Analysis of Current and Future Computer Science Needs via Advertised Faculty Searches for 2019

Craig E. Wills

Professor and Department Head
Computer Science Department
Worcester Polytechnic Institute
Worcester, MA 01609

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Abstract

This work uses the same methodology as work over the past five years to study where Computer Science departments are choosing to invest faculty positions by examining data obtained from advertised faculty 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 409 institutions seeking to fill hundreds of tenure-track faculty positions in Computer Science. There was a small one-year increase in the number of institutions searching but there has been a 83% increase over the five years of our studies. The number of tenure-track positions sought shows a one-year increase of 5% and a 118% increase over the five years.

We clustered the specific Computer Science topics mentioned in ads into 16 areas. As part of our work this year we compared this classification with other classifications from the CRA, csrankings.org, csmetrics.org and arXiv.org, which resulted in small adjustments to our classification.

In terms of specific areas, we found that the clustered areas of Security, AI/Data Mining/Machine Learning and Data Science are the areas of greatest investment. Aggregating the Data Science, AI/DM/ML and Databases clusters again resulted in close to one-third of all hires sought in these data-oriented areas. We found that roughly 25-60% of all hires are for areas that are, or may be, interdisciplinary in nature.

Differences are also seen when analyzing results based on the type of institution. Positions related to Security have the highest percentages for all but top-100 institutions. The area of Artificial Intelligence/Data Mining/Machine Learning is of most interest for top-100 PhD institutions. Roughly 35% of positions for PhD institutions are in data-oriented areas. The results show a strong interest in data-oriented areas by public PhD and private PhD&MS&BS institutions while public MS&BS institutions are most interested in Security.

1 Introduction

The wealth of faculty searches in Computer Science during this hiring season for tenured and tenure-track positions starting in 2019 again affords the opportunity to study areas of Computer Science where departments are choosing to invest in new faculty hires. This is the fifth 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]. The longitudinal aspect also allows insight into the number of positions and the areas being sought over time.

The primary focus of this work is 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.

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 missed or may 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 an assumption on the number of positions being sought.

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

As in past years, we used three 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], and the Chronicle of Higher Education Vitae site[3]. We again augmented these sources with positions posted on the SIGCSE mailing list, which often includes ads for more undergraduate-focused institutions. We considered ads posted on these venues between August 2018 and mid-November 2018, 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 non-tenure-track positions such as lecturers, instructors or researchers and we only considered institutions awarding at least a BS degree. 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

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

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

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

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 409 institutions (364 are in the U.S.). 306 (75%) 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 [6] found searches for 406 institutions (356 in the U.S.) with 78% of these institutions indicating a specific number of positions being searched for.

The left-side of Figure 1 shows five-year results for the number of institutions searching for tenure-track faculty. It shows only a 1% increase over the past year, but a 83% increase over the five years of our studies.

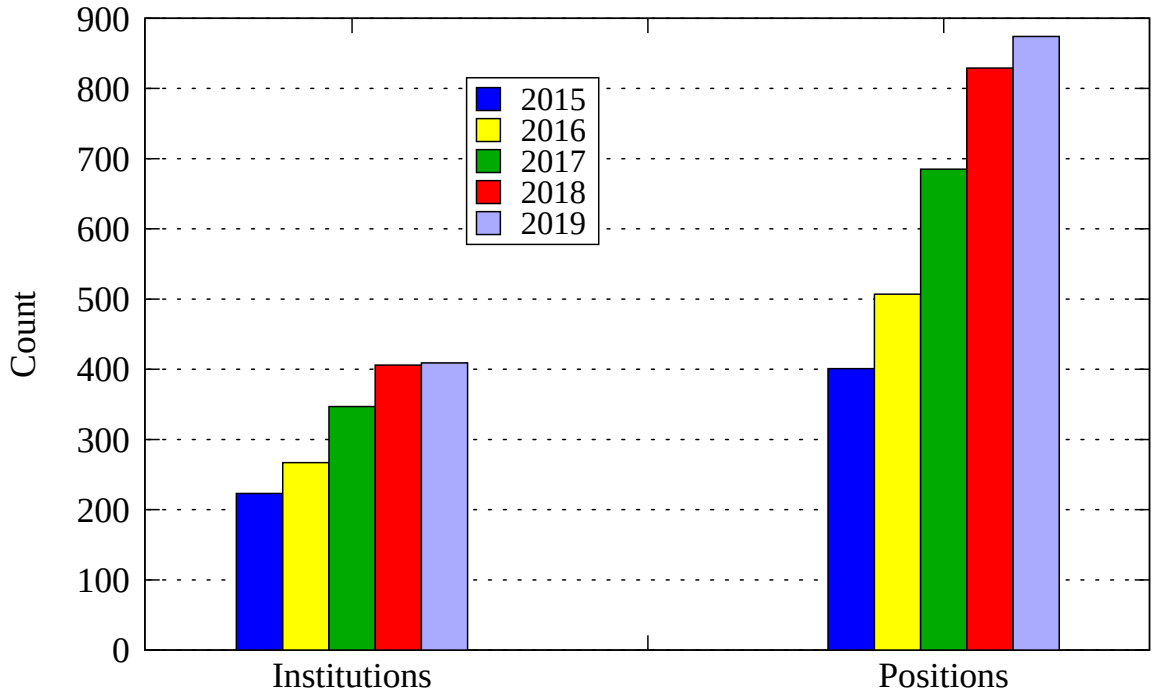

Figure 1: Five-Year Results for Number of Institutions Searching and Total Number of Positions Being Sought

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] where we surveyed institutions on their hiring outcomes we found those seeking multiple positions responded seeking a median of 3 and mean of roughly 3.5 positions. The right-side of Figure 1 shows the total number of positions searched for using a value of three

for "multiple position" searches for a total of 874 positions. This value represents a 5% one-year increase and a 118% increase over the five years of our studies.

