Outcomes of Advertised Computer Science Faculty Searches for 2018

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Abstract

This work directly follows previous work that analyzed current and future Computer Science needs via advertised tenure-track faculty searches for 2018. This follow-on work looks to understand the relative success of institutions in hiring the tenured/tenure-track faculty in the areas of Computer Science that were being sought.

Responses to a survey were obtained from 176 institutions that reported seeking tenure-track faculty in 2018. Survey respondents reported seeking 363 tenure-track faculty positions and filling 269 such positions for an aggregate success rate of 74%. Examination on the success of the search for each of the institutions found that 22% failed to hire any faculty, while 54% succeeded in hiring at least as many faculty as were being sought. These survey results are similar to 2017.

In terms of results for different types of institutions, the top-100 PhD institutions had the smallest reported failed search rate of 7% while BS institutions had the highest reported failed search rate of 31%. Public PhD (62%) and private PhD (58%) institutions had the highest rate of hiring at least as many faculty as were being sought. Public MS&BS (48%) institutions had the lowest reported rate in hiring as many faculty as were being sought.

Reported results on the previous position for hired faculty show that three types of such positions predominant. 29% of hired faculty start with a newly-earned PhD, 27% were previously in a tenured or tenure-track position at another institution and 23% were previously in a post-doc/researcher position. These results are similar to those in 2017.

In comparing the areas of filled positions with the areas in which positions were sought, the area of Security showed the biggest negative difference with 14% of filled positions, but 20% of sought positions. Data-oriented areas, consisting of AI/DM/ML (Artificial Intelligence, Data Mining and Machine Learning), Data Science and Databases, accounted for 31% of sought positions and 28% of filled positions. In general, the net percentage differences between areas sought and filled were smaller than similar results in 2017.

Taulbee Survey results were used to compare areas of PhD production with areas of faculty positions sought and filled. Security is the area with most obvious discrepancy between percentage of PhDs produced (4%) and faculty positions sought (20%). Security and AI/DM/ML are the areas with the highest discrepancy between PhDs produced and positions filled with a net of 10% and 6% more positions filled than PhDs produced.

1 Introduction

This work directly follows previous work analyzing current and future Computer Science needs via advertised tenure-track faculty searches for 2018 [2]. The work seeks to understand the relative success of institutions in hiring the tenured/tenure-track faculty in the areas that were being sought. This report also follows on from a similar study of tenure-track faculty hiring outcomes in 2017 [1].

The primary tool used for this work is a survey sent to the advertised search committee contact or head of the department (or related program). Survey results are analyzed and as appropriate, the analysis takes into account ads that were posted by each institution (and summarized in [2]) as well as pertinent results reported in the 2017 CRA Taulbee Survey of PhD-producing Computer Science departments [3]. The remainder of this report elaborates on the methodology used to obtain data and the results from analyzing it.

2 Methodology

A survey consisting of four numeric-answer questions and one open-text-response question was constructed using the Qualtrics survey tool, which created a survey that could be taken online. The four numeric questions asked about the number of faculty sought to hire, the number that were hired, the number of faculty hired in a list of areas and the previous positions of the faculty hired. The open-response question allowed respondents to provide any additional feedback. The survey instructions and questions are shown in Appendix A.

Invitations were emailed to 456 institutions (some with multiple search contacts) in June 2018. These institutions placed ads between August and December 2017 for tenure-track positions to begin in 2018. The previous report on hiring needs [2] was based on ads placed by 387 institutions prior to November 15, 2017, but ads for the dataset continued to be collected through calendar-year 2017. The email message sent to each search included a URL for them to use in participating. The URL contained the email address for each contact so that survey results could be linked to information from the ads for each institution.

3 Results

We obtained survey responses from 176 institutions (vs. 155 in 2017 [1]) that reported seeking tenure-track faculty in 2018. Survey responses were dropped if the number of faculty positions being sought was zero or not specified. Multiple responses from the same institution were combined in cases that multiple searches from the institution led to multiple survey responses. 56 of the respondents provided written-text feedback as part of their response.

