Analysis of Current and Future Computer Science Needs via Advertised Faculty Searches for 2024

Craig E. Wills
Computer Science Department
Worcester Polytechnic Institute
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Abstract

This work uses the same methodology applied over ten years to study where Computer Science departments are choosing to invest faculty positions using data obtained from advertised tenure-track searches for the current hiring season. While the number of and areas for faculty searches does not necessarily translate into the same for faculty hires, we believe that they provide insight into current and future needs within the discipline.

We analyzed ads from 423 institutions seeking to fill 865 tenure-track faculty positions in Computer Science. The number of institutions is a drop from last year's record number year at this time (mid-November), but is still the second-highest number of institutions searching in the ten years of this study. In contrast, the number of tenure-track positions being sought are at intermediate levels for the ten-year time period. The relative drop in positions being sought compared to last year's record high in positions is primarily due to a 16% reduction in the average number of positions being sought per each U.S. PhD-granting institution.

We clustered the specific Computer Science topics mentioned in ads into 16 areas. In terms of specific areas, we found that the clustered area of Artificial Intelligence/Data Mining/Machine Learning accounts for 21% of all positions being sought, which is up from 18% last year and is the highest in the ten years of our study. This increase reflects and leads the growing impact of AI on society. The clustered area of Security accounts for 18% of all sought positions. The area of HCI/Interactive Media shows a significant gain over last year. Both the Systems/Networking and Software Engineering clusters dropped to a five-year low in percentage of positions being sought. Aggregating the Data Science, AI/DM/ML and Databases clusters results in 34% of all hires sought in these data-oriented areas, which is a ten-year high.

Differences are also seen when analyzing results based on the type of institution. As was the case last year, positions in the clustered area of AI/DM/ML have the highest percentages for (particularly private) PhD institutions. Again positions related to Security have the highest percentages for MS and BS/BA institutions. Security is the second-most sought area for public PhD institutions while HCI/IntMedia is the second-most sought area for private PhD institutions. AI/DM/ML is the second-most sought area for MS for BS/BA institutions.

1 Introduction

The number of faculty searches in Computer Science during this hiring season for tenured and tenure-track positions starting in 2024 again affords the opportunity to study areas of Computer Science where departments are choosing to invest in new faculty hires. This is the tenth such report detailing results from a study of faculty hiring ads in Computer Science. It uses a similar methodology as done in previous years [1, 2, 3, 6, 8, 9, 10, 11, 13, 14]. The longitudinal aspect also allows insight into the number of positions and the areas being sought over time for both PhD and non-PhD granting institutions.

The focus of this work has always been to study where departments specifically, and the discipline more generally, are choosing to invest precious tenure-track faculty positions. It is an opportunity to understand where Computer Science departments think they are in terms of current needs as well as where they think they are going. It is also an opportunity to see how many institutions are searching and for how many positions.

With this focus, there are a number of caveats to our study:

1. Our study is not exhaustive in that it does not necessarily take into account all searches currently underway for this hiring season. We describe the methodology used to discover ads, but ads may have been only placed in other venues or not have been placed in the timeframe of our study.

2. While our study focuses on preferred areas for faculty applicants, not all ads identify such preferred areas. These searches are accounted for in the data, but are not considered when analyzing particular areas of interest.

3. Similarly not all ads identify the specific number of positions being sought. In analyzing these searches we make assumptions on the number of positions being sought for such ads.

4. Our study analyzes searches and not hires. The number and areas of actual faculty hires may not match what is being sought.

2 Methodology

We used four primary sources for obtaining ads for Computer Science faculty positions: the Computer Research Association (CRA) Job postings[1] the Association for Computing Machinery (ACM) list of jobs[2], the Chronicle of Higher Education Vitae site[3] and the HigherEdJobs site[4]. We again augmented these sources with positions posted on the SIGCSE jobs mailing list, which often includes ads for more undergraduate-focused institutions. We considered ads posted on these venues between August 2023 and mid-November 2023, which is the same timeframe used in our previous studies.

Only ads for tenured and tenure-track positions by departments containing Computer Science or closely-related programs were considered. We did not consider other positions such as teaching

[1] https://cra.org/ads/

[2] http://jobs.acm.org/jobs/search

[3] https://chroniclevitae.com/job_search/new

[4] https://www.higheredjobs.com/faculty/

professors, professors of practice, lecturers, instructors or researchers and we only considered institutions awarding at least a BS or a BA degree in Computer Science. Searches for Deans or Department Chair positions were noted, but not considered because they do not reveal information regarding areas. Similarly, searches for other departments and programs with interest in faculty with Computer Science background were noted, but also not considered.

3 Results

3.1 Institutions and Positions

Using this methodology our resulting dataset contains information for faculty searches from 423 institutions (396 are in the U.S.). 340 (80%) of these institutions indicate a specific number of positions being searched for with the remaining searches using non-specific phrases such as "multiple positions," "several positions" or just "positions" to indicate the number. As comparison, our previous-year study [13] with a comparable timeframe found searches for 437 institutions (413 in the U.S.) with 80% of these institutions indicating a specific number of positions being searched for.

The left-side of Figure 1 shows all ten years of results for the number of institutions searching for tenure-track faculty. It shows that the number of institutions searching for tenure-track faculty is the second largest in the ten years of our studies.