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 19 Dean and Chair searches (down from 27 last year) as well as many faculty searches in other departments. These other departments include Electrical & Computer Engineering, Information School/Science/Technology, Bio-related, Health and Business. Ads found for these other departments were not considered in our analysis.

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[4]. 306 (75%) of the 409 institutions listed specific topics, similar to the 76% from 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 1512 specific topics are mentioned in ads (versus 1289 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 again use the fixed value of three for multiple-position searches resulting in a total of 874 "positions" being searched for with 677 (77%) 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 accounts for the highest percentage of both mentions and positions, although it accounts for relatively more positions. Security was also the top topic for each metric the past two years. Data Science is the topic with the second highest percentage of mentions and positions. AI is third in percentage of positions and Machine Learning is third in percentage of mentions.

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 Big Data. 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

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

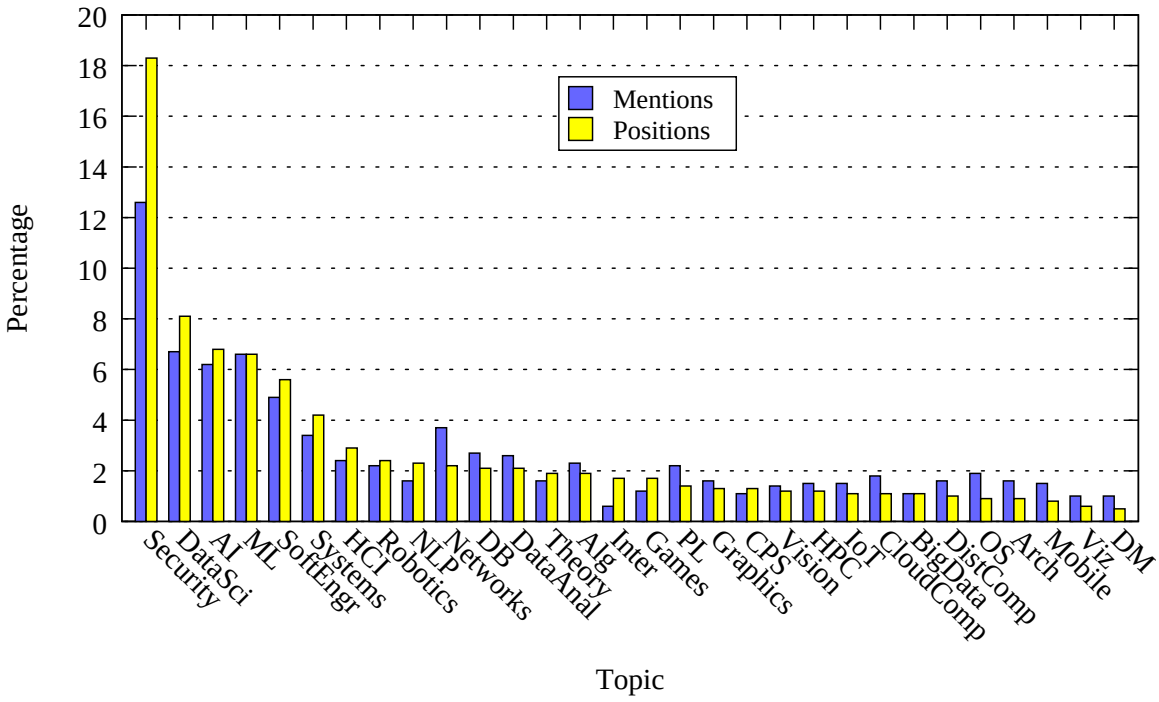

Figure 2: Topic Percentage by Mentions and by Positions

clusters—one with topics in traditional Computer Science (OtherCS) and one with topics more interdisciplinary in nature (OtherInter). In comparison to clusters used in previous years, there were a few changes made in the mapping of topics to clustered areas. In addition, the two smallest clustered areas from previous years (in terms of percentage of positions sought) were merged with other areas in this year's study. Bioinformatics was added as a topic to the Computational Science area and Games, which included interactive media, was merged with HCI to form an HCI/Interactive Media area.

Table 1 represents one categorization of the Computer Science topics seen in tenure-track faculty ads. Similar categorizations have been done for CS topics in four other known contexts:

1. CRA Hiring Categories—job announcements can be searched for using 23 provided categories on the CRA job site. A similar set of categories is used in the Taulbee report [7] to identify specialties of PhD-producing Computer Science departments.

2. `csrankings.org`—this site ranks Computer Science departments "based on the number of publications by faculty that have appeared at the most selective conferences in each area of computer science." The conferences are classified into 26 areas (categories).

3. `csmetrics.org`—this site also ranks Computer Science departments by considering publications that appear in venues, which are grouped by discipline categories. The venues are classified into 33 categories.

