques applied to natural language. It includes instruction in computer programming and linguistics and linguistic analysis. The program consists of a core of required courses in computer science, math, and linguistics. Electives can be taken in either department. Students will take courses specific to natural language processing and a practicum in their senior year.

The B.S. in Linguistics & Computer Science requires a minimum of 108 credit hours to complete the following requirements.

[1] See Appendix 1 for the letter of support

- *Required Courses: Linguistics (40 credits)*
    - LING 332U Do I speak wrong? Language Myths in the USA (or LING 232 Language & Society or LING 432 Sociolinguistics) (4)
    - LING 390 Introduction to Linguistics (4)
    - LING 391 Introduction to Applied Linguistics (WIC) or WR 227Z Technical Writing (4)
    - LING 392 Structure of English (4)
    - LING 415 Linguistic Phonetics (4)
    - LING 411 Syntax (4)
    - LING 418 Linguistic Morphology (or LING 419 Language Typology) (4)
    - LING 414 Linguistic Pragmatics (4)
    - LING 476 Corpus Linguistics (4)
    - LING 409 NLP Practicum (4)

- *Required Courses: Computer Science (40 credits)*
    - Lower Division (24 credits)
        - CS 161 Introduction to Programming and Problem Solving (4)
        - CS 162 Introduction to Computer Science (4)
        - CS 163 Data Structures (4)
        - CS 205 System Programming and Architecture (4)
        - CS 250 Discrete Structures I (4)
        - CS 251 Discrete Structures II (4)
    - Upper Division (16 credits)
        - CS 302 Programming Methodologies and Software Implementation (4)
        - CS 350 Algorithms and Complexity (4)
        - CS 445 Machine Learning (4)
        - CS 444 Natural Language Processing (4)
    - *Other Required Courses (16 credits)*
        - MTH 251 Calculus I (4)
        - MTH 252 Calculus II (4)
        - STAT 451 Applied Statistics for Engineers and Scientists I (4)
        - MTH 261 Introduction to Linear Algebra (4)
    - *Advisor-approved NLP Elective (4 credits)*
        - One advisor-approved NLP elective course (4 credits) must be taken. The possible courses will change as the NLP industry evolves. Some examples may include CS 410 Topic: Adventures in Natural Language Processing (4), CS 410 Topic: Large Language Models (4), etc.
    - *Other Electives (choose 8 credits from the following)*
        - CS 305 Social, Ethical, and Legal Implications of Computing (2)
        - CS 410 Spoken Language Interfaces (4)
        - CS 466 Voice Assistants (4)
        - Ling 433 Psycholinguistics (4)

- Ling 416 Discourse Analysis (4)
- Ling 412 Phonology (4)
- Ling 417 Endangered Languages (4)
- Other advisor-approved electives

This curriculum provides a balance of lower and upper division courses, drawing on existing structures of the two departments. The basic programming courses are largely lower division courses housed in the Department of Computer Science (CS), while the linguistics courses and more specialized language processing courses are upper division courses, more suited to students ready for skills in language analysis.

- *Other requirements*
  - Students must satisfy all university requirements for the B.S. degree; including the residency requirement; and maintain a 2.5 grade point average in the major. All courses used to satisfy major requirements must be taken for a letter grade and must be graded C- or better.
  - By the end of the first quarter of admission to the program, students must consult with the adviser to select the appropriate courses.

d. Manner in which the program will be delivered, including program location (if offered outside of the main campus), course scheduling, and the use of technology (for both on-campus and off-campus delivery).

*Manner of delivery:*

Individual units that contribute courses to the Linguistics & Computer Science degree will be sensitive to the needs and preferences of the student body which may have changed during the pandemic. Future students will have spent part of their high school careers online and they may have strong preferences for or against online instruction.

Many courses included in the program will be offered online, hybrid, and in person. Currently, each department (Applied Linguistics, Computer Science, and Mathematics) offers several of their contributing courses in person, in hybrid format, and fully online.

*Course scheduling:*

All core classes are shared by multiple existing programs at PSU and multiple sections will be available most terms, including summer term (Applied Linguistics is the exception where typically only one course pertaining to this degree, LING 390, will be offered in the summer). The Department of Applied Linguistics will coordinate with the Department of Computer Science to ensure that students are able to satisfy their requirements (coordination with the Department of Mathematics and Statistics will not be needed because the math and statistics courses that are required are offered frequently in multiple sections).

*Use of technology:*

Improvements in instructional technology and increased faculty expertise in alternative modes of instruction (online and hybrid) will benefit PSU programs going forward.

e. Adequacy and quality of faculty delivering the program.

All of the proposed courses are regularly offered in the respective departments (Applied Linguistics, Computer Science, and Math and Statistics). As such, each department has the necessary capacity of offering the courses for this degree. However, Dr. Ameeta Agrawal's elective in NLP (CS 410/510 Topic: Natural Language Processing) has been at capacity (25 students) each time she has taught it. For this reason, another faculty line in Computer Science will be necessary to sustain the higher demand for NLP courses that the new degree will create.

All contributing units have quality control measures in place to ensure that the faculty teaching these courses have the appropriate qualifications. This means that courses numbered 200 and below are taught by instructors with a Master's degree or higher, consistent with standards at community colleges. Courses numbered 300 and above are taught by faculty, including adjunct faculty, with a Ph.D. in the relevant discipline.

f. Adequacy of faculty resources – full-time, part-time, adjunct.

The Department of Applied Linguistics employs full-time faculty in all required courses, and there is excess capacity in linguistics courses.

The Department of Computer Science has provided a statement[2] of adequacy of resources for the required courses, up to the total number of students projected elsewhere in this document (with the exception that one new hire in Computer Science will be needed).

g. Other staff.

Based on projected enrollments, and excess capacity in existing courses, existing staff resources are adequate for the Department of Applied Linguistics.

The Department of Computer Science will require an additional hire to meet the increased demand in NLP courses. This faculty member will also be expected to teach an NLP-related course for the Department of Linguistics once a year.

Additionally, we will require resources from the respective Colleges and the University as a whole to market the program to prospective students. This is particularly true for marketing to students with an interest in language so they can take the computer programming courses early in their college programs. Additional resources will be needed to reach out to underrepresented and minoritized communities to support and foster student success.

h. Adequacy of facilities, library, and other resources.

Both departments have adequate facilities and technological resources to carry out this program. The program will consist of existing courses which already have adequate facilities and technological resources. No additional facilities or technological resources will be needed.

The PSU Library is fully equipped to provide the necessary resources and support for the new Bachelor of Science degree in Computational Linguistics, given that the program consists of pre-existing courses that have already been offered by the relevant departments, with only two new CS courses being proposed at present. It is possible that the library may need to acquire additional

[2] See Appendix 2 for statement

resources to support the newly proposed courses, so it will be necessary for instructors to inform the CS subject librarian of their curriculum. With the additional resources provided by the Orbis Cascade Alliance libraries, the library can offer students and faculty access to a wider range of materials in the subject area even if they are not currently held in the library's own collection. The Library also has a variety of specialized databases such as Linguistics and Language Behavior Abstracts (LLBA), ACL Anthology, IEEE Xplore, ACM Digital Libraries, arXiv.org, JSTOR, and ScienceDirect, providing access to full-text articles for students and faculty looking to stay up-to-date with the latest research in the field. Subject librarians have experience in supporting research and coursework in various disciplines and are available to provide one-on-one research consultations and instruction on information literacy skills specific to the program. As the program evolves, we will continuously update and expand our collection to accommodate the needs of the curriculum in the field.

i. Anticipated start date.

Fall 2025

## 2. Relationship to Mission and Goals

a. Manner in which the proposed program supports the institution's mission, signature areas of focus, and strategic priorities.

**Access**
The proposed program reduces the cost to students by combining linguistics and computer science to save about one academic year of study compared to a dual major in linguistics and computer science. It improves student navigation of course work and progress towards graduation by providing a new, highly respected program of study. With clearly laid out paths to graduation in competitive fields, students' time and money costs of education are reduced. Cost savings of this type are important to all students but particularly important to low-income, first-generation students who are often from racial/ethnic minoritized groups.

**Equity and inclusion**
The proposed program offers new guidance to students on a path of study that is in high demand. This benefits all students but is particularly helpful to students who are from BIPOC populations or first-generation college students and who may not be able to access informal sources of information from friends and family about which skills are in high demand. Research in labor economics has suggested that one important source of disadvantage for women and minoritized populations is a lack of informal networks that link people to high demand majors and eventually occupations. Any move to increase transparency in paths to success is likely to disproportionately benefit students from underrepresented groups.

**Student learning**
In linguistics and NLP courses, faculty often mention some applications and connections to respective fields. Formalizing this program and making the connections between the two fields stronger in a programmatic way will enhance student learning and understanding of these interdisciplinary connections. Students in both departments will also have more practical research opportunities (see below).

**Research and scholarly work**
The proposed program improves the communication channels between linguistics and computer science which have, heretofore, been weak at PSU. This program will open up opportunities for

joint projects and research between linguistics and computer science faculty and students. (In anticipation of the new program, we have already begun such work, e.g., linguistics faculty are serving on PhD committees for Computer Science students in the field of NLP, and the faculty and students are collaborating on projects, publications, and monthly Brown Bags in the field of NLP).

**Service**
The proposed program serves the needs of local and other employers by educating students in a high demand field.

**The proposed major in Linguistics & Computer Science contributes to the fulfillment of PSU strategic priorities in the following ways:**

1. Offers new guidance to students on a path of study that is in high demand. This benefits all students but is particularly helpful to students who are from minoritized populations or first-generation college students and who may not be able to access informal sources of information from friends and family about which skills are in high demand.
2. Reduces the cost to students by combining linguistics and computer science to save about 1 academic year of study compared to a dual major in these degrees.
3. Improves student navigation of course work and progress towards graduation by providing a new, highly respected program of study.
4. Provides a competitive advantage in the labor market to enrolled students based on market research report (attached elsewhere in document).
5. Strengthens students' learning in both fields by more clearly demonstrating the interdisciplinary connections, as well as by providing more research opportunities across the two departments.
6. Serves the needs of local and other employers by educating students in a high demand field.
7. Serves the needs of the NLP profession to diversify the field in terms of gender (i.e., attracting more female students from linguistics) and linguistic backgrounds.
8. Places a laser focus on student success by being committed to providing instruction in multiple formats (in-person, online, hybrid, attend anywhere).
9. Contributes to PSU's financial sustainability by requesting a small investment (one faculty line and marketing support) in return for increased enrollment of local, out-of-state, and international student populations.

b. Manner in which the proposed program contributes to institutional and statewide goals for student access and diversity, quality learning, research, knowledge creation and innovation, and economic and cultural support of Oregon and its communities.

**Student access:**
This program ensures that students have equal and equitable opportunities to explore a combined degree in linguistics and computer science. Providing clear pathways to success is most important for students who are first generation college students and who are less likely to consider combining classes from different disciplines in a way that is rewarded in the labor market.

**Diversity:**

Computer Science is a male-dominated field[3] while females receive more degrees than males in applied linguistics (as also shown by COGNOS numbers of students who graduated with Computer Science and Applied Linguistics degrees from PSU; see Figure 1 in Demographic Summary Info from AL and CS[4]). As such, a combination of computer science and applied linguistics courses in the proposed degree should increase diversity in both fields. Our plan to market the new degree to foreign language and computer science students at PCC and other community colleges will further add to the diversity efforts.

**Quality learning:**
The proposed Linguistics & Computer Science major is an efficient way for students to achieve mastery in the fundamentals of linguistics and computer science without having to exceed the minimum credits required for a bachelor's degree.

**Research:**
Faculty in linguistics and computer science are active researchers. Faculty in all units engage in undergraduate research usually through the Honors program or informally within the department. The new degree will improve communication between the contributing units and will lead to more opportunities for inter-departmental collaboration on research.

**Knowledge creation and innovation:**
Each of the contributing units has areas of expertise that are unique to the unit. As became evident from monthly brown bags on the topic of NLP (conducted by the faculty in Applied Linguistics and Computer Science), faculty and students from these two disciplines can learn a lot from each other. More formal collaboration in a form of the proposed degree across the two departments will strengthen this relationship and may lead to exciting projects and grant opportunities.

**Economic and cultural support of Oregon and its communities:**
PSU's motto is "Let knowledge serve the city." The proposed program will help to ensure that knowledge serves Oregon and all its communities. The program will draw from both resident and non-resident US students. Since Asia is the largest growing market in NLP, the program is likely to attract overseas students especially from this area. This will enhance the cultural diversity of Portland and the surrounding area.

Although the US NLP market tends to concentrate in the Silicon Valley, as more and more companies consider applications of NLP to their business model, graduates of this program will have a highly useful skill set that can benefit a wide variety of Oregon businesses (e.g., Intel, consulting services for Deloitte, Cambia Health Solutions). Additionally, a well-educated workforce is attractive to out-of-state businesses considering locating in Oregon.

c. Manner in which the program meets regional or statewide needs and enhances the state's capacity to:
    i. improve educational attainment in the region and state;
    ii. respond effectively to social, economic, and environmental challenges and opportunities; and
    iii. address civic and cultural demands of citizenship.

[3] https://www.computerscience.org/resources/women-in-computer-science/
[4] Appendix 3

This proposal supports the goals outlined in the HECC's 2016-2020 Strategic Plan as well as the strategic initiatives of the HECC's 2017-2021 Strategic Framework (the latter serves as an addendum to the Strategic Plan).[5]

By reducing the time to degree by one year for students interested in both linguistics and computer science, the program supports **Strategic Action Area C: Streamlining Learner Pathways**, "...We will partner with secondary and postsecondary institutions to *eliminate unnecessary impediments to student access and progress towards completion*, especially transfer credit loss and *redundant coursework*." (emphasis added).

**Strategic Action Area C: Streamlining Learner Pathways** includes linking graduates with careers. Since the NLP field is fast growing, our proposal directly addresses this aspect of HECC's Strategic Plan.

This program supports the **Student Completion Model (SCM)** outlined in the HECC Strategic Plan. The Linguistics & Computer Science degree provides a coherent degree plan that is supported by prospective employers that we interviewed, creates a useful skill set, and requires fewer credits than a double major in linguistics and computer science.

The market analysis reports[6] highlight strong demand for this degree in the US in general, but also in the Oregon-Washington-California tri-state area in particular.

### 3. Accreditation

a. Accrediting body or professional society that has established standards in the area in which the program lies, if applicable.

The program will be housed in the Department of Applied Linguistics which is part of the College of Liberal Arts and Sciences. All PSU programs, including online offerings, are accredited by the Northwest Commission on Colleges and Universities (NWCCU). Portland State is an approved State Authorization Reciprocity Agreement (SARA) institution. SARA establishes standards for post-secondary distance education established across member states, districts and territories in the US.

b. Ability of the program to meet professional accreditation standards. If the program does not or cannot meet those standards, the proposal should identify the area(s) in which it is deficient and indicate steps needed to qualify the program for accreditation and date by which it would be expected to be fully accredited.

Not applicable

c. If the proposed program is a graduate program in which the institution offers an undergraduate program, proposal should identify whether or not the undergraduate program is accredited and, if not, what would be required to qualify it for accreditation.

Not applicable

d. If accreditation is a goal, the proposal should identify the steps being taken to achieve accreditation. If the program is not seeking accreditation, the proposal should indicate why it is not.

[5] The newly approved HECC Strategic Plan was not available prior to the writing of this proposal.
[6] Appendix 4

Not applicable

## 4. Need

a. Anticipated fall term headcount and FTE enrollment over each of the next five years.

We have three primary sources of data for projections for enrollment. First, Dr. Ameeta Agrawal's elective in NLP (CS 410/510 Topic: Natural Language Processing) has been at capacity (25 students) each time she has taught it. Second, Applied Linguistics has 1-2 students per year who complete the linguistics degree and then go into computer science. We expect there to be much higher student demand once the coursework from the two fields is integrated into one cohesive degree. Several linguistics graduates from our program also went into Master's programs in computational linguistics. The proposed Linguistics & Computer Science program could attract even more such students who are interested in getting stronger preparation for their Master's degree.

The NLP industry is expected to be fast growing in coming years. Revenues for the NLP software market in North America are expected to increase from $365 million in 2017 to $4.5 billion by 2025[7]. Worldwide, the NLP market is predicted to be "almost 14 times larger in 2025 than it was in 2017, increasing from around three billion U.S. dollars in 2017 to over 43 billion in 2025"[8]. Importantly, demand for skills in this area is currently high and is predicted to be among the top ten growing tech skills in coming years[9]. Additionally, although "the global COVID-19 outbreak has significantly impacted businesses worldwide … the COVID-19 pandemic has positively influenced the adoption of NLP-based services due to the nationwide lockdowns imposed by governments in countries across the globe"[10].

Market analysis (conducted by the OAI) confirms that indeed the field of NLP is fast growing and the demand for such jobs is high, especially in the tri-state region of Washington, Oregon, and California[11].

Additionally, market analysis indicates that there are no equivalent degree programs at the Bachelor's level in Oregon. Our own search for such programs indicated that there are a total of eight competitor degree programs in the country, and only one of them is in the Washington-Oregon-California tri-state region (specifically, in California).

Based on all of the above, we have the following (conservative) projections:

| Year | Predicted Fall Enrollment | Predicted yearly FTE |
|---|---|---|
| 1 | 5-10 | 5-10 |
| 2 | 10-15 | 10-15 |
| 3 | 15-25 | 15-25 |

[7] https://www.statista.com/statistics/607909/north-america-natural-language-processing-market-revenues
[8] https://www.statista.com/statistics/607891/worldwide-natural-language-processing-market-revenues
[9] https://www.statista.com/statistics/1198329/fastest-growing-tech-jobs
[10] https://www.grandviewresearch.com/industry-analysis/natural-language-processing-market-report
[11] Appendix 4

| | | |
|---|---|---|
| 4 | 25-30 | 25-30 |
| 5 | 30-40 | 30-40 |

b. Expected degrees/certificates produced over the next five years.

The current overlap between applied linguistics and computer science is modest. CS 311 and CS 320 are the only Computer Science courses that are automatically approved as electives for the BA in Applied Linguistics. No Applied Linguistics courses are approved for the BS in Computer Science. Additionally, over the years we have occasionally had computer science students in our linguistics courses.

Thus, we anticipate a slow ramp up of anticipated graduates in Linguistics & Computer Science. We also expect that the Linguistics & Computer Science program will attract new students to PSU, including an anticipated recovery in the number of overseas students. Students from Asia and India are very interested and typically strong in computer science in general and NLP in particular. The Pacific Northwest area is attractive to many students, but currently there are no BS in Linguistics & Computer Science programs in the area. University of Washington is the closest, but it offers Masters, not Bachelors, in computational linguistics. Of the total of eight similar BS programs, six are on the East Coast or in the Midwest, and only two are in the Western part of the US (California and Nevada).

**Predicted graduates in Linguistics & Computer Science**

| Year from program inception | Graduates |
|---|---|
| 1 | 0 |
| 2 | 0 |
| 3 | 5-10 |
| 4 | 20 |
| 5 | 25 |

c. Characteristics of students to be served (resident/nonresident/international; traditional/ nontraditional; full-time/part-time, etc.).

The degree should be attractive to a range of students who wish to combine a background in linguistics and computer science. While North America "is estimated to hold the largest revenue share [of the NLP market] of 30.7% in 2022", Asia Pacific is the fastest growing market and is projected to expand at the highest compound annual growth rate of 42.7% by 2030[12]. Thus, post-pandemic, we expect this degree to be particularly attractive to international students from the Asia Pacific region.

The mix of instructional styles (in-class, hybrid, and online) will enable a broad group of students including those who combine work, family and school to participate in a program that prepares students for rapidly expanding job opportunities. As Figure 5 in Demographic Summary Info[13] indicates, PSU has about 30% to 35% of first-generation students in Applied Linguistics and

[12] https://www.grandviewresearch.com/industry-analysis/natural-language-processing-market-report
[13] Appendix 3

Computer Science programs (based on the COGNOS data for the two programs over the last 5 years). As Figure 3 in the same file indicates, we expect to have about 50% of students who will transfer 90 to 135 credits, and about 30% of students with 45 to 90 transfer credits. (However, with more international enrollments, these figures could change.) These percentages of transfer students, which are similar across the applied linguistics and computer science programs, have been taken into account in the degree maps. Finally, based on Figure 4 (in the same file), we expect to attract students from various racial and other backgrounds. Currently, Computer Science attracts more Asian and international students, while Applied Linguistics attracts more African American, Hispanic/Latino, and mixed-race students. Given the current bias in the field of NLP on English as the dominant language (as stated by employers that we interviewed), the field of NLP would benefit from more diversification if the proposed program attracts a higher number of international students, as well as linguistics students with backgrounds in languages other than English.

Given the high rate of transfer students, locally we plan to market the new degree to foreign language and computer science students at PCC and other community colleges.

d. Evidence of market demand.

The full market analysis report conducted by the Office of Academic Innovation is included in Appendix 4. The report focuses on the external market for "linguistics and computer science" degrees as well as related job positions (Machine Learning Engineer, Natural Language Processing Scientist). The report only found one degree with the "linguistics and computer science" CIP code, whereas we located a total of eight in the US. Nevertheless, together this information indicates that the demand for jobs is high in this area, but there are only a few programs offering such degrees.

In examining all reports, we find that the Natural Language Processing Scientist report most closely relates to the skills our graduates will learn, given the structure of the curriculum, and so we will focus on the findings of this particular report. The chart on p. 4 indicates that the number of jobs in this area is projected to grow over the next 10 years. The top specialized skills (see p. 10) are computer science, Python programming language, machine learning, algorithms, and data analysis. The first four skills mentioned will be addressed by the computer science courses in the proposed curriculum, while data analysis will be the heavy focus of courses in applied linguistics. Additionally, the top "soft" skills mentioned are communication and problem-solving, which will be addressed in courses in both departments, but in particular in applied linguistics. As such, we see that the structure of our proposed curriculum matches the skill set required for these jobs. The Natural Language Processing Scientist in WA-OR-CA report indicates that the demand for these jobs, as well as the compensation, is much higher in our tri-state area than the national average.

e. If the program's location is shared with another similar Oregon public university program, the proposal should provide externally validated evidence of need (e.g., surveys, focus groups, documented requests, occupational/employment statistics and forecasts).

Not applicable. No such programs exist in Oregon

f. Estimate the prospects for success of program graduates (employment or graduate school) and consideration of licensure, if appropriate. What are the expected career paths for students in this program?

We will measure performance in individual classes based on student evaluations of the courses. We will track employment and graduate school admissions for students in the program in order to assess the marketability of these students.

The main motivation for proposing a BS in Linguistics & Computer Science is that it would provide employment opportunities in the field of Natural Language Processing (NLP). This field is fast-growing and the demand for jobs in NLP will continue to increase rapidly. The NLP market is predicted to be "almost 14 times larger in 2025 than it was in 2017, increasing from around three billion U.S. dollars in 2017 to over 43 billion in 2025"[14].

One evidence of such high demand and interest in the NLP field is that every year several students in undergraduate and/or graduate programs in the Department of Applied Linguistics at PSU decide to undertake additional coursework or programs in the Department of Computer Science. And the field of NLP is exactly that, a combination of linguistics and computer science: "Natural language processing (NLP) combines linguistics and artificial intelligence[15] (AI) to enable computers to understand human or natural language[16] input"[17]. In order to streamline this process for students who seek to have a background in both linguistics and computer science for the purposes of finding employment in the field of NLP, we are proposing a single degree in Linguistics & Computer Science (rather than a double major in the two fields).

## 5. Outcomes and Quality Assessment

a. Expected learning outcomes of the program.

Comprehensive learning outcomes, as stated below, have been developed for this program by the two primary departments: Applied Linguistics and Computer Science. The needs of employers (11 employers in NLP-related fields were interviewed), and NLP profession as a whole, are reflected in these learning outcomes.

**Field**
Students will exit the program with a thorough understanding of the current state of the field of computational linguistics including its relationship to computer science and applied linguistics.

**Analysis**
Students will exit the program with skills in analyzing language data, building arguments with language data, and building models based on that analysis using relevant tools (programming languages and software) in the field.

**Theory**
Students will exit the program with a solid understanding of the concepts and methods in computational linguistics and the role of theories in the field including the ethical and social implications of linguistic diversity in NLP.

**Application**

[14] https://www.statista.com/statistics/607891/worldwide-natural-language-processing-market-revenues
[15] https://www.sciencedirect.com/topics/computer-science/artificial-intelligence
[16] https://www.sciencedirect.com/topics/computer-science/natural-languages
[17] https://www.sciencedirect.com/topics/computer-science/natural-language-processing#:~:text=Natural%20language%20processing%20(NLP)%20is,for%20mathematically%20precise%20algorithmic%20solutions

Students will exit the program with the ability to apply their computational linguistic knowledge and analytical skills to a variety of language-related problems in the world through the design and implementation of NLP systems.

**Affect**
Students will exit the program with a conscious awareness of their own and other people's emotional reactions to language, language issues, and linguistic diversity.

**Professional**
Students will exit the program with skills that enhances their ability to gain employment or continue on to graduate school including using effective communication and working collaboratively.

**Future goals**
Students will exit the program with an understanding of the scope and sequence of their course of study and how that course of study can apply to their future goals.

b. Methods by which the learning outcomes will be assessed and used to improve curriculum and instruction.

The learning outcomes draw on existing learning outcomes in the undergraduate applied linguistics and undergraduate computer science programs. We will measure performance in individual classes based on student evaluations of the courses. We will also have an advisory board consisting of employers in the NLP industry who will help us interpret student course evaluations with regard to the needs of the NLP industry. Revisions to curriculum will be made, as needed, based on these evaluations and discussions with NLP industry experts. In our interviews with industry partners, several have already agreed to serve on the advisory board.

c. Nature and level of research and/or scholarly work expected of program faculty; indicators of success in those areas.

There would be no changes to the scholarly expectations for faculty. These expectations are set at the level of the individual units.

**6. Program Integration and Collaboration**

a. Closely related programs in this or other Oregon colleges and universities.

Not applicable. No such programs exist in Oregon

b. Ways in which the program complements other similar programs in other Oregon institutions and other related programs at this institution. Proposal should identify the potential for collaboration.

This program will provide a set of skills that will be useful to students seeking employment or planning to go to graduate school in the field of NLP. The new major allows students to acquire skills that were not previously available without a double major. Our program allows students to study this field in Portland. (California is the only state in the Western part of US that offers a similar program).

c. If applicable, proposal should state why this program may not be collaborating with existing similar programs.

Not applicable

d. Potential impacts on other programs.

The proposed Linguistics & Computer Science major will be housed in the Department of Applied Linguistics. Resources within the department are adequate to support this program due to excess capacity in courses included in the major. The program also requires enrollment in computer science, mathematics, and statistics courses. Statement of support from the Department of Computer Science is attached[18]. The Computer Science department will be seeking a new hire to accommodate the increased demand in NLP courses that this program will create. This hire is supported by the Deans of CLAS and MCECS[19]. We anticipate a very positive impact in terms of faculty connections improving across the units that will supply courses to the major.

## 7. External Review

If the proposed program is a graduate level program, follow the guidelines provided in *External Review of New Graduate Level Academic Programs* in addition to completing all of the above information.

Not applicable

*Revised May 2016*

[18] Appendix 2
[19] Appendix 1

**Appendix 1**

Joseph L. Bull, Ph.D.
H. Chik M. Erzurumlu Dean
Maseeh College of Engineering and Computer Science
Portland State University

Post Office Box 751
Portland, Oregon 97207-0751

503-725-2820 tel
503-725-2825 fax
www.pdx.edu/engineering

October 31, 2023

Re: Letter of Support for proposed Bachelor's degree in Computational Linguistics

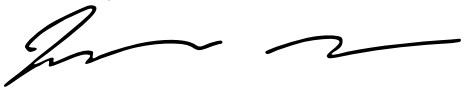
Dear Colleagues:

I am writing to convey my support and enthusiasm for the proposed Bachelor's degree in Computational Linquistics, which is a collaboration between the CLAS and the Maseeh College, and an outcome of a productive ongoing collaboration between the Department of Applied Linguististics and the Department of Computer Science. The program's curriculum will position graduates to work in the fields of Natural Language Processing and AI. While it uses mostly existing courses, it is innovative in the combination of topics and applications. It will one of the first undergraduate programs to address this subject area.

Graduates will be prepared for a wide range of career paths in industry and education and research. I am excited about the potential for this program to contribute to the learning and preservation of endangered languages, particularly Native American languages.

I anticipate that the Department of Computer Science will require an additional hire to meet the increased demand in NLP courses. I am supportive of that and anticipate that this faculty member will teach an NLP-related course for this program each year.

Sincerely,



Joseph L. Bull, Ph.D.
H. Chik M. Erzurumlu Dean
Maseeh College of Engineering and Computer Science
Portland State University

**Appendix 2**

**Maseeh College of Engineering & Computer Science**
Department of Computer Science

Post Office Box 751
Portland, Oregon 97207-0751

503-725-4036 tel
503-725-3211 fax
Email: cs@pdx.edu

October 30, 2023

**Letter of Support for proposed Bachelor's degree in Computational Linguistics**

Dear Colleagues:

I am writing this letter in my capacity as chair of the Department of Computer Science to confirm my strong support for the proposed Bachelor's degree in Computational Linguistics. The proposal is one outcome of an ongoing and productive collaboration between my department and the Department of Applied Linguistics. This has resulted in a strong and coherent curriculum that combines (mostly existing) courses from each of our respective areas that will position students to work in the burgeoning fields of Natural Language Processing (NLP) and, more broadly, Artificial Intelligence (AI). Graduates from this program will have developed skills and knowledge for a wide range of rewarding careers, whether in the commercial sector (ChatGPT and voice assistants like Alexa or Siri are well-known examples), or in language education and research (such as the preservation and teaching of endangered languages). The resulting baccalaureate degree will be one of the first programs in the country to address the demand in this subject area, particularly as an undergraduate program, and will be a novel and distinguishing feature of our curricular offerings that will help to attract more students to PSU.

The curriculum includes two new Computer Science courses focused on topics in NLP. Each of these has already been offered multiple times as a special topics class and has proved popular with our students. Separate proposals to establish permanent course numbers for each of these courses will be passing through the curriculum oversight processes this academic year, in parallel with the new degree proposal, and we hope that they will be approved in time for the 2024-25 Bulletin. A practical consideration for my department is that we currently only have one faculty member who can teach these specialized courses. To ensure that we can deliver the new degree in a sustainable manner, and before the new degree can be formally launched, it will be necessary to recruit an additional faculty member with expertise in NLP. This will guarantee that the new courses can be offered on a regular and consistent schedule (to provide a smooth path to graduation for students in the program), to allow for occasional absences (as the result of a sabbatical, for example), and to support faculty retention. This has been discussed by the faculty and has support to be included as part of a strategic hiring plan within the department.

I am excited about the potential of this new program for our students, and for our university, and I am happy to provide this letter of support for the proposal. Please feel free to contact me if any further information is needed.