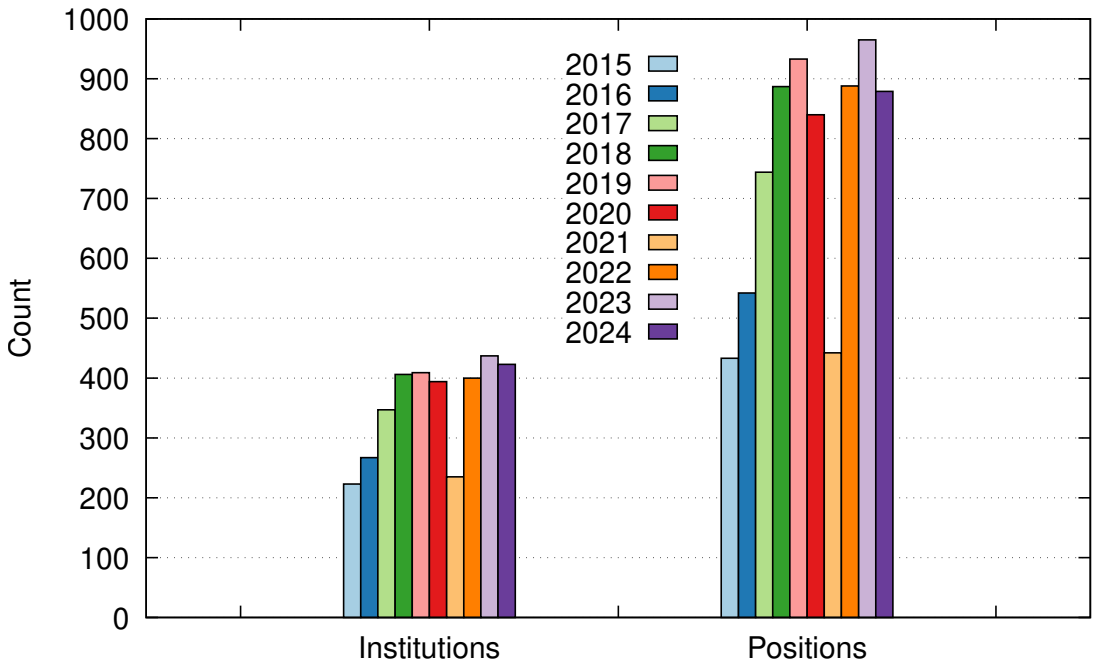

Figure 1: Ten-Year Results for Number of Institutions Searching and Total Number of Positions Being Sought

In terms of the total number of positions, in the past we experimented with treating such "Multiple Position" searches as meaning two, three or four positions and settled on a value of three. In

related work [4, 5, 7, 12] where we surveyed institutions on their hiring outcomes we found those seeking multiple positions responded seeking a median of three positions. Many of the institutions seeking multiple positions are in the U.S. News Rankings of the 100 Best Graduate schools for Computer Science[5]. In the related work we found the median number of four positions being sought by these institutions.

The right-side of Figure 1 shows the total number of positions searched for using a value of four for "multiple position" searches for the top-100 institutions and a value of three for all other institutions. The result is a total of 879 positions, which is a decrease from last year, but in the upper half over the ten years of our studies. We analyze the number of institutions and positions based on the type of institution later in the report.

Finally, in terms of institutions and positions we did encounter additional ads for Computer Scientists that were noted, but not considered in our analysis. We found 33 Dean and Chair leadership searches (up from 23 last year) as well as many faculty searches in other departments. These other departments include traditional fields such as Electrical & Computer Engineering, Information School/Science/Technology, Bio-related, Health and Business. We also observe ads for faculty positions in newer interdisciplinary departments such as Data Science and Cybersecurity. Again for purposes of our study, we only include positions in departments housing Computer Science.

3.2 Results by Topic

In the same way that not all ads list a specific number of positions, it is also the case that not all ads list specific or preferred topics of interest[6]. 311 (74%) of the 423 institutions listed specific topics, similar to last year. In studying particular topics of interest, we only considered the ads from these institutions for our analysis.

In the initial step of our study, we determined the number of times that a specific topic was mentioned in an ad. Thus an ad for a single faculty position with preferred interest for the topics of HCI, Security, Machine Learning and Robotics would count one "mention" for each of these four topics. Another institution looking to focus three positions for the topic of Security would be one mention for Security. A total of 1508 specific topics are mentioned in ads (versus 1678 last year).

While mentioned topics are one metric, another approach is to consider a faculty search as a "vote" for a topic of current and future need. Using this approach a single position with four topics of interest would be investing 0.25 positions for each topic, while three positions focused in a single topic would invest 3.0 positions in that single topic.

The problem with weighting topics based on the number of positions is that not all ads list a specific number of positions. We use the same assumption as previously described for multiple-position searches resulting in a total of 879 "positions" being searched for with 640 (73%) of the positions indicating preferences for specific topics. Figure 2 shows the percentage of mentions and positions for topics with at least one percent for either mentions or positions. They are shown in rank order based on the percentage of positions.

The results show that the topic of Security again accounts for the highest percentage of both mentions and positions, although it accounts for relatively more positions. Security was also the

[5] https://www.usnews.com/best-graduate-schools/top-science-schools/computer-science-rankings

[6] We use the term "topic" to refer to a sub-domain of Computer Science listed in ads and the term "area" to refer to a clustering of topics.