The remainder of this section reports results from analyzing the survey responses. As appropriate, the analysis take into account ads that were posted by each institution and summarized in [2] as well as pertinent results reported in the 2017 Taulbee Survey of PhD-producing Computer Science departments [3]. Written-text feedback is included as appropriate.

3.1 Faculty Positions Being Sought

A summary of the faculty positions sought for the 176 institutions based on responses to the survey is shown in Table 1. Information from the ads dataset is used to classify each institution according to the highest Computer Science degree it offers. As done in [2], PhD-granting institutions are further classified into PhD100 and PhDMore using the U.S. News Rankings of the 100 Best Graduate schools[1], which were updated in 2018, for the top-100 U.S. and then more PhD institutions including those not in the U.S.

Table 1: Summary of Faculty Positions Sought by Highest Degree Offered

Highest Degree	Number of Institutions	Number of Positions Sought			Total Positions
		1	2	3+	
PhD100	45	6 (13%)	9 (20%)	30 (67%)	145
PhDMore	25	7 (28%)	8 (32%)	10 (40%)	65
MS	29	13 (45%)	10 (34%)	6 (21%)	51
BS	77	56 (73%)	18 (23%)	3 (4%)	102
All	176	82 (47%)	45 (26%)	49 (28%)	363

The table shows that 47% of all institutions responding to the survey were seeking to hire one tenure-track faculty member, 26% were seeking to hire two, and 28% were seeking to hire three or more tenure-track faculty members. Not surprisingly there is variation based on the type of institution with 73% of BS institutions reporting they sought to hire one faculty member while 67% of PhD100 institutions reported seeking to hire three or more.

The last column in Table 1 shows that the 176 institutions reported seeking to fill a total of 363 tenure-track faculty positions (vs. 327 in 2017). The largest number (145) of these positions are for PhD100 institutions with MS institutions reporting the smallest number (51).

A natural and important question to ask is if the institutions responding to the survey are representative of all institutions seeking to hire tenure-track faculty for 2018. As a means to answer this question we examined four sets of institutions in terms of the number of positions they were seeking to hire. The first set (Nov17Ads) uses total positions for all institutions with ads placed by November 15, 2017, which were the set of ads used for the analysis of needs report [2]. The second set (2018Ads) uses total positions of ads for 2018 tenure-track positions placed by the end of 2017, which is the set of faculty invite to participate in the survey. The third set (SurveyAds) uses the total positions specified in the ads placed by the survey-responding institutions. The final set (SurveyResp) uses the total positions reported by survey respondents.

Figure 1 shows the representation for each degree type of institution for each of the four sets of institutions. The relative proportions are shown for each of institutions and faculty positions. The relative proportion of all types of responding institutions (SurveyResp) are within 9% percent of the 2018Ads set with BS and PhD100 institutions responding at a bit higher rates and PhDMore and MS institutions responding at a bit lower rates.

Similarly the relative proportion of all positions for responding institutions are within 7% of all positions for the 2018Ads set. As described in [2] determining the number of positions being