Sincerely,

Mark P. Jones

Mark P. Jones (mpj@pdx.edu)
Professor and Department Chair
Department of Computer Science

**Appendix 3**

## Demographic Summary Info from AL and CS

(based on PSU RCAT Data)

**Figure 1**

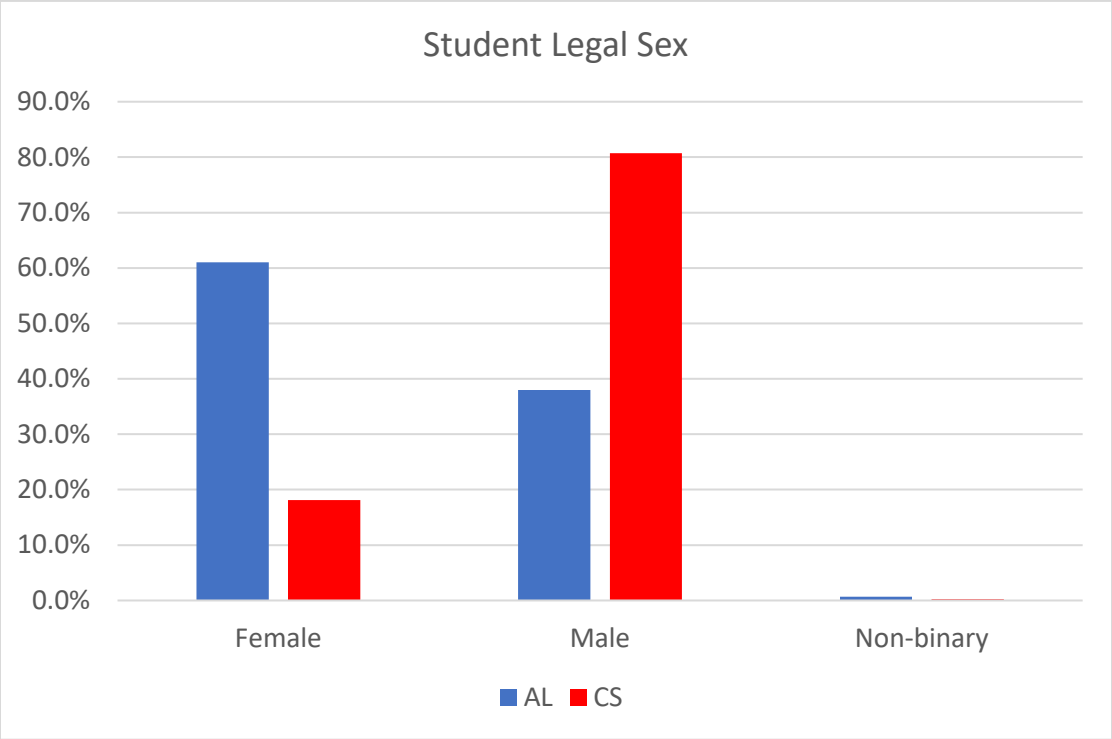


**Figure 2**

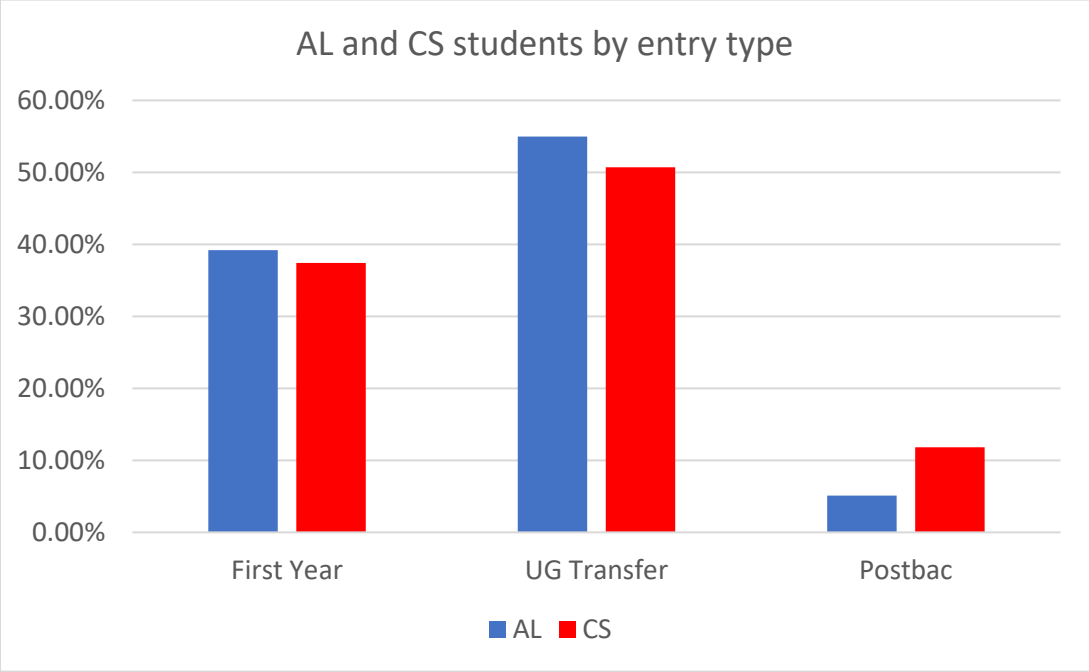



**Figure 3**

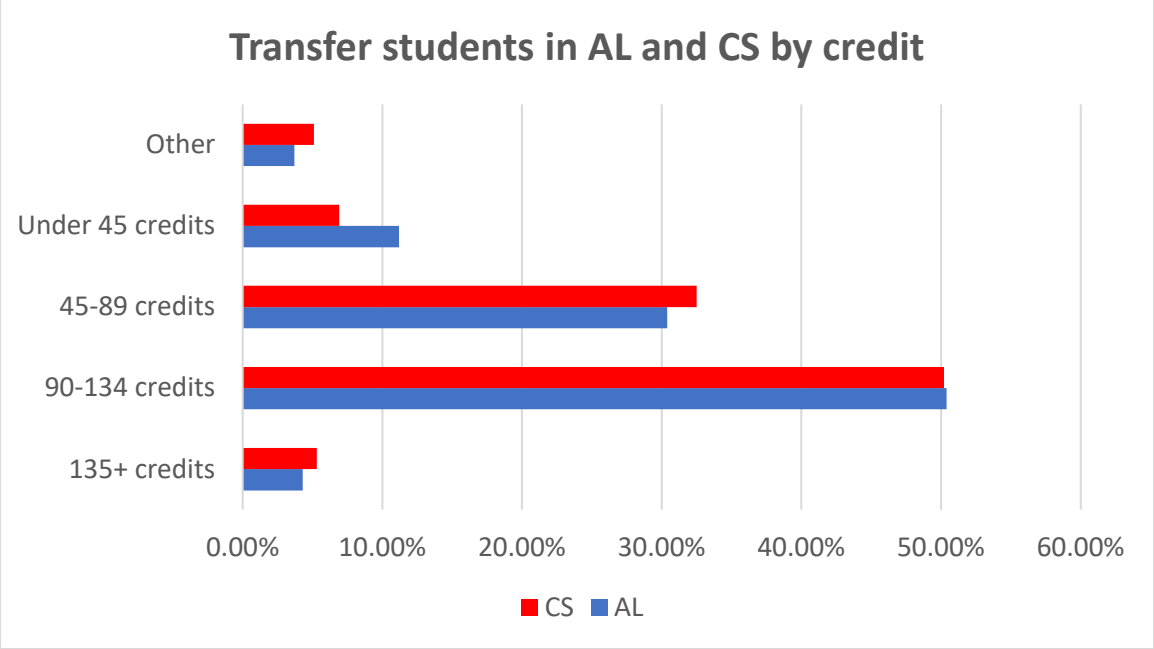


**Figure 4**

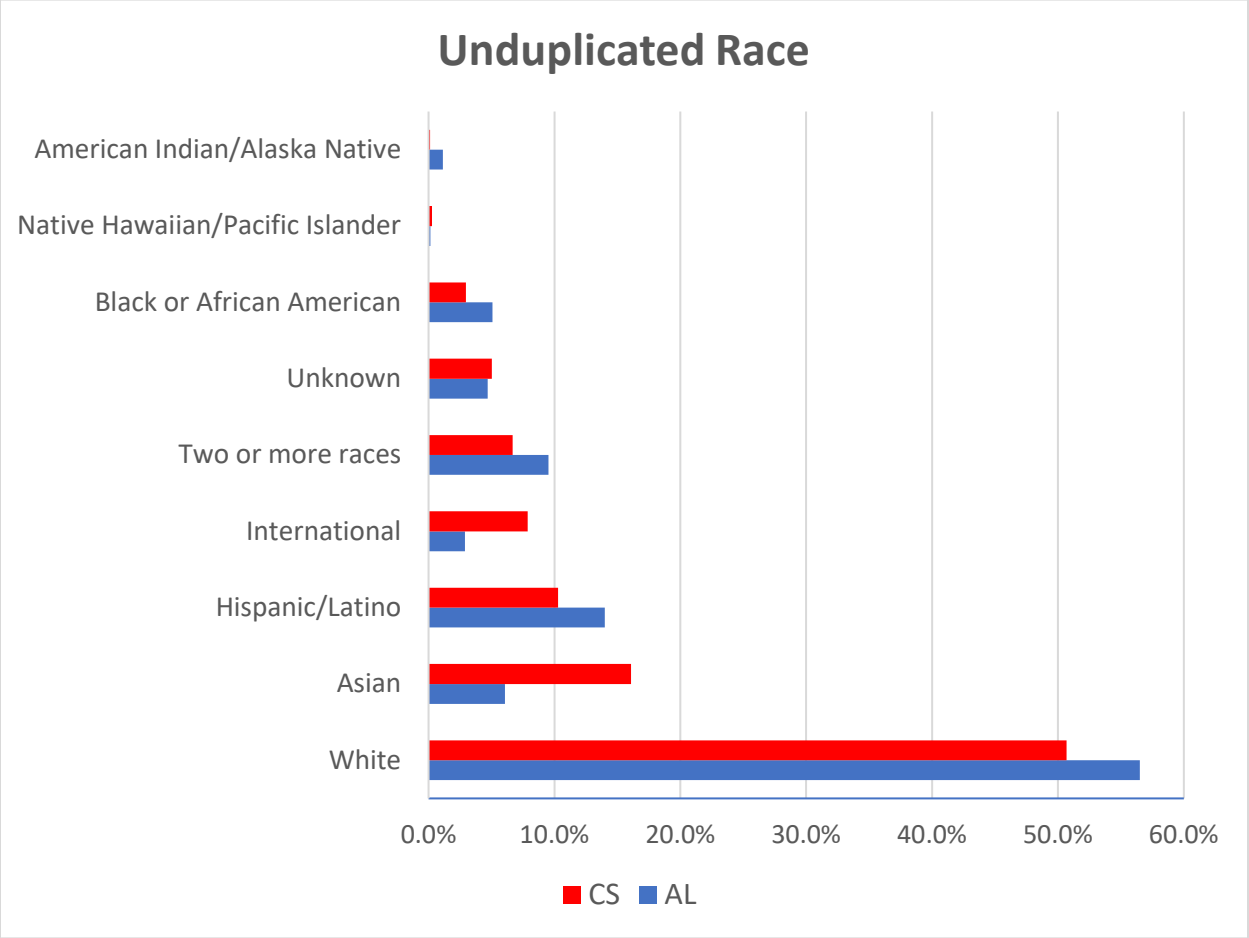
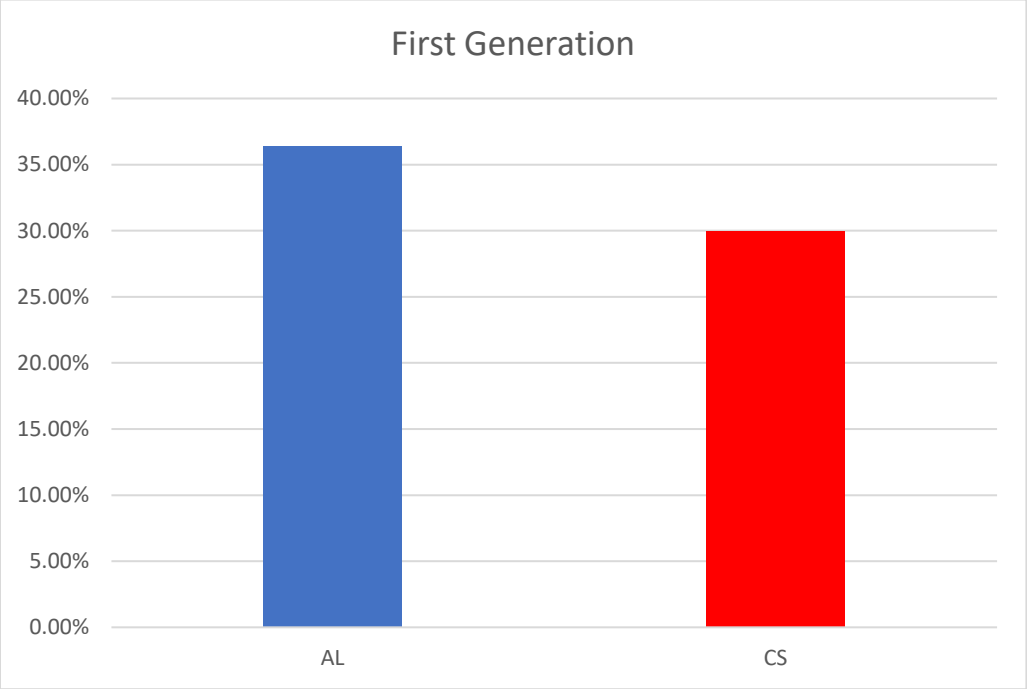

Unduplicated Race
American Indian/Alaska Native
Native Hawaiian/Pacific Islander
Black or African American
Unknown
Two or more races
International
Hispanic/Latino
Asian
White
0.0%
10.0%
20.0%
30.0%
40.0%
50.0%
60.0%
CS
AL

**Figure 5**


First Generation
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
AL
CS

Appendix 4

# Program Overview

## Linguistics and Computer Science

Lightcast Q1 2023 Data Set

March 2023

Oregon

# Parameters

**Completions Year:** 2021

**Jobs Timeframe:** 2021 - 2023

**Job Postings Timeframe:** Jan 2022 - Dec 2022

**Programs:**

| Code | Description |
|---|---|
| 30.4801 | Linguistics and Computer Science |

**Regions:**

| Code | Description |
|---|---|
| 0 | United States |

**Education Level:** Any

**Tuition Type:** Tuition & Fees

**Graduate Status:** Undergraduate

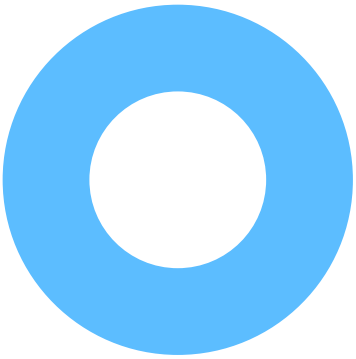
**Residency:** In-State

There are not enough institutions in this search to display this information.

## Program Overview

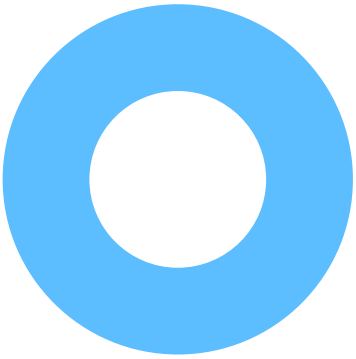

| | Completions (2021) | % Completions | Institutions (2021) | % Institutions |
|---|---|---|---|---|
| All Programs | 6 | 100% | 1 | 100% |
| Distance Offered Programs | 0 | 0% | 0 | 0% |
| Non-Distance Offered Programs | 6 | 100% | 1 | 100% |

## Market Share by Institution Type



| Institution Type | Completions (2021) | Market Share |
|---|---|---|
| Public, 4-year or above | 6 | 100.0% |

## Market Share by Program

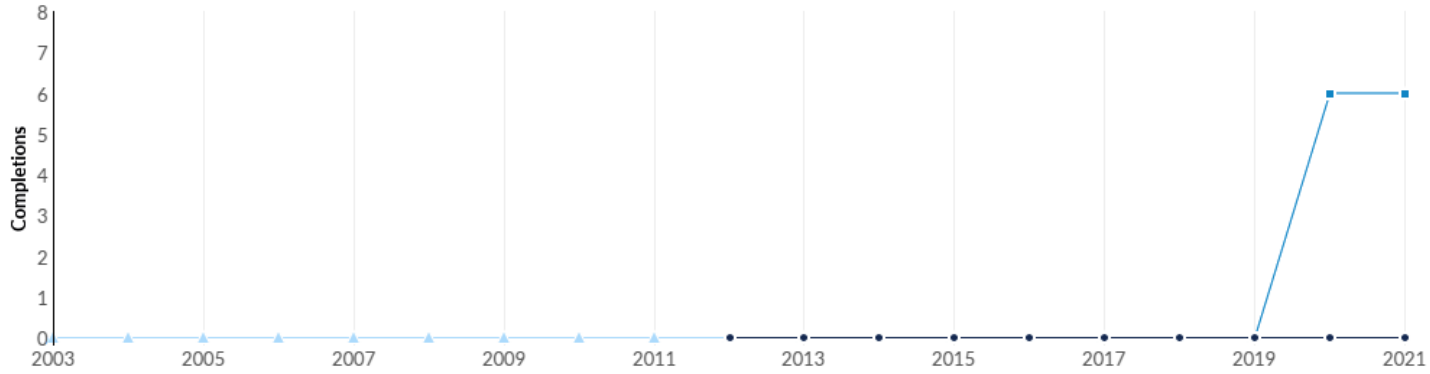


| Program | Completions (2021) | Market Share |
|---|---|---|
| Linguistics and Computer Science (30.4801) | 6 | 100.0% |

## Completions by Institution

| Institution | Completions (2021) | Growth % YOY (2021) | Market Share (2021) | IPEDS Tuition & Fees (2021) | Completions Trend (2017-2021) |
|---|---|---|---|---|---|
| Stony Brook University | 6 | 0.0% | 100.0% | $10,455 | |

## Regional Trends




| | 2012 Completions | 2021 Completions | % Change |
|---|---|---|---|
| Distance Offered Programs | 0 | 0 | 0.0% |
| Non-Distance Offered Programs | 0 | 6 | Insf. Data |
| All Programs | 0 | 6 | Insf. Data |

# Regional Completions by Award Level

| Award Level | Completions (2021) | Percent |
|---|---|---|
| Master's Degree | 6 | 100.0% |
| Award of less than 1 academic year | 0 | 0.0% |
| Award of at least 1 but less than 2 academic years | 0 | 0.0% |
| Associate's Degree | 0 | 0.0% |
| Award of at least 2 but less than 4 academic years | 0 | 0.0% |
| Bachelor's Degree | 0 | 0.0% |
| Postbaccalaureate certificate | 0 | 0.0% |
| Post-masters certificate | 0 | 0.0% |
| Doctor's Degree | 0 | 0.0% |

## Similar Programs

| 148 | 833,647 |
| --- | --- |
| Programs (2021) | Completions (2021) |

| CIP Code | Program | Completions (2021) |
| --- | --- | --- |
| 24.0101 | Liberal Arts and Sciences/Liberal Studies | 366,667 |
| 24.0102 | General Studies | 129,753 |
| 11.0701 | Computer Science | 59,346 |
| 11.0101 | Computer and Information Sciences, General | 51,511 |
| 24.0199 | Liberal Arts and Sciences, General Studies and Humanities, Other | 37,634 |
| 11.0103 | Information Technology | 31,478 |
| 27.0101 | Mathematics, General | 29,750 |
| 11.0401 | Information Science/Studies | 18,279 |
| 14.0901 | Computer Engineering, General | 13,416 |
| 30.0000 | Multi-/Interdisciplinary Studies, General | 9,051 |

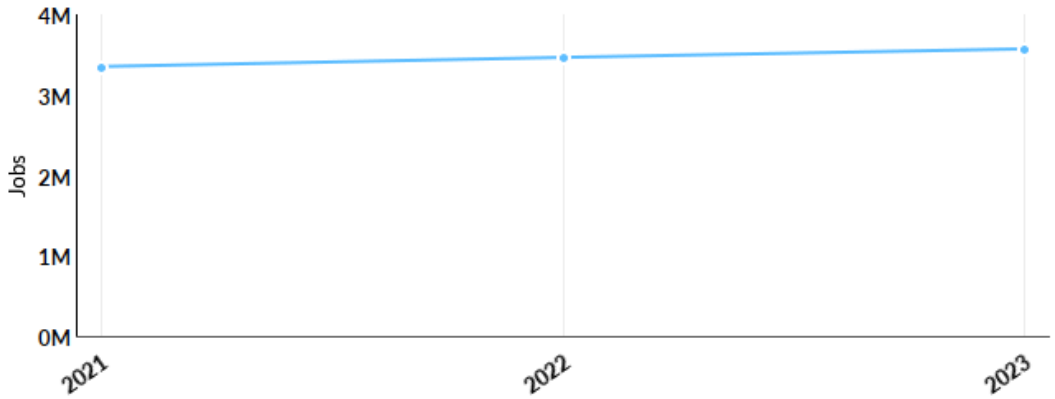
## Target Occupations

| 3.35M | +6.5% | $47.27/hr<br>$98.3K/yr | 391,919 |
|---|---|---|---|
| Jobs (2021) | % Change (2021-2023) | Median Earnings | Annual Openings |

| Occupation | 2021 Jobs | Annual Openings | Median Earnings | Growth (2021 - 2023) |
|---|---|---|---|---|
| Postsecondary Teachers | 1,780,693 | 203,592 | $38.09/hr | +3.27% |
| Software Developers | 1,452,426 | 173,188 | $57.88/hr | +10.18% |
| Data Scientists | 112,163 | 14,692 | $48.32/hr | +11.39% |
| Mathematical Science Occupations, All Other | 4,886 | 447 | $29.96/hr | +2.15% |

## Growth

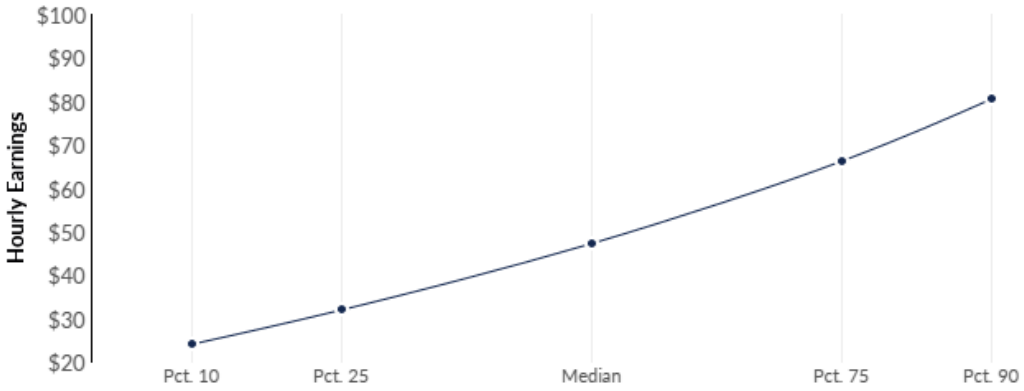
| 3,350,168 | 3,569,176 | 219,008 | 6.5% |
|---|---|---|---|
| 2021 Jobs | 2023 Jobs | Change (2021-2023) | % Change (2021-2023) |




| Occupation | 2021 Jobs | 2023 Jobs | Change | % Change |
|---|---|---|---|---|
| Software Developers (15-1252) | 1,452,426 | 1,600,278 | 147,852 | 10% |
| Data Scientists (15-2051) | 112,163 | 124,940 | 12,777 | 11% |
| Mathematical Science Occupations, All Other (15-2099) | 4,886 | 4,991 | 105 | 2% |
| Postsecondary Teachers (25-1099) | 1,780,693 | 1,838,966 | 58,273 | 3% |

## Percentile Earnings

| $31.98/hr | $47.27/hr | $66.25/hr |
|---|---|---|
| 25th Percentile Earnings | Median Earnings | 75th Percentile Earnings |




| Occupation | 25th Percentile Earnings | Median Earnings | 75th Percentile Earnings |
|---|---|---|---|
| Software Developers (15-1252) | $43.26 | $57.88 | $73.12 |
| Data Scientists (15-2051) | $36.90 | $48.32 | $62.90 |
| Mathematical Science Occupations, All Other (15-2099) | $22.65 | $29.96 | $46.68 |
| Postsecondary Teachers (25-1099) | $27.29 | $38.09 | $54.95 |

## Job Postings Summary

| 1.81M | 2 : 1 | 25 days |
|---|---|---|
| **Unique Postings** | **Posting Intensity** | **Median Posting Duration** |
| 4.09M Total Postings |  | Regional Average: 29 days |
| | Regional Average: 3 : 1 | |

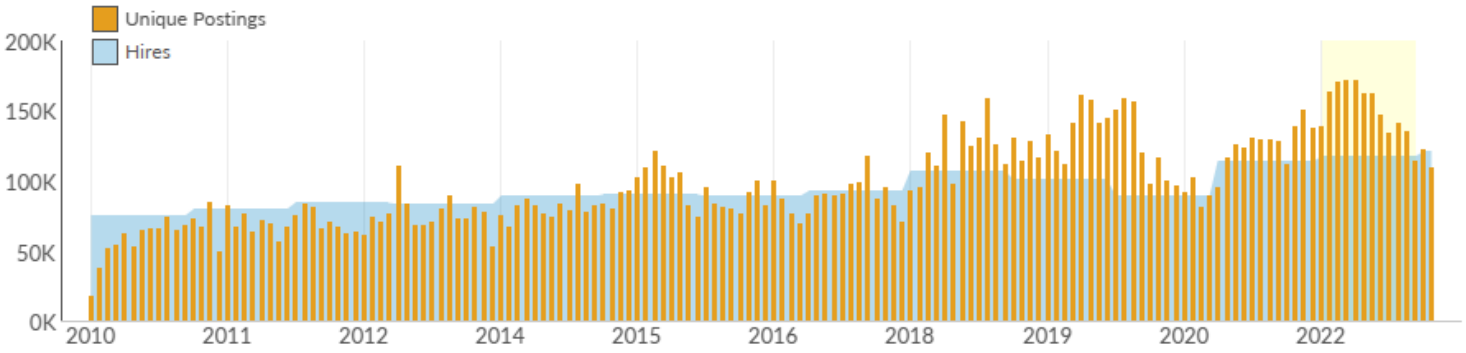
There were **4.09M** total job postings for your selection from January 2022 to December 2022, of which **1.81M** were unique. These numbers give us a Posting Intensity of **2-to-1**, meaning that for every 2 postings there is 1 unique job posting.

This is close to the Posting Intensity for all other occupations and companies in the region (3-to-1), indicating that they are putting average effort toward hiring for this position.