4. `arXiv.org/cs`—this site is a "highly-automated electronic archive and distribution server for research articles." Computer Science is one of the covered areas. This portion of the site

Table 1: Topics Grouped in Each Clustered Area

Area	Constituent Topics
AI/DM/ML	Artificial Intelligence, Computational Linguistics, Data Mining, Deep Learning, Knowledge Representation, Machine Learning, Natural Language Processing, Optimization
Arch	Architecture, Computer Organization, Hardware
Compiler/PL	Compilers, Programming Languages
CompSci	Biological Computing, Biomedical, Bioinformatics, Computational Biology, Computational Life Science, Computational Neuroscience, Network Science, Neuro Engineering, Numerical Analysis, Scientific Computation
DataSci	Big Data, Data Analytics, Data Engineering, Data Science, Visualization
DB	Databases, Data Management, Information Management, Information Retrieval
HCI/IntMedia	Augmented Reality, Accessibility, Animation, Computer-Supported Cooperative Work, Cognitive Science, Digital Media, Disability Technology, Games, HCI, Immersive Systems, Interactive Computing, Multimedia, Virtual Reality
ImageSci	Graphics, Image Processing, Medical Imaging, Vision
Mobile	Human-Centered Computing, Mobile Systems, Ubiquitous Computing
Robotics/CPS	Autonomous/Vehicular Systems, Cyber-Physical Systems, Embedded Systems, Intelligent Systems, Internet of Things, Real-Time Systems, Robotics
Security	Block Chain, Cryptography, Forensics, Information Assurance, Malware, Privacy, Reverse Engineering, Risk Analysis, Security, Trusted Computing
SoftEngr	Software Engineering, Software Systems
Sys/Net	Cloud Computing, Computer Systems, Distributed Computing, High Performance Computing, Infrastructure, Networking, Operating Systems, Parallel Computing, Storage Systems, System Analysis, Systems
Theory/Alg	Algorithms, Computational Geometry, Formal Methods, Logic, Theory, Verification
OtherCS	Analysis, CS Education, Data Structures, Information Technology, Informatics, Introductory CS, Modeling, Next Generation Computing, Quantum Computing, Simulation, Social Computing, Software, Speech Recognition, Web Technologies
OtherInter	Computer Engineering, Electrical Engineering, Environmental Informatics, Financial Technology, Health, Health Informatics, Intelligent Tutoring, Interdisciplinary, Learning Science, Operations Research, Systems Engineering

classifies articles into 40 categories within Computer Science

The mapping of categories from these other categorizations with the 16 areas used in our study are shown in Table 2. There is generally a good correspondence, but as would be expected for classifications developed by different groups for different purposes, there are variations. For example, some of the categories in Table 2 map across multiple clustered areas. Most such instances (which are indicated with a '*'), map across two areas, but the "AI/Machine Learning/Robotics/Vision" for CRA Hiring is mapped across three areas—AI/DM/ML, Image Science and Robotics/CPS. The area of DataSci has almost no mapped categories, although it frequently is an area mentioned in faculty ads. Topics such as AI, Machine Learning and Data Mining are often included for Data Science, but these topics are also relevant for other areas and thus represented as their own area in our classification.

The comparison of CS categorizations did influence the mapping change of some topics to areas in Table 1 as well as the removal of the areas of Bioinformatics and Games, which was not listed in any other categorization. Although not a focus of our study, the comparisons in Table 2 shows the need for classifications to evolve over time as the field itself evolves and grows.

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. It shows that the Security clustered area has the highest percentage of positions (20%), but AI/DM/ML has the highest percentage of mentions (16%). Data Science has the third highest percentage of positions with Sys/Net having the third highest percentage of mentions.

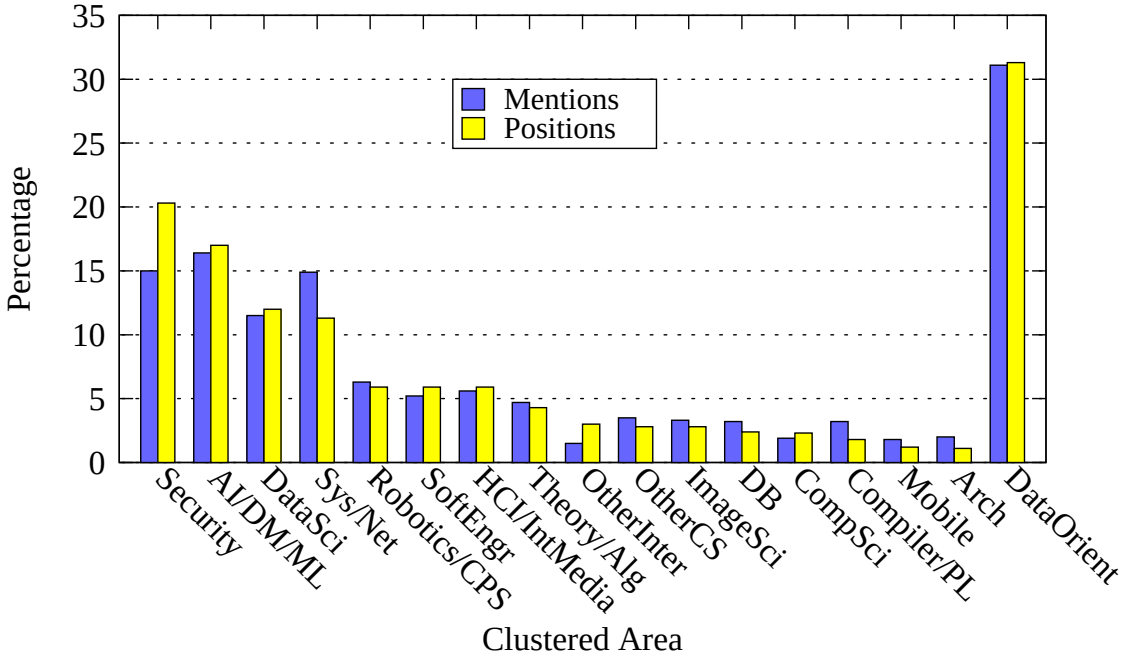

Figure 3: Clustered Area Percentage by Mentions and Positions

Table 2: Mapping of Other Computer Science Categorizations to the Clustered Areas