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[1] http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-science-schools/computer-science-rankings
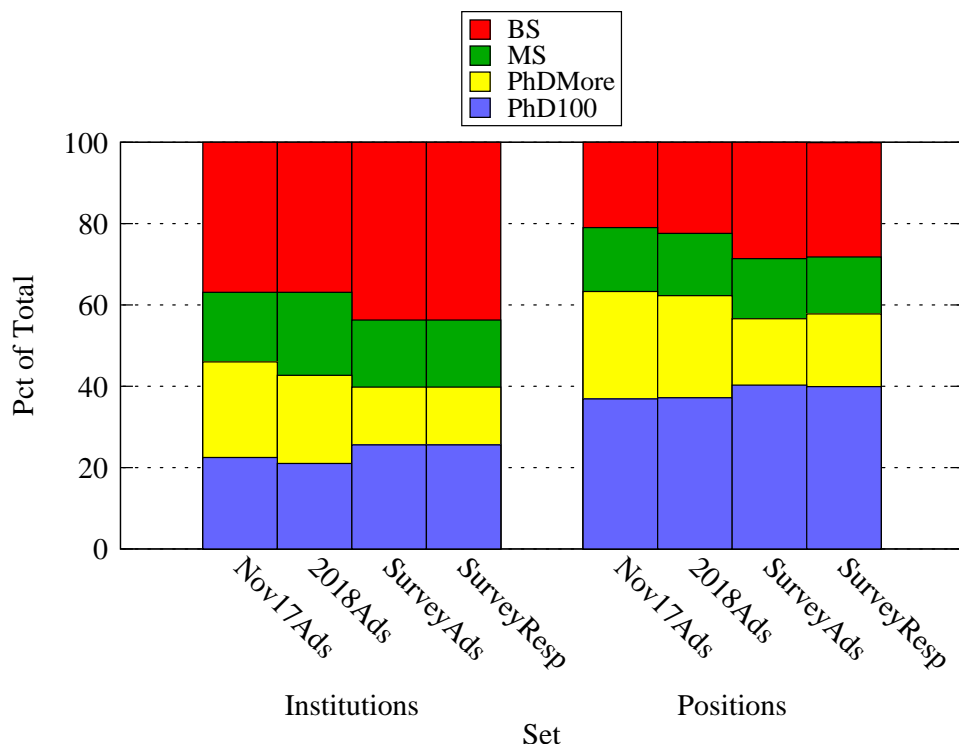
Figure 1: Comparison of Institution and Position Percentages by Highest Degree Offered

sought by an institution based on an ad is not always clear. Non-specific phrases include "multiple positions," "several positions" or just "positions." Position proportions in Figure 1 based on ads use an estimate of three positions for such non-specific searches. We note that 35 of the 176 institutions responding to the survey used non-specific numbers of positions in their ads. Using survey results for these institutions, we obtain a median of 3 and a mean of 3.4 for the actual number of positions being sought. We also observe that the ads of the remaining institutions indicated specific numbers of positions for a total of 217, yet the survey respondents for these institutions responded with a total of 236 positions seeking to be filled. These discrepancies indicate that the number of positions in ads are only an approximation of the actual number being sought.

The end result is that the relative closeness of proportions between the complete set of institutions and those responding to the survey allow us to have confidence that results for the responding set are representative of the larger set.

An addition to the ads dataset compiled for [2] allows us to also analyze the results based on whether a response is from a U.S. public, U.S. private or non-U.S institution. Table 2 shows results for positions being sought using this institution type combined with highest degree offered. For this analysis, PhD100 and PhDMore institutions are combined as are MS and BS. Four non-U.S. institutions responding to the survey are dropped in this analysis.

The results show that many more public (47) than private (19) PhD institutions responded to the survey. In contrast more private MS&BS institutions (60) responded in comparison to public MS&BS institutions (46). Responses for private institutions reported seeking only a single position at a higher rate than for public institutions. This result is consistent with results reported in [2].

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Table 2: Summary of Faculty Positions Sought by Institution Type and Highest Degree Offered

Type/ Degree	Number of Institutions	Number of Positions Sought			Total Positions
		1	2	3+	
Pub/PhD	47	8 (17%)	13 (28%)	26 (55%)	144
Prv/PhD	19	5 (26%)	3 (16%)	11 (58%)	52
Pub/MSBS	46	27 (59%)	15 (33%)	4 (9%)	69
Prv/MSBS	60	42 (70%)	13 (22%)	5 (8%)	84
All	172	82 (48%)	44 (26%)	46 (27%)	349

3.2 Positions Being Filled

The survey results provide more precise, but similar information on positions being sought as obtained from posted ads. However the survey is needed to understand the success of institutions in filling these positions. Table 3 shows the number of tenure-track faculty positions filled based on the responses by the 176 institutions participating in the survey. The table shows these institutions reported filling a total of 269 positions with PhD100 institutions filling the most positions with 120 and MS institutions filling the least with 31.