# Job Postings vs. Hires

| 151,124 | 117,969 |
|---|---|
| Avg. Monthly Postings (Jan 2022 - Dec 2022) | Avg. Monthly Hires (Jan 2022 - Dec 2022) |

In an average month, there were **151,124** newly posted job postings for *4 Occupations*, and **117,969** actually hired. This means there was approximately 1 hire for every 1 unique job posting for *4 Occupations*.




| Occupation | Avg Monthly Postings (Jan 2022 - Dec 2022) | Avg Monthly Hires (Jan 2022 - Dec 2022) |
|---|---|---|
| Software Developers | 102,777 | 54,662 |
| Postsecondary Teachers | 25,210 | 58,089 |
| Data Scientists | 23,036 | 5,065 |
| Mathematical Science Occupations, All Other | 101 | 153 |

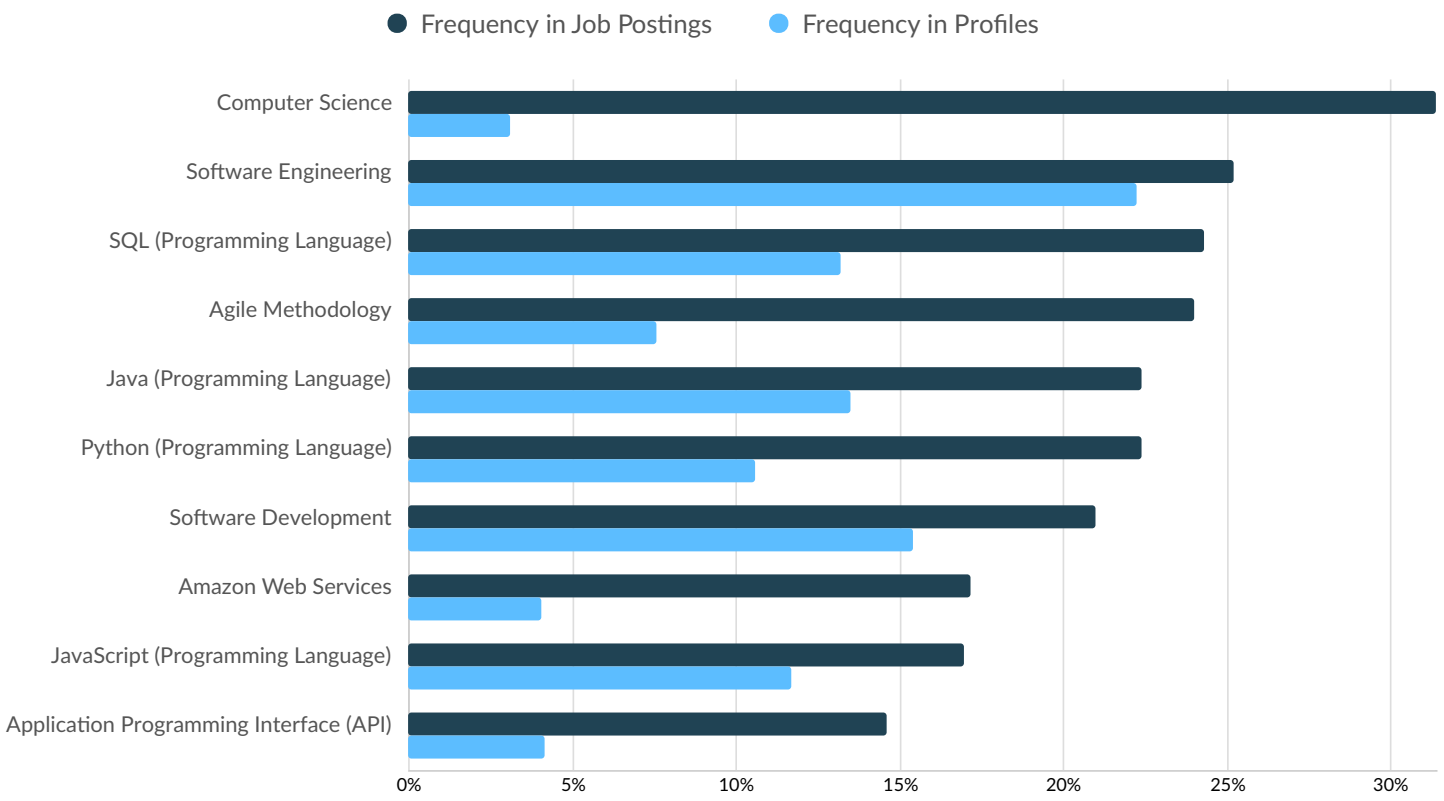
## Top Companies Posting

| Company | Total/Unique (Jan 2022 - Dec 2022) | Posting Intensity | Median Posting Duration |
|---|---|---|---|
| Randstad | 50,325 / 31,883 | 2 : 1 | 21 days |
| Amazon | 84,503 / 27,516 | 3 : 1 | 33 days |
| CyberCoders | 66,385 / 22,439 | 3 : 1 | 30 days |
| Jobot | 68,663 / 21,797 | 3 : 1 | 25 days |
| Humana | 38,626 / 16,363 | 2 : 1 | 27 days |
| Deloitte | 24,631 / 15,712 | 2 : 1 | 23 days |
| General Dynamics | 22,475 / 13,087 | 2 : 1 | 25 days |
| Capital One | 59,678 / 13,065 | 5 : 1 | 20 days |
| Motion Recruitment | 18,996 / 11,580 | 2 : 1 | 17 days |
| Elevance Health | 18,581 / 10,498 | 2 : 1 | 31 days |

## Top Posted Job Titles

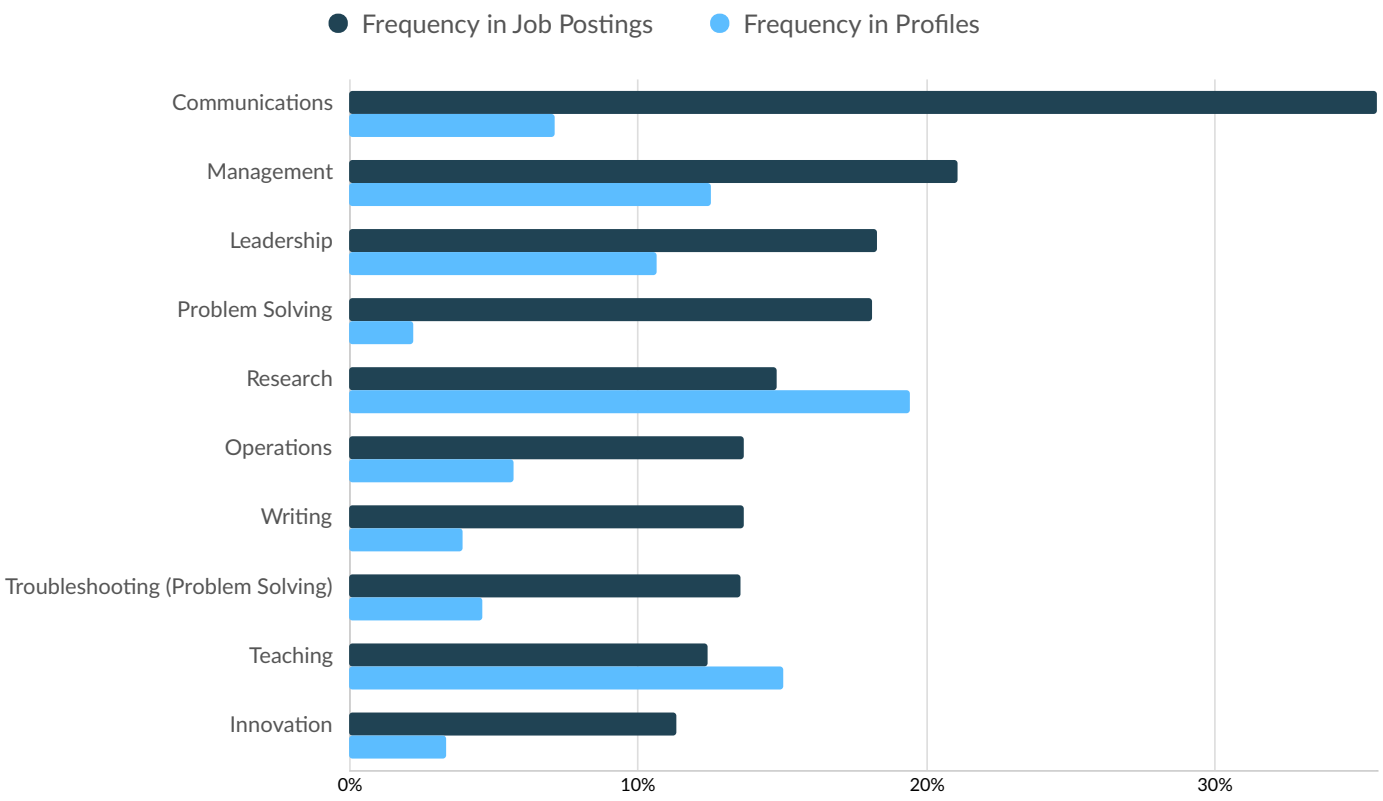
| Job Title | Total/Unique (Jan 2022 - Dec 2022) | Posting Intensity | Median Posting Duration |
|---|---|---|---|
| Software Engineers | 332,491 / 121,767 | 3 : 1 | 24 days |
| Data Analysts | 98,459 / 40,223 | 2 : 1 | 26 days |
| Data Scientists | 74,666 / 34,740 | 2 : 1 | 23 days |
| Software Developers | 77,984 / 33,603 | 2 : 1 | 25 days |
| DevOps Engineers | 60,813 / 30,592 | 2 : 1 | 23 days |
| Java Developers | 54,076 / 28,753 | 2 : 1 | 22 days |
| Full Stack Software Engineers | 63,471 / 22,385 | 3 : 1 | 23 days |
| Software Development Engineers | 73,751 / 22,194 | 3 : 1 | 26 days |
| Full Stack Developers | 44,823 / 20,273 | 2 : 1 | 25 days |
| .NET Developers | 35,705 / 20,210 | 2 : 1 | 24 days |

# Top Specialized Skills



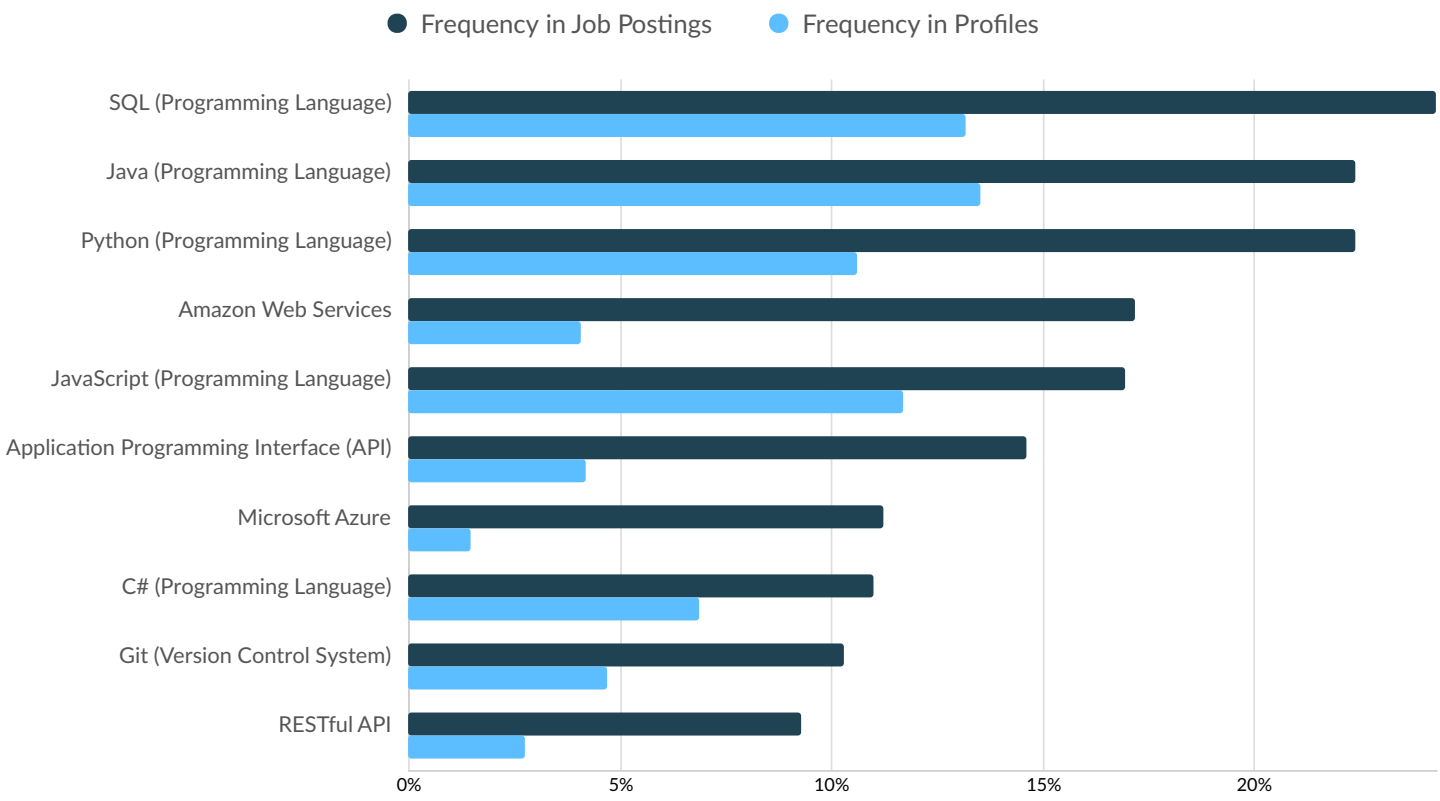

| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Computer Science | 569,196 | 31% | 116,962 | 3% |
| Software Engineering | 457,037 | 25% | 835,382 | 22% |
| SQL (Programming Language) | 440,529 | 24% | 495,201 | 13% |
| Agile Methodology | 435,665 | 24% | 285,629 | 8% |
| Java (Programming Language) | 406,345 | 22% | 508,025 | 14% |
| Python (Programming Language) | 405,785 | 22% | 398,784 | 11% |
| Software Development | 380,322 | 21% | 579,732 | 15% |
| Amazon Web Services | 311,671 | 17% | 153,641 | 4% |
| JavaScript (Programming Language) | 307,625 | 17% | 439,964 | 12% |
| Application Programming Interface (API) | 265,221 | 15% | 157,345 | 4% |

# Top Common Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Communications | 646,380 | 36% | 268,212 | 7% |
| Management | 382,296 | 21% | 471,013 | 13% |
| Leadership | 332,404 | 18% | 401,465 | 11% |
| Problem Solving | 329,108 | 18% | 84,509 | 2% |
| Research | 268,728 | 15% | 729,875 | 19% |
| Operations | 248,711 | 14% | 214,345 | 6% |
| Writing | 248,136 | 14% | 148,499 | 4% |
| Troubleshooting (Problem Solving) | 245,836 | 14% | 173,808 | 5% |
| Teaching | 225,245 | 12% | 565,775 | 15% |
| Innovation | 205,944 | 11% | 127,354 | 3% |

# Top Software Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| SQL (Programming Language) | 440,721 | 24% | 495,201 | 13% |
| Java (Programming Language) | 406,473 | 22% | 508,025 | 14% |
| Python (Programming Language) | 405,990 | 22% | 398,784 | 11% |
| Amazon Web Services | 311,735 | 17% | 153,641 | 4% |
| JavaScript (Programming Language) | 307,716 | 17% | 439,964 | 12% |
| Application Programming Interface (API) | 265,311 | 15% | 157,345 | 4% |
| Microsoft Azure | 204,033 | 11% | 55,997 | 1% |
| C# (Programming Language) | 199,392 | 11% | 258,371 | 7% |
| Git (Version Control System) | 187,135 | 10% | 176,795 | 5% |
| RESTful API | 168,429 | 9% | 103,660 | 3% |

# Top Qualifications

| Qualification | Postings with Qualification |
|---|---|
| Security Clearance | 50,940 |
| Secret Clearance | 33,950 |
| Top Secret-Sensitive Compartmented Information (TS/SCI Clearance) | 31,823 |
| Valid Driver's License | 27,477 |
| Registered Nurse (RN) | 22,590 |
| Master Of Business Administration (MBA) | 19,015 |
| Board Certified/Board Eligible | 12,467 |
| CompTIA Security+ | 11,939 |
| Top Secret Clearance | 9,903 |
| Certified Information Systems Security Professional | 9,442 |

# Appendix A

## Program Selection Details

| CIP Code | Program Name |
| --- | --- |
| 30.4801 | Linguistics and Computer Science |

# Appendix B - Data Sources and Calculations

## Institution Data

The institution data in this report is taken directly from the national IPEDS database published by the U.S. Department of Education's National Center for Education Statistics.

## Location Quotient

Location quotient (LQ) is a way of quantifying how concentrated a particular industry, cluster, occupation, or demographic group is in a region as compared to the nation. It can reveal what makes a particular region unique in comparison to the national average.

## Occupation Data

Emsi occupation employment data are based on final Emsi industry data and final Emsi staffing patterns. Wage estimates are based on Occupational Employment Statistics (QCEW and Non-QCEW Employees classes of worker) and the American Community Survey (Self-Employed and Extended Proprietors). Occupational wage estimates are also affected by county-level Emsi earnings by industry.

## Lightcast Job Postings

Job postings are collected from various sources and processed/enriched to provide information such as standardized company name, occupation, skills, and geography.

## State Data Sources

This report uses state data from the following agencies: Alabama Department of Labor; Alaska Department of Labor and Workforce Development; Arizona Commerce Authority; Arkansas Division of Workforce Services; California Employment Development Department; Colorado Department of Labor and Employment; Connecticut Department of Labor; Delaware Office of Occupational and Labor Market Information; District of Columbia Department of Employment Services; Florida Department of Economic Opportunity; Georgia Labor Market Explorer; Hawaii Workforce Infonet; Idaho Department of Labor; Illinois Department of Employment Security; Indiana Department of Workforce Development; Iowa Workforce Development; Kansas Department of Labor; Kentucky Center for Statistics; Louisiana Workforce Commission; Maine Department of Labor; Maryland Department of Labor; Commonwealth of Massachusetts, Mass.gov; Michigan Department of Technology, Management and Budget; Minnesota Department of Employment and Economic Development; Mississippi Department of Employment Security; Missouri Economic Research and Information Center; Montana Department of Labor and Industry; Nebraska Department of Labor, NEworks; Nevada Department of Employment, Training and Rehabilitation; New Hampshire Employment Security; New Jersey Department of Labor and Workforce Development; New Mexico Department of Workforce Solutions; New York Department of Labor; North Carolina Department of Commerce; North Dakota Job Service; Ohio Department of Job and Family Services; Oklahoma Employment Security Commission; Oregon Employment Department; Pennsylvania Department of Labor and Industry, Center for Workforce Information and Analysis; Rhode Island Department of Labor and Training; South Carolina Department of Employment and Workforce; South Dakota Department of Labor and Regulation; Tennessee Department of Labor & Workforce Development; Texas Workforce Commission; Utah Department of Workforce Services; Vermont Department of Labor; Virginia Employment Commission; Washington State Employment Security Department; West Virginia Department of Commerce; Wisconsin Department of Workforce Development; Wyoming Department of Workforce Services

# Program Overview

2 Programs

Lightcast Q1 2023 Data Set

March 2023

Oregon

# Parameters

**Completions Year:** 2021

**Jobs Timeframe:** 2021 - 2023

**Job Postings Timeframe:** Jan 2022 - Dec 2022

**Programs:**

| Code | Description |
|---|---|
| 11.0701 | Computer Science |
| 16.0102 | Linguistics |

**Regions:**

| Code | Description |
|---|---|
| 0 | United States |

**Education Level:**

| Description |
|---|
| Bachelor's degree |

**Tuition Type:** Tuition & Fees

**Graduate Status:** Undergraduate

**Residency:** In-State

675

Institutions

7% Growth (2017-2021)

41,338

Completions

60% Growth (2017-2021)

## Completions Distribution

Average: 61.2

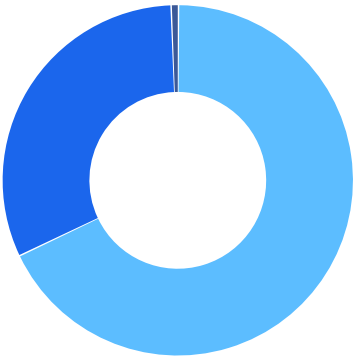
1 — 850

Median: 19

## Program Overview

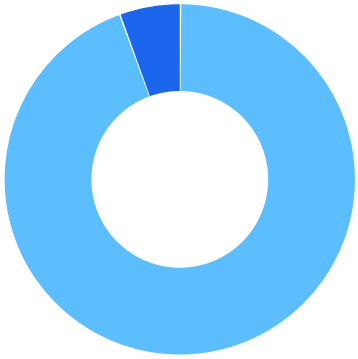

| | Completions (2021) | % Completions | Institutions (2021) | % Institutions |
|---|---|---|---|---|
| All Programs | 41,338 | 100% | 675 | 100% |
| Distance Offered Programs | 3,768 | 9% | 51 | 8% |
| Non-Distance Offered Programs | 37,570 | 91% | 626 | 93% |

## Market Share by Institution Type



| Institution Type | Completions (2021) | Market Share |
|---|---|---|
| Public, 4-year or above | 28,048 | 67.9% |
| Private not-for-profit, 4-year or above | 13,010 | 31.5% |
| Private for-profit, 4-year or above | 280 | 0.7% |

## Market Share by Program

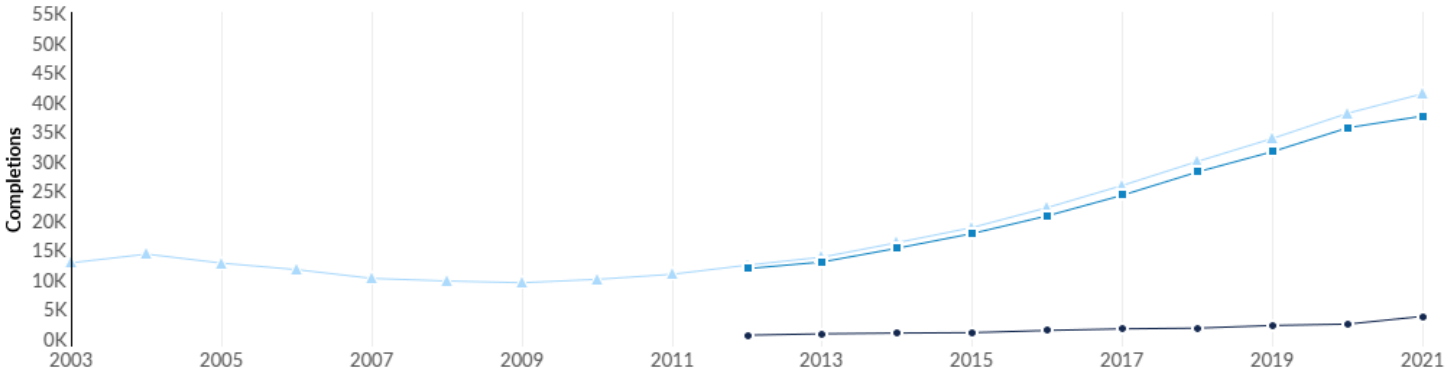


| Program | Completions (2021) | Market Share |
|---|---|---|
| Computer Science (11.0701) | 39,014 | 94.4% |
| Linguistics (16.0102) | 2,324 | 5.6% |

## Completions by Institution

| Institution | Bachelor's Degree Completions (2021) | Growth % YOY (2021) | Market Share (2021) | IPEDS Tuition & Fees (2021) | Completions Trend (2017-2021) |
|---|---|---|---|---|---|
| University of California-Berkeley | 850 | -5.0% | 2.1% | $14,226 | |
| University of Maryland-College Park | 831 | 7.4% | 2.0% | $10,955 | |
| University of California-Irvine | 822 | 2.1% | 2.0% | $13,775 | |
| Oregon State University | 762 | 17.1% | 1.8% | $12,188 | |
| University of California-Santa Cruz | 703 | -0.1% | 1.7% | $14,070 | |
| University of North Carolina at Charlotte | 633 | 17.4% | 1.5% | $7,188 | |
| University of California-San Diego | 611 | 23.2% | 1.5% | $14,700 | |
| University of Minnesota-Twin Cities | 551 | 15.3% | 1.3% | $15,254 | |
| Arizona State University Campus Immersion | 531 | 14.7% | 1.3% | $11,348 | |
| University of Colorado Boulder | 511 | 7.8% | 1.2% | $12,610 | |

## Regional Trends




| | 2012 Completions | 2021 Completions | % Change |
|---|---|---|---|
| Distance Offered Programs | 583 | 3,768 | +546.3% |
| Non-Distance Offered Programs | 11,819 | 37,570 | +217.9% |
| All Programs | 12,402 | 41,338 | +233.3% |

## Regional Completions by Award Level

| Award Level | Completions (2021) | Percent |
|---|---|---|
| Bachelor's Degree | 41,338 | 100.0% |

## Similar Programs

| 243 | 709,306 |
|---|---|
| Programs (2021) | Completions (2021) |

| CIP Code | Program | Bachelor's Degree Completions (2021) |
|---|---|---|
| 52.0201 | Business Administration and Management, General | 146,202 |
| 26.0101 | Biology/Biological Sciences, General | 81,399 |
| 52.1401 | Marketing/Marketing Management, General | 43,443 |
| 43.0104 | Criminal Justice/Safety Studies | 31,169 |
| 11.0101 | Computer and Information Sciences, General | 25,818 |
| 24.0101 | Liberal Arts and Sciences/Liberal Studies | 24,904 |
| 52.0101 | Business/Commerce, General | 24,828 |
| 30.9999 | Multi-/Interdisciplinary Studies, Other | 24,057 |
| 27.0101 | Mathematics, General | 21,022 |
| 51.0701 | Health/Health Care Administration/Management | 14,112 |

# Target Occupations

*Filtered by the proportion of the national workforce in these occupations with a Bachelor's degree

| 2.47M | +7.3% | $47.18/hr<br>$98.1K/yr | 271,815 |
|---|---|---|---|
| *Jobs (2021)** | *% Change (2021-2023)** | Median Earnings | *Annual Openings** |

| Occupation | *2021 Jobs** | *Annual Openings** | Median Earnings | *Growth (2021 - 2023)** |
|---|---|---|---|---|
| Software Developers | *739,285* | *88,153* | $57.88/hr | *+10.18%* |
| Computer User Support Specialists | *264,258* | *28,018* | $23.95/hr | *+5.16%* |
| Computer Systems Analysts | *256,307* | *25,728* | $47.63/hr | *+5.45%* |
| Computer and Information Systems Managers | *236,265* | *26,376* | $76.17/hr | *+7.30%* |
| Computer Occupations, All Other | *161,735* | *16,467* | $45.14/hr | *+5.68%* |
| Network and Computer Systems Administrators | *138,989* | *12,508* | $38.66/hr | *+3.85%* |
| Software Quality Assurance Analysts and Testers | *102,738* | *12,085* | $47.19/hr | *+8.70%* |
| Computer Programmers | *87,605* | *7,759* | $43.73/hr | *+2.28%* |
| Information Security Analysts | *73,569* | *9,225* | $49.29/hr | *+10.06%* |
| Computer Network Architects | *70,379* | *6,168* | $57.82/hr | *+4.17%* |
| Computer Network Support Specialists | *69,996* | *7,228* | $30.18/hr | *+4.15%* |
| Web Developers | *57,823* | *7,171* | $34.66/hr | *+9.31%* |
| Web and Digital Interface Designers | *55,717* | *7,598* | $35.88/hr | *+10.01%* |
| Database Administrators | *41,023* | *3,927* | $46.40/hr | *+4.76%* |
| Computer Hardware Engineers | *36,626* | *3,425* | $61.41/hr | *+5.13%* |
| Interpreters and Translators | *31,020* | *4,700* | $24.06/hr | *+8.50%* |
| Database Architects | *23,583* | *2,417* | $59.13/hr | *+6.03%* |
| Statisticians | *12,932* | *1,555* | $45.78/hr | *+9.23%* |
| Computer and Information Research Scientists | *12,001* | *1,312* | $63.22/hr | *+7.49%* |

## Job Postings Summary

| 3.83M | 2 : 1 | 25 days |
|---|---|---|
| **Unique Postings** | **Posting Intensity** | **Median Posting Duration** |
| 8.65M Total Postings |  | Regional Average: 29 days |
| | Regional Average: 3 : 1 | |

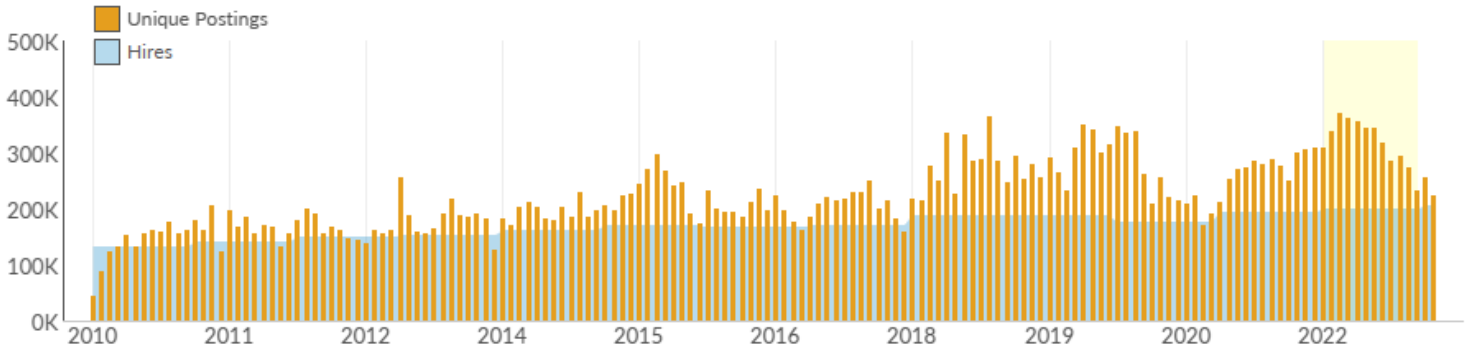
There were **8.65M** total job postings for your selection from January 2022 to December 2022, of which **3.83M** were unique. These numbers give us a Posting Intensity of **2-to-1**, meaning that for every 2 postings there is 1 unique job posting.

This is close to the Posting Intensity for all other occupations and companies in the region (3-to-1), indicating that they are putting average effort toward hiring for this position.

## Job Postings vs. Hires

| 319,083 | 200,502 |
|---|---|
| Avg. Monthly Postings (Jan 2022 - Dec 2022) | Avg. Monthly Hires (Jan 2022 - Dec 2022) |

In an average month, there were **319,083** newly posted job postings for *19 Occupations*, and **200,502** actually hired. This means there was approximately 1 hire for every 2 unique job postings for *19 Occupations*.




| Occupation | Avg Monthly Postings (Jan 2022 - Dec 2022) | Avg Monthly Hires (Jan 2022 - Dec 2022) |
|---|---|---|
| Software Developers | 102,777 | 54,662 |
| Computer Occupations, All Other | 58,529 | 14,781 |
| Computer User Support Specialists | 30,608 | 29,431 |
| Computer Systems Analysts | 22,687 | 17,876 |
| Web Developers | 16,283 | 4,058 |
| Information Security Analysts | 15,012 | 7,705 |
| Database Administrators | 12,245 | 3,022 |
| Network and Computer Systems Administrators | 11,035 | 10,700 |
| Software Quality Assurance Analysts and Testers | 10,914 | 8,608 |
| Computer Network Architects | 8,914 | 5,877 |
| Database Architects | 8,173 | 1,895 |
| Computer Programmers | 6,306 | 5,033 |

| | | |
|---|---|---|
| Computer and Information Systems Managers | 4,012 | 18,071 |
| Computer Network Support Specialists | 2,627 | 6,782 |
| Statisticians | 2,520 | 1,418 |
| Interpreters and Translators | 2,399 | 2,958 |
| Web and Digital Interface Designers | 1,674 | 4,373 |
| Computer Hardware Engineers | 1,213 | 2,025 |
| Computer and Information Research Scientists | 1,156 | 1,227 |

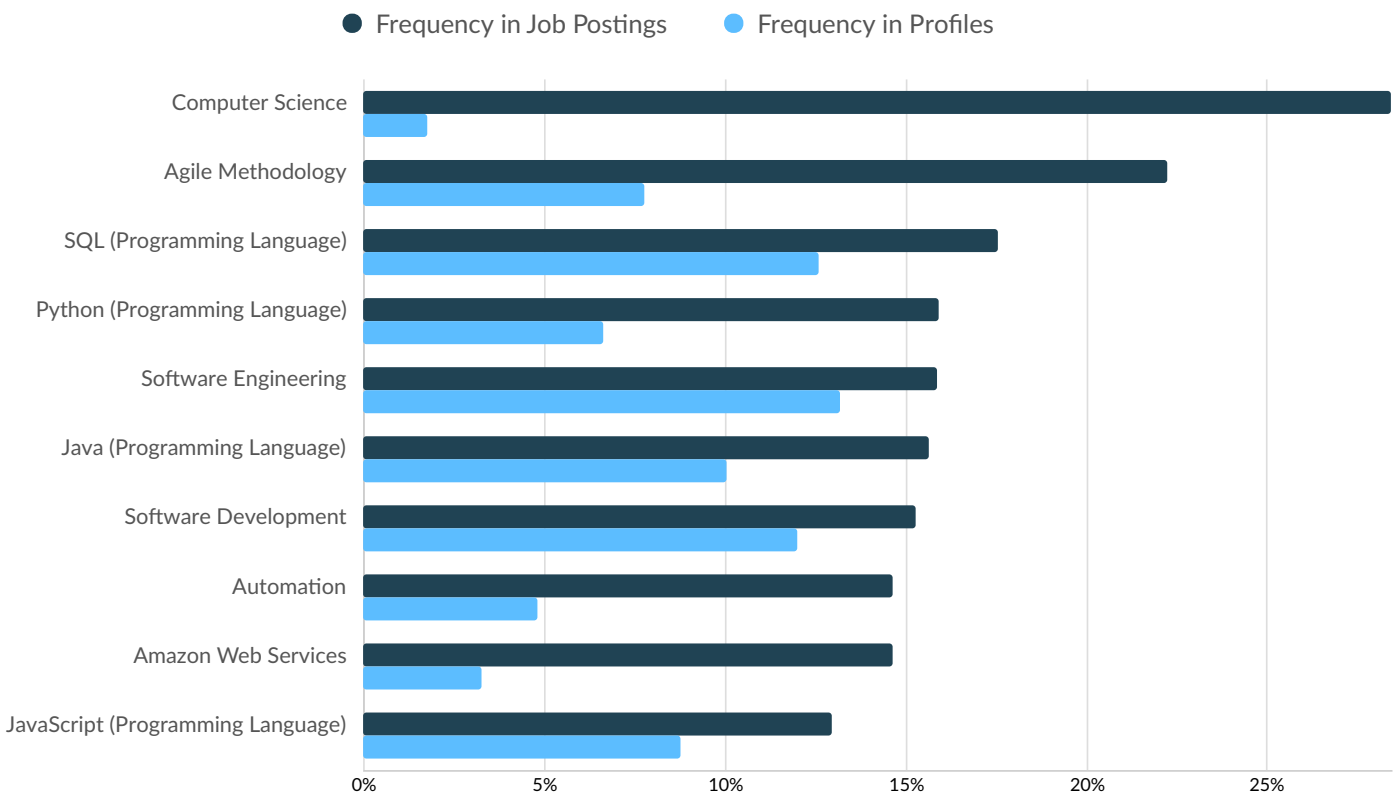
## Top Companies Posting

| Company | Total/Unique (Jan 2022 - Dec 2022) | Posting Intensity | Median Posting Duration |
|---|---|---|---|
| Randstad | 118,284 / 73,642 | 2 : 1  | 21 days |
| Deloitte | 75,883 / 47,714 | 2 : 1  | 23 days |
| Amazon | 121,522 / 44,105 | 3 : 1  | 33 days |
| CyberCoders | 111,122 / 38,038 | 3 : 1  | 30 days |
| General Dynamics | 74,405 / 37,177 | 2 : 1  | 25 days |
| Humana | 75,694 / 34,563 | 2 : 1  | 30 days |
| Jobot | 107,898 / 34,418 | 3 : 1  | 25 days |
| Robert Half | 45,379 / 31,003 | 1 : 1  | 30 days |
| KPMG | 112,300 / 25,551 | 4 : 1  | 21 days |
| TEKsystems | 42,703 / 24,628 | 2 : 1  | 24 days |

