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U.S. Demand for AI-Related Talent

CSET Data Brief

CENTER *for* SECURITY *and* EMERGING TECHNOLOGY

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Artificial intelligence seems ubiquitous at the moment, promising a revolution affecting every aspect of life. Mentions of "artificial intelligence" in licensed news sources from LexisNexis[1] have increased from just over 6,000 in 2015 to nearly 83,000 in 2019—growing more than an order of magnitude over four years. Both industry and government see AI as a technology pivotal to future growth and long-term competitiveness: a 2018 McKinsey Global Institute report suggests that AI could contribute an additional $13 trillion in global economic output by 2030,[2] and the U.S. military has doubled down on AI development and implementation, drafting the first Department of Defense Artificial Intelligence Strategy and establishing the Joint Artificial Intelligence Center in 2018.[3] Meanwhile, forecasts that China is taking the lead in AI have prompted the United States to join a G7 international panel setting ethical guidelines for the use of AI.[4]

As both the government and private sector work to reap the benefits offered by artificial intelligence, it remains unclear how creating AI applications, integrating them into existing processes, and deploying them effectively will actually play out. Technologies like GPS started with PhD physicists, but it took entire industries of engineers, designers, testers, program managers, and business analysts—most of them with more modest and varied educations—to convert equations and space technology into the broad and varied GPS devices all of us depend on today.

As the United States makes an analogous AI transition, a key question is what skills will be needed and where? Essentially all recent analyses focus on top-end, PhD-level researchers. While crucial for developing novel AI concepts and techniques, a much larger workforce with less education but broader skills is needed to integrate these concepts into technologies and systems driving military and economic progress and leading us toward an AI-enabled society.[5]

To explore the nature of education that will be needed, we start with market demand, using the Burning Glass dataset, which incorporates more than 45,000 online job sites, to reveal the geographic and sectoral spread and associated educational requirements serving as market signals to our AI-relevant talent pool.[6]

This brief is a first step at understanding the broader landscape of talent relevant to AI, assessing it through the lens of market signals sent via job

postings.[7] Understanding the full range of AI-related talent needed must go beyond the usual focus on research and new algorithms to encompass the skills needed to integrate and use AI in a broad range of sectors and legacy systems. While not exclusive to AI, these jobs are critical to integrating AI into our economy and military capability; they include roles like Software Development Engineers, Systems Engineers, and Business Analysts.[8] Job posting data does not tell us the number of positions filled or by whom, but does show the skill types and job locations marketed as opportunities across the United States.

Findings

First, the market signal for AI talent is significant and growing rapidly. As of 2019, AI-related positions comprised roughly three million of the 34 million job postings captured by Burning Glass (Figure 1), almost tripling annually since 2010 (Figure 2).[9] Details of what constitutes core AI and AI-adjacent positions are included in the appendix; core AI involves a limited number of skill clusters critical to the creation of AI, like machine learning and natural language processing, while AI-adjacent positions encompass a broader range of skill clusters needed to integrate and use AI, like statistical software and test automation.

Figure 1: Total vs AI job postings (2019)

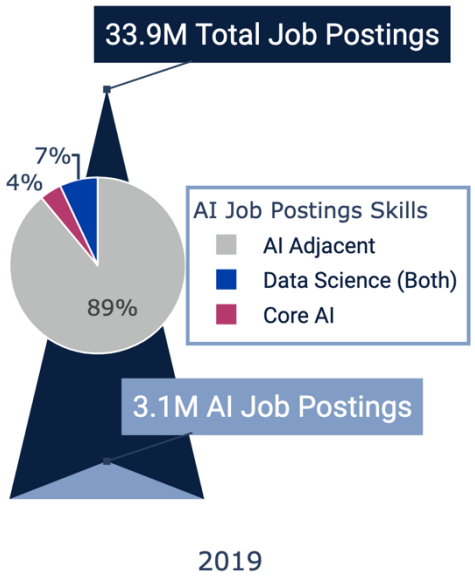

Figure 1 shows AI-related job postings as a subset of total job postings, and further breaks down AI-related job postings into Core AI and AI-Adjacent categories. Data Science job postings are represented separately in this figure because they are counted in both Core and Adjacent AI.