Table 3: Summary of Positions Filled by Highest Degree Offered

Highest Degree	Number of Institutions	Number of Positions Filled				Total Positions	Overall Success %
		0	1	2	3+		
PhD100	45	3 (7%)	11 (24%)	11 (24%)	20 (44%)	120	83%
PhDMore	25	3 (12%)	7 (28%)	9 (36%)	6 (24%)	50	77%
MS	29	8 (28%)	13 (45%)	6 (21%)	2 (7%)	31	61%
BS	77	24 (31%)	38 (49%)	15 (19%)	0 (0%)	68	67%
All	176	38 (22%)	69 (39%)	41 (23%)	28 (16%)	269	74%

Looking at the number of positions filled by each institution we see 22% of all institutions reported having a "failed" search where no faculty positions were filled (it was 18% in 2017 [1]). 31% of BS institutions reported having failed searches (vs. 24% in 2017). Not surprisingly, PhD100 institutions had the lowest proportion of failed searches (7%) and the highest proportion making three or more hires (44%).

The last column in Table 3 combines results from it and Table 1 to show an overall search success rate of 74% where 269 positions were filled out of a total of 349 positions being sought. As expected there is variation amongst institution type with PhD100 institutions having an overall 83% success rate, PhDMore having a 77% rate, MS having a 61% rate and BS having a 67% success rate.

Table 4 shows the same results as Table 3 based on classifying institutions by type and highest degree offered. Combining with results from Table 2, both public and private PhD institutions show similar overall success rates of 83% and 85%, but public MS&BS institutions have an overall success rate of 59%, which is lower than the 69% rate for private MS&BS institutions.

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Table 4: Summary of Positions Filled by Institution Type and Highest Degree Offered

Type/ Degree	Number of Institutions	Number of Positions Filled				Total Positions	Overall Success %
		0	1	2	3+		
Pub/PhD	47	3 (6%)	13 (28%)	12 (26%)	19 (40%)	119	83%
Prv/PhD	19	2 (11%)	5 (26%)	6 (32%)	6 (32%)	44	85%
Pub/MSBS	46	15 (33%)	22 (48%)	8 (17%)	1 (2%)	41	59%
Prv/MSBS	60	17 (28%)	29 (48%)	13 (22%)	1 (2%)	58	69%
All	172	37 (22%)	69 (40%)	39 (23%)	27 (16%)	262	75%

As comparison, Table F2 in the 2017 Taulbee Survey [3] presents similar aggregate search results for PhD-granting institutions in 2016-17. Those results report a tenure-track search success rate of 83% (360/434) for all U.S. Computer Science Departments. This success rate is the same as the combined success rate for U.S. PhD-granting (Pub/PhD and Prv/PhD) institutions of 83% (163/196) in our survey responses.

3.3 Positions Being Filled for Each Institution

A problem with the aggregated results is they do not take into account the specific results for each institution. For example, an institution seeking to hire three faculty and only hiring two is not a "failed" search, but it is less than successful. In contrast an institution may be seeking two faculty, but it is more than successful in being able to hire three faculty. The result is an aggregated success of 100% (5/5) for these two institutions, where the results of the individual searches is lost.

As a means to analyze the search results for each of the 176 institutions responding to the survey seeking to fill at least one faculty position, we defined four categories of institutional search results:

1. *failed* if no faculty were hired,

2. *less* than successful if the number of faculty hired was at least one, but less than the number being sought,

3. *success* if the number of faculty hired was that same as the number being sought, and

4. *more* than successful if the number of faculty hired was more than the number being sought.