# Top Posted Job Titles

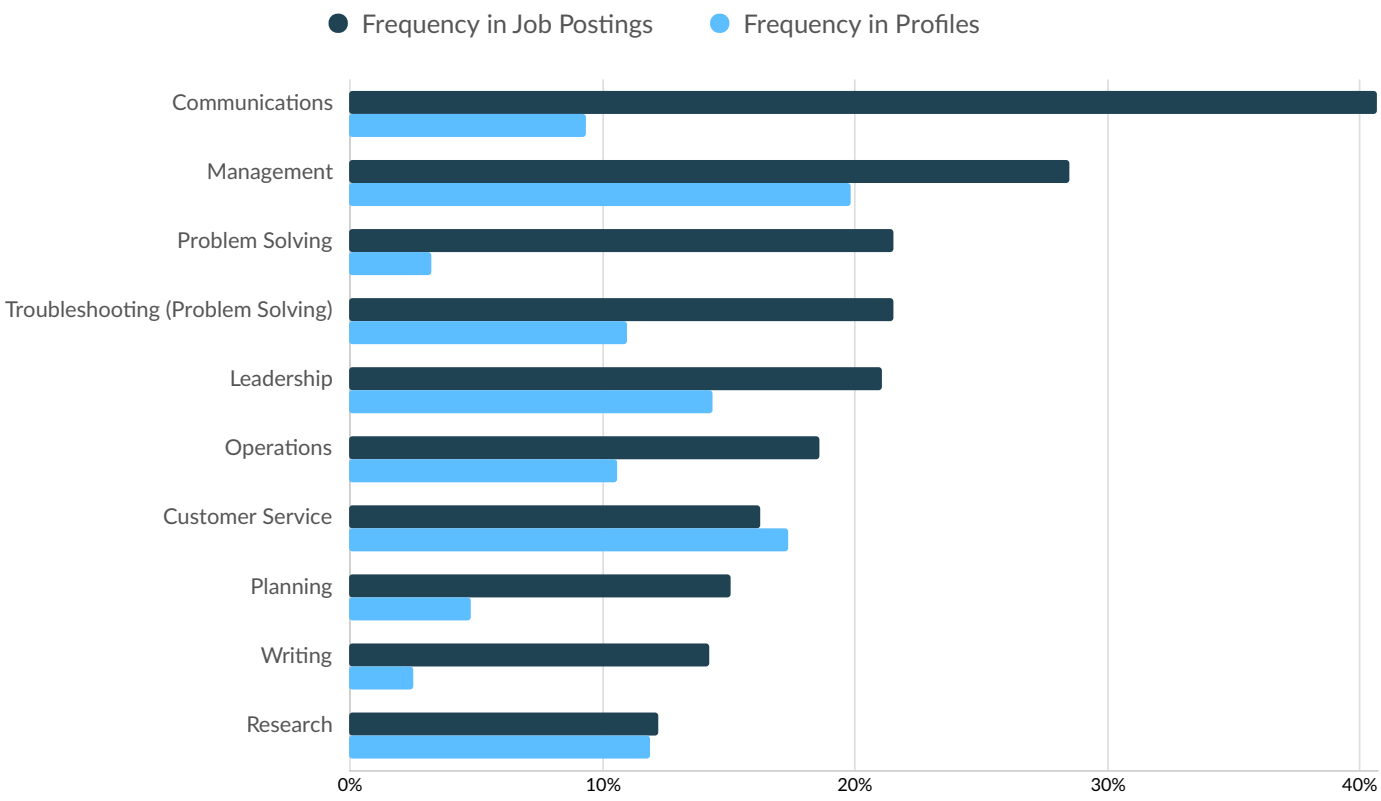
| Job Title | Total/Unique (Jan 2022 - Dec 2022) | Posting Intensity | Median Posting Duration |
|---|---|---|---|
| Software Engineers | 333,316 / 122,138 | 3 : 1 | 24 days |
| Systems Engineers | 102,094 / 43,000 | 2 : 1 | 23 days |
| Data Engineers | 78,073 / 37,842 | 2 : 1 | 23 days |
| Software Developers | 78,387 / 33,814 | 2 : 1 | 25 days |
| DevOps Engineers | 62,050 / 31,230 | 2 : 1 | 23 days |
| Java Developers | 54,227 / 28,841 | 2 : 1 | 22 days |
| Systems Administrators | 66,926 / 28,265 | 2 : 1 | 24 days |
| Network Engineers | 65,791 / 28,231 | 2 : 1 | 23 days |
| Business Systems Analysts | 49,007 / 24,091 | 2 : 1 | 24 days |
| Full Stack Developers | 51,833 / 23,696 | 2 : 1 | 25 days |

# Top Specialized Skills



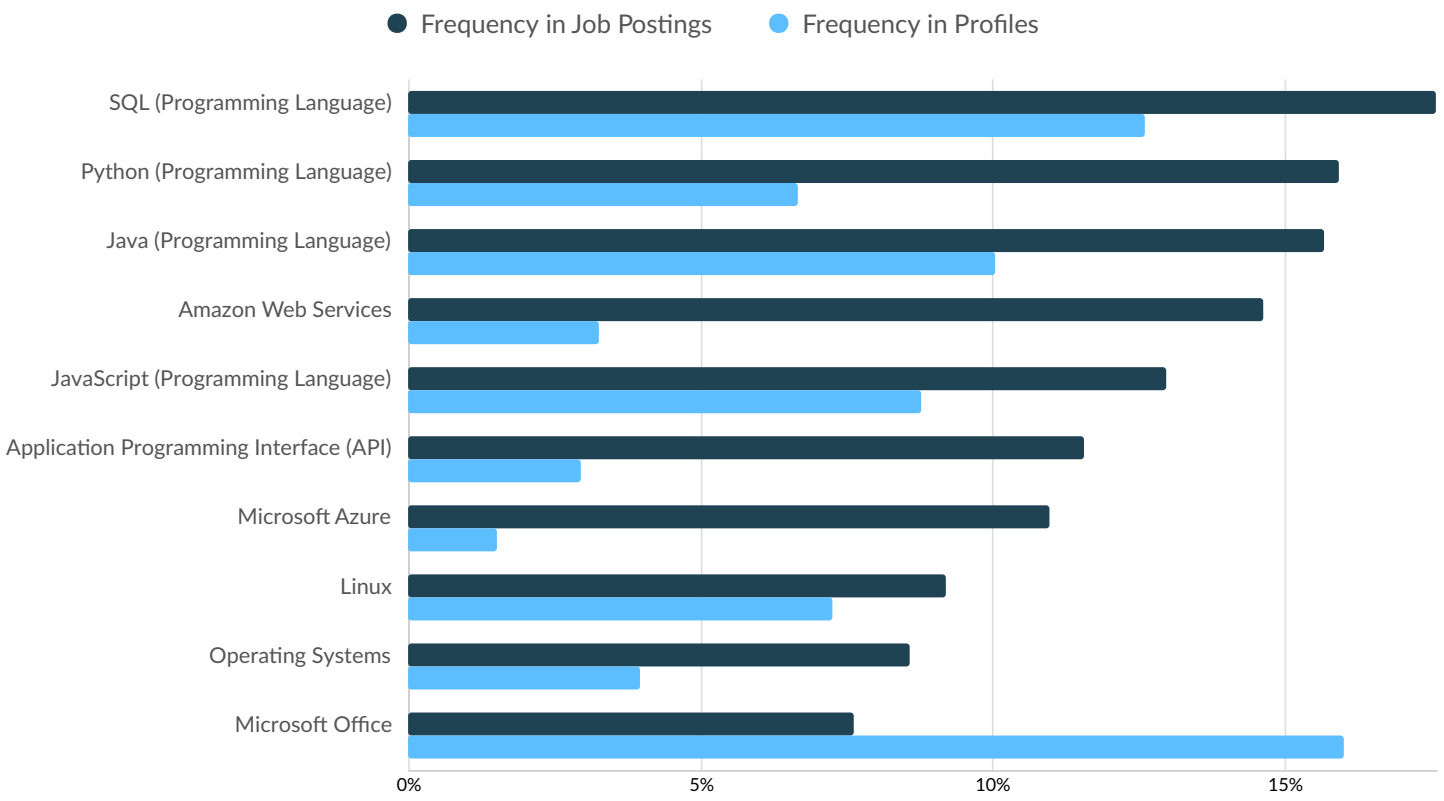

| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Computer Science | 1,088,802 | 28% | 139,267 | 2% |
| Agile Methodology | 851,128 | 22% | 612,160 | 8% |
| SQL (Programming Language) | 673,089 | 18% | 991,391 | 13% |
| Python (Programming Language) | 609,670 | 16% | 524,522 | 7% |
| Software Engineering | 607,275 | 16% | 1,037,118 | 13% |
| Java (Programming Language) | 599,852 | 16% | 790,528 | 10% |
| Software Development | 585,436 | 15% | 944,093 | 12% |
| Automation | 560,450 | 15% | 380,023 | 5% |
| Amazon Web Services | 560,264 | 15% | 256,129 | 3% |
| JavaScript (Programming Language) | 496,488 | 13% | 692,041 | 9% |

# Top Common Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Communications | 1,558,449 | 41% | 736,255 | 9% |
| Management | 1,091,024 | 28% | 1,562,792 | 20% |
| Problem Solving | 826,019 | 22% | 257,938 | 3% |
| Troubleshooting (Problem Solving) | 825,705 | 22% | 865,830 | 11% |
| Leadership | 808,304 | 21% | 1,132,587 | 14% |
| Operations | 712,813 | 19% | 837,337 | 11% |
| Customer Service | 622,517 | 16% | 1,369,937 | 17% |
| Planning | 577,758 | 15% | 379,406 | 5% |
| Writing | 544,869 | 14% | 199,616 | 3% |
| Research | 468,734 | 12% | 939,053 | 12% |

# Top Software Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| SQL (Programming Language) | 673,372 | 18% | 991,391 | 13% |
| Python (Programming Language) | 610,048 | 16% | 524,522 | 7% |
| Java (Programming Language) | 600,134 | 16% | 790,528 | 10% |
| Amazon Web Services | 560,396 | 15% | 256,129 | 3% |
| JavaScript (Programming Language) | 496,699 | 13% | 692,041 | 9% |
| Application Programming Interface (API) | 442,846 | 12% | 231,893 | 3% |
| Microsoft Azure | 419,813 | 11% | 118,863 | 2% |
| Linux | 352,161 | 9% | 570,593 | 7% |
| Operating Systems | 328,087 | 9% | 311,470 | 4% |
| Microsoft Office | 291,901 | 8% | 1,260,315 | 16% |

# Top Qualifications

| Qualification | Postings with Qualification |
|---|---|
| Security Clearance | 141,181 |
| Top Secret-Sensitive Compartmented Information (TS/SCI Clearance) | 106,751 |
| Valid Driver's License | 104,757 |
| Secret Clearance | 101,653 |
| Certified Information Systems Security Professional | 94,024 |
| Project Management Professional Certification | 68,247 |
| CompTIA Security+ | 66,528 |
| CompTIA A+ | 55,540 |
| Cisco Certified Network Associate | 50,365 |
| Certified Information System Auditor (CISA) | 40,121 |

# Appendix A

## Program Selection Details

| CIP Code | Program Name |
| --- | --- |
| 11.0701 | Computer Science |
| 16.0102 | Linguistics |

# Appendix B - Data Sources and Calculations

## Institution Data

The institution data in this report is taken directly from the national IPEDS database published by the U.S. Department of Education's National Center for Education Statistics.

## Occupation Data

Emsi occupation employment data are based on final Emsi industry data and final Emsi staffing patterns. Wage estimates are based on Occupational Employment Statistics (QCEW and Non-QCEW Employees classes of worker) and the American Community Survey (Self-Employed and Extended Proprietors). Occupational wage estimates are also affected by county-level Emsi earnings by industry.

## Lightcast Job Postings

Job postings are collected from various sources and processed/enriched to provide information such as standardized company name, occupation, skills, and geography.

## State Data Sources

This report uses state data from the following agencies: Alabama Department of Labor; Alaska Department of Labor and Workforce Development; Arizona Commerce Authority; Arkansas Division of Workforce Services; California Employment Development Department; Colorado Department of Labor and Employment; Connecticut Department of Labor; Delaware Office of Occupational and Labor Market Information; District of Columbia Department of Employment Services; Florida Department of Economic Opportunity; Georgia Labor Market Explorer; Hawaii Workforce Infonet; Idaho Department of Labor; Illinois Department of Employment Security; Indiana Department of Workforce Development; Iowa Workforce Development; Kansas Department of Labor; Kentucky Center for Statistics; Louisiana Workforce Commission; Maine Department of Labor; Maryland Department of Labor; Commonwealth of Massachusetts, Mass.gov; Michigan Department of Technology, Management and Budget; Minnesota Department of Employment and Economic Development; Mississippi Department of Employment Security; Missouri Economic Research and Information Center; Montana Department of Labor and Industry; Nebraska Department of Labor, NEworks; Nevada Department of Employment, Training and Rehabilitation; New Hampshire Employment Security; New Jersey Department of Labor and Workforce Development; New Mexico Department of Workforce Solutions; New York Department of Labor; North Carolina Department of Commerce; North Dakota Job Service; Ohio Department of Job and Family Services; Oklahoma Employment Security Commission; Oregon Employment Department; Pennsylvania Department of Labor and Industry, Center for Workforce Information and Analysis; Rhode Island Department of Labor and Training; South Carolina Department of Employment and Workforce; South Dakota Department of Labor and Regulation; Tennessee Department of Labor & Workforce Development; Texas Workforce Commission; Utah Department of Workforce Services; Vermont Department of Labor; Virginia Employment Commission; Washington State Employment Security Department; West Virginia Department of Commerce; Wisconsin Department of Workforce Development; Wyoming Department of Workforce Services

# Machine Learning Engineers*
## in the United States

*Job titles used in government data sources are slightly different from the one you've chosen. This report uses data from the closest matching official classifications (listed below) as a proxy for Machine Learning Engineers data.

Software Developers

# Contents

# What is Lightcast Data?

Lightcast data is a hybrid dataset derived from official government sources such as the US Census Bureau, Bureau of Economic Analysis, and Bureau of Labor Statistics. Leveraging the unique strengths of each source, our data modeling team creates an authoritative dataset that captures more than 99% of all workers in the United States. This core offering is then enriched with data from online social profiles, resumés, and job postings to give you a complete view of the workforce.

Lightcast data is frequently cited in major publications such as *The Atlantic*, *Forbes*, *Harvard Business Review*, *The New York Times*, *The Wall Street Journal*, and *USA Today*.

# Report Parameters

## 1 Occupation

Software Developers

## 1 Nation

0 United States

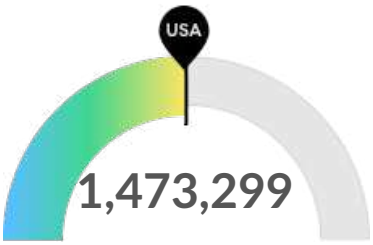
## Class of Worker

QCEW Employees

The information in this report pertains to the chosen occupation and geographical area.

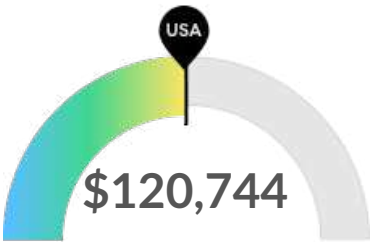
# Executive Summary

## Average Job Posting Demand Over an Average Supply of Regional Jobs



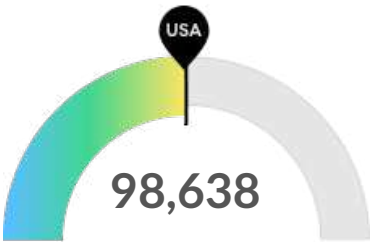

### Jobs (2022)

United States is about average for this kind of job. The national average for an area this size is 1,473,299* employees, while there are 1,473,299 here.




### Compensation

Earnings are about average in United States. The national median salary for Machine Learning Engineers is $120,744, compared to $120,744 here.




### Job Posting Demand

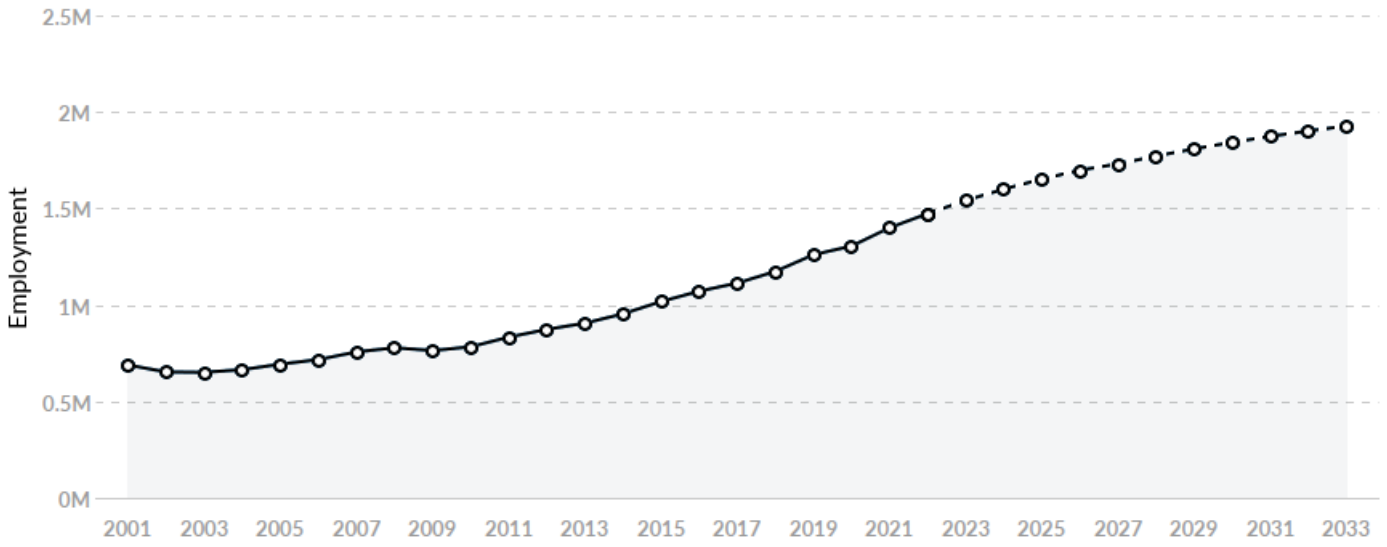
Job posting activity is about average in United States. The national average for an area this size is 98,638* job postings/mo, while there are 98,638 here.

*National average values are derived by taking the national value for Machine Learning Engineers and scaling it down to account for the difference in overall workforce size between the nation and United States. In other words, the values represent the national average adjusted for region size.

# Jobs

## Regional Employment Is About Equal to the National Average

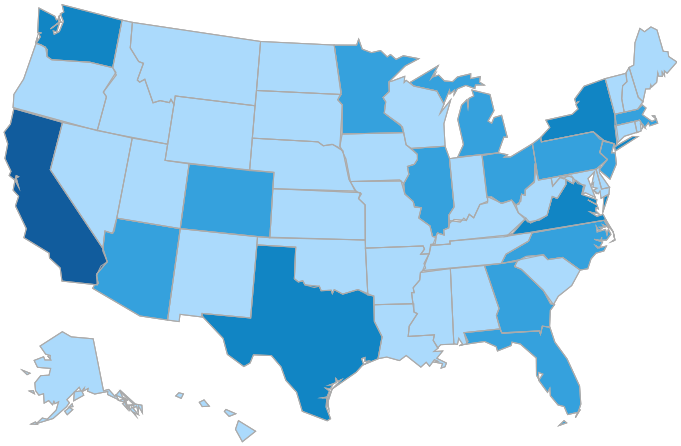
An average area of this size typically has 1,473,299* jobs, while there are 1,473,299 here.




| | Region | 2022 Jobs | 2023 Jobs | Change | % Change |
|---|---|---|---|---|---|
| ● | United States | 1,473,299 | 1,541,457 | 68,159 | 4.6% |
| ● | National Average | 1,473,299 | 1,541,457 | 68,159 | 4.6% |

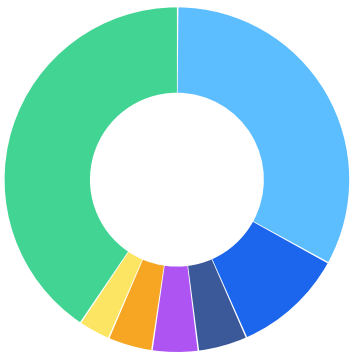
*National average values are derived by taking the national value for Machine Learning Engineers and scaling it down to account for the difference in overall workforce size between the nation and United States. In other words, the values represent the national average adjusted for region size.

## Regional Breakdown



| State | 2022 Jobs |
|---|---|
| California | 242,904 |
| Texas | 116,223 |
| Washington | 88,635 |
| New York | 82,261 |
| Virginia | 71,457 |

## Most Jobs are Found in the Computer Systems Design and Related Services Industry Sector

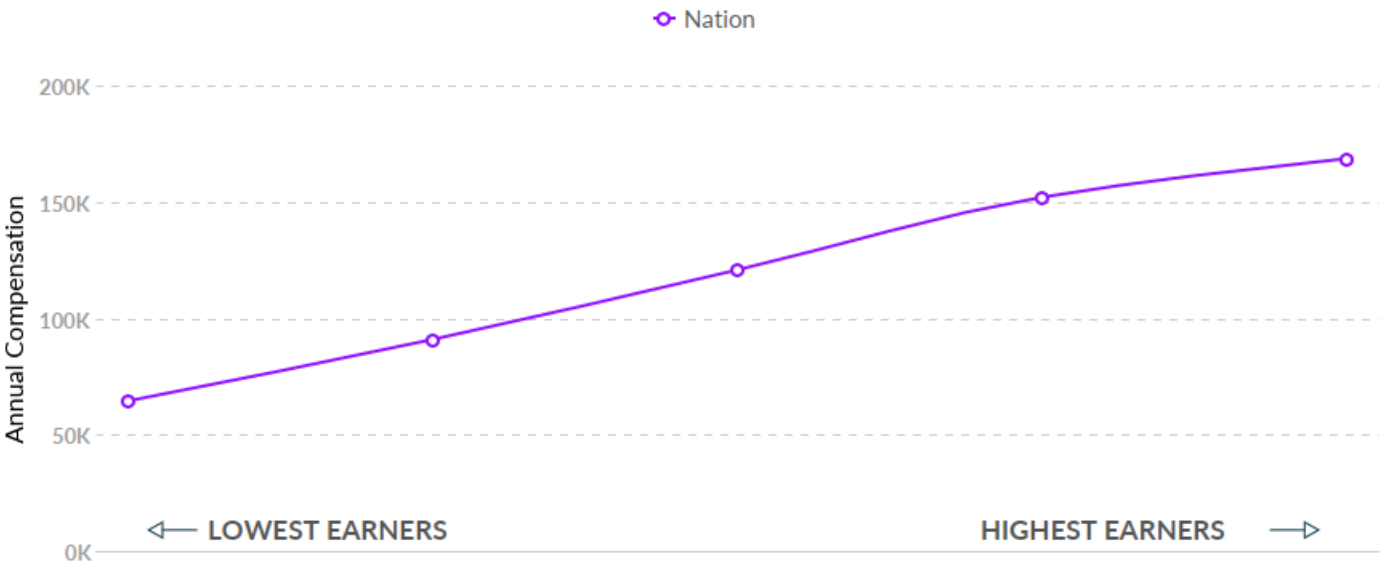


| Industry | % of Occupation in Industry (2022) |
|---|---|
| Computer Systems Design and Related Services | 32.9% |
| Software Publishers | 10.4% |
| Management of Companies and Enterprises | 4.6% |
| Other Information Services | 4.3% |
| Data Processing, Hosting, and Related Services | 4.1% |
| Scientific Research and Development Services | 3.0% |
| Other | 40.6% |

# Compensation

## Regional Compensation Is the Same Cost as the Nation

In 2021, the median compensation for Machine Learning Engineers in the United States is $120,744.



# Job Posting Activity

### 1,380,928 Unique Job Postings

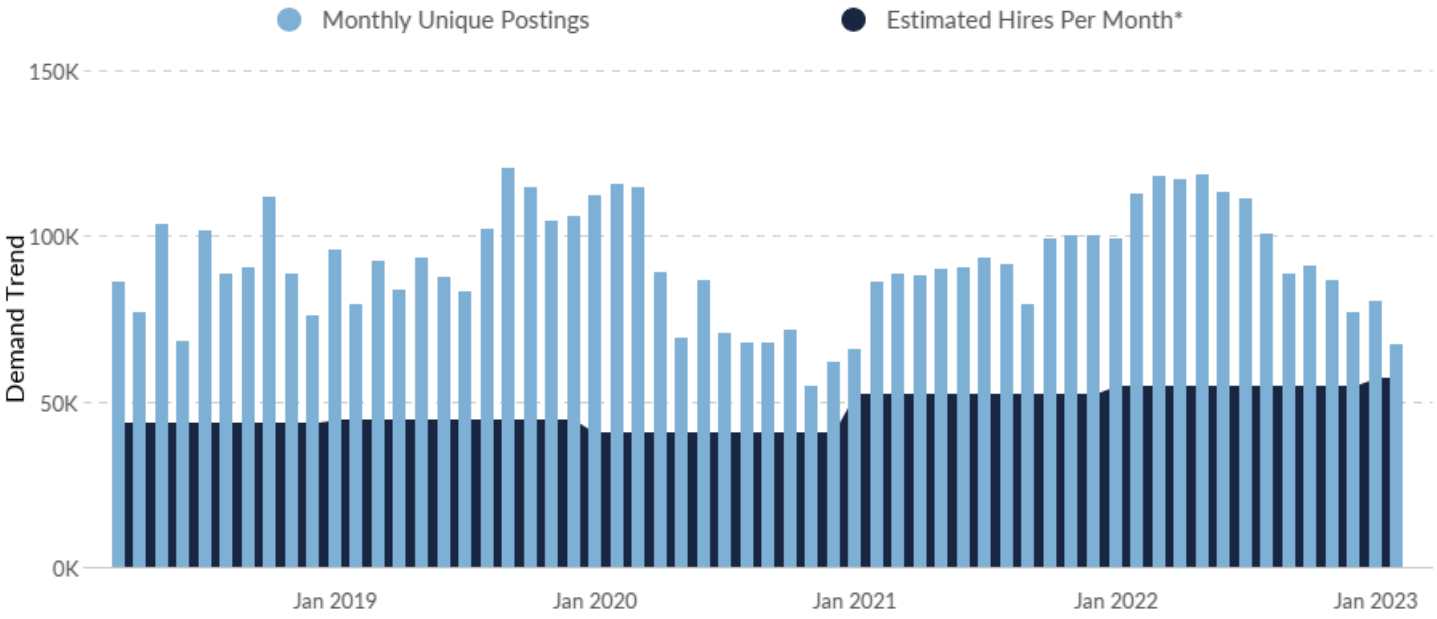
The number of unique postings for this job from Jan 2022 to Feb 2023.

### 43,322 Employers Competing

All employers in the region who posted for this job from Jan 2022 to Feb 2023.

### 24 Day Median Duration

Posting duration is 4 days shorter than what's typical in the region.