Figure 2: Total AI relevant job postings (2010–2019)

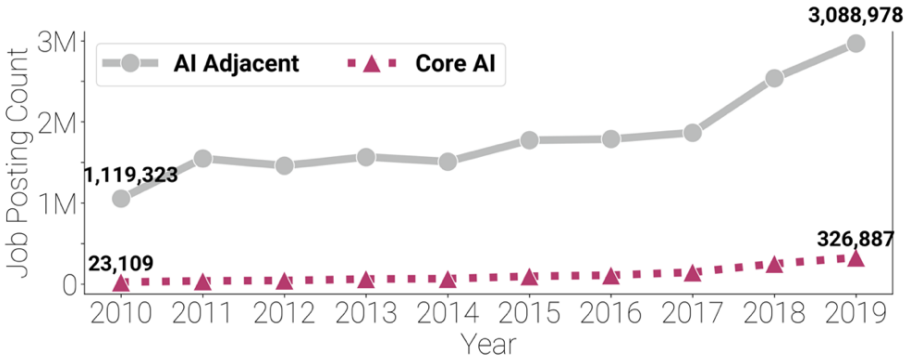

Figure 2 shows job postings over time, illustrating the growth of AI-related job postings from 2010 to 2019 in the United States. We report the raw count of job postings, as all job postings in the U.S. increased drastically starting in 2016 as reported by the U.S. Bureau of Labor Statistics[10].

The range of education levels needed to support the growing AI job market has been surprisingly stable over the past decade, despite the rapidly changing landscape and perception of AI as an emerging technology. There is a clear demand for AI talent with bachelor degrees; roughly 80 percent of all job postings require a four-year degree, with more than half of those listing no other preferred degrees (Figure 3).[11]

Figure 3: Minimum degree requirements over time

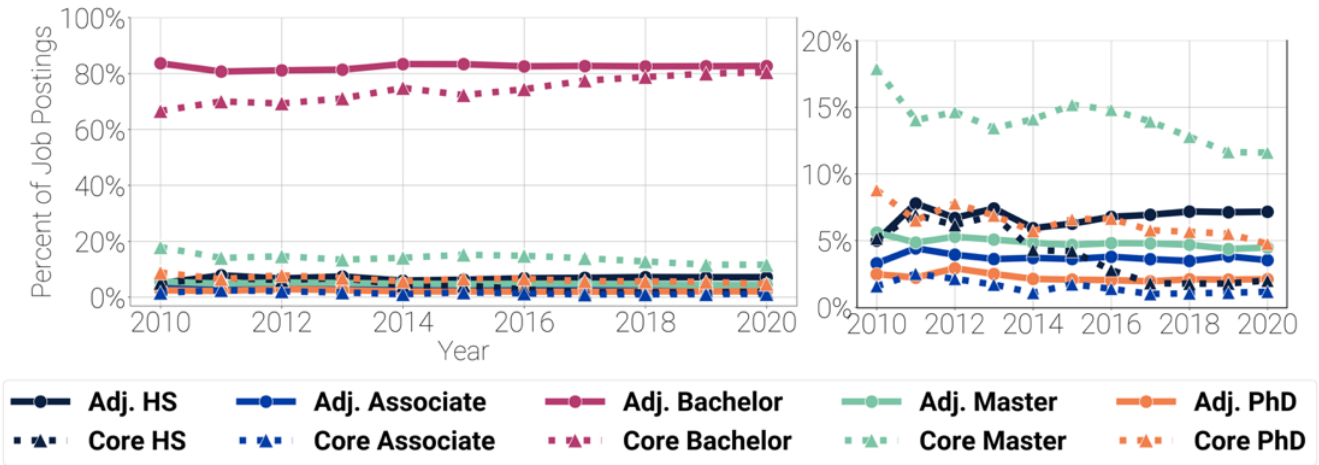

Figure 3 shows the minimum degree requirements for Core AI and AI-Adjacent jobs respectively, where the job postings listed minimum degree requirements.

The education requirements across core and adjacent AI job postings are strikingly similar, with bachelor degrees representing the highest demand category at 80 and 83 percent respectively of total 2019 postings in those skill clusters. We do see one divergence: a higher demand for masters and

PhDs in Core AI, representing 12 and six percent respectively of total 2019 job postings (12 and six percent respectively represent 28,650 job postings requiring a masters degree and 13,573 requiring a PhD). High school and two-year degrees make up only two and one percent respectively in these skill clusters. However, for the types of jobs that broadly integrate and implement AI across military and economic capabilities, high school and two-year degrees increase slightly and represent seven and four percent respectively, with masters degrees and PhDs shifting downward to four and two percent (Figure 4).