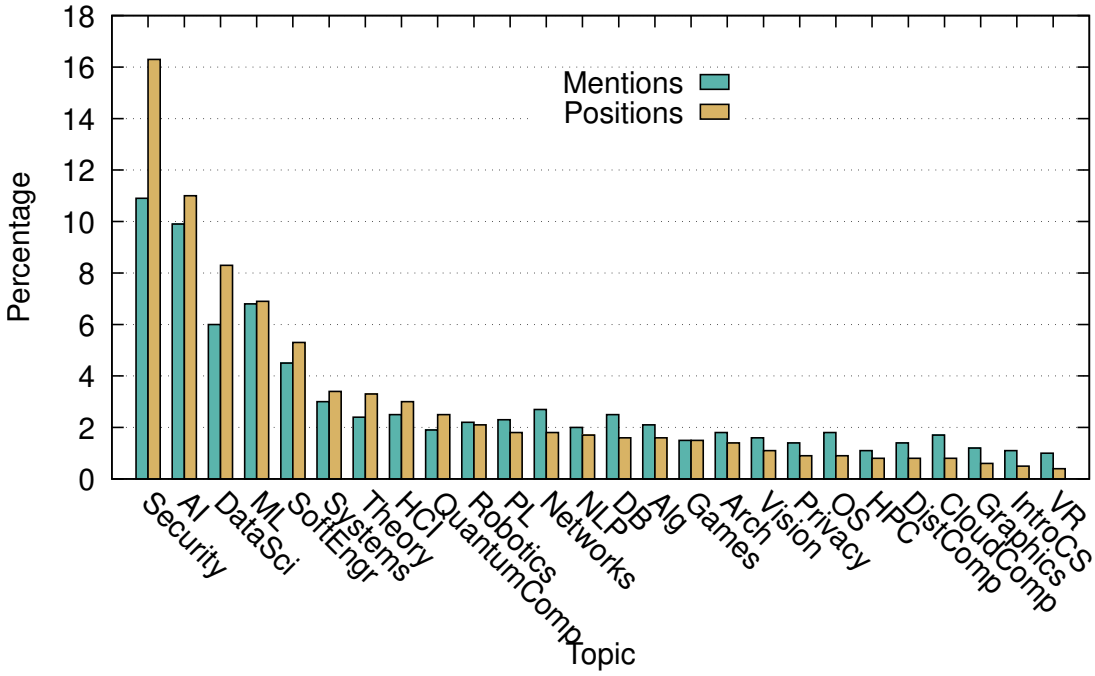

Figure 2: Topic Percentage by Mentions and by Positions

top topic for each metric the past many years. AI moved up in the year's topics to be second in the percentage of both mentions and positions. Machine Learning and Data Science switch between third and fourth in terms of percentage of mentions and positions. Software Engineering is fifth in both the percentage of mentions and positions. Other topics with smaller percentages, but bigger increases relative to last year in the percentage of positions include HCI and Games.

3.3 Clustering Topics into Areas

Figure 2 does not show topics that appear less frequently in ads nor does it group similar topics, such as Data Science and Data Analytics or Security and Privacy. To address these issues, we clustered topics into 16 areas. These clustered areas and the set of topics constituting the area are shown in Table 1. Topics with a small number of mentions and not clearly fitting into a cluster are included in two other clusters—one with topics in traditional Computer Science (OtherCS) and one with topics more interdisciplinary in nature (OtherInter). These are the same clustered areas as used in previous studies.

3.4 Results Based on Clustered Areas

Given the clustered areas in Table 1, Figure 3 shows the same results as Figure 2 except it uses the 16 areas rather than the topics directly. The areas are again ordered by percentage of positions. This year the clustered area of AI/DM/ML has the highest percentage of mentions (21%) and positions (21%). The Security clustered area has the second highest percentage of mentions (13%) and positions (18%). Data Science has the third highest percentage of positions (10%) with

Table 1: Topics Grouped in Each Clustered Area

Area	Constituent Topics
AI/DM/ML	Artificial Intelligence, AI Ethics/Fairness/Explanability, Computational Linguistics, Data Mining, Deep Learning, Explainable AI, Generative AI, Large-Language Models, Machine Learning, Natural Language Processing, Optimization, Reinforcement Learning, Responsible AI
Arch	Architecture, Computer Organization, Hardware
Compiler/PL	Compilers, Programming Languages
CompSci	Bioinformatics, Biomedical, Computational Biology, Computational Medicine, Computational Neuroscience, Computational Science, Network Science, Scientific Computation
DataSci	Big Data, Computational Analytics, Data Analytics, Data Engineering, Data Science Visual Analytics, Visual Computing, Visualization
DB	Databases, Data Management, Information Systems
HCI/IntMedia	Accessibility, Augmented Reality, Assistive Technology, Computer-Supported Cooperative Work, Games, Human-Computer Interaction, Immersive Computing, Metaverse, Multimedia, Novel Computing, Virtual Reality
ImageSci	Graphics, Image Processing, Vision
Mobile	Human-Centered Computing, Mobile Systems, Ubiquitous Computing
Robotics/CPS	Autonomous/Vehicular Systems, Cyber-Physical Systems, Digital Twins, Embedded Systems, Human-Robotic Interaction, Intelligent Systems, Internet of Things, RealTime Computing, Robotics, Sensors, Smart Cities, Smart Systems
Security	Cryptography, Forensics, Privacy, Security, Trusted Computing
SoftEngr	Software Development, Software Engineering
Sys/Net	Cloud Computing, Data Centers, Distributed Computing, Edge Computing, High Performance Computing, Infrastructure, Main Frame Computing, Networking, Operating Systems, Parallel Computing, Storage, System Analysis, Systems
Theory/Alg	Algorithms, Discrete Math, Formal Methods, Logic, Quantum Computing, Theory, Verification
OtherCS	Applied Computing, CS Education, Data Structures, Ethics, Informatics, Information Technology, Information Science, Information Technology, Introductory CS, Modeling, Next Generation Computing, Simulation, Social Implications, Social Computing, Software, Speech Recogniton, Web Technologies
OtherInter	Atmospheric Science, Computer Engineering, Computational Environmental Science, Computational Math, Computational Photography, Computational Social Science, Creative Computing, Development Operations, Digital Artifacts, Digital Health, Equity, Financial Technology, Generative Art, Health, Health Informatics, Inclusive Design, Interdisciplinary, Learning Science, Music, Public Policy, Social Justice, Spatial Computing, Statistics

Systems/Networking having the third highest percentage of mentions (13%) and the fourth most positions (9%).