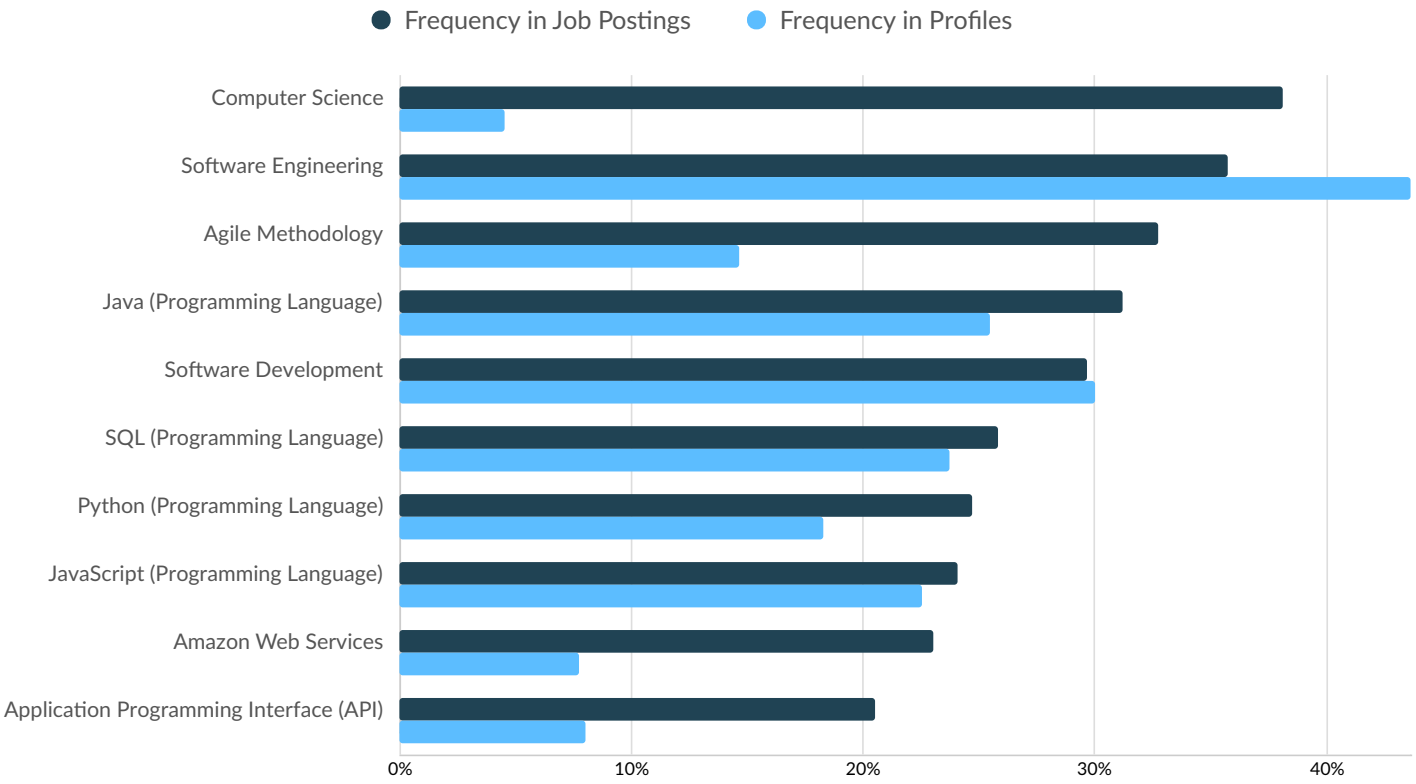

| Occupation | Avg Monthly Postings (Jan 2022 - Feb 2023) | Avg Monthly Hires (Jan 2022 - Feb 2023) |
|---|---|---|
| Software Developers | 98,638 | 54,991 |

*A hire is reported by the Quarterly Workforce Indicators when an individual's Social Security Number appears on a company's payroll and was not there the quarter before. Lightcast hires are calculated using a combination of Lightcast jobs data, information on separation rates from the Bureau of Labor Statistics (BLS), and industry-based hires data from the Census Bureau.

| Top Companies | Unique Postings |
|---|---|
| Randstad | 30,452 |
| Amazon | 26,047 |
| CyberCoders | 25,422 |
| Jobot | 22,815 |
| Capital One | 15,072 |
| Humana | 12,801 |
| Motion Recruitment | 12,163 |
| General Dynamics | 11,598 |
| Deloitte | 11,510 |
| Dell Technologies | 9,700 |

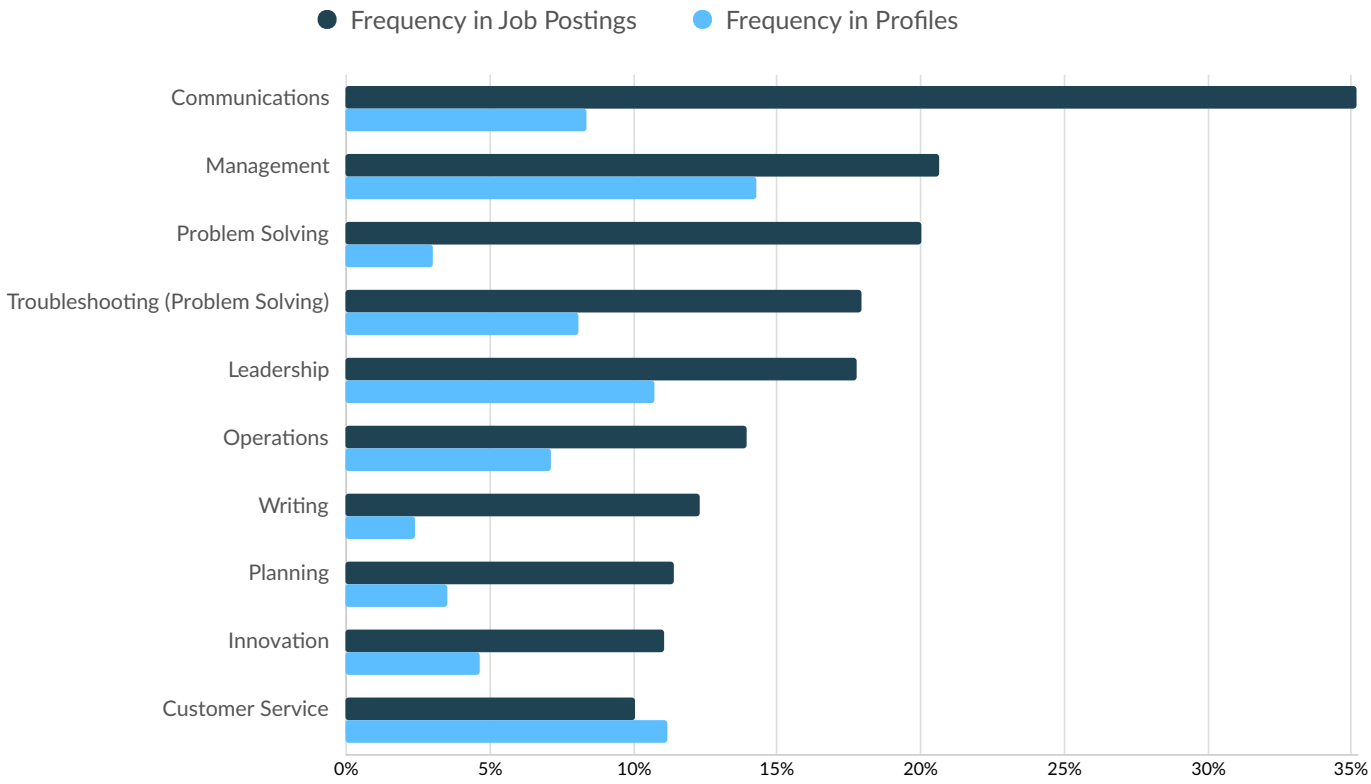
| Top Job Titles | Unique Postings |
|---|---|
| Software Engineers | 134,527 |
| Software Developers | 37,485 |
| DevOps Engineers | 34,010 |
| Java Developers | 32,057 |
| Full Stack Software Engineers | 25,381 |
| Software Development Engineers | 23,034 |
| .NET Developers | 23,001 |
| Full Stack Developers | 22,849 |
| Principal Software Engineers | 22,117 |
| Lead Software Engineers | 16,256 |

## Top Specialized Skills



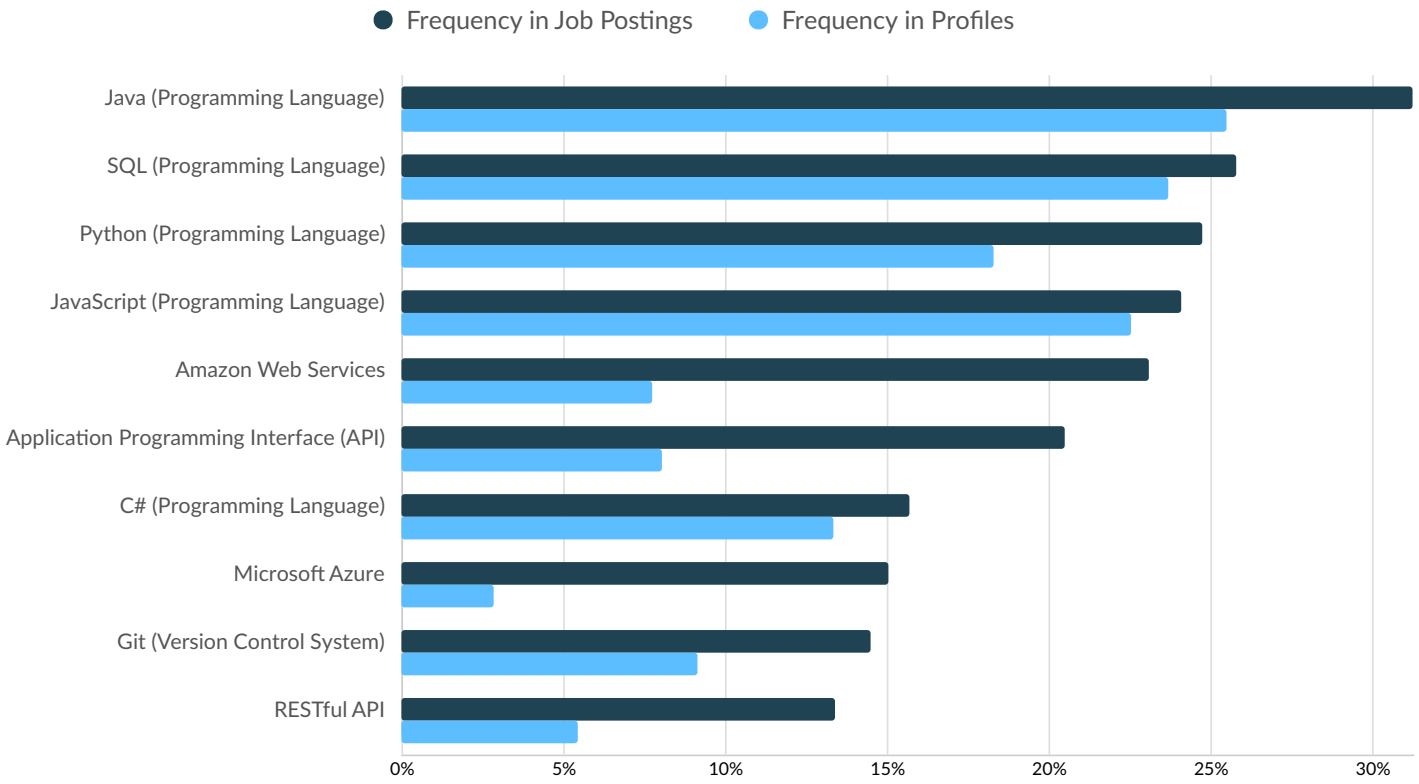

| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Computer Science | 526,629 | 38% | 85,437 | 5% |
| Software Engineering | 493,791 | 36% | 818,284 | 44% |
| Agile Methodology | 452,336 | 33% | 274,603 | 15% |
| Java (Programming Language) | 431,600 | 31% | 477,890 | 26% |
| Software Development | 410,308 | 30% | 562,410 | 30% |
| SQL (Programming Language) | 356,645 | 26% | 444,512 | 24% |
| Python (Programming Language) | 341,525 | 25% | 342,875 | 18% |
| JavaScript (Programming Language) | 332,584 | 24% | 422,970 | 23% |
| Amazon Web Services | 318,776 | 23% | 145,285 | 8% |
| Application Programming Interface (API) | 283,450 | 21% | 150,716 | 8% |

## Top Common Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Communications | 486,126 | 35% | 156,958 | 8% |
| Management | 285,774 | 21% | 267,830 | 14% |
| Problem Solving | 277,058 | 20% | 56,794 | 3% |
| Troubleshooting (Problem Solving) | 247,733 | 18% | 151,943 | 8% |
| Leadership | 245,776 | 18% | 201,236 | 11% |
| Operations | 192,572 | 14% | 133,860 | 7% |
| Writing | 170,348 | 12% | 45,680 | 2% |
| Planning | 158,044 | 11% | 66,391 | 4% |
| Innovation | 153,321 | 11% | 87,436 | 5% |
| Customer Service | 139,013 | 10% | 209,715 | 11% |

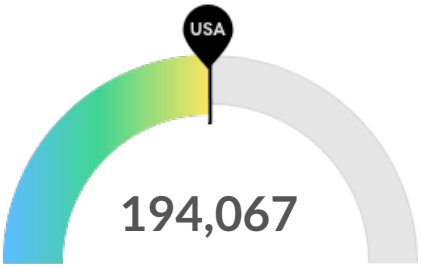
## Top Software Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Java (Programming Language) | 431,725 | 31% | 477,890 | 26% |
| SQL (Programming Language) | 356,773 | 26% | 444,512 | 24% |
| Python (Programming Language) | 341,672 | 25% | 342,875 | 18% |
| JavaScript (Programming Language) | 332,680 | 24% | 422,970 | 23% |
| Amazon Web Services | 318,836 | 23% | 145,285 | 8% |
| Application Programming Interface (API) | 283,541 | 21% | 150,716 | 8% |
| C# (Programming Language) | 216,885 | 16% | 250,557 | 13% |
| Microsoft Azure | 208,018 | 15% | 53,086 | 3% |
| Git (Version Control System) | 200,541 | 15% | 171,089 | 9% |
| RESTful API | 185,337 | 13% | 102,034 | 5% |

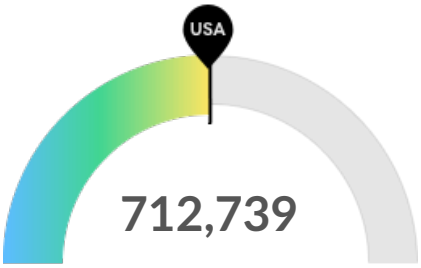
# Demographics

## Retirement Risk Is About Average, While Overall Diversity Is About Average



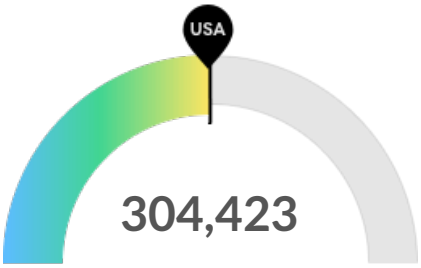

### Retiring Soon

Retirement risk is about average in the United States. The national average for an area this size is 194,067* employees 55 or older, while there are 194,067 here.




### Racial Diversity

Racial diversity is about average in the United States. The national average for an area this size is 712,739* racially diverse employees, while there are 712,739 here.

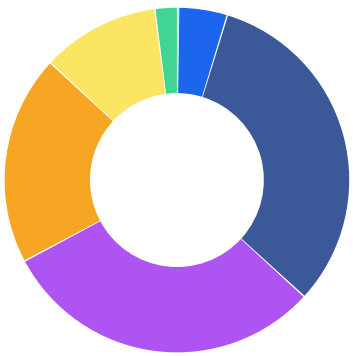



### Gender Diversity

Gender diversity is about average in the United States. The national average for an area this size is 304,423* female employees, while there are 304,423 here.

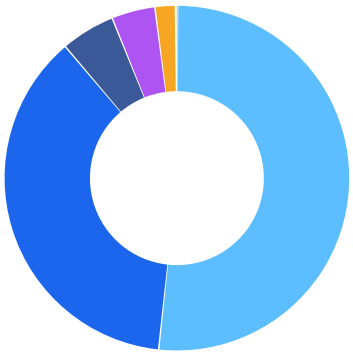
*National average values are derived by taking the national value for Machine Learning Engineers and scaling it down to account for the difference in overall workforce size between the nation and the United States. In other words, the values represent the national average adjusted for region size.

## Occupation Age Breakdown



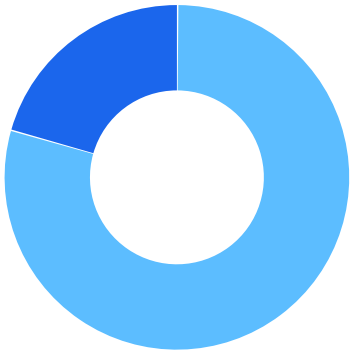
| | % of Jobs | Jobs |
|---|---|---|
| 14-18 | 0.1% | 1,258 |
| 19-24 | 4.6% | 67,343 |
| 25-34 | 32.1% | 472,379 |
| 35-44 | 30.4% | 448,326 |
| 45-54 | 19.7% | 289,925 |
| 55-64 | 11.1% | 162,875 |
| 65+ | 2.1% | 31,192 |

## Occupation Race/Ethnicity Breakdown



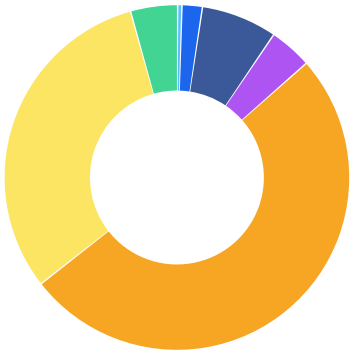
| | % of Jobs | Jobs |
|---|---|---|
| White | 51.6% | 760,560 |
| Asian | 37.1% | 546,748 |
| Hispanic or Latino | 5.1% | 74,794 |
| Black or African American | 4.1% | 60,044 |
| Two or More Races | 1.9% | 28,134 |
| American Indian or Alaska Native | 0.1% | 1,882 |
| Native Hawaiian or Other Pacific Islander | 0.1% | 1,138 |

## Occupation Gender Breakdown



| | % of Jobs | Jobs |
|---|---|---|
| Males | 79.3% | 1,168,876 |
| Females | 20.7% | 304,423 |

## National Educational Attainment



| | % of Jobs |
|---|---|
| Less than high school diploma | 0.4% |
| High school diploma or equivalent | 1.9% |
| Some college, no degree | 7.1% |
| Associate's degree | 4.0% |
| Bachelor's degree | 51.0% |
| Master's degree | 31.2% |
| Doctoral or professional degree | 4.4% |

# Occupational Programs

### 32 Programs

Of the programs that can train for this job, 32 have produced completions in the last 5 years.

### 217,487 Completions (2021)

The completions from all regional institutions for all degree types.

### 167,255 Openings (2021)

The average number of openings for an occupation in the region is 26,759.

| CIP Code | Top Programs | Completions (2021) |
|---|---|---|
| 11.0701 | Computer Science | 59,346 |
| 11.0101 | Computer and Information Sciences, General | 51,511 |
| 11.0103 | Information Technology | 31,478 |
| 11.0401 | Information Science/Studies | 18,279 |
| 14.0901 | Computer Engineering, General | 13,416 |
| 11.0201 | Computer Programming/Programmer, General | 8,719 |
| 14.0903 | Computer Software Engineering | 4,226 |
| 11.1099 | Computer/Information Technology Services Administration ... | 4,000 |
| 14.2701 | Systems Engineering | 3,904 |
| 11.0104 | Informatics | 2,726 |

| Top Schools | Completions (2021) |
|---|---|
| Georgia Institute of Technology-Main Campus | 3,315 |
| University of Maryland Global Campus | 2,871 |
| Western Governors University | 2,640 |
| The University of Texas at Dallas | 2,101 |
| The Pennsylvania State University | 2,094 |
| University of Illinois Urbana-Champaign | 1,919 |
| University of Maryland-College Park | 1,844 |
| University of California-Berkeley | 1,843 |
| University of Michigan-Ann Arbor | 1,817 |
| University of Southern California | 1,809 |

# Appendix A

**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.

**Sample of Reported Job Titles:**
Software Engineer
Application Integration Engineer
Systems Engineer
Software Development Engineer
Software Developer
Software Architect
Network Engineer
Infrastructure Engineer
Developer
Application Developer

**Related O*NET Occupation:**
Software Developers (15-1252.00)

# Machine Learning Engineers*
## in 3 States

*Job titles used in government data sources are slightly different from the one you've chosen. This report uses data from the closest matching official classifications (listed below) as a proxy for Machine Learning Engineers data.

Software Developers

# Contents

# What is Lightcast Data?

Lightcast data is a hybrid dataset derived from official government sources such as the US Census Bureau, Bureau of Economic Analysis, and Bureau of Labor Statistics. Leveraging the unique strengths of each source, our data modeling team creates an authoritative dataset that captures more than 99% of all workers in the United States. This core offering is then enriched with data from online social profiles, resumés, and job postings to give you a complete view of the workforce.

Lightcast data is frequently cited in major publications such as *The Atlantic*, *Forbes*, *Harvard Business Review*, *The New York Times*, *The Wall Street Journal*, and *USA Today*.

# Report Parameters

## 1 Occupation

Software Developers

## 3 States

| | | | |
|---|---|---|---|
| 6 | California | 53 | Washington |
| 41 | Oregon | | |

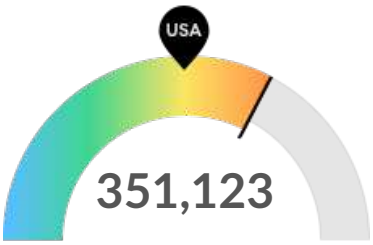
## Class of Worker

QCEW Employees

The information in this report pertains to the chosen occupation and geographical areas.

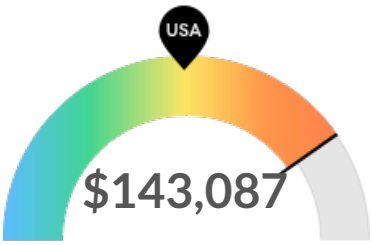
# Executive Summary

## Aggressive Job Posting Demand Over a Deep Supply of Regional Jobs



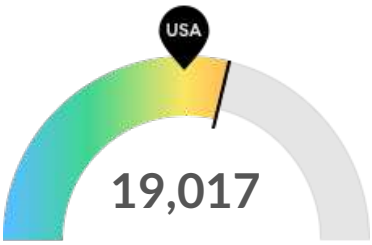

### Jobs (2022)

Your area is a hotspot for this kind of job. The national average for an area this size is 229,515* employees, while there are 351,123 here.




### Compensation

Earnings are high in your area. The national median salary for Machine Learning Engineers is $120,744, compared to $143,087 here.




### Job Posting Demand

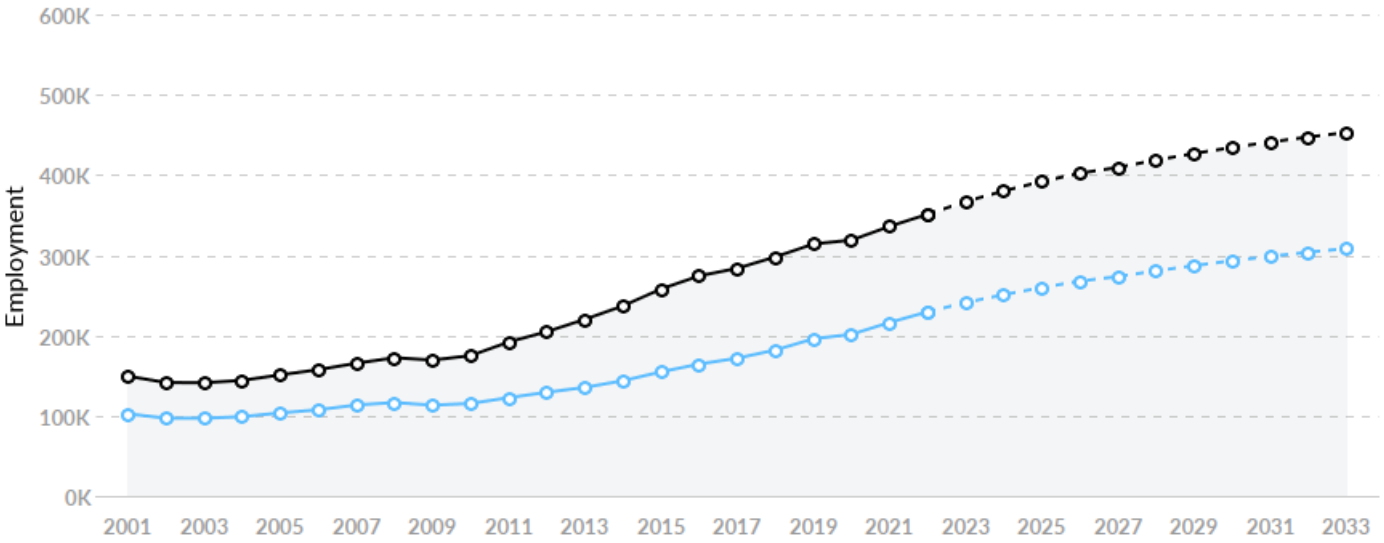
Job posting activity is high in your area. The national average for an area this size is 15,366* job postings/mo, while there are 19,017 here.

*National average values are derived by taking the national value for Machine Learning Engineers and scaling it down to account for the difference in overall workforce size between the nation and your area. In other words, the values represent the national average adjusted for region size.

# Jobs

## Regional Employment Is Higher Than the National Average

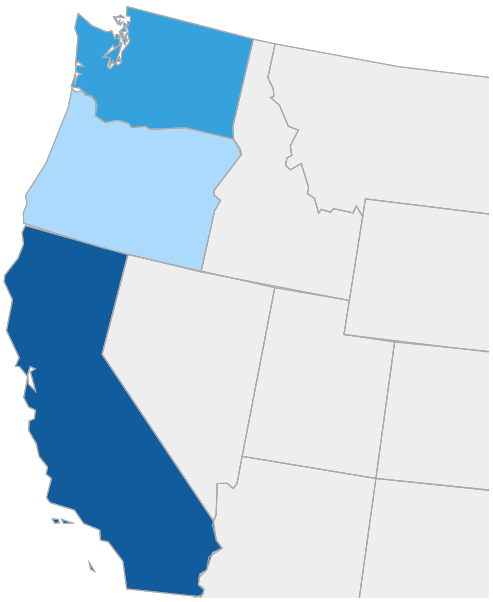
An average area of this size typically has 229,515* jobs, while there are 351,123 here. This higher than average supply of jobs may make it easier for workers in this field to find employment in your area.




| | Region | 2022 Jobs | 2023 Jobs | Change | % Change |
|---|---|---|---|---|---|
| ● | 3 States | 351,123 | 366,872 | 15,748 | 4.5% |
| ● | National Average | 229,515 | 240,971 | 11,457 | 5.0% |

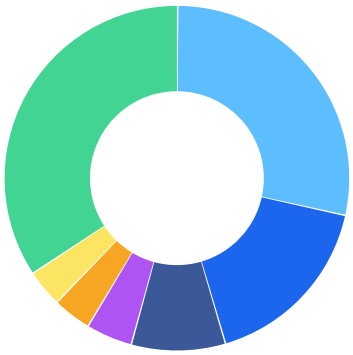
*National average values are derived by taking the national value for Machine Learning Engineers and scaling it down to account for the difference in overall workforce size between the nation and your area. In other words, the values represent the national average adjusted for region size.

## Regional Breakdown



| State | 2022 Jobs |
|---|---|
| California | 242,904 |
| Washington | 88,635 |
| Oregon | 19,585 |

## Most Jobs are Found in the Computer Systems Design and Related Services Industry Sector

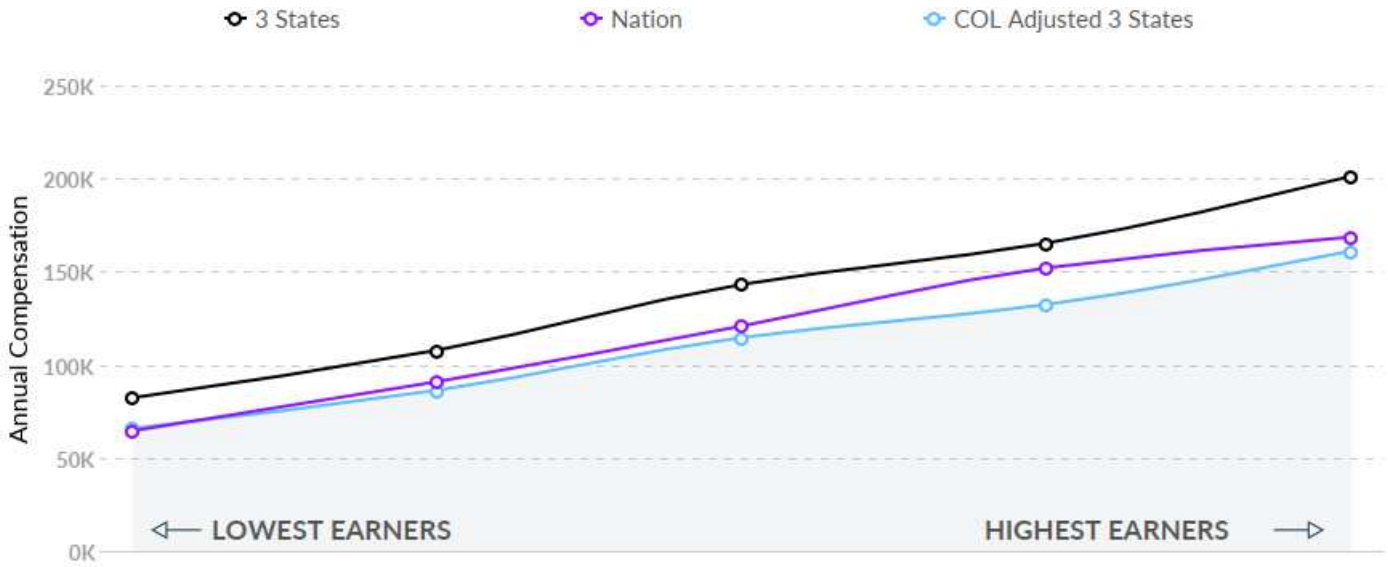


| Industry | % of Occupation in Industry (2022) |
|---|---|
| Computer Systems Design and Related Services | 28.4% |
| Software Publishers | 17.0% |
| Other Information Services | 8.8% |
| Data Processing, Hosting, and Related Services | 4.3% |
| Computer and Peripheral Equipment Manufacturing | 3.6% |
| Management of Companies and Enterprises | 3.5% |
| Other | 34.4% |

# Compensation

## Regional Compensation Is 19% Higher Than National Compensation

For Machine Learning Engineers, the 2021 median wage in your area is $143,087, while the national median wage is $120,744.



# Job Posting Activity

**266,242 Unique Job Postings**

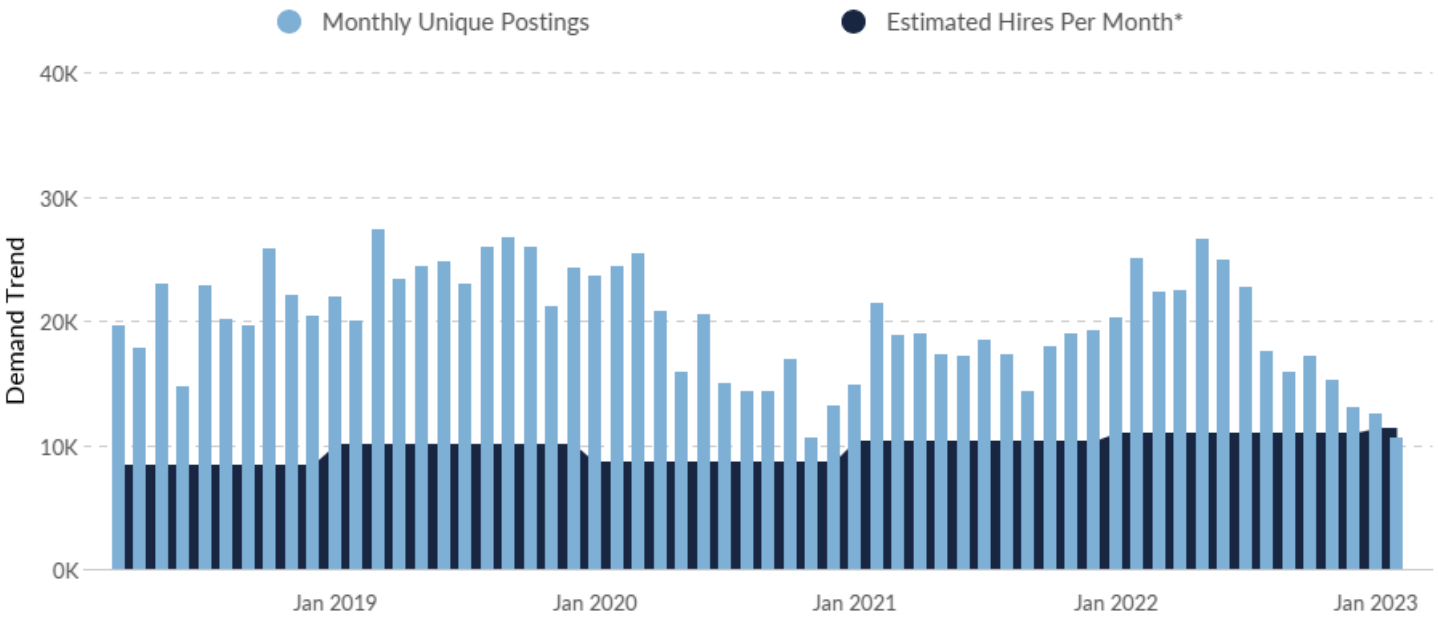
The number of unique postings for this job from Jan 2022 to Feb 2023.