Clustered Area	CS Categorization (Count of Categories)			
	CRA Hiring (23)	csrankings.org (26)	csmetrics.org (33)	arXiv.org/cs (40)
AI/DM/ML	AI/Machine Learning/Robotics/Vision*, Databases/Information Retrival/Data Mining*	AI, Machine Learning/Data Mining, Natural Language Processing	AI, Data Mining, Machine Learning, Natural Language Processing	AI, Computation and Language, Databases*, Machine Learning, Multi-Agent Systems, Neural and Evolutionary Computing
Arch	Hardware/Architecture	Computer Architecture	Architecture	Hardware Architecture
Compiler/PL	Programming Languages/Compilers	Programming Languages	Programming Languages	Programming Languages
CompSci	Computational Biology, Computational Neuroscience, Numerical/Scientific Computing/HPC*, Synthetic Biology	Comp Bio/Bioinformatics	Bioinformatics	Computational Engineering, Finance and Science*, Numerical Analysis
DataSci	Graphics/Visualization*	Visualization		
DB	Databases/Info Retrieval/Data Mining*, Information Systems/Information Science*	Web/Info Retrieval*, Databases	Databases, Info Retrieval	Databases*, Info Retrieval
HCI/IntMedia	HCI/CSCW	Human-Computer Interaction	Human Computer Interaction, Multimedia	Human-Computer Interaction, Multimedia, Sound
ImageSci	AI/ML/Robotics/Vision*, Graphics/Visualization*	Computer Vision, Computer Graphics	Graphics, Vision	Computer Vision/Pattern Recognition, Graphics
Mobile	Mobile/Ubiquitous/ Embedded Computing*	Mobile Computing	Mobile	
Robotics/CPS	AI/ML/Robotics/Vision*, Mobile/Ubiquitous/ Embedded Computing*	Embedded/Real-Time Systems, Robotics	Embedded/Real-Time*, Robotics	Robotics, Systems and Control
Security	Info Assurance/Security/ Privacy/Cryptography	Computer Security, Cryptography	Cryptography, Security	Cryptography/Security
SoftEngr	Software Engineering	Software Engineering	Software Engineering	Software Engineering
Sys/Net	Networks/Operating Systems, Numerical/Scientific Computing/HPC*	Computer Networks, HPC, Measurement/Performance Analysis, Operating Systems	Distributed Systems, Embedded/Real-Time*, HPC, Networks, Operating Systems, Parallel Computing, Performance Analysis, Systems	Distributed/Parallel/Cluster Computing, Networking and Internet Architecture, Operating Systems, Performance
Theory/Alg	Theory/Algorithms	Algorithms/Complexity, Logic/Verification	Algorithms, Theory, Verification	Computational Complexity, Computational Geometry, DataStructures/Algorithms, Discrete Math, Formal Languages/Automata Theory, Logic
OtherCS	CS Education, CS/CE, Other, Quantum Computing, Social Computing/Social Informatics	Web/Info Retrieval*, Design Automation	Design Automation, Web Technologies, Other	Game Theory, Computers and Society, General Literature, Other Computer Science, Social and Information Networks, Symbolic Computation
OtherInter	Technology Policy, Information Systems/Information Science*	Economics and Computation	Circuits	Computational Engineering, Finance and Science*, Digital Libraries, Emerging Technologies, Information Theory, Mathematical Software

* Indicates a category that is mapped to more than one clustered area.

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 31% of both mentions and 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 each of the five years of our studies. Clustered areas percentages for all years were determined based on the 2019 clustering of topics shown in Table 1. Clustered areas are ordered based on 2019 percentages.