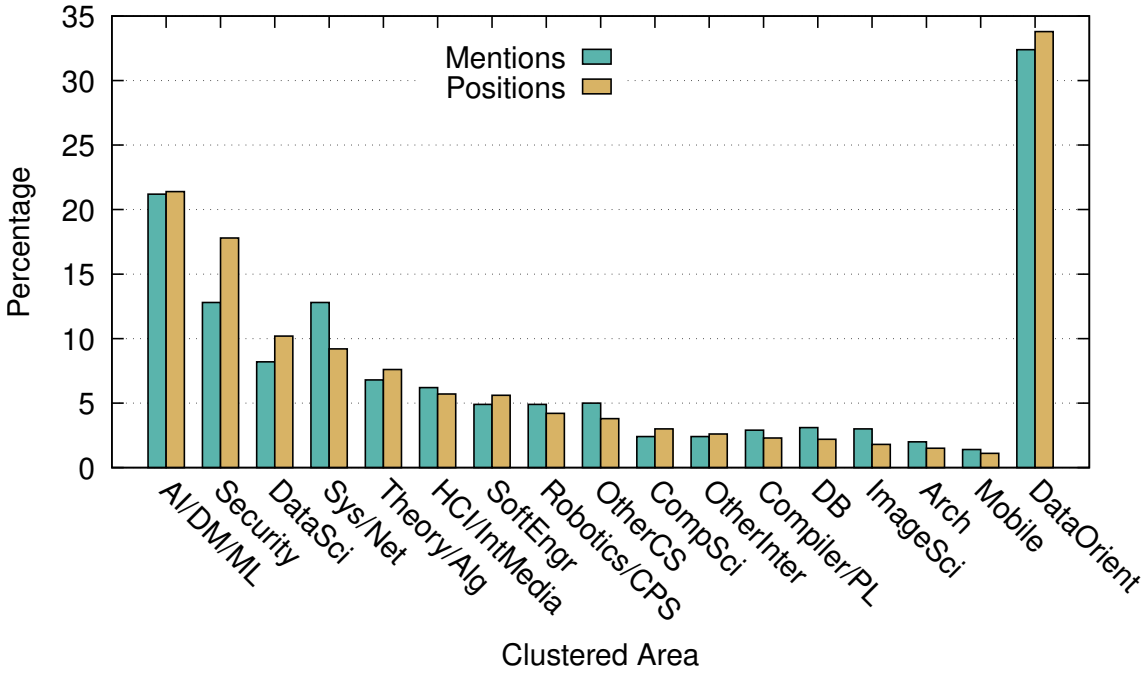

Figure 3: Clustered Area Percentage by Mentions and Positions

The right-most clustered area in Figure 3 is the Data Oriented cluster that further aggregates results for the DataSci, AI/DM/ML and DB clusters. This aggregated cluster was introduced because of overlap between the three data-oriented clusters while still retaining the three distinct clusters as defined in Table 1. As shown in the figure, this aggregated cluster accounts for 32% of mentions and 34% of positions.

3.5 Results Comparison with Previous Years

Figure 4 shows a more complete comparison of clustered area results based on percentage of positions for the past five years of our studies. Clustered areas are ordered based on 2024 percentages.

The results shows the percentage of positions being sought in the AI/DM/ML area jumped to a five-year (as well as a ten-year) high reflecting and leading the growing impact of AI on society. The percentage of positions being targeted for Security hires dropped to 18% this year, which is representative of the past five years. The DataSci area again ranks third, although its percentage is the lowest in five years. HCI/IntMedia shows a significant gain over last year. Both the Sys/Net and SoftEngr clusters dropped to a five-year low in percentage of positions being sought. The aggregated DataOrient (AI/DM/ML, DataSci and DB) cluster rose to a five-year (as well as ten-year) high with 34% of all positions being sought for these areas.