**14,604 Employers Competing**

All employers in the region who posted for this job from Jan 2022 to Feb 2023.

**24 Day Median Duration**

Posting duration is 4 days shorter than what's typical in the region.



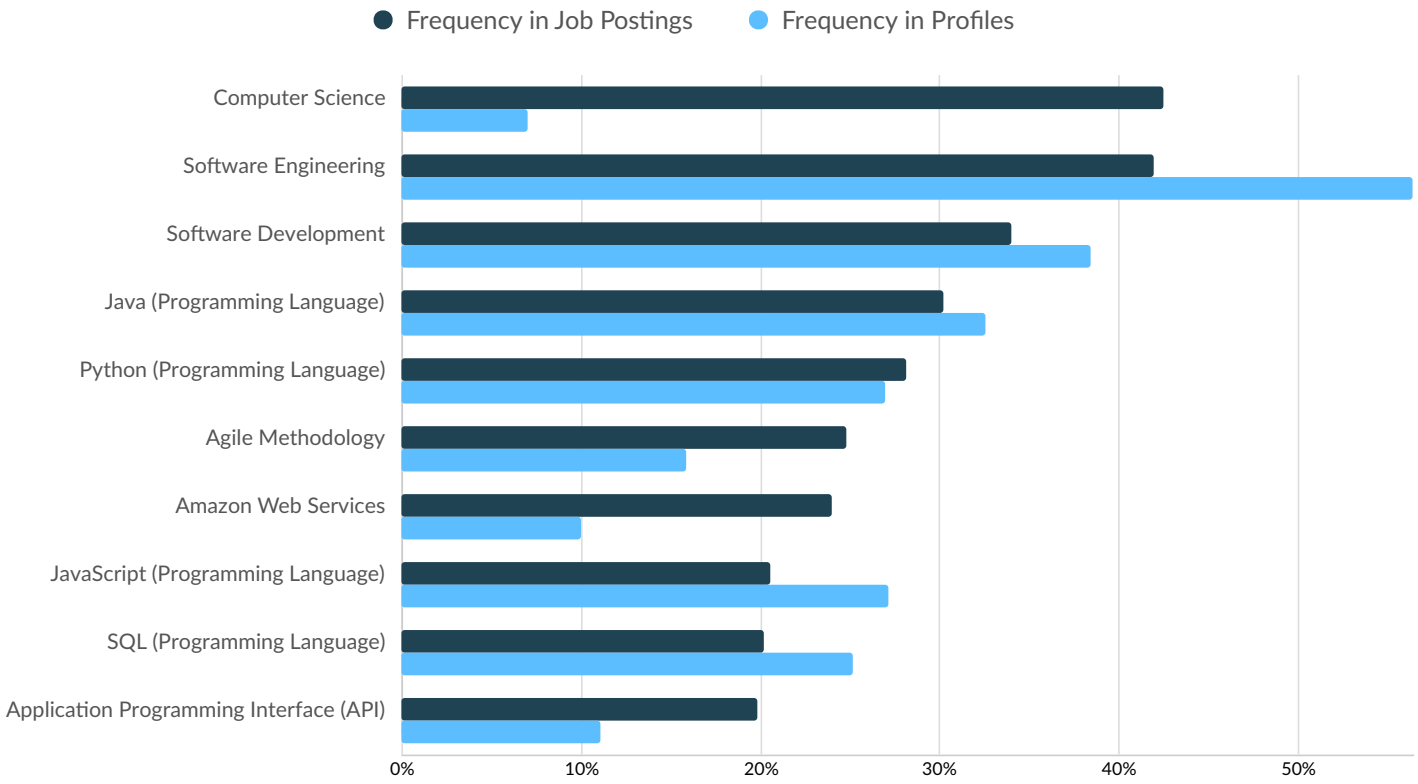

| Occupation | Avg Monthly Postings (Jan 2022 - Feb 2023) | Avg Monthly Hires (Jan 2022 - Feb 2023) |
|---|---|---|
| Software Developers | 19,017 | 11,012 |

*A hire is reported by the Quarterly Workforce Indicators when an individual's Social Security Number appears on a company's payroll and was not there the quarter before. Lightcast hires are calculated using a combination of Lightcast jobs data, information on separation rates from the Bureau of Labor Statistics (BLS), and industry-based hires data from the Census Bureau.

| Top Companies | Unique Postings |
|---|---|
| Amazon | 15,009 |
| CyberCoders | 7,204 |
| Jobot | 5,521 |
| Boeing | 4,167 |
| Motion Recruitment | 3,770 |
| Randstad | 3,523 |
| eBay | 2,722 |
| Apple | 2,410 |
| Google | 2,230 |
| Revature | 2,083 |

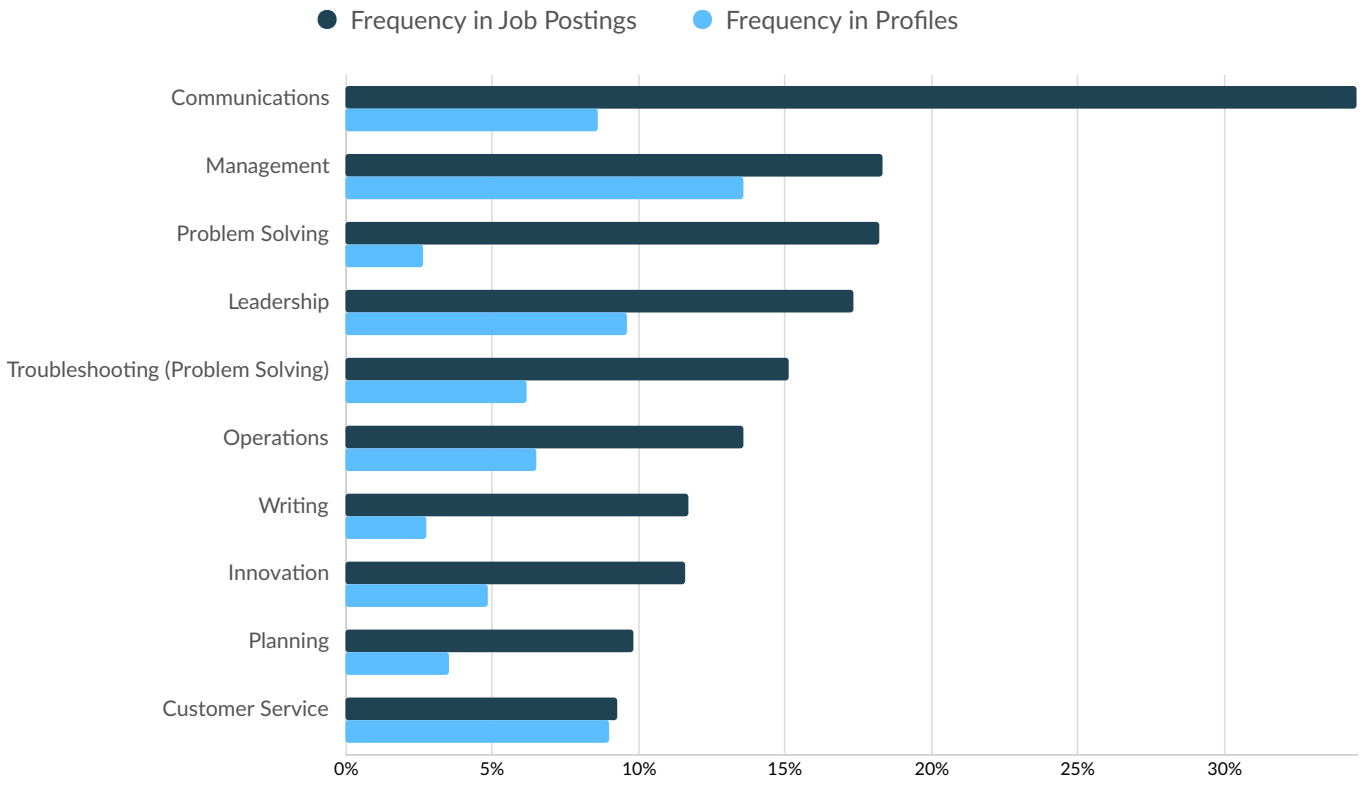
| Top Job Titles | Unique Postings |
|---|---|
| Software Engineers | 28,546 |
| Software Development Engineers | 10,243 |
| DevOps Engineers | 6,511 |
| Full Stack Software Engineers | 5,385 |
| Principal Software Engineers | 5,323 |
| Software Developers | 5,127 |
| Java Developers | 3,850 |
| Back End Software Engineers | 3,550 |
| Staff Software Engineers | 3,543 |
| Full Stack Developers | 3,378 |

## Top Specialized Skills



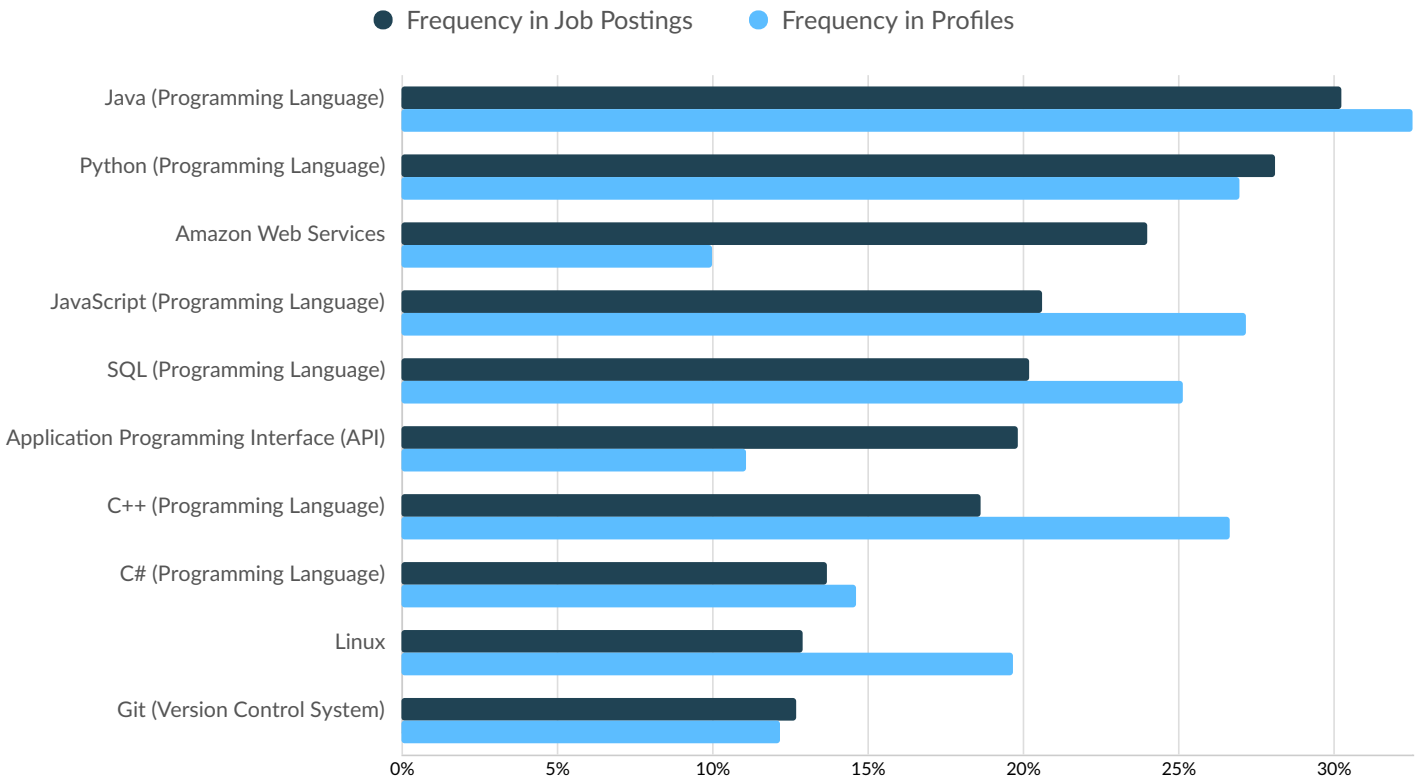

| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Computer Science | 113,189 | 43% | 37,302 | 7% |
| Software Engineering | 111,673 | 42% | 299,139 | 56% |
| Software Development | 90,654 | 34% | 204,071 | 38% |
| Java (Programming Language) | 80,559 | 30% | 172,660 | 33% |
| Python (Programming Language) | 74,917 | 28% | 143,084 | 27% |
| Agile Methodology | 66,214 | 25% | 84,058 | 16% |
| Amazon Web Services | 63,950 | 24% | 53,002 | 10% |
| JavaScript (Programming Language) | 54,855 | 21% | 144,290 | 27% |
| SQL (Programming Language) | 53,845 | 20% | 133,555 | 25% |
| Application Programming Interface (API) | 52,787 | 20% | 58,862 | 11% |

## Top Common Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Communications | 91,942 | 35% | 45,814 | 9% |
| Management | 48,900 | 18% | 72,011 | 14% |
| Problem Solving | 48,533 | 18% | 14,102 | 3% |
| Leadership | 46,243 | 17% | 51,038 | 10% |
| Troubleshooting (Problem Solving) | 40,340 | 15% | 32,760 | 6% |
| Operations | 36,233 | 14% | 34,658 | 7% |
| Writing | 31,186 | 12% | 14,742 | 3% |
| Innovation | 30,830 | 12% | 25,741 | 5% |
| Planning | 26,139 | 10% | 18,724 | 4% |
| Customer Service | 24,756 | 9% | 47,790 | 9% |

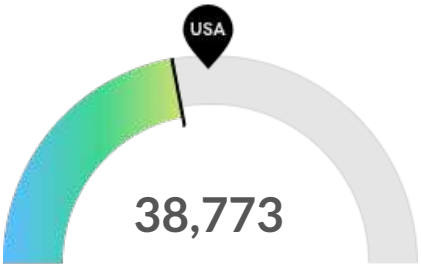
## Top Software Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Java (Programming Language) | 80,572 | 30% | 172,660 | 33% |
| Python (Programming Language) | 74,945 | 28% | 143,084 | 27% |
| Amazon Web Services | 63,957 | 24% | 53,002 | 10% |
| JavaScript (Programming Language) | 54,884 | 21% | 144,290 | 27% |
| SQL (Programming Language) | 53,876 | 20% | 133,555 | 25% |
| Application Programming Interface (API) | 52,799 | 20% | 58,862 | 11% |
| C++ (Programming Language) | 49,728 | 19% | 141,409 | 27% |
| C# (Programming Language) | 36,529 | 14% | 77,683 | 15% |
| Linux | 34,413 | 13% | 104,422 | 20% |
| Git (Version Control System) | 33,824 | 13% | 64,759 | 12% |

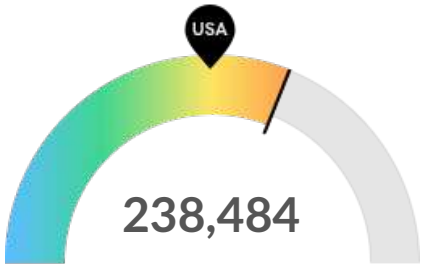
# Demographics

## Retirement Risk Is Low, While Overall Diversity Is High



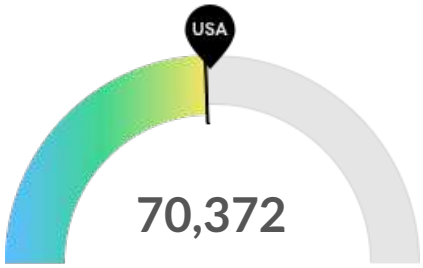

### Retiring Soon

Retirement risk is low in your area. The national average for an area this size is 46,251* employees 55 or older, while there are 38,773 here.




### Racial Diversity

Racial diversity is high in your area. The national average for an area this size is 169,863* racially diverse employees, while there are 238,484 here.

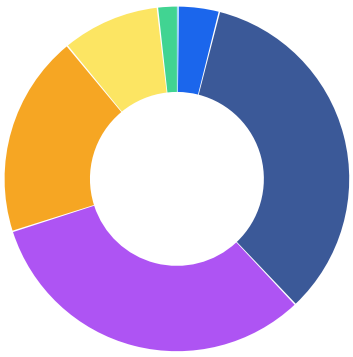



### Gender Diversity

Gender diversity is about average in your area. The national average for an area this size is 72,552* female employees, while there are 70,372 here.

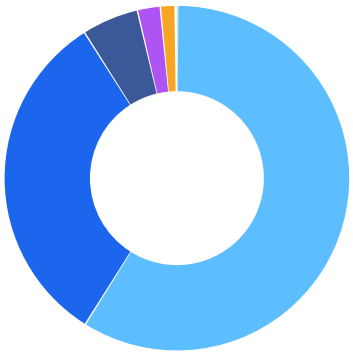
*National average values are derived by taking the national value for Machine Learning Engineers and scaling it down to account for the difference in overall workforce size between the nation and your area. In other words, the values represent the national average adjusted for region size.

## Occupation Age Breakdown



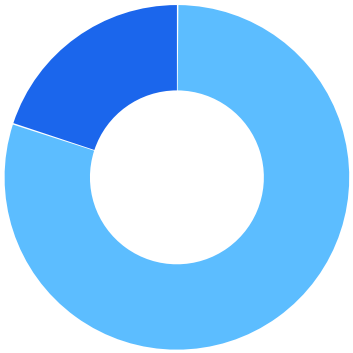
| | % of Jobs | Jobs |
|---|---|---|
| 14-18 | 0.1% | 182 |
| 19-24 | 3.8% | 13,487 |
| 25-34 | 34.0% | 119,376 |
| 35-44 | 32.1% | 112,763 |
| 45-54 | 19.0% | 66,542 |
| 55-64 | 9.2% | 32,182 |
| 65+ | 1.9% | 6,592 |

## Occupation Race/Ethnicity Breakdown



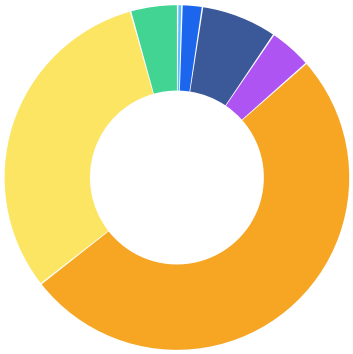
| | % of Jobs | Jobs |
|---|---|---|
| Asian | 58.8% | 206,627 |
| White | 32.1% | 112,639 |
| Hispanic or Latino | 5.3% | 18,658 |
| Two or More Races | 2.1% | 7,534 |
| Black or African American | 1.4% | 4,842 |
| Native Hawaiian or Other Pacific Islander | 0.1% | 480 |
| American Indian or Alaska Native | 0.1% | 343 |

## Occupation Gender Breakdown



| | % of Jobs | Jobs |
|---|---|---|
| Males | 80.0% | 280,751 |
| Females | 20.0% | 70,372 |

## National Educational Attainment



| | % of Jobs |
|---|---|
| Less than high school diploma | 0.4% |
| High school diploma or equivalent | 1.9% |
| Some college, no degree | 7.1% |
| Associate's degree | 4.0% |
| Bachelor's degree | 51.0% |
| Master's degree | 31.2% |
| Doctoral or professional degree | 4.4% |

# Occupational Programs

### 28 Programs

Of the programs that can train for this job, 28 have produced completions in the last 5 years.

### 31,541 Completions (2021)

The completions from all regional institutions for all degree types.

### 37,367 Openings (2021)

The average number of openings for an occupation in the region is 4,264.

| CIP Code | Top Programs | Completions (2021) |
|---|---|---|
| 11.0701 | Computer Science | 16,328 |
| 11.0103 | Information Technology | 2,803 |
| 14.0901 | Computer Engineering, General | 2,578 |
| 11.0101 | Computer and Information Sciences, General | 1,931 |
| 11.0201 | Computer Programming/Programmer, General | 1,809 |
| 14.0903 | Computer Software Engineering | 906 |
| 11.0199 | Computer and Information Sciences, Other | 826 |
| 11.0401 | Information Science/Studies | 739 |
| 11.0104 | Informatics | 601 |
| 14.2701 | Systems Engineering | 553 |

| Top Schools | Completions (2021) |
|---|---|
| University of California-Berkeley | 1,843 |
| University of Southern California | 1,809 |
| University of Washington-Seattle Campus | 1,761 |
| University of California-Irvine | 1,544 |
| University of California-San Diego | 1,421 |
| San Jose State University | 1,202 |
| University of California-Santa Cruz | 1,157 |
| Oregon State University | 873 |
| Stanford University | 661 |
| University of California-Los Angeles | 607 |

# Appendix A

**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.

**Sample of Reported Job Titles:**
Software Engineer
Application Integration Engineer
Systems Engineer
Software Development Engineer
Software Developer
Software Architect
Network Engineer
Infrastructure Engineer
Developer
Application Developer

**Related O*NET Occupation:**
Software Developers (15-1252.00)

# Natural Language Processing Scientists*
## in the United States

*Job titles used in government data sources are slightly different from the one you've chosen. This report uses data from the closest matching official classifications (listed below) as a proxy for Natural Language Processing Scientists data.

Computer and Information Research Scientists

# Contents

# What is Lightcast Data?

Lightcast data is a hybrid dataset derived from official government sources such as the US Census Bureau, Bureau of Economic Analysis, and Bureau of Labor Statistics. Leveraging the unique strengths of each source, our data modeling team creates an authoritative dataset that captures more than 99% of all workers in the United States. This core offering is then enriched with data from online social profiles, resumés, and job postings to give you a complete view of the workforce.

Lightcast data is frequently cited in major publications such as *The Atlantic*, *Forbes*, *Harvard Business Review*, *The New York Times*, *The Wall Street Journal*, and *USA Today*.

# Report Parameters

## 1 Occupation

Computer and Information Research Scientists

## 1 Nation

| | |
|---|---|
| 0 | United States |

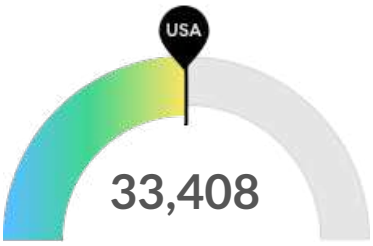
## Class of Worker

QCEW Employees

The information in this report pertains to the chosen occupation and geographical area.

# Executive Summary

## Average Job Posting Demand Over an Average Supply of Regional Jobs

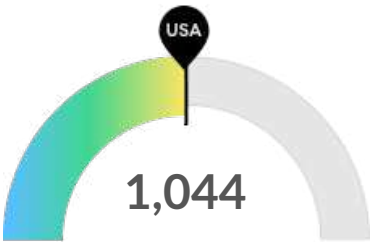



### Jobs (2021)

United States is about average for this kind of job. The national average for an area this size is 33,408* employees, while there are 33,408 here.


### Compensation

Earnings are about average in United States. The national median salary for Natural Language Processing Scientists is $131,498, compared to $131,498 here.




### Job Posting Demand

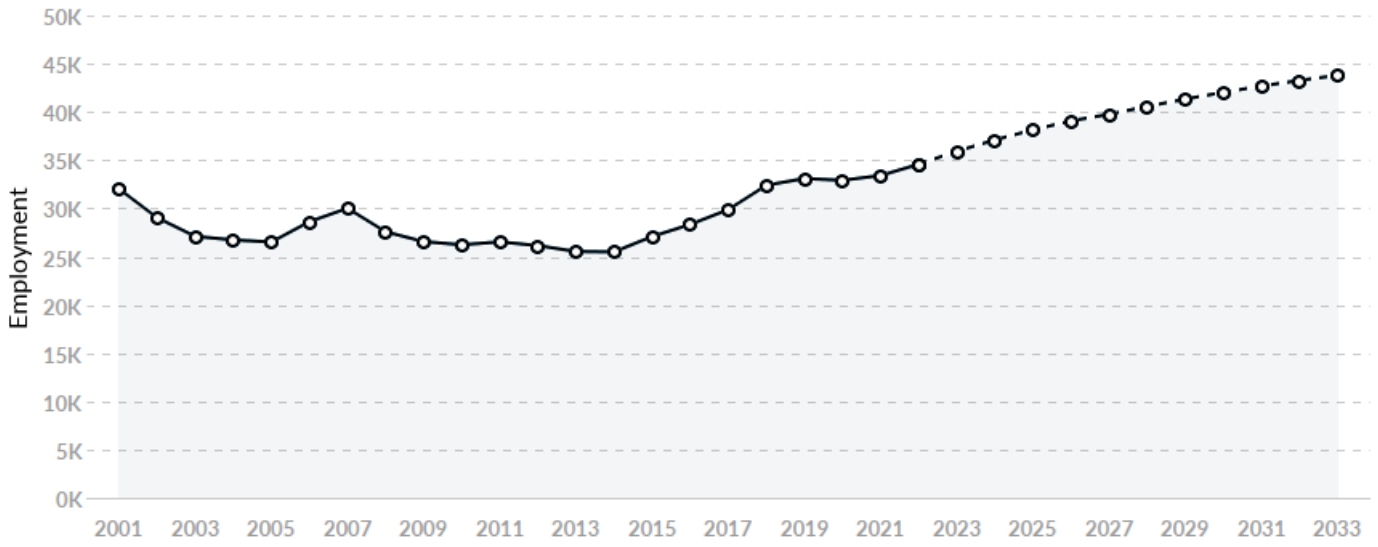
Job posting activity is about average in United States. The national average for an area this size is 1,044* job posting/mo, while there is 1,044 here.

*National average values are derived by taking the national value for Natural Language Processing Scientists and scaling it down to account for the difference in overall workforce size between the nation and United States. In other words, the values represent the national average adjusted for region size.

# Jobs

## Regional Employment Is About Equal to the National Average

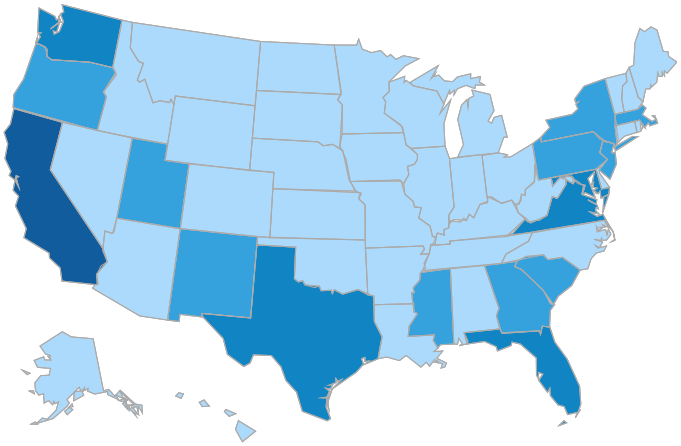
An average area of this size typically has 33,408* jobs, while there are 33,408 here.




| | Region | 2021 Jobs | 2023 Jobs | Change | % Change |
|---|---|---|---|---|---|
| ● | United States | 33,408 | 35,927 | 2,519 | 7.5% |
| ● | National Average | 33,408 | 35,927 | 2,519 | 7.5% |

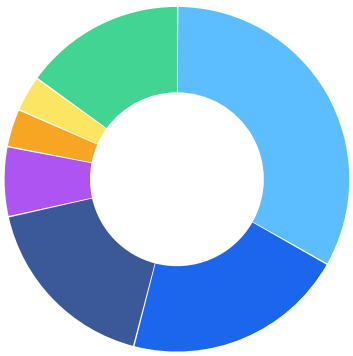
*National average values are derived by taking the national value for Natural Language Processing Scientists and scaling it down to account for the difference in overall workforce size between the nation and United States. In other words, the values represent the national average adjusted for region size.

## Regional Breakdown



| State | 2021 Jobs |
|---|---|
| California | 8,309 |
| Virginia | 2,573 |
| Washington | 2,427 |
| Maryland | 2,216 |
| Texas | 2,137 |

## Most Jobs are Found in the Federal Government, Civilian Industry Sector

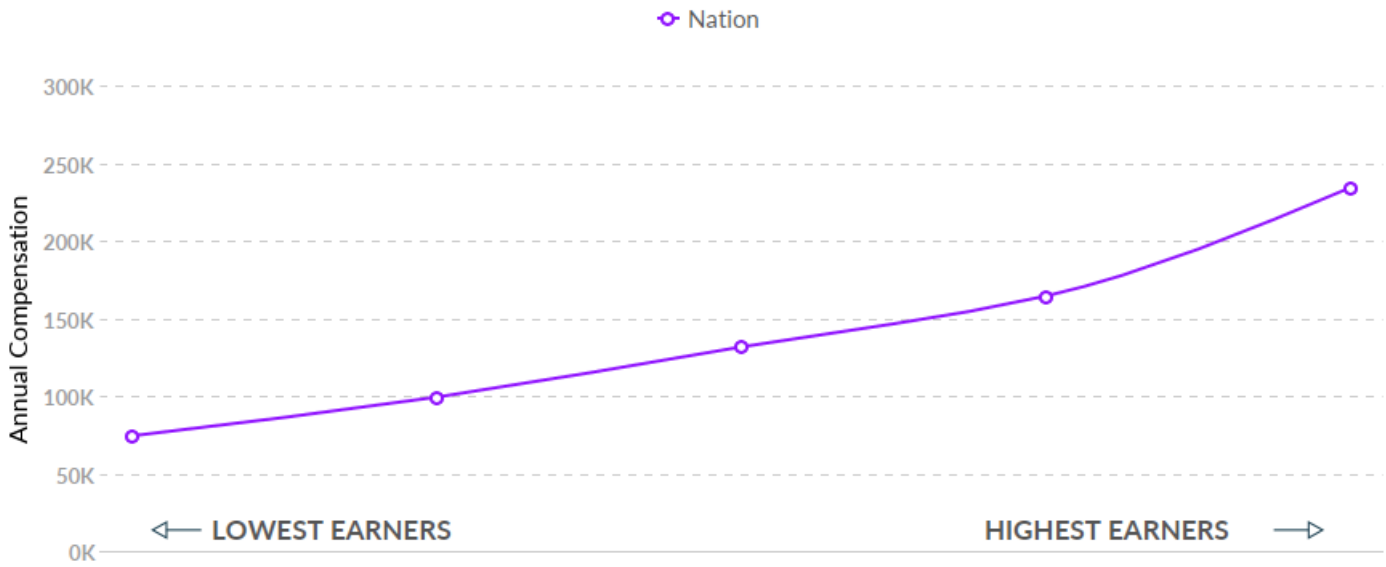


| Industry | % of Occupation in Industry (2021) |
|---|---|
| Federal Government, Civilian | 33.1% |
| Computer Systems Design and Related Services | 20.8% |
| Scientific Research and Development Services | 17.5% |
| Software Publishers | 6.5% |
| Other Information Services | 3.6% |
| Education and Hospitals (State Government) | 3.3% |
| Other | 15.1% |

# Compensation

## Regional Compensation Is the Same Cost as the Nation

In 2021, the median compensation for Natural Language Processing Scientists in the United States is $131,498.