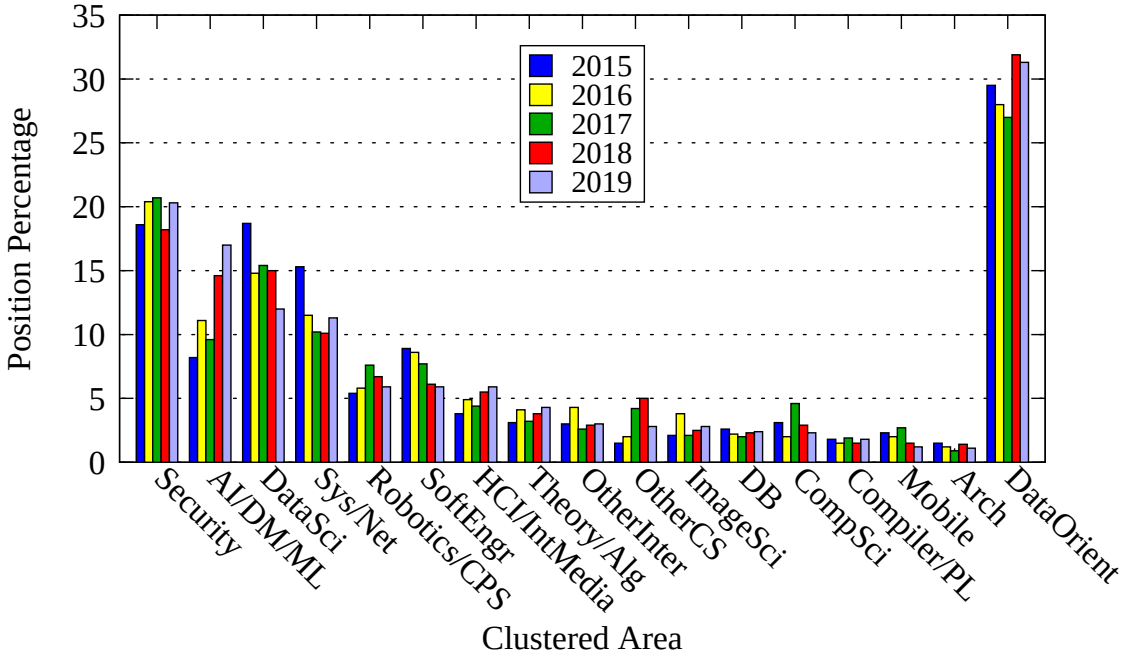

Figure 4: Five-Year Comparison of Clustered Area Percentage by Positions

The results show the percentage of positions are being targeted for Security hires has been the highest, or close to it, for each of the five years. The percentage of positions for the AI/DM/ML clustered area has more than doubled during this time. Many of these positions have been taken from the area of DataSci, which has generally dropped in percentage over the five years, although it is still the third highest. The Sys/Net clustered area has generally dropped in percentage, although it is a bit up this year. The percentage of positions in SoftEngr has dropped each year and it has a comparable percentage to Robotics/CPS and HCI/IntMedia, which has grown its percentage over the five years. Among the remaining areas for 2019, Theory/Alg is at its highest percentage (4%) and Mobile is at its lowest percentage (1%) over the five years.

3.6 Results for Interdisciplinary Clustered Areas

Another question we again examined is how the interdisciplinary nature of Computer Science is affecting hiring. Specific clusters in Table 1 that are more interdisciplinary include the Data Science, Robotics/CPS, Computational Science, and Other Interdisciplinary clusters. Combining the results for these clusters from Figure 3 shows that 23% of the positions are for these more interdisciplinary areas. Moreover, other clusters such as AI/DM/ML and Security either support interdisciplinary work or may include work with other disciplines. Including these two clusters, which have some amount of interdisciplinary nature, results in up to 61% of the positions being interdisciplinary in nature. The total percentages are comparable to the previous year results.

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 3 shows a breakdown of results based on whether the institution is public, private or non-U.S.-based. The results show that 204 (50%) of the institutions are public and account for 447 (51%) of the total positions. The included non-U.S.-based institutions tend towards seeking higher numbers of positions.

Table 3: 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	204	87 (43%)	45 (22%)	27 (13%)	45 (22%)	447	83%
Private	160	104 (65%)	20 (12%)	4 (2%)	32 (20%)	286	65%
Non-U.S.	45	9 (20%)	5 (11%)	13 (29%)	18 (40%)	141	87%
All	409	200 (49%)	70 (17%)	44 (11%)	95 (23%)	874	77%

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, MS or PhD. Our dataset includes 183 PhD institutions—up from 178 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[5], which were updated in 2018, for the top-100

[5] http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-science-schools/computer-science-rankings

U.S. and then more PhD institutions including those not in the U.S. The "PhD100" list accounts for 87 (vs. 84 last year) institutions in our dataset. The remaining PhD programs, including 44 non-U.S.-based, are denoted as "PhDMore." Table 4 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 five-year period.

Table 4: 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	87	7 (8%)	15 (17%)	16 (18%)	49 (56%)	309	76%
PhDMore	96	30 (31%)	13 (14%)	17 (18%)	36 (38%)	251	88%
MS	82	42 (51%)	26 (32%)	9 (11%)	5 (6%)	140	88%
BS	144	121 (84%)	16 (11%)	2 (1%)	5 (3%)	174	56%
All	409	200 (49%)	70 (17%)	44 (11%)	95 (23%)	874	77%

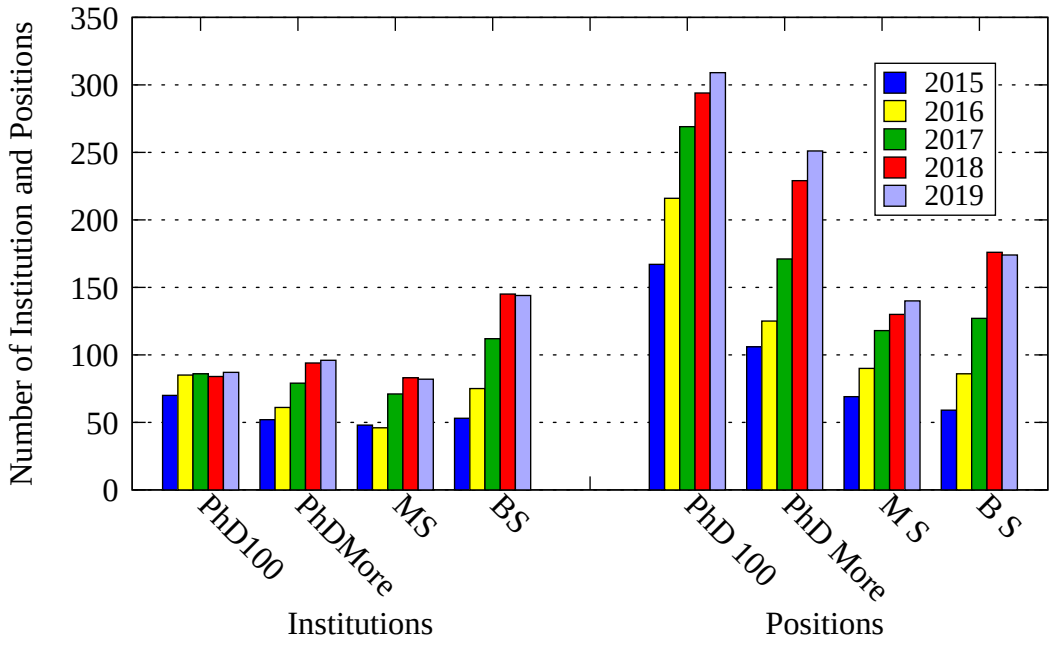

Figure 5: Five-Year Counts of Institutions Searching and Positions Being Sought by Highest Degree Offered

Table 4 reveals differences between the different types of institutions. Ads for 84% of the BS institutions are for a single position while 56% of the ads for PhD100 institutions are for multiple positions. The overall percentages are generally comparable as last year.