Figure 4: Minimum degree requirements for AI-related job postings

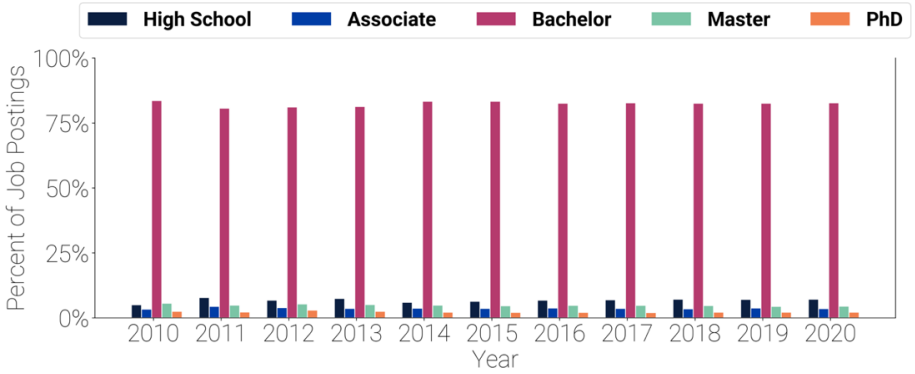

Figure 4 shows all U.S. AI-related job postings broken down by their minimum degree requirements across the years.

Artificial intelligence is often framed as an emerging technology, but clearly already drives a strong demand for related talent across sectors (as assessed using the North American Industry Classification System (NAICS) codes provided by Burning Glass[12]) (Figure 5). While this demand is predictably strong in the Professional, Scientific, and Technical Services sector, Manufacturing and Finance and Insurance are next in line, both posting more than 250,000 jobs in 2019, and the Administrative sector has seen a dramatic increase since 2017. The Information sector shows the fifth largest postings in 2019 at just under 150,000; this is a sector most people go to first when they think of AI, and rightfully so, as companies like Facebook and Microsoft are often categorized as Information. While AI may still be emerging, it is already here to stay in several American economic sectors not traditionally associated with research and development.

Figure 5: AI-related job posting count by sector over time

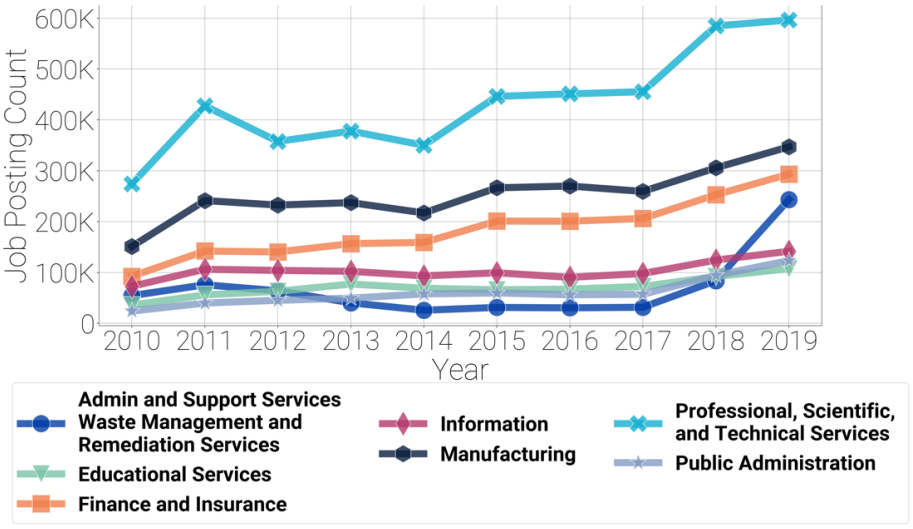

Figure 5 shows the AI-related job posting counts from 2010 to 2019 for the seven NAICS 2 that end 2019 with at least 100K job postings. This graph highlights Professional, Scientific and Technical services as the sector with the most AI-related jobs. with Manufacturing and Finance and Insurance having the second and third most AI-related jobs.

Not only is AI more than just research, the skills required to implement and use AI are in demand far beyond Silicon Valley, offering job opportunities across America. A few core hotspots in states like California, Massachusetts, and Texas come to mind when thinking of AI jobs, and raw total numbers of postings reinforce that perception. However, if we look at those same job posting numbers relative to the working age population of a state in 2019, we see a much broader impact of AI upon the economy (Figure 6).[13]

Some states (including the District of Columbia) have an unusually high demand for these skills compared to others of more similar working age populations; the District of Columbia is by far the most striking example, but Colorado, Washington state, and Minnesota all suddenly jump to the top 10 states for market demand in these skills. AI-related jobs may have an outsized economic impact on these states, one that is less obvious when looking at raw job totals and that may affect decisions around education and training opportunities.