# Job Posting Activity

### 27,131 Unique Job Postings

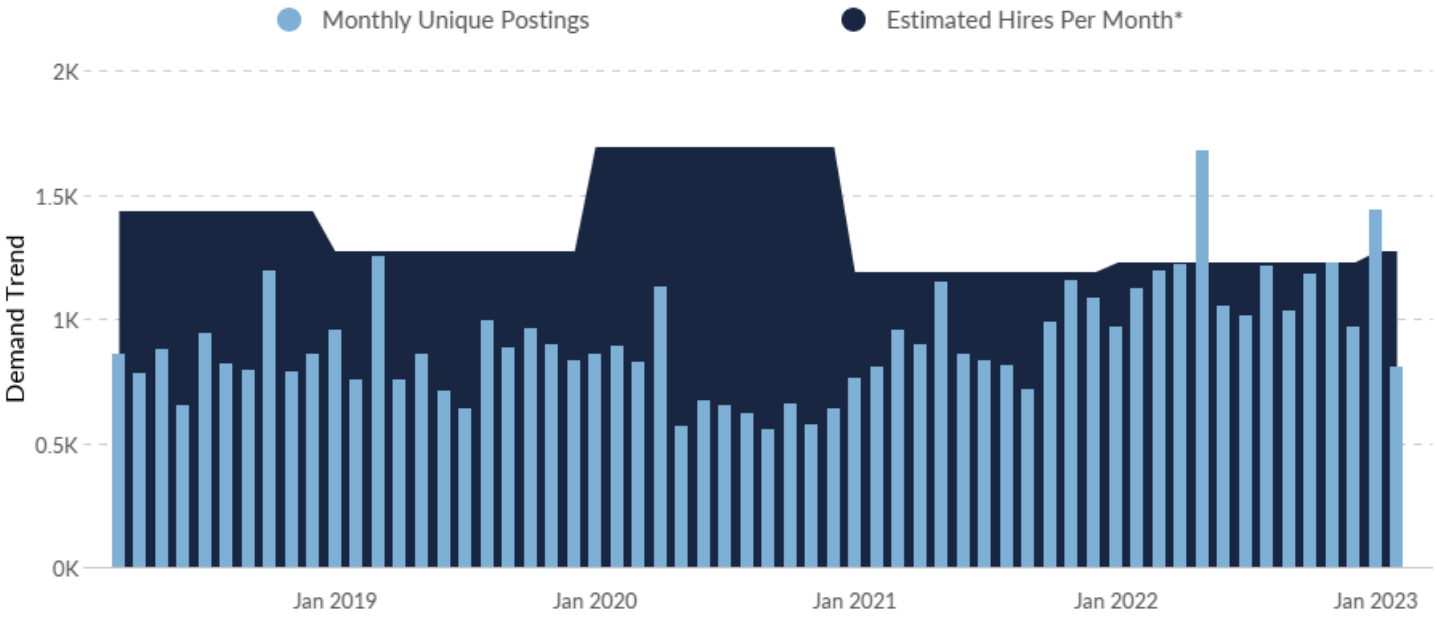
The number of unique postings for this job from Jan 2021 to Feb 2023.

### 3,522 Employers Competing

All employers in the region who posted for this job from Jan 2021 to Feb 2023.

### 24 Day Median Duration

Posting duration is 6 days shorter than what's typical in the region.



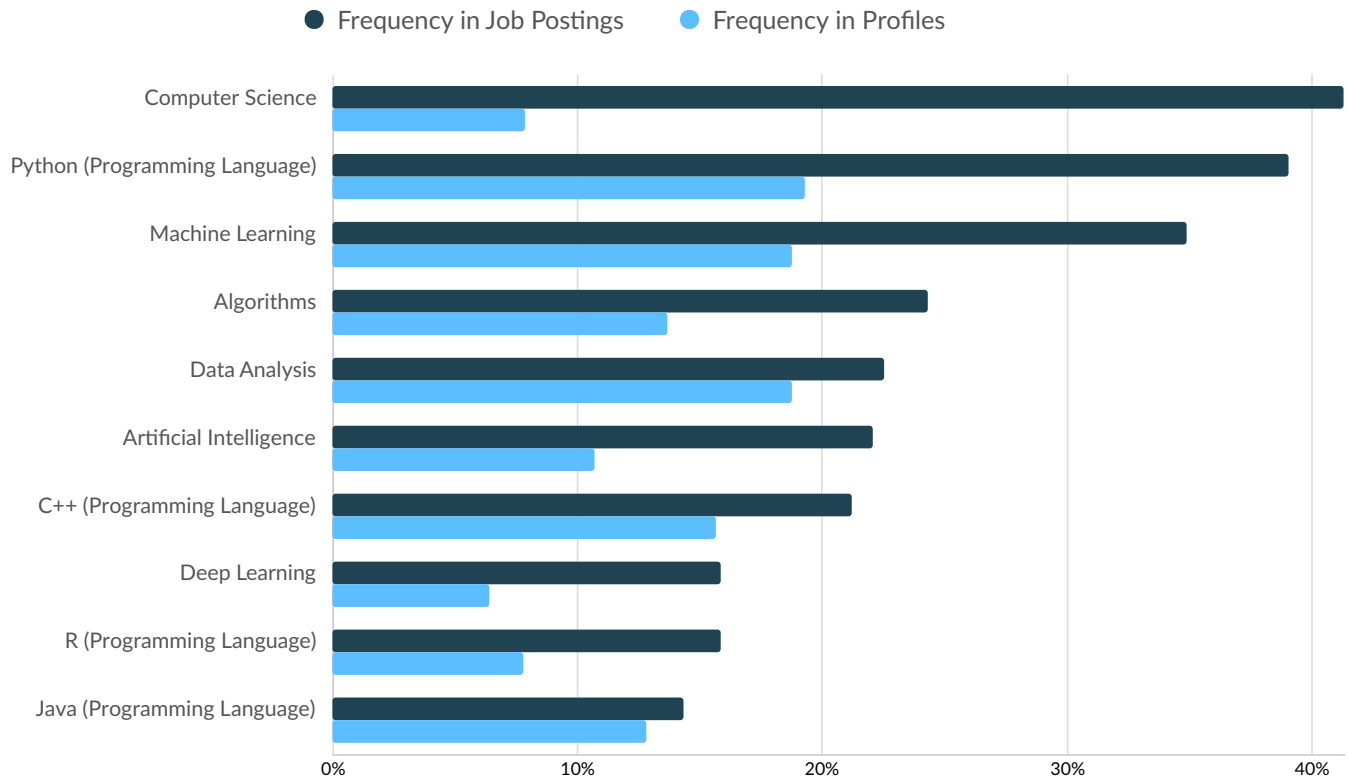

| Occupation | Avg Monthly Postings (Jan 2021 - Feb 2023) | Avg Monthly Hires (Jan 2021 - Feb 2023) |
|---|---|---|
| Computer and Information Research Scientists | 1,044 | 1,212 |

*A hire is reported by the Quarterly Workforce Indicators when an individual's Social Security Number appears on a company's payroll and was not there the quarter before. Lightcast hires are calculated using a combination of Lightcast jobs data, information on separation rates from the Bureau of Labor Statistics (BLS), and industry-based hires data from the Census Bureau.

| Top Companies | Unique Postings |
|---|---|
| National Security Agency | 1,136 |
| Wells Fargo | 600 |
| Meta | 536 |
| Amazon | 496 |
| Internal Revenue Service | 460 |
| Elevance Health | 379 |
| Oak Ridge National Laboratory | 360 |
| Microsoft | 336 |
| Pfizer | 261 |
| Sandia Corporation | 250 |

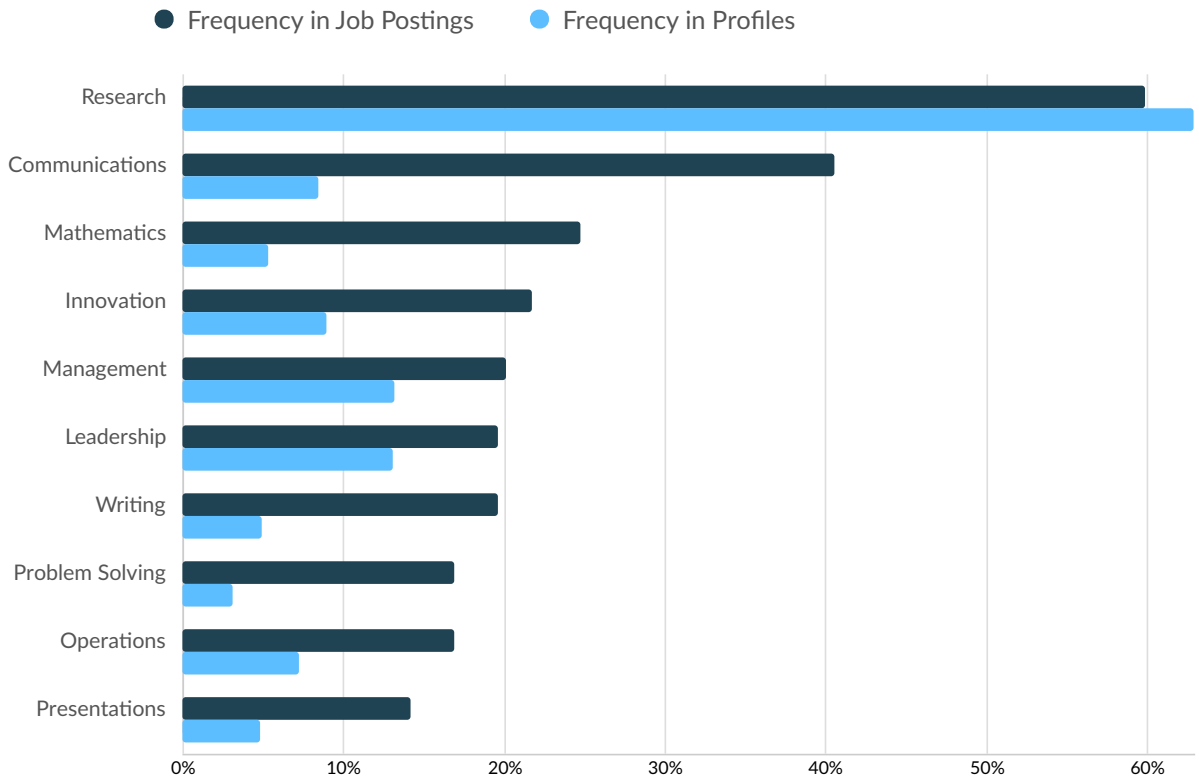
| Top Job Titles | Unique Postings |
|---|---|
| Computer Scientists | 3,581 |
| Machine Learning Scientists | 2,059 |
| Staff Scientists | 1,748 |
| Research Engineers | 1,605 |
| Computational Scientists | 1,499 |
| Research Scientists | 870 |
| Machine Learning Research Scie... | 739 |
| Computer Vision Scientists | 726 |
| Cybersecurity Research Scientists | 665 |
| Big Data Analysts | 384 |

## Top Specialized Skills



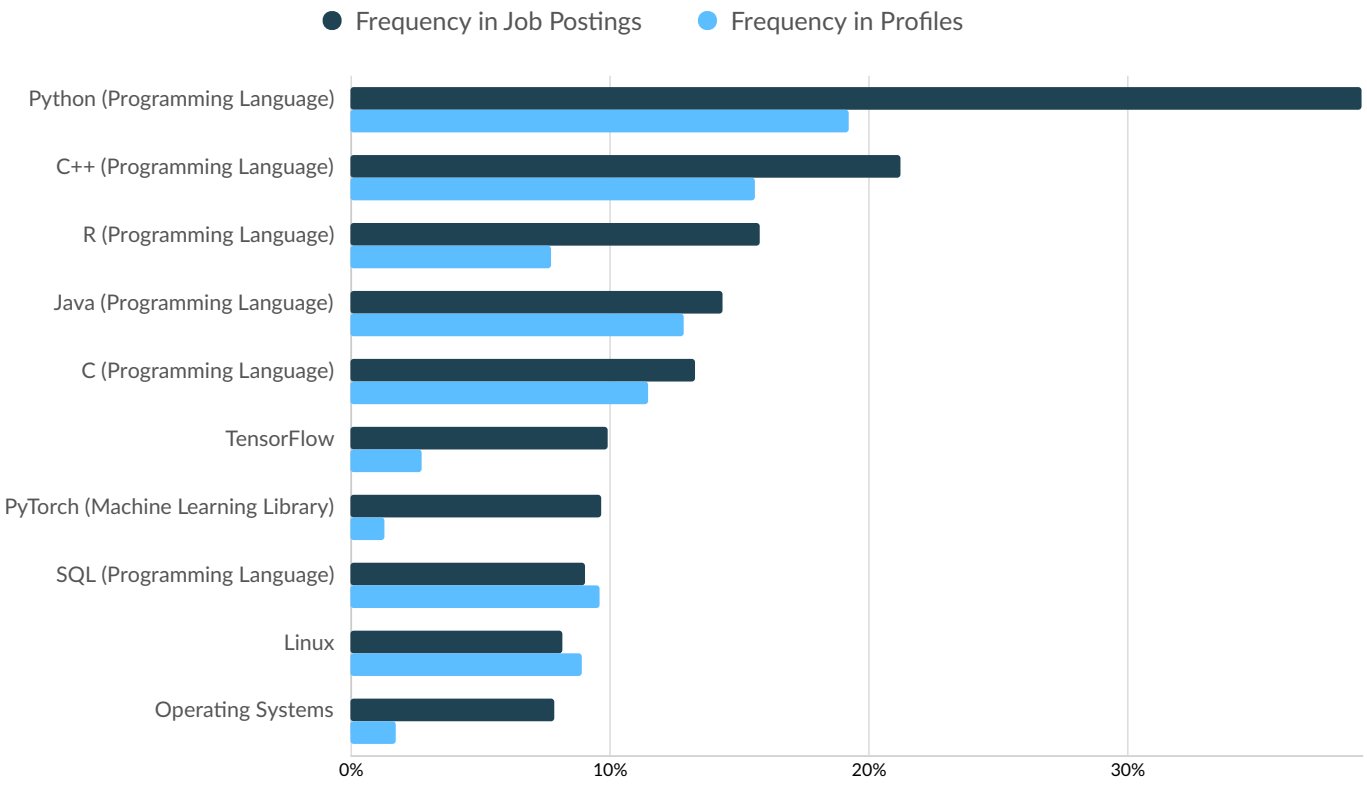

| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Computer Science | 11,214 | 41% | 3,803 | 8% |
| Python (Programming Language) | 10,601 | 39% | 9,291 | 19% |
| Machine Learning | 9,480 | 35% | 9,044 | 19% |
| Algorithms | 6,599 | 24% | 6,585 | 14% |
| Data Analysis | 6,119 | 23% | 9,054 | 19% |
| Artificial Intelligence | 5,991 | 22% | 5,155 | 11% |
| C++ (Programming Language) | 5,759 | 21% | 7,542 | 16% |
| Deep Learning | 4,308 | 16% | 3,095 | 6% |
| R (Programming Language) | 4,299 | 16% | 3,746 | 8% |
| Java (Programming Language) | 3,897 | 14% | 6,193 | 13% |

## Top Common Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Research | 16,237 | 60% | 30,310 | 63% |
| Communications | 10,998 | 41% | 4,079 | 8% |
| Mathematics | 6,709 | 25% | 2,554 | 5% |
| Innovation | 5,903 | 22% | 4,314 | 9% |
| Management | 5,470 | 20% | 6,377 | 13% |
| Leadership | 5,337 | 20% | 6,283 | 13% |
| Writing | 5,321 | 20% | 2,373 | 5% |
| Problem Solving | 4,581 | 17% | 1,488 | 3% |
| Operations | 4,575 | 17% | 3,506 | 7% |
| Presentations | 3,851 | 14% | 2,338 | 5% |

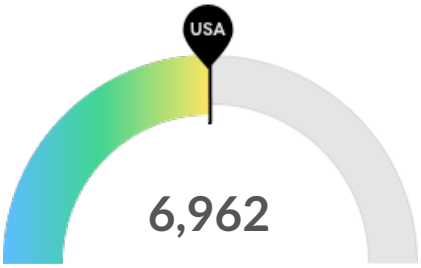
## Top Software Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Python (Programming Language) | 10,603 | 39% | 9,291 | 19% |
| C++ (Programming Language) | 5,760 | 21% | 7,542 | 16% |
| R (Programming Language) | 4,300 | 16% | 3,746 | 8% |
| Java (Programming Language) | 3,898 | 14% | 6,193 | 13% |
| C (Programming Language) | 3,617 | 13% | 5,532 | 11% |
| TensorFlow | 2,691 | 10% | 1,311 | 3% |
| PyTorch (Machine Learning Library) | 2,638 | 10% | 622 | 1% |
| SQL (Programming Language) | 2,461 | 9% | 4,654 | 10% |
| Linux | 2,229 | 8% | 4,305 | 9% |
| Operating Systems | 2,130 | 8% | 844 | 2% |

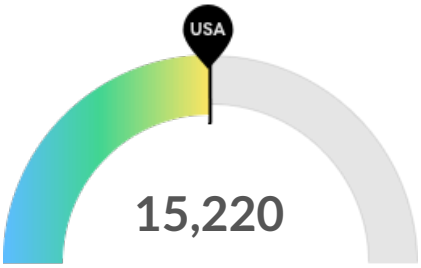
# Demographics

## Retirement Risk Is About Average, While Overall Diversity Is About Average



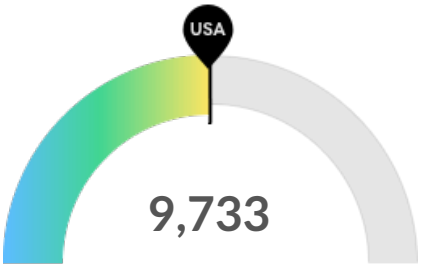

### Retiring Soon

Retirement risk is about average in the United States. The national average for an area this size is 6,962* employees 55 or older, while there are 6,962 here.




### Racial Diversity

Racial diversity is about average in the United States. The national average for an area this size is 15,220* racially diverse employees, while there are 15,220 here.

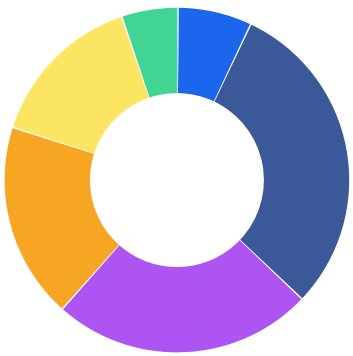



### Gender Diversity

Gender diversity is about average in the United States. The national average for an area this size is 9,733* female employees, while there are 9,733 here.

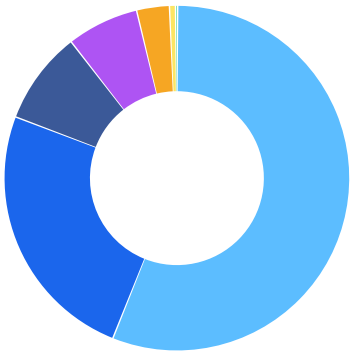
*National average values are derived by taking the national value for Natural Language Processing Scientists and scaling it down to account for the difference in overall workforce size between the nation and the United States. In other words, the values represent the national average adjusted for region size.

## Occupation Age Breakdown



| | % of Jobs | Jobs |
|---|---|---|
| 14-18 | 0.1% | 20 |
| 19-24 | 6.9% | 2,392 |
| 25-34 | 30.0% | 10,392 |
| 35-44 | 24.5% | 8,462 |
| 45-54 | 18.4% | 6,355 |
| 55-64 | 14.9% | 5,149 |
| 65+ | 5.2% | 1,813 |

## Occupation Race/Ethnicity Breakdown

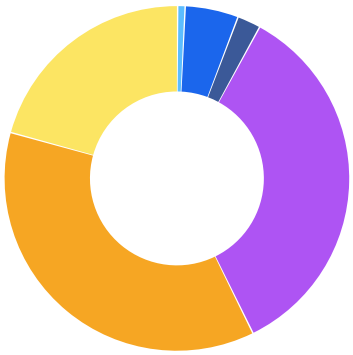


| | % of Jobs | Jobs |
|---|---|---|
| White | 56.0% | 19,362 |
| Asian | 24.7% | 8,548 |
| Black or African American | 8.7% | 3,017 |
| Hispanic or Latino | 6.7% | 2,331 |
| Two or More Races | 3.1% | 1,061 |
| American Indian or Alaska Native | 0.6% | 195 |
| Native Hawaiian or Other Pacific Islander | 0.2% | 69 |

## Occupation Gender Breakdown

| | % of Jobs | Jobs |
|---|---|---|
| Males | 71.9% | 24,849 |
| Females | 28.1% | 9,733 |

## National Educational Attainment



| | % of Jobs |
|---|---|
| High school diploma or equivalent | 0.7% |
| Some college, no degree | 5.0% |
| Associate's degree | 2.2% |
| Bachelor's degree | 34.8% |
| Master's degree | 36.6% |
| Doctoral or professional degree | 20.8% |

# Occupational Programs

### 23 Programs

Of the programs that can train for this job, 23 have produced completions in the last 5 years.

### 205,634 Completions (2021)

The completions from all regional institutions for all degree types.

### 3,568 Openings (2021)

The average number of openings for an occupation in the region is 26,759.

| CIP Code | Top Programs | Completions (2021) |
|---|---|---|
| 11.0701 | Computer Science | 59,346 |
| 11.0101 | Computer and Information Sciences, General | 51,511 |
| 11.0103 | Information Technology | 31,478 |
| 11.0401 | Information Science/Studies | 18,279 |
| 11.0901 | Computer Systems Networking and Telecommunications | 14,182 |
| 11.0201 | Computer Programming/Programmer, General | 8,719 |
| 11.1099 | Computer/Information Technology Services Administration ... | 4,000 |
| 11.0104 | Informatics | 2,726 |
| 11.0202 | Computer Programming, Specific Applications | 2,399 |
| 11.0501 | Computer Systems Analysis/Analyst | 2,305 |

| Top Schools | Completions (2021) |
|---|---|
| Georgia Institute of Technology-Main Campus | 3,124 |
| University of Maryland Global Campus | 2,871 |
| Western Governors University | 2,640 |
| MyComputerCareer.edu-Columbus | 2,358 |
| University of California-Berkeley | 1,843 |
| MyComputerCareer.edu-Raleigh | 1,830 |
| University of Phoenix-Arizona | 1,811 |
| The Pennsylvania State University | 1,769 |
| The University of Texas at Dallas | 1,730 |
| University of Washington-Seattle Campus | 1,721 |

# Appendix A

**Computer and Information Research Scientists (SOC 15-1221):**
Conduct research into fundamental computer and information science as theorists, designers, or inventors. Develop solutions to problems in the field of computer hardware and software.

**Sample of Reported Job Titles:**
Computer Scientist
Research Scientist
Control System Computer Scientist
Scientific Programmer Analyst
Computer Specialist
Information Scientist
Research and Development Specialist (R and D Specialist)
Programming Methodology Researcher
Programming Languages Researcher
Multi-Disciplined Language Analyst

**Related O*NET Occupation:**
Computer and Information Research Scientists (15-1221.00)

# Natural Language Processing Scientists*
## in 3 States

*Job titles used in government data sources are slightly different from the one you've chosen. This report uses data from the closest matching official classifications (listed below) as a proxy for Natural Language Processing Scientists data.

Computer and Information Research Scientists

# Contents

# What is Lightcast Data?

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Lightcast data is frequently cited in major publications such as *The Atlantic*, *Forbes*, *Harvard Business Review*, *The New York Times*, *The Wall Street Journal*, and *USA Today*.

# Report Parameters

## 1 Occupation

Computer and Information Research Scientists

## 3 States

| | | | |
|---|---|---|---|
| 6 | California | 53 | Washington |
| 41 | Oregon | | |

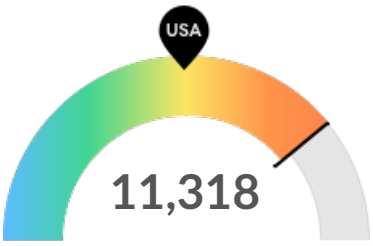
## Class of Worker

QCEW Employees

The information in this report pertains to the chosen occupation and geographical areas.

# Executive Summary

## Aggressive Job Posting Demand Over a Deep Supply of Regional Jobs

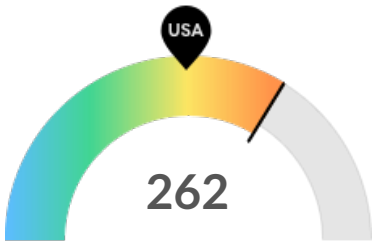



### Jobs (2021)

Your area is a hotspot for this kind of job. The national average for an area this size is 5,160* employees, while there are 11,318 here.


### Compensation

Earnings are high in your area. The national median salary for Natural Language Processing Scientists is $131,498, compared to $157,997 here.




### Job Posting Demand

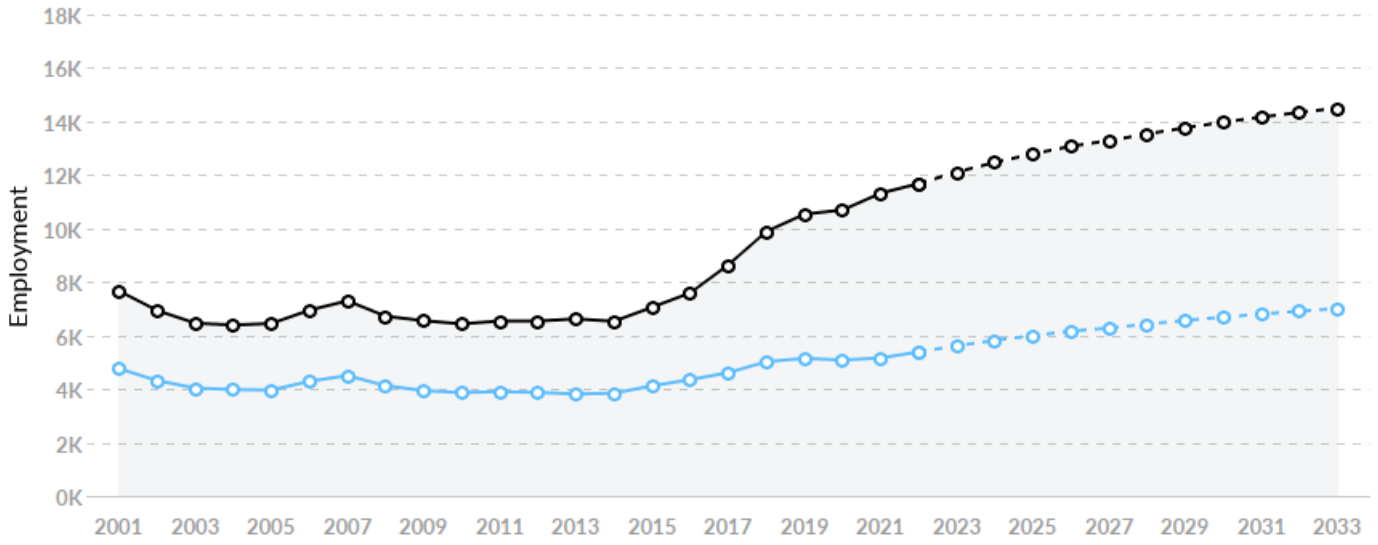
Job posting activity is high in your area. The national average for an area this size is 161* job postings/mo, while there are 262 here.

*National average values are derived by taking the national value for Natural Language Processing Scientists and scaling it down to account for the difference in overall workforce size between the nation and your area. In other words, the values represent the national average adjusted for region size.

# Jobs

## Regional Employment Is Higher Than the National Average

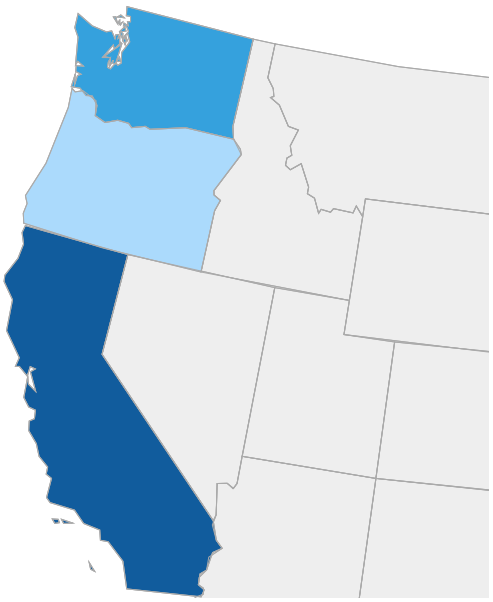
An average area of this size typically has 5,160* jobs, while there are 11,318 here. This higher than average supply of jobs may make it easier for workers in this field to find employment in your area.




| | Region | 2021 Jobs | 2023 Jobs | Change | % Change |
|---|---|---|---|---|---|
| ● | 3 States | 11,318 | 12,109 | 791 | 7.0% |
| ● | National Average | 5,160 | 5,616 | 456 | 8.8% |

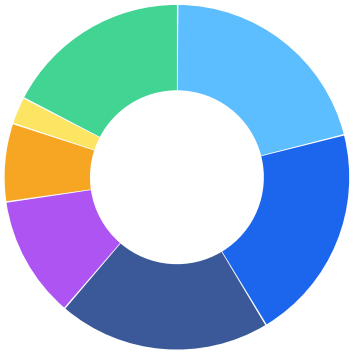
*National average values are derived by taking the national value for Natural Language Processing Scientists and scaling it down to account for the difference in overall workforce size between the nation and your area. In other words, the values represent the national average adjusted for region size.