As shown, the distributions translate into a total number of 309 positions for PhD100 institutions. We note that this number is particularly sensitive to the number of positions assumed for "multiple position" searches as over half of these searches are not specific in the number of positions being sought. The right-side of Figure 5 shows five-year results for the number of positions being searched for by the four types of institutions. It shows that the number of positions for BS institutions did not increase from previous years.

The last column of Table 4 shows that only 56% of positions from BS institutions identify specific areas of interest while 88% of PhDMore and MS institutions do so with the percentages for PhD100 institutions in between. In order to understand differences on areas of interest between different types of institutions for 2019 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 of institutions.

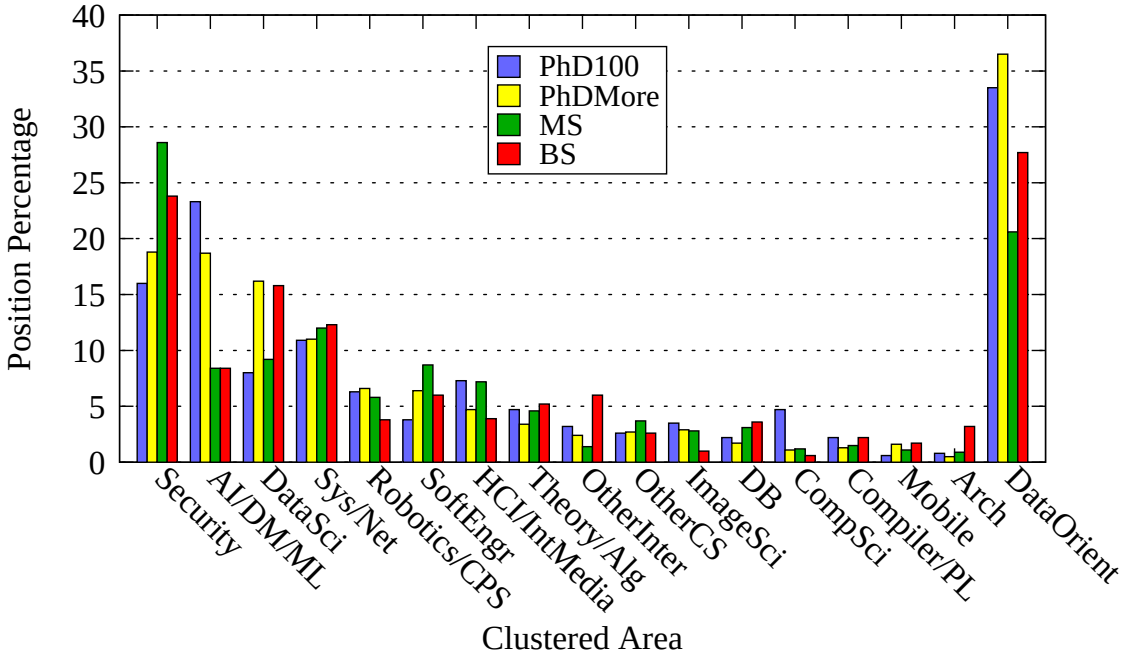

Figure 6: Clustered Area Percentage by Highest Degree Offered

Figure 6 shows a number of interesting results. Positions related to Security have the highest percentages for all but PhD100 institutions. AI/DM/ML is of most interest for PhD100 institutions and is also of much interest for PhDMore institutions. DataSci accounts for a much higher percentage of positions for PhDMore and BS institutions with roughly half the number for PhD100 and MS institutions. These results translate into roughly 35% of positions being sought by PhD-granting institutions (a bit higher for PhDMore) are for the Data Oriented aggregated cluster, while roughly 21% of positions for MS and 28% for BS institutions are in the Data Oriented cluster.

In terms of other clustered areas, the Systems/Networking area is the next most of interest to all types of institutions. HCI/Interactive Media is next most of interest for PhD100, Robotics/CPS for PhDMore, Software Engineering for MS and other interdisciplinary for BS institutions.

4.3 Results by Combination of Institution Type and Highest Degree Offered

A third summary of positions searches is shown in Table 5 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. The non-U.S. institutions are dropped in this analysis, but their results are shown in Table 3 as well as included in Table 4 and Figure 5.

Table 5: 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	100	25 (25%)	18 (18%)	17 (17%)	40 (40%)	282	82%
Prv/PhD	39	3 (8%)	6 (15%)	3 (8%)	27 (69%)	139	76%
Pub/MSBS	104	62 (60%)	27 (26%)	10 (10%)	5 (5%)	165	84%
Prv/MSBS	121	101 (83%)	14 (12%)	1 (1%)	5 (4%)	147	54%
All U.S.	364	191 (52%)	65 (18%)	31 (9%)	77 (21%)	733	76%

The results in Table 5 show that public institutions account for the clear majority of PhD-producing schools while there is a higher number of private MS&BS institutions. Nearly 70% of private PhD institutions are searching for multiple positions while over 80% of public PhD and MS&BS institutions identify specific topics on interest in their ads. Figure 7 shows five-year results for the number of institutions searching and the number of positions sought based on this institution classification. In particular, the number of positions sought (right side of figure) generally increases each year over the five years except for private PhD and MS&BS positions this year. Again, a caveat is that the high percentage of "multiple position" ads for private PhD institutions makes the count highly dependent on the number of positions assumed for such ads.