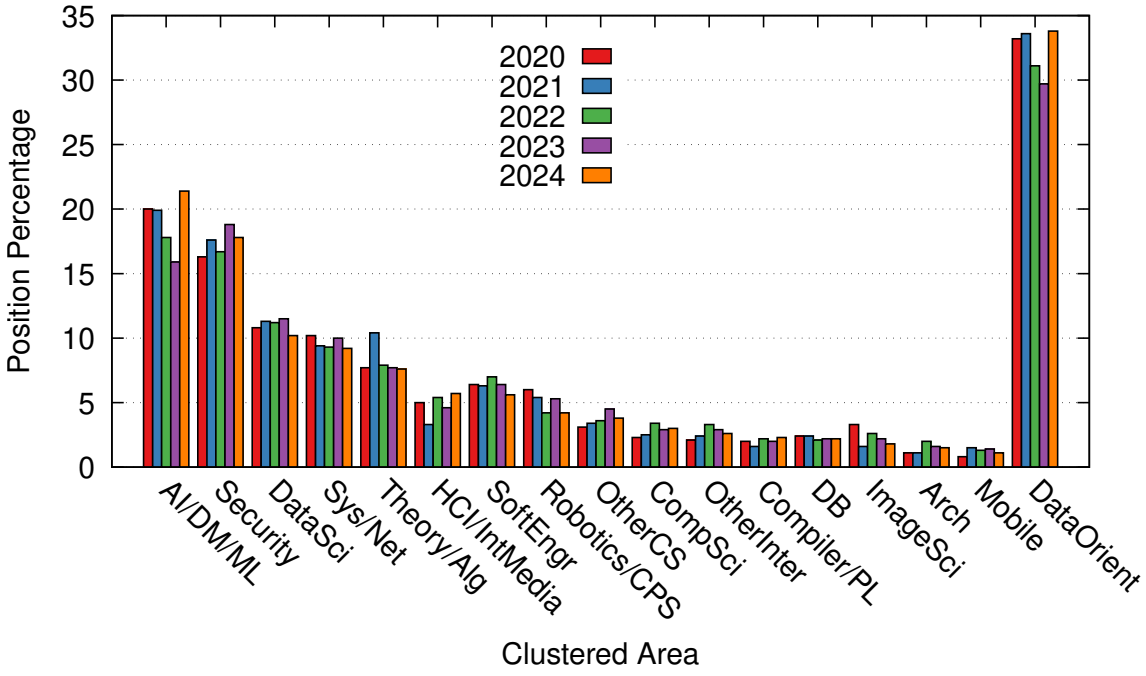

Figure 4: Five-Year Comparison of Clustered Area Percentage by Positions

4 Results by Type of Institution and Highest Degree Offered

As means to better understand the results we augmented the dataset to include additional information about each institution.

4.1 Results by Type of Institution

Table 2 shows a breakdown of results based on whether the institution is public, private or non-U.S.-based. The results show that 221 (52%) of the institutions are public and account for 495 (56%) of the total positions. The percentage of public institutions and positions are similar to last year's study. There are 175 (41%) private institutions accounting for 310 (35%) of positions. The 27 non-U.S.-based institutions account for 6% of the total and 74 (8%) of the positions.

4.2 Results by Highest Degree Offered

We also characterize each institution based on the highest degree it offers. For example, undergraduate-only programs may not have the same needs as PhD programs. For this portion of the study we augmented our dataset to include the highest degree offered by each program—BS/BA, MS or PhD. Our dataset includes 178 PhD institutions—up from 170 last year. In order to study faculty investments at the most prominent U.S. programs, we further subdivided this group by using the U.S. News Rankings of the 100 Best Graduate schools for the top-100 U.S. and then more PhD institutions including those not in the U.S. The "PhD100" list accounts for 90 institutions in our dataset. The remaining PhD programs, including 27 non-U.S.-based, are denoted as "PhDMore."

Table 2: Summary of Position Searches by Institution Type

Institution Type	Number of Institutions	Advertised Number of Positions 1	2	3+	Multiple	Total Positions	% Positions w/ Specific Topic
Public	221	104 (47%)	39 (18%)	30 (14%)	48 (22%)	495	74%
Private	175	119 (68%)	27 (15%)	8 (5%)	21 (12%)	310	69%
Non-U.S.	27	5 (19%)	3 (11%)	5 (19%)	14 (52%)	74	76%
All	423	228 (54%)	69 (16%)	43 (10%)	83 (20%)	879	73%

Table 3 shows summary results based on the four highest degree types. The left-side of Figure 5 shows longitudinal results for the number of institutions searching over a ten-year period. It shows the number of PhD100 institutions seeking tenure-track faculty to be at a ten-year high.

Table 3: Summary of Position Searches by Highest Degree Offered

Institution Type	Number of Institutions	Advertised Number of Positions 1	2	3+	Multiple	Total Positions	% Positions w/ Specific Topic
PhD100	90	17 (19%)	14 (16%)	17 (19%)	42 (47%)	328	74%
PhDMore	88	31 (35%)	15 (17%)	14 (16%)	28 (32%)	210	81%
MS	94	56 (60%)	19 (20%)	9 (10%)	10 (11%)	156	77%
BS/BA	151	124 (82%)	21 (14%)	3 (2%)	3 (2%)	185	58%
All	423	228 (54%)	69 (16%)	43 (10%)	83 (20%)	879	73%

Table 3 reveals differences between the different types of institutions. Ads for 82% of the BS/BA institutions are for a single position while 47% of the ads for PhD100 institutions are for multiple positions, which is smaller than the percentage of 61% last year. The number of PhD100 institutions seeking only one or two positions is 35% compared with 20% last year. As shown, the distributions translate into a total number of 328 positions for PhD100 institutions, which is down from 399 last year. We note that this number is particularly sensitive to the number of positions assumed for "multiple position" searches as nearly half of these searches are not specific in the number of positions being sought.

The right-side of Figure 5 shows ten-year results for the number of positions being searched for by the four types of institutions. It shows that the number of positions being sought by MS and BS/BA institutions are second-most over the past ten years while the number of positions sought by PhD100 and PhDMore institutions are at intermediate levels relative to this time period.