## Regional Breakdown



| State | 2021 Jobs |
|---|---|
| California | 8,309 |
| Washington | 2,427 |
| Oregon | 582 |

## Most Jobs are Found in the Scientific Research and Development Services Industry Sector

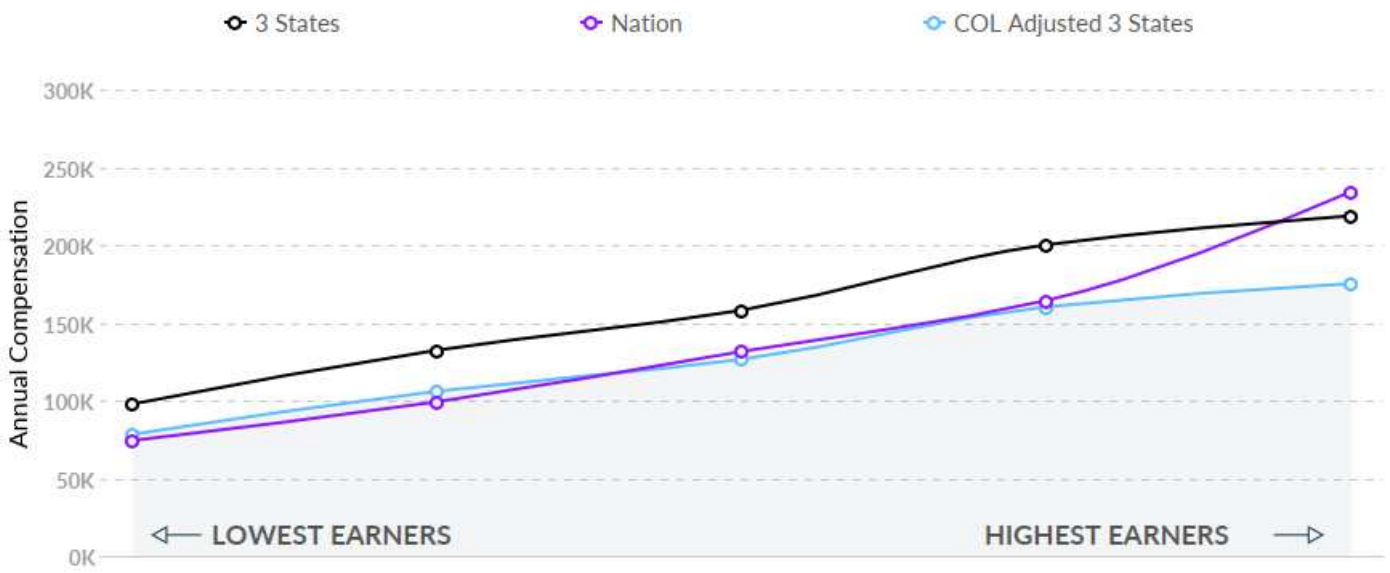


| Industry | % of Occupation in Industry (2021) |
|---|---|
| Scientific Research and Development Services | 21.0% |
| Computer Systems Design and Related Services | 20.3% |
| Federal Government, Civilian | 19.9% |
| Software Publishers | 11.4% |
| Other Information Services | 7.3% |
| Employment Services | 2.6% |
| Other | 17.5% |

# Compensation

## Regional Compensation Is 20% Higher Than National Compensation

For Natural Language Processing Scientists, the 2021 median wage in your area is $157,997, while the national median wage is $131,498.



# Job Posting Activity

**6,804 Unique Job Postings**

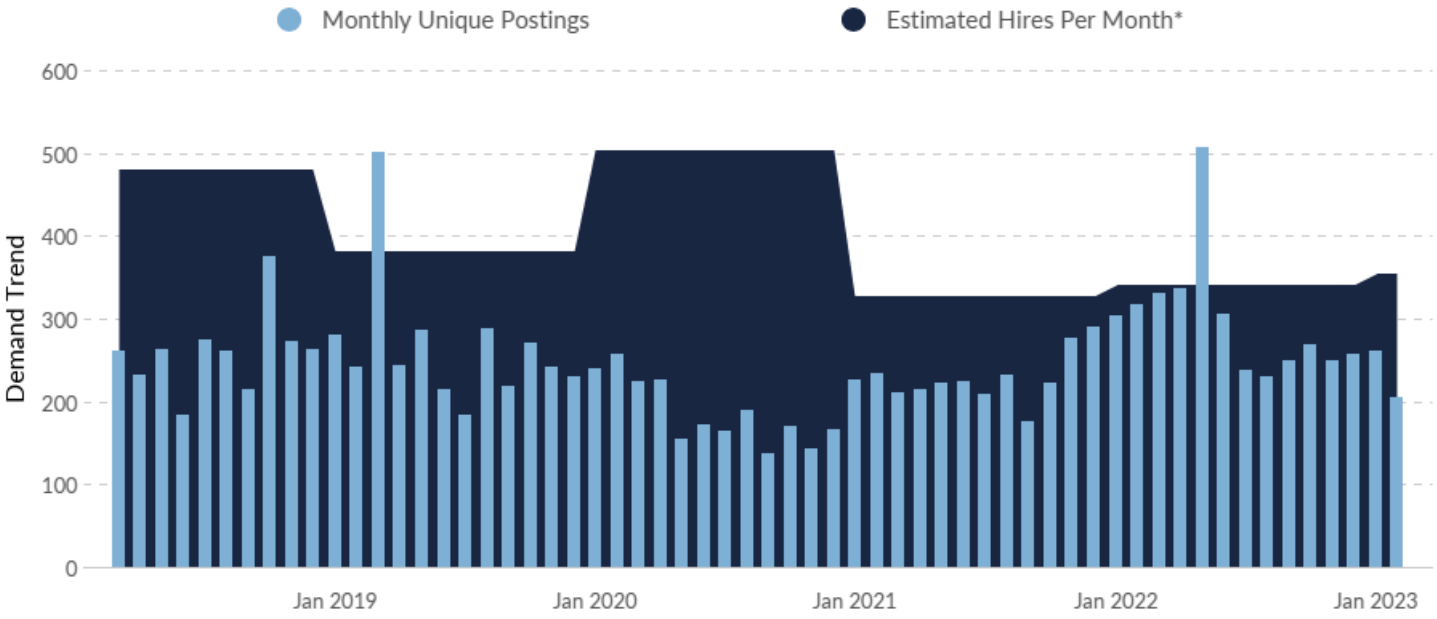
The number of unique postings for this job from Jan 2021 to Feb 2023.

**1,454 Employers Competing**

All employers in the region who posted for this job from Jan 2021 to Feb 2023.

**24 Day Median Duration**

Posting duration is 6 days shorter than what's typical in the region.



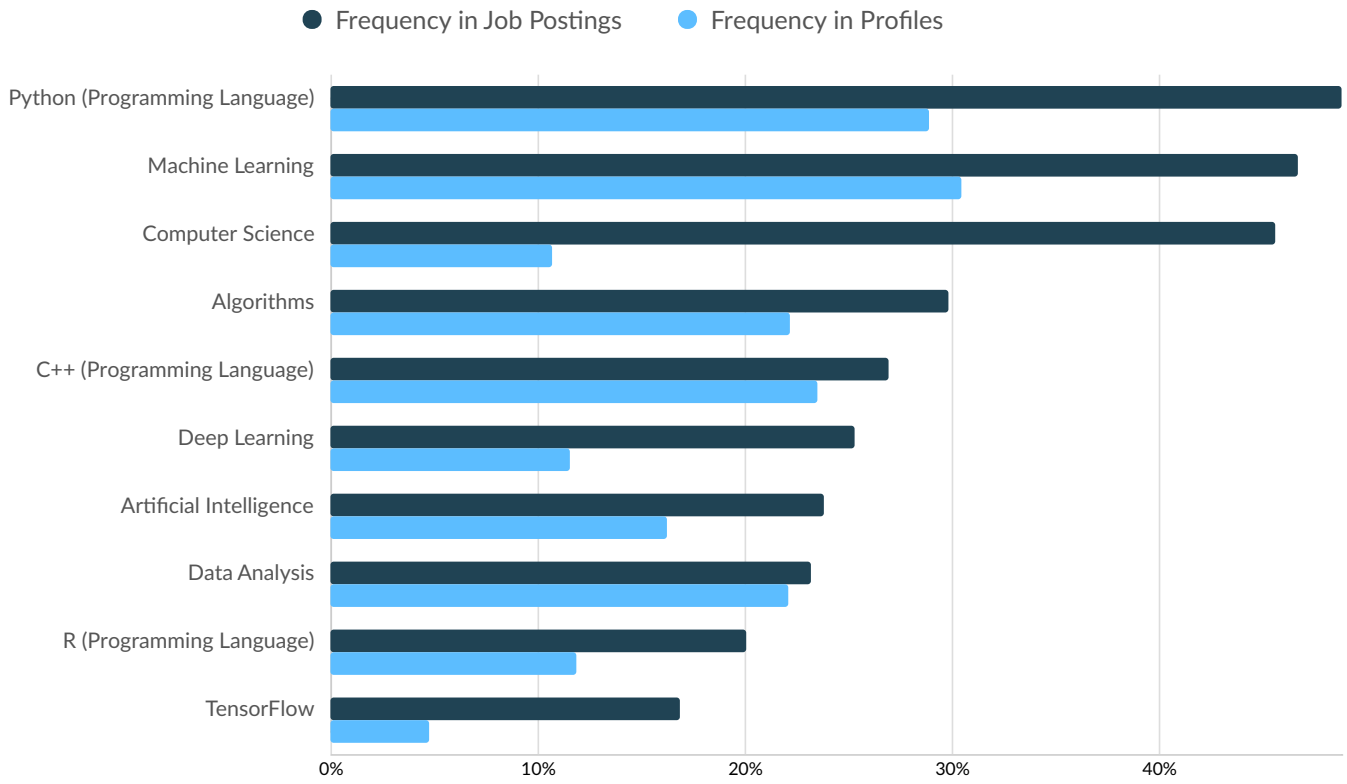

| Occupation | Avg Monthly Postings (Jan 2021 - Feb 2023) | Avg Monthly Hires (Jan 2021 - Feb 2023) |
|---|---|---|
| Computer and Information Research Scientists | 262 | 336 |

*A hire is reported by the Quarterly Workforce Indicators when an individual's Social Security Number appears on a company's payroll and was not there the quarter before. Lightcast hires are calculated using a combination of Lightcast jobs data, information on separation rates from the Bureau of Labor Statistics (BLS), and industry-based hires data from the Census Bureau.

| Top Companies | Unique Postings |
|---|---|
| Amazon | 357 |
| Meta | 223 |
| Microsoft | 200 |
| National Security Agency | 198 |
| Genentech | 168 |
| Apple | 107 |
| Elevance Health | 99 |
| Stanford University | 94 |
| University of California | 94 |
| Johnson & Johnson | 91 |

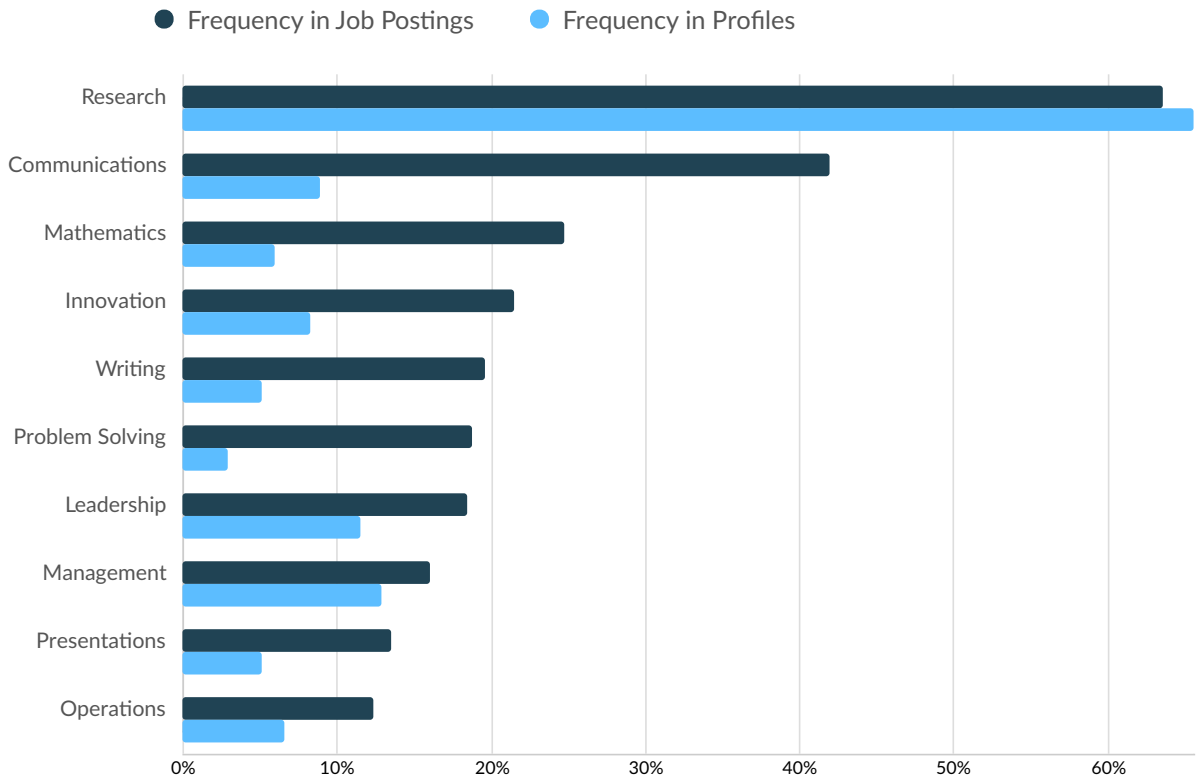
| Top Job Titles | Unique Postings |
|---|---|
| Machine Learning Scientists | 847 |
| Computer Scientists | 530 |
| Staff Scientists | 450 |
| Computational Scientists | 369 |
| Research Engineers | 349 |
| Computer Vision Scientists | 300 |
| Research Scientists | 280 |
| Machine Learning Research Scie... | 270 |
| Applied Scientists | 154 |
| Social Science Research Analysts | 73 |

## Top Specialized Skills



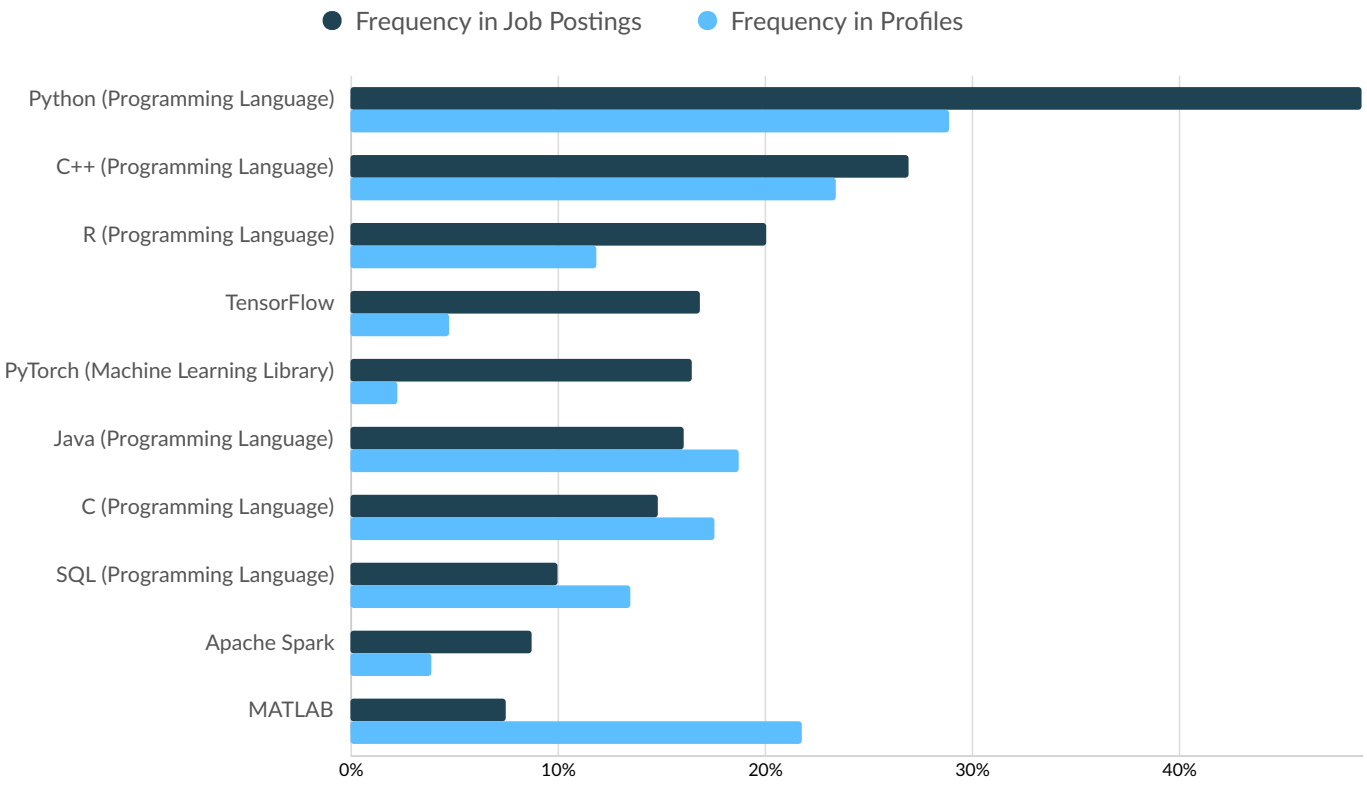

| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Python (Programming Language) | 3,322 | 49% | 4,210 | 29% |
| Machine Learning | 3,181 | 47% | 4,430 | 30% |
| Computer Science | 3,106 | 46% | 1,556 | 11% |
| Algorithms | 2,033 | 30% | 3,227 | 22% |
| C++ (Programming Language) | 1,833 | 27% | 3,417 | 23% |
| Deep Learning | 1,720 | 25% | 1,688 | 12% |
| Artificial Intelligence | 1,620 | 24% | 2,360 | 16% |
| Data Analysis | 1,577 | 23% | 3,212 | 22% |
| R (Programming Language) | 1,366 | 20% | 1,727 | 12% |
| TensorFlow | 1,150 | 17% | 697 | 5% |

## Top Common Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Research | 4,331 | 64% | 9,546 | 66% |
| Communications | 2,857 | 42% | 1,303 | 9% |
| Mathematics | 1,683 | 25% | 878 | 6% |
| Innovation | 1,465 | 22% | 1,214 | 8% |
| Writing | 1,339 | 20% | 755 | 5% |
| Problem Solving | 1,275 | 19% | 421 | 3% |
| Leadership | 1,256 | 18% | 1,678 | 12% |
| Management | 1,094 | 16% | 1,883 | 13% |
| Presentations | 919 | 14% | 741 | 5% |
| Operations | 844 | 12% | 958 | 7% |

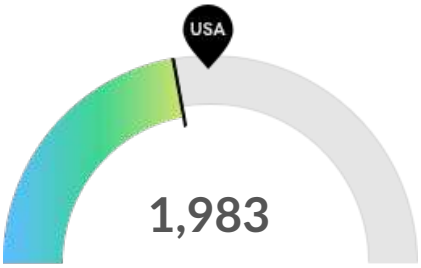
## Top Software Skills




| Skills | Postings | % of Total Postings | Profiles | % of Total Profiles |
|---|---|---|---|---|
| Python (Programming Language) | 3,323 | 49% | 4,210 | 29% |
| C++ (Programming Language) | 1,833 | 27% | 3,417 | 23% |
| R (Programming Language) | 1,366 | 20% | 1,727 | 12% |
| TensorFlow | 1,151 | 17% | 697 | 5% |
| PyTorch (Machine Learning Library) | 1,121 | 16% | 334 | 2% |
| Java (Programming Language) | 1,093 | 16% | 2,724 | 19% |
| C (Programming Language) | 1,009 | 15% | 2,555 | 18% |
| SQL (Programming Language) | 680 | 10% | 1,963 | 13% |
| Apache Spark | 597 | 9% | 568 | 4% |
| MATLAB | 510 | 7% | 3,171 | 22% |

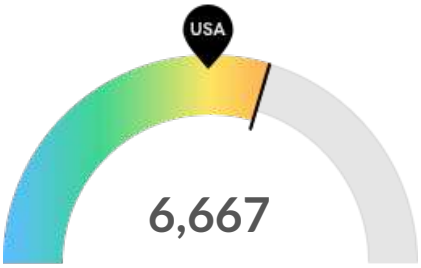
# Demographics

## Retirement Risk Is Low, While Overall Diversity Is High



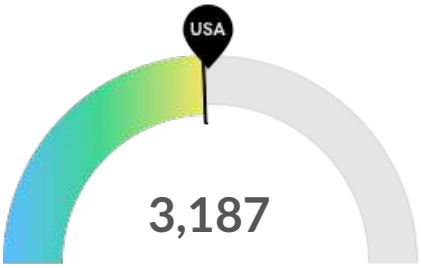

### Retiring Soon

Retirement risk is low in your area. The national average for an area this size is 2,351* employees 55 or older, while there are 1,983 here.




### Racial Diversity

Racial diversity is high in your area. The national average for an area this size is 5,139* racially diverse employees, while there are 6,667 here.

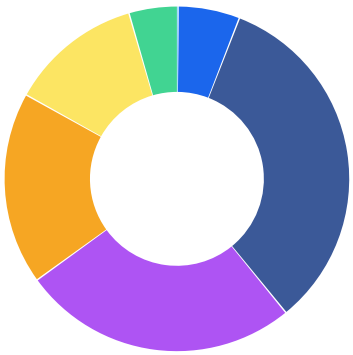



### Gender Diversity

Gender diversity is about average in your area. The national average for an area this size is 3,286* female employees, while there are 3,187 here.

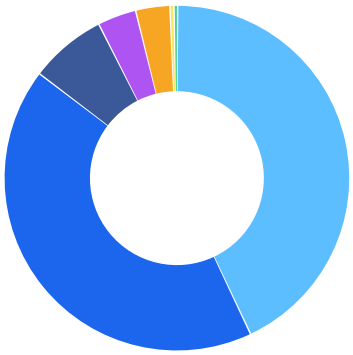
*National average values are derived by taking the national value for Natural Language Processing Scientists and scaling it down to account for the difference in overall workforce size between the nation and your area. In other words, the values represent the national average adjusted for region size.

## Occupation Age Breakdown



| | % of Jobs | Jobs |
|---|---|---|
| 14-18 | 0.1% | 6 |
| 19-24 | 5.8% | 675 |
| 25-34 | 33.2% | 3,878 |
| 35-44 | 25.9% | 3,027 |
| 45-54 | 18.1% | 2,108 |
| 55-64 | 12.4% | 1,451 |
| 65+ | 4.6% | 532 |

## Occupation Race/Ethnicity Breakdown

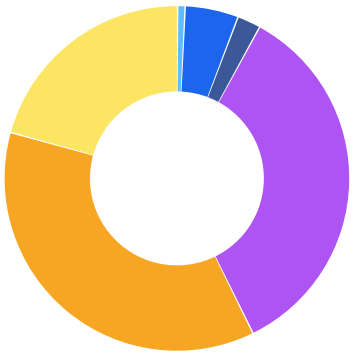


| | % of Jobs | Jobs |
|---|---|---|
| White | 42.9% | 5,009 |
| Asian | 42.4% | 4,947 |
| Hispanic or Latino | 7.2% | 839 |
| Black or African American | 3.6% | 423 |
| Two or More Races | 3.2% | 374 |
| American Indian or Alaska Native | 0.4% | 44 |
| Native Hawaiian or Other Pacific Islander | 0.3% | 39 |

## Occupation Gender Breakdown

| | % of Jobs | Jobs |
|---|---|---|
| Males | 72.7% | 8,489 |
| Females | 27.3% | 3,187 |

## National Educational Attainment



| | % of Jobs |
|---|---|
| High school diploma or equivalent | 0.7% |
| Some college, no degree | 5.0% |
| Associate's degree | 2.2% |
| Bachelor's degree | 34.8% |
| Master's degree | 36.6% |
| Doctoral or professional degree | 20.8% |

# Occupational Programs

### 21 Programs

Of the programs that can train for this job, 21 have produced completions in the last 5 years.

### 28,417 Completions (2021)

The completions from all regional institutions for all degree types.

### 1,147 Openings (2021)

The average number of openings for an occupation in the region is 4,264.

| CIP Code | Top Programs | Completions (2021) |
|---|---|---|
| 11.0701 | Computer Science | 16,328 |
| 11.0103 | Information Technology | 2,803 |
| 11.0101 | Computer and Information Sciences, General | 1,931 |
| 11.0201 | Computer Programming/Programmer, General | 1,809 |
| 11.0901 | Computer Systems Networking and Telecommunications | 1,553 |
| 11.0199 | Computer and Information Sciences, Other | 826 |
| 11.0401 | Information Science/Studies | 739 |
| 11.0104 | Informatics | 601 |
| 11.0804 | Modeling, Virtual Environments and Simulation | 368 |
| 11.1099 | Computer/Information Technology Services Administration ... | 306 |

| Top Schools | Completions (2021) |
|---|---|
| University of California-Berkeley | 1,843 |
| University of Washington-Seattle Campus | 1,721 |
| University of Southern California | 1,640 |
| University of California-Irvine | 1,231 |
| University of California-San Diego | 1,180 |
| University of California-Santa Cruz | 965 |
| Oregon State University | 873 |
| Stanford University | 661 |
| University of California-Los Angeles | 515 |
| California State University-Fullerton | 459 |

# Appendix A

**Computer and Information Research Scientists (SOC 15-1221):**
Conduct research into fundamental computer and information science as theorists, designers, or inventors. Develop solutions to problems in the field of computer hardware and software.

**Sample of Reported Job Titles:**
Computer Scientist
Research Scientist
Control System Computer Scientist
Scientific Programmer Analyst
Computer Specialist
Information Scientist
Research and Development Specialist (R and D Specialist)
Programming Methodology Researcher
Programming Languages Researcher
Multi-Disciplined Language Analyst

**Related O*NET Occupation:**
Computer and Information Research Scientists (15-1221.00)

Portland State University seeks the Oregon Higher Education Coordinating Commission approval to offer an instructional program leading to a B.S. in Linguistics & Computer Science.

**Program Description and Justification**

1. Identify the institution, degree, and title of the program.

Institution: Portland State University
Degree: Bachelor of Science
Title: Linguistics & Computer Science

2. Describe the purpose and relationship of the proposed program to the institution's mission and strategic plan.

**Access**
The proposed program reduces the cost to students by combining linguistics and computer science to save about one academic year of study compared to a dual major in linguistics and computer science. It improves student navigation of course work and progress towards graduation by providing a new, highly respected program of study. With clearly laid out paths to graduation in competitive fields, students' time and money costs of education are reduced. Cost savings of this type are important to all students but particularly important to low-income, first-generation students who are often from racial/ethnic minoritized groups.

**Equity and inclusion**
The proposed program offers new guidance to students on a path of study that is in high demand. This benefits all students but is particularly helpful to students who are from BIPOC populations or first-generation college students and who may not be able to access informal sources of information from friends and family about which skills are in high demand. Research in labor economics has suggested that one important source of disadvantage for women and minoritized populations is a lack of informal networks that link people to high demand majors and eventually occupations. Any move to increase transparency in paths to success is likely to disproportionately benefit students from underrepresented groups.

**Student learning**
In linguistics and NLP courses, faculty often mention some applications and connections to respective fields. Formalizing this program and making the connections between the two fields stronger in a programmatic way will enhance student learning and understanding of these interdisciplinary connections. Students in both departments will also have more practical research opportunities (see below).

**Research and scholarly work**
The proposed program improves the communication channels between linguistics and computer science which have, heretofore, been weak at PSU. This program will open up opportunities for

joint projects and research between linguistics and computer science faculty and students. (In anticipation of the new program, we have already begun such work, e.g., linguistics faculty are serving on PhD committees for Computer Science students in the field of NLP, and the faculty and students are collaborating on projects, publications, and monthly Brown Bags in the field of NLP).

**Service**
The proposed program serves the needs of local and other employers by educating students in a high demand field.

**The proposed major in Linguistics & Computer Science contributes to the fulfillment of PSU strategic priorities in the following ways:**

1. Offers new guidance to students on a path of study that is in high demand. This benefits all students but is particularly helpful to students who are from minoritized populations or first-generation college students and who may not be able to access informal sources of information from friends and family about which skills are in high demand.
2. Reduces the cost to students by combining linguistics and computer science to save about 1 academic year of study compared to a dual major in these degrees.
3. Improves student navigation of course work and progress towards graduation by providing a new, highly respected program of study.
4. Provides a competitive advantage in the labor market to enrolled students based on market research report (attached elsewhere in document).
5. Strengthens students' learning in both fields by more clearly demonstrating the interdisciplinary connections, as well as by providing more research opportunities across the two departments.
6. Serves the needs of local and other employers by educating students in a high demand field.
7. Serves the needs of the NLP profession to diversify the field in terms of gender (i.e., attracting more female students from linguistics) and linguistic backgrounds.
8. Places a laser focus on student success by being committed to providing instruction in multiple formats (in-person, online, hybrid, attend anywhere).
9. Contributes to PSU's financial sustainability by requesting a small investment (one faculty line and marketing support) in return for increased enrollment of local, out-of-state, and international student populations.

3. What evidence of need does the institution have for the program?

The full market analysis report conducted by the Office of Academic Innovation is included in Appendix 4 of the full proposal. The report focuses on the external market for "linguistics and computer science" degrees as well as related job positions (Machine Learning Engineer, Natural Language Processing Scientist). The report only found one degree with the "linguistics and computer science" CIP code, whereas we located a total of eight in the US. Nevertheless, together this information indicates that the demand for jobs is high in this area, but there are only a few programs offering such degrees.

In examining all reports, we find that the Natural Language Processing Scientist report most closely relates to the skills our graduates will learn, given the structure of the curriculum, and so we will focus on the findings of this particular report. The chart on p. 4 indicates that the number of jobs in this area is projected to grow over the next 10 years. The top specialized skills (see p. 10) are computer science, Python programming language, machine learning, algorithms, and data analysis. The first four skills mentioned will be addressed by the computer science courses in the proposed curriculum, while data analysis will be the heavy focus of courses in applied linguistics. Additionally, the top "soft" skills mentioned are communication and problem-solving, which will be addressed in courses in both departments, but in particular in applied linguistics. As such, we see that the structure of our proposed curriculum matches the skill set required for these jobs. The Natural Language Processing Scientist in WA-OR-CA report indicates that the demand for these jobs, as well as the compensation, is much higher in our tri-state area than the national average.

4. Are there similar programs in the state? If so, how does the proposed program supplement, complement, or collaborate with those programs?

Not applicable. No such programs exist in Oregon

All appropriate University committees and the Statewide Provosts Council have approved the proposed program. The Portland State University Board of Trustees approved the program on April 3, 2025.

**Recommendation to the Commission**

The Statewide Provosts Council recommends that the Oregon Higher Education Coordinating Commission authorize Portland State University to establish an instructional program leading to a B.S. in Linguistics & Computer Science, effective fall 2025.

**Institution:** Portland State University
**Program:** B.S. in Linguistics & Computer Science

Action: At the **5.14.25** meeting, the Statewide Provosts Council approved a new program for **Portland State University, B.S. in Linguistics & Computer Science** to move forward to the Oregon Higher Education Coordinating Commission for its review and approval. The **Portland State University** Board of Trustees approved the **B.S. in Linguistics & Computer Science** program at its 4**/3/25** meeting.

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**Eastern Oregon University**
Peter Geissinger, Provost
X Approved
__Opposed
__Abstained

**Oregon State University**
Ed Feser, Provost
X Approved
__Opposed
__Abstained

**Portland State University**
Shelly Chabon, Provost
X Approved
__Opposed
__Abstained

**University of Oregon**
Chris Long, Provost
X Approved
__Opposed
__Abstained

**Oregon Health & Science University**
Marie Chisholm-Burns, Provost
X Approved
__Opposed
__Abstained

**Oregon Tech**
Hesham ElRewini, Interim Provost
X Approved
__Opposed
__Abstained

**Southern Oregon University**
Casey Shillam, Provost
X Approved
__Opposed
__Abstained

**Western Oregon University**
Jose Coll, Provost
X Approved
__Opposed
__Abstained