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. While Security is again the area of most interest for three of the institution type combinations, it is represented by a much lower percentage (12%) for private PhD institutions. In contrast, the area of AI/DM/ML accounts for 28% of the positions for private PhD institutions, 18% for public PhD institutions and a much lower percentage for MS&BS institutions. Interestingly, Data Science accounts for a relatively high percentage (22%) of positions for private BS institutions. The end result is that 39% of positions for private PhD institutions are in the Data Oriented cluster with 34% for private MS&BS, 31% for public PhD and only 17% for public MS&BS institutions. Other notable results include Systems/Networking as a relatively low percentage area for private PhD institutions and Software Engineering as a relative high percentage area for public MS&BS institutions.

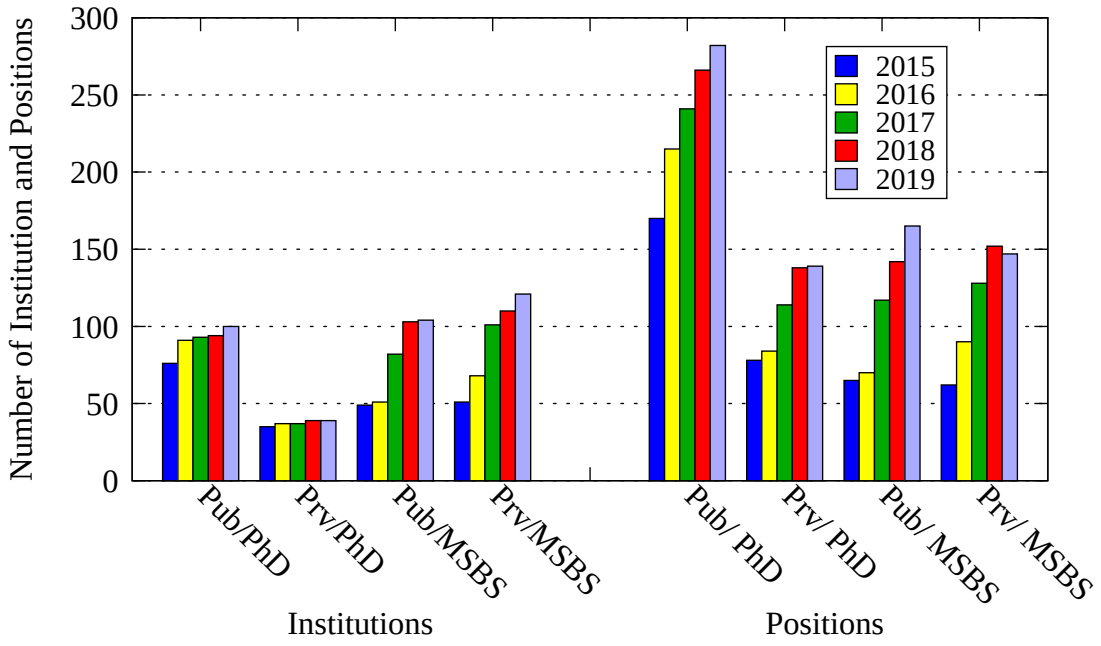

Figure 7: Five-Year Counts of Institutions Searching and Positions Being Sought by Institution Type and Highest Degree Offered

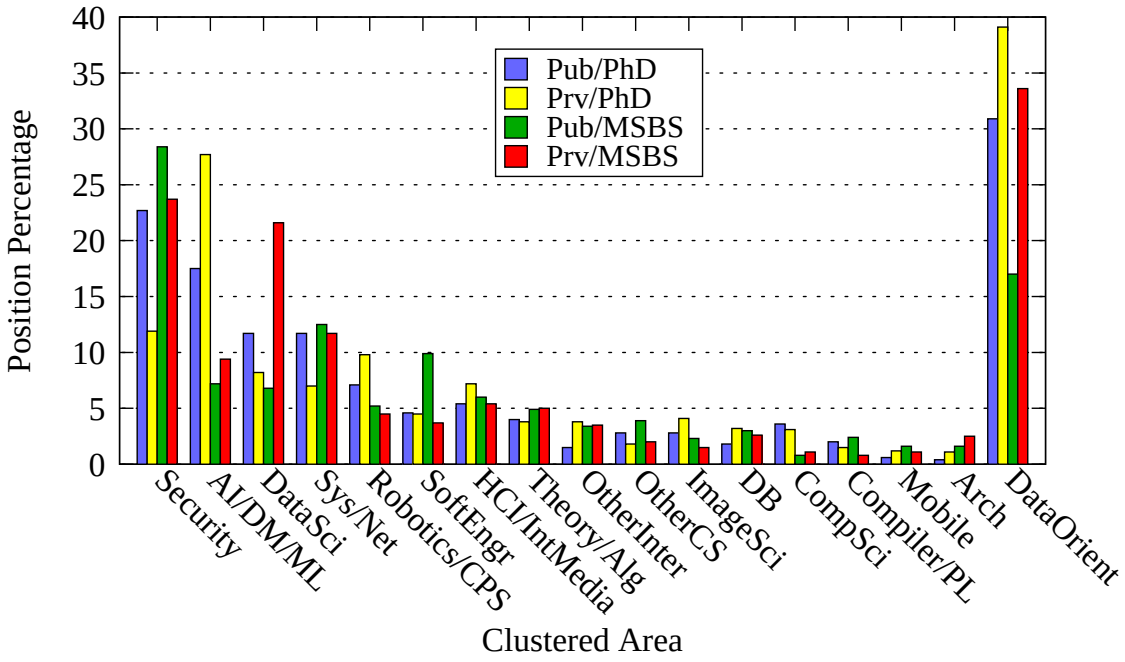

Figure 8: Clustered Area Percentage by Institution Type and Highest Degree Offered

4.4 Interdisciplinary Results by Institution Type and Highest Degree Offered

Figure 9 shows the five-year percentage of positions devoted to areas that are more and some amount of interdisciplinary in nature based upon the highest degree offered of each institution. The results show that the impact of interdisciplinary areas is even more pronounced for PhD institutions with roughly 25-65% of all positions devoted to these areas by public and private PhD institutions in 2019. In contrast, public MS&BS institutions have a range of 16-52% and private MS&BS institutions have a range of 31-64% of positions devoted to interdisciplinary areas. These percentages are increased from last year for private MS&BS institutions.