Figure 6: AI-related job postings by state (total and normalized to over 18 population) in 2019

State Code	AI Job Posting Count	State Code	Normalized AI Job Posting Count (per 100,000)
1. CA	583,716	1. DC	11,246
2. TX	250,811	2. VA	2,974
3. VA	198,487	3. MA	2,066
4. NY	188,156	4. MD	2,018
5. FL	151,103	5. CO	2,010
6. IL	114,794	6. CA	1,906
7. NC	114,538	7. WA	1,421
8. MA	114,452	8. NC	1,399
9. GA	106,176	9. GA	1,309
10. OH	99,306	10. MN	1,280

Figure 6 shows the top 10 states with the most AI-related job postings (includes Core AI and AI-adjacent job postings) compared to the top 10 states with the most AI-related job postings, normalized by the state population over the age of 18. There are 91 job postings with no state listed, representing 0.003 percent of AI job postings from 2019 in the United States.

Takeaways

Artificial intelligence has already made a significant impact across the United States and across economic sectors, with roughly one percent of 2019 job postings seeking AI-related skills. This trend goes beyond research and traditional tech, extending to Manufacturing, Finance and Insurance, and Administrative sectors. Additionally, AI-related jobs are in demand across the country, with 40 percent of states (including DC) demonstrating demand for these roles at more than 1000 per 100,000 working-age people in the state.

This analysis offers a clearer understanding of how to consider policies in the employment landscape, ensuring better pairing of education efforts to industries and locations. Job demand for the full range of AI-related skills may also be a more relevant measure of how future efforts to grow new economic areas leveraging AI translate into local hiring. There is real value for policymakers and education planners in better understanding the talent pipeline for jobs adjacent to AI.

For U.S. students deciding whether to pursue a career in artificial intelligence, there is a clear market demand in a broad range of locations and applications. The vast majority of listings—roughly 80 percent—seek four-year degrees, so we must ensure a sustained pipeline across the United States. Additionally, if the talent pool for master's degrees and PhDs is found to be insufficient, we must carefully consider the market signal being sent and make what appears to many as a longer, more expensive path more attractive.

Future work will include assessments of various industrial sectors, such as manufacturing and transportation, as well as the value of specific types of degrees and less traditional certifications. This analysis will study specific breakdowns of the types of degrees (e.g., computer science, computer engineering, business, mathematics, etc.), the highest value certifications and skills, sectoral differences in these demand signals across areas (including manufacturing, information services, transportation, etc.), AI sectors with more hype than skill and vice versa, and the role of the defense industrial base in the competition for AI-related talent.

This brief has only scratched the surface of questions around U.S. market demand for AI talent. Abundantly clear, however, is the growing and widespread demand for AI skills and its impact across this nation.

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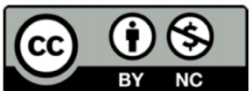
The authors are solely responsible for the views expressed in this piece and for any errors.



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Appendix: Methodology

- **Identifying AI job postings:** We use the AI taxonomy provided by Burning Glass to select job postings that have skill clusters categorized as Core AI and AI-adjacent in order to compile a comprehensive list of AI job postings. For each skill cluster, there is a list of corresponding skills. Table 1 provides the skill clusters we chose and the count of skills for each skill cluster.

Table 1: AI Taxonomy

AI Category	Skill Cluster	Number of Skills
Core AI	Artificial Intelligence	7
	Data Science	10
	Machine Learning	28
	Natural Language Processing (NLP)	24
AI Adjacent	Automation Engineering	14
	Data Mining	8
	Data Science	15
	Economics	5
	Industrial Automation	1
	IT Automation	12
	Mathematical Modeling	4
	Mathematical Software	5
	Mathematics	1
	Medical Research	1
	Research Methodology	1
	Robotics	9
	Scripting Languages	1
	Signal Processing	1
	Statistical Software	38
	Statistics	10
	System Design and Implementation	1
	Test Automation	15

- **Manual Verification**: Job postings are categorized into skill clusters by regular expression matching of skill names in the given job posting, leaving room for some noisy data. For example, all job postings from Panda Express were being categorized as Data Science, since one skill for Data Science is Pandas. We manually identified and removed these types of errors, as well as occupation names and career area names unrelated to AI. The files containing the occupation codes and occupation names that we excluded are available on CSET's GitHub (link). Additionally, we verified the job titles that were being represented in our dataset and found that for the

job postings containing a job title, the majority of titles were explicitly in line with AI-related jobs. The full job title list for 2019 is available on CSET's GitHub (link).