The last column of Table 3 shows that only 58% of positions from BS/BA institutions identify specific areas of interest while 81% of PhDMore institutions do so with the percentages for PhD100 and MS institutions in between. In order to understand differences on areas of interest between different types of institutions for 2024 searches, we break down the results in Figure 3 based upon the type. Figure 6 shows the results (in the same rank order as Figure 3) grouped by the four types

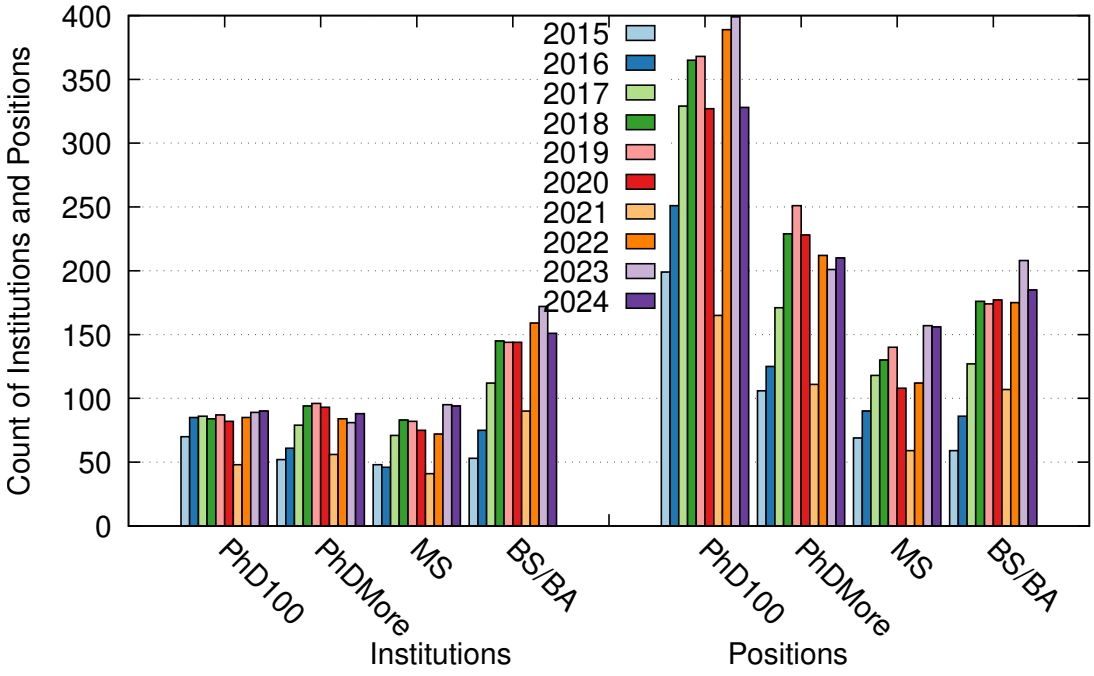

Figure 5: Ten-Year Counts of Institutions Searching and Positions Being Sought by Highest Degree Offered

of institutions.

Figure 6 shows a number of interesting results. AI/DM/ML continues to be of most interest for PhD100 and PhDMore institutions (with Security second). Positions related to Security have the highest percentages for MS and BS/BA institutions (with AI/DM/ML second for MS and DataSci second for BS/BA). DataSci has the third-most positions for MS institutions with AI/DM/ML third-most for BS/BA institutions. The area of Theory/Alg accounts for the third-most positions in each of the PhD100 and PhDMore types while it accounts for much less for MS and BS/BA institutions. In other notable results, The area of SoftEngr is sought by a much higher percentage of MS institutions while Robotics/CPS and CompSci are relatively more popular among PhD100 and PhDMore institutions. Finally, the last set of results show that 35% of positions being sought by PhD100 and BS/BA institutions are for the Data Oriented aggregated cluster with the other types of institutions a bit less.

4.3 Results by Combination of Institution Type and Highest Degree Offered

A third summary of position searches is shown in Table 4 where institutions are classified based on a combination of type and highest degree offered. For this analysis, PhD100 and U.S. PhDMore institutions are combined as are U.S. MS and BS/BA institutions (designated as "MB" in the table and subsequent graphs). The non-U.S. institutions are dropped in this analysis, but their results are shown in Table 2 as well as included in Table 3 and Figure 5.

The results in Table 4 show that public institutions account for the majority of PhD-producing schools while there is a bit higher number of private (over public) MS&BS/BA institutions. 38% of