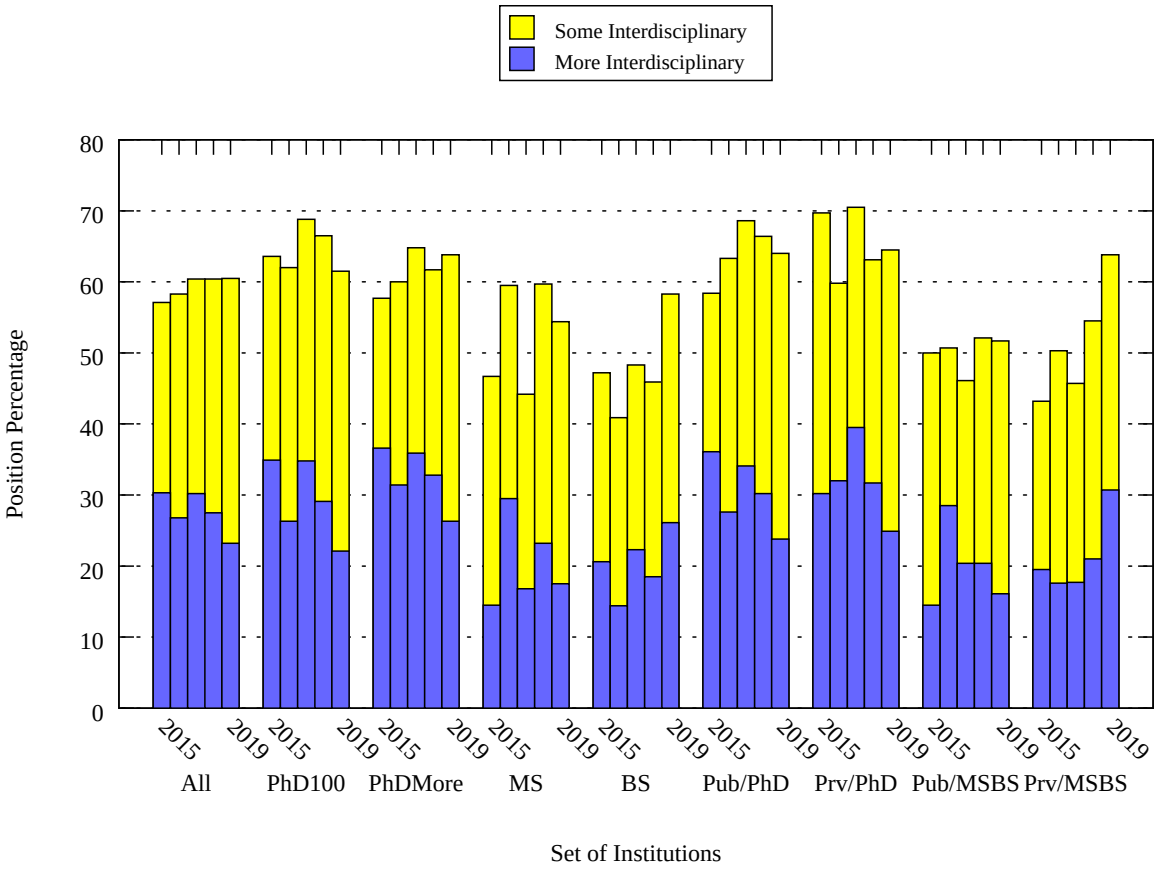

Figure 9: Investment in Interdisciplinary Clustered Areas by Different Sets of Institutions

5 Summary and Future Work

This work uses the same methodology as work over the past five years to study where Computer Science departments are choosing to invest faculty positions by examining data obtained from advertised faculty 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 409 institutions seeking to fill hundreds of tenure-track faculty positions in Computer Science. There was a small one-year increase in the number of institutions searching but there has been a 83% increase over the five years of our studies. The number of tenure-track positions sought shows a one-year increase of 5% and a 118% increase over the five years.

We clustered the specific Computer Science topics mentioned in ads into 16 areas. As part of our work this year we compared this classification with other classifications from the CRA, csrankings.org, csmetrics.org and arXiv.org, which resulted in small adjustments to our classification.

In terms of specific areas, we found that the clustered areas of Security, AI/Data Mining/Machine Learning and Data Science are the areas of greatest investment. Aggregating the Data Science, AI/DM/ML and Databases clusters again resulted in close to one-third of all hires sought in these data-oriented areas. We found that roughly 25-60% of all hires are for areas that are, or may be, interdisciplinary in nature.

Differences are also seen when analyzing results based on the type of institution. Positions related to Security have the highest percentages for all but top-100 institutions. The area of Artificial Intelligence/Data Mining/Machine Learning is of most interest for top-100 PhD institutions. Roughly 35% of positions for PhD institutions are in data-oriented areas. The results show a strong interest in data-oriented areas by public PhD and private PhD&MS&BS institutions while public MS&BS institutions are most interested in Security. Finally, the results show that the impact of interdisciplinary areas is even more pronounced for PhD institutions with roughly 25-65% of all positions devoted to these areas by public and private PhD institutions in 2019.

A continued direction for future work is to examine how these searches translate into actual hires. Such follow-up was done for the past two years [4, 5] and should continue to look both at numbers of actual hires as well as the areas in which these hires occur.

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