- **Source Code**: SQL queries used to collect the data presented in this data brief can be found on CSET's GitHub (link)

Endnotes

[1] The data used was taken from 2209 sources from LexisNexis Metabase that were present in all years from 2011 through 2020. These sources include 809 marked as Local news, 524 marked as Trade, and 257 marked as National news. To correct for yearly fluctuations in the total number of articles published, the counts within each year are multiplied by the maximum yearly count overall years divided by the current year's count; Nexis Metabase (2020). Nexis Metabase, https://www.lexisnexis.com/en-us/products/data-as-a-service/academic.page.

[2] Jacques Bughin, Jeongmin Seong, James Manyika, Michael Chui, and Raoul Joshi, "Notes from the AI Frontier: Modeling the Impact of AI on the World Economy," *McKinsey Global Institute,* September 2018, https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/Notes%20from%20the%20frontier%20Modeling%20the%20impact%20of%20AI%20on%20the%20world%20economy/MGI-Notes-from-the-AI-frontier-Modeling-the-impact-of-AI-on-the-world-economy-September-2018.ashx.

[3] "Summary of the 2018 Department of Defense Artificial Intelligence Strategy: Harnessing AI to Advance Our Security and Prosperity," *Department of Defense*, February 2019, https://media.defense.gov/2019/Feb/12/2002088963/-1/-1/1/SUMMARY-OF-DOD-AI-STRATEGY.PDF; Deputy Secretary of Defense, *Establishment of the Joint Artificial Intelligence Center*, June 27, 2018, https://admin.govexec.com/media/establishment_of_the_joint_artificial_intelligence_center_osd008412-18_r....pdf.

[4] Natalie Sherman, "Is China gaining an edge in artificial intelligence?" *BBC News,* November 12, 2019, https://www.bbc.com/news/business-50255191; Amy Webb, "China Is Leading in Artificial Intelligence--and American Businesses Should Take Note," *Inc. Magazine*, September 2018, https://www.inc.com/magazine/201809/amy-webb/china-artificial-intelligence.html; Fabian Westerheide, "China — The First Artificial Intelligence Superpower," *Forbes,* January 14, 2020, https://www.forbes.com/sites/cognitiveworld/2020/01/14/china-artificial-intelligence-superpower/#22ea3ac32f05; "US Joins G7 Artificial Intelligence Group to Counter China," *U.S. News & World Report*, May 28, 2020, https://www.usnews.com/news/business/articles/2020-05-28/us-joins-g7-artificial-intelligence-group-to-counter-china.

[5] Terence Tse, Mark Esposito, Takaaki Mizuno, and Danny Goh, "The Dumb Reason Your AI Project Will Fail," *Harvard Business Review,* June 8, 2020, https://hbr.org/2020/06/the-dumb-reason-your-ai-project-will-fail.

[6] Burning Glass database, https://www.burning-glass.com.

[7] In this analysis, we focus on the educational mix and domestic locations of jobs categorized as both core and adjacent AI positions; note that data science is listed in both the core AI and AI-adjacent categories, thus job postings tagged as data science are present in both datasets (see Appendix).

[8] Full list can be found at https://github.com/georgetown-cset/AI_marketdemand_BG.

[9] This growth occurs within an overall expansion of employment growth in the United States since 2014, as highlighted by the Bureau of Labor Statistics: https://www.bls.gov/opub/mlr/2019/article/employment-growth-accelerates-in-2018.htm.

[10] "Employment growth accelerates in 2018, extending a lengthy expansion," U.S. Bureau of Labor Statistics, May 2019, https://www.bls.gov/opub/mlr/2019/article/employment-growth-accelerates-in-2018.htm.

[11] Job postings in Core AI that do not list a minimum degree requirement range from 19 to 25 percent, and in AI-Adjacent roles that do not list a minimum degree requirement, 25 to 32 percent across the years.

[12] AI-related job postings in the United States that do not have an assigned NAICS 2 range from 27 to 33 percent across the years.

[13] "State Population by Characteristics: 2010–2019," United States Census Bureau, https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-detail.html.