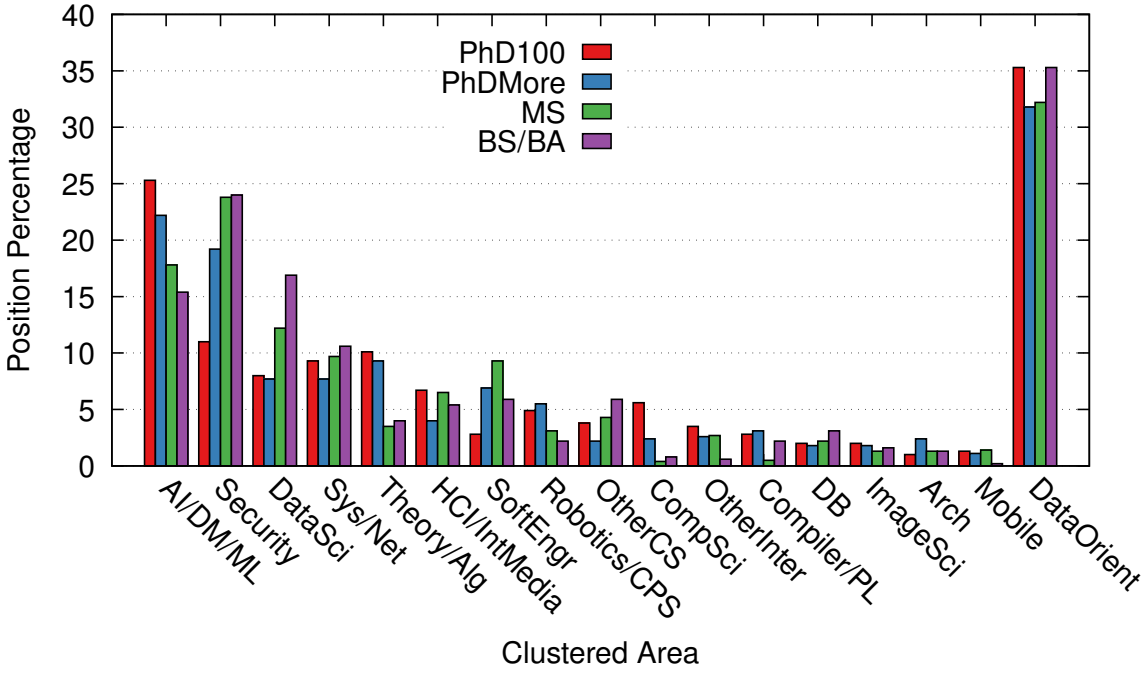

Figure 6: Clustered Area Percentage by Highest Degree Offered

Table 4: Summary of Position Searches by Institution Type and Highest Degree Offered

Institution Type	Number of Institutions	Advertised Number of Positions 1	2	3+	Multiple	Total Positions	% Positions w/ Specific Topic
Pub/PhD	102	25 (25%)	19 (19%)	20 (20%)	38 (37%)	311	75%
Prv/PhD	50	18 (36%)	7 (14%)	6 (12%)	19 (38%)	156	79%
Pub/MB	119	79 (66%)	20 (17%)	10 (8%)	10 (8%)	184	73%
Prv/MB	125	101 (81%)	20 (16%)	2 (2%)	2 (2%)	154	59%
All U.S.	396	223 (56%)	66 (17%)	38 (10%)	69 (17%)	805	72%

private PhD institutions are searching for multiple positions while 76% of PhD institutions (public and private) identify specific topics on interest in their ads. Figure 7 shows ten-year results for the number of institutions searching and the number of positions sought based on this institution classification. The left side of the figure show a ten-year high for the number of public and private PhD institutions searching for tenure-track faculty.

The right side of the figure shows the number of positions sought in 2024 are the second-most in the ten years of our study for public and private MS&BS/BA institutions. However, despite more PhD institutions searching, the number of positions being sought by these institutions are at intermediate levels across the ten-year period. Relative to last year, results in Table 4 show the average number of positions being sought dropped 16% from 3.6 to 3.1 positions per U.S. PhD institution. Again, a caveat is that the high percentage of "multiple position" ads for PhD institutions makes the count highly dependent on the number of positions assumed for such ads.

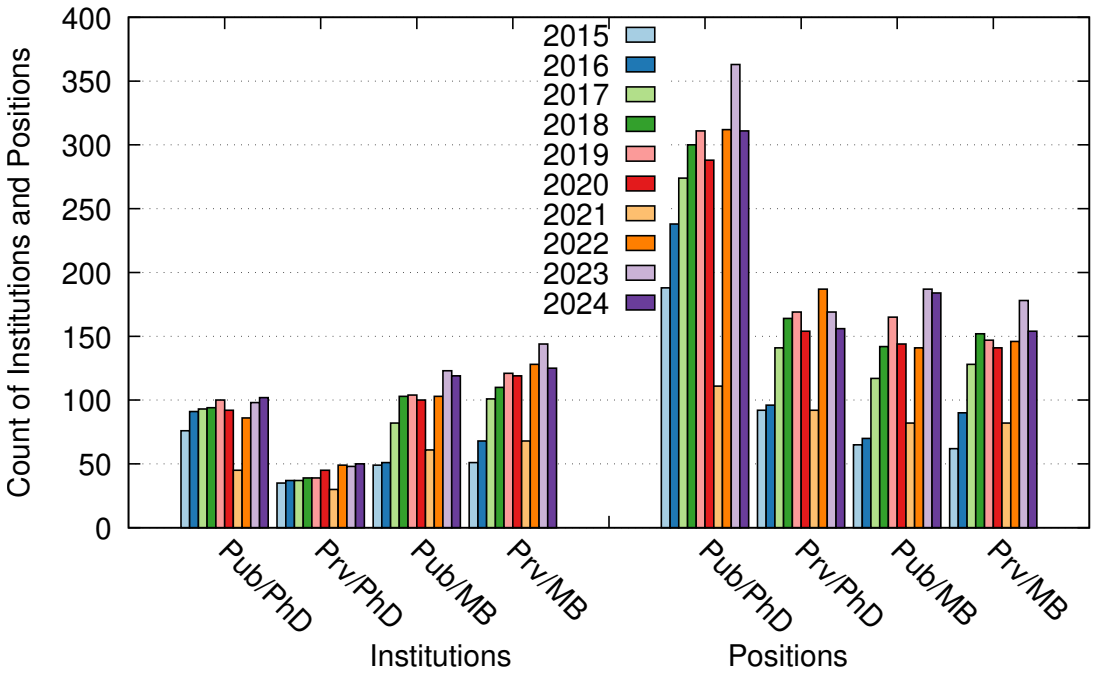

Figure 7: Ten-Year Counts of Institutions Searching and Positions Being Sought by Institution Type and Highest Degree Offered

Figure 8 shows the percentage of positions for each of the clustered areas using this classification for institutions. The figure both shows similarities and differences with results shown in Figure 6. The area of AI/DM/ML is the area of most interest for both public and private PhD institutions while Security is of most interest for both public and private MS&BS/BA institution types. Over 30% of private PhD positions are being sought in AI/DM/ML and over 25% of public MSBS/BA positions are being sought in Security.

The DataSci clustered area has smaller representation for PhD than MS&BS/BA institutions. The Theory/Alg area is of most interest for public PhD institutions while SoftEngr is relatively higher for public MS&BS/BA institutions. The last set of results in Figure 8 shows that 39% of

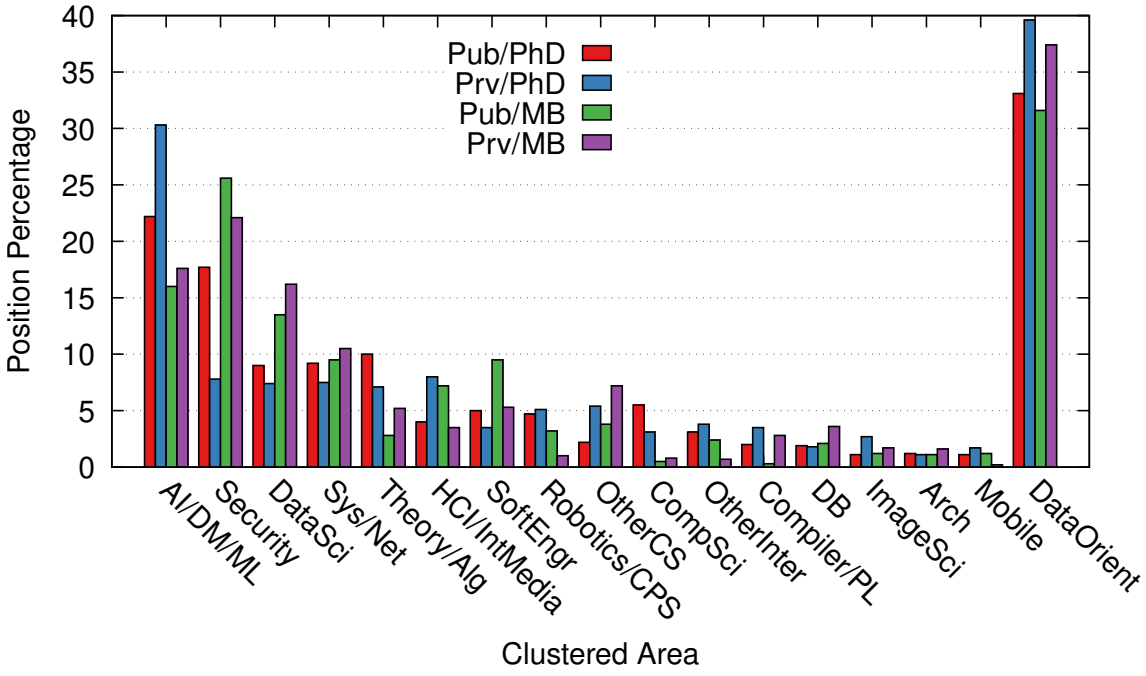

Figure 8: Clustered Area Percentage by Institution Type and Highest Degree Offered

positions for private PhD institutions are in the Data Oriented cluster with 33% for public PhD, 37% for private MS&BS/BA, and 32% for public MS&BS/BA institutions.

5 Summary and Future Work

This work uses the same methodology applied over ten years to study where Computer Science departments are choosing to invest faculty positions using data obtained from advertised tenure-track searches for the current hiring season. While the number of and areas for faculty searches does not necessarily translate into the same for faculty hires, we believe that they provide insight into current and future needs within the discipline.

We analyzed ads from 423 institutions seeking to fill 865 tenure-track faculty positions in Computer Science. The number of institutions is a drop from last year's record number year at this time (mid-November), but is still the second-highest number of institutions searching in the ten years of this study. In contrast, the number of tenure-track positions being sought are at intermediate levels for the ten-year time period. The relative drop in positions being sought compared to last year's record high in positions is primarily due to a 16% reduction in the average number of positions being sought per each U.S. PhD-granting institution.

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of HCI/Interactive Media shows a significant gain over last year. Both the Systems/Networking and Software Engineering clusters dropped to a five-year low in percentage of positions being sought. Aggregating the Data Science, AI/DM/ML and Databases clusters results in 34% of all hires sought in these data-oriented areas, which is a ten-year high.

Differences are also seen when analyzing results based on the type of institution. As was the case last year, positions in the clustered area of AI/DM/ML have the highest percentages for (particularly private) PhD institutions. Again positions related to Security have the highest percentages for MS and BS/BA institutions. Security is the second-most sought area for public PhD institutions while HCI/IntMedia is the second-most sought area for private PhD institutions. AI/DM/ML is the second-most sought area for MS for BS/BA institutions.

A continued direction for future work is to examine how these searches translate into actual hires. Results for the number of hires, but without areas, for only U.S. PhD-granting is published as part of Taulbee survey results [15]. Follow-up on the number and areas of new hires across all institution types was previously done with a survey of department and search chairs [4, 5, 7, 12]. New faculty hires could also be identified and surveyed directly to learn their area as well as pathway to becoming a faculty member. Another direction to extend the work is to examine faculty hiring in areas such as Data Science that reside outside of departments housing Computer Science Examination of faculty hiring for teaching-track positions is also a potential direction of future work.

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