Figure 2 shows the percentage of institutions in each of these categories based both on the number of positions sought as well as the institution type. The left grouping in the figure shows that 22% of all searches for all types of institutions failed, 24% were less than successful, 48% of searches were a success and 6% were more than successful. Overall, 54% of institutions responding to the survey reported success or more in their search. This result is comparable to the 53% reported in 2017. The first grouping also shows that 38% (28% in 2017) of all single-position searches failed with the remaining 62% (72% in 2017) at least successful. Two-position searches failed for 13% (17% in 2017) of institutions and were at least successful for 53% (37% for 2017) of
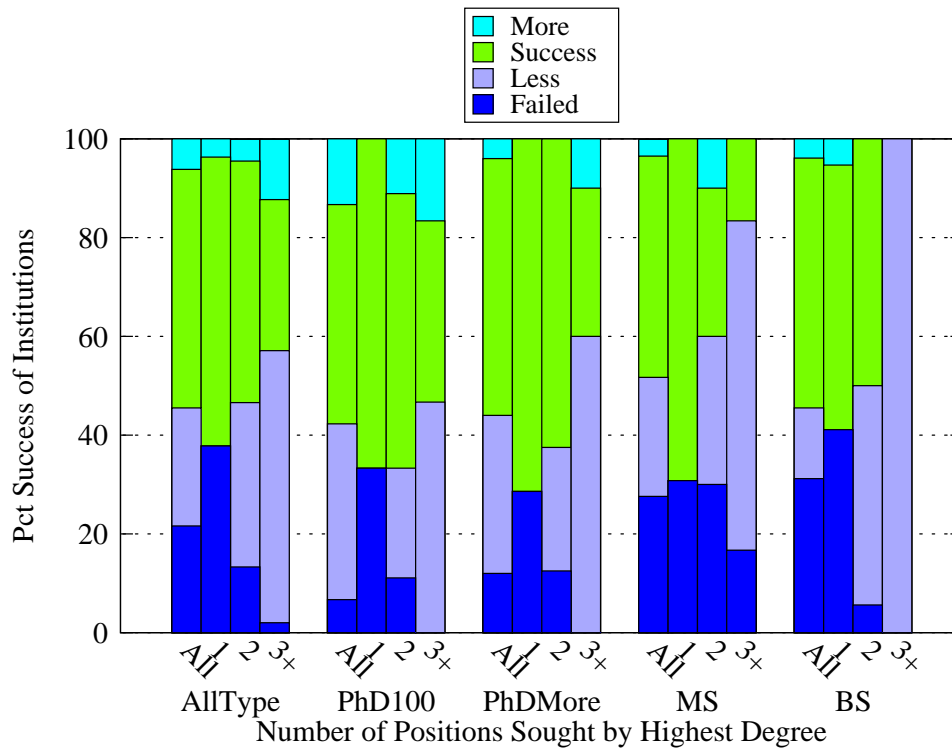
Figure 2: Percentages of Search Success by Highest Degree Offered

institutions. Finally, searches for three or more positions failed for 2% (2% for 2017) of institutions and were at least successful for 43% (39% in 2017) of institutions.

The remaining groupings in Figure 2 show the breakdown based on highest degree offered. Searches for all PhD100 institutions failed for 7% and were at least successful for 58%. Searches for all PhDMore institutions failed for 12% and were at least successful for 56%. Searches for all MS institutions failed for 28% and were at least successful for 48%. Searches for all BS institutions failed for 31% and were at least successful for 55%. These percentages indicate that PhD100 institutions were the most successful and MS institutions the least successful in hiring at least as many tenure-track faculty as were being sought.

Figure 3 shows a similar breakdown based on a combination of institution type and highest degree offered. Searches for all public PhD institutions failed for 6% and were at least successful for 62%. Searches for all private PhD institutions failed for 11% and were at least successful for 58%. Searches for all public MS&BS institutions failed for 33% and were at least successful for 48%. Searches for all private MS&BS institutions failed for 28% and were at least successful for 57%. These percentages indicate that public PhD institutions were the most successful and public MS&BS institutions the least successful in hiring at least as many tenure-track faculty as were being sought.

In comparison, the 2017 Taulbee Survey [3] only aggregates the number of faculty positions filled or unfilled, but does not provide per-institution results. However Table F2a in that report does provide reasons why positions are left unfilled with the top three being 52% due to offers turned down, 28% due to hiring in progress and 14% due to not finding a person who met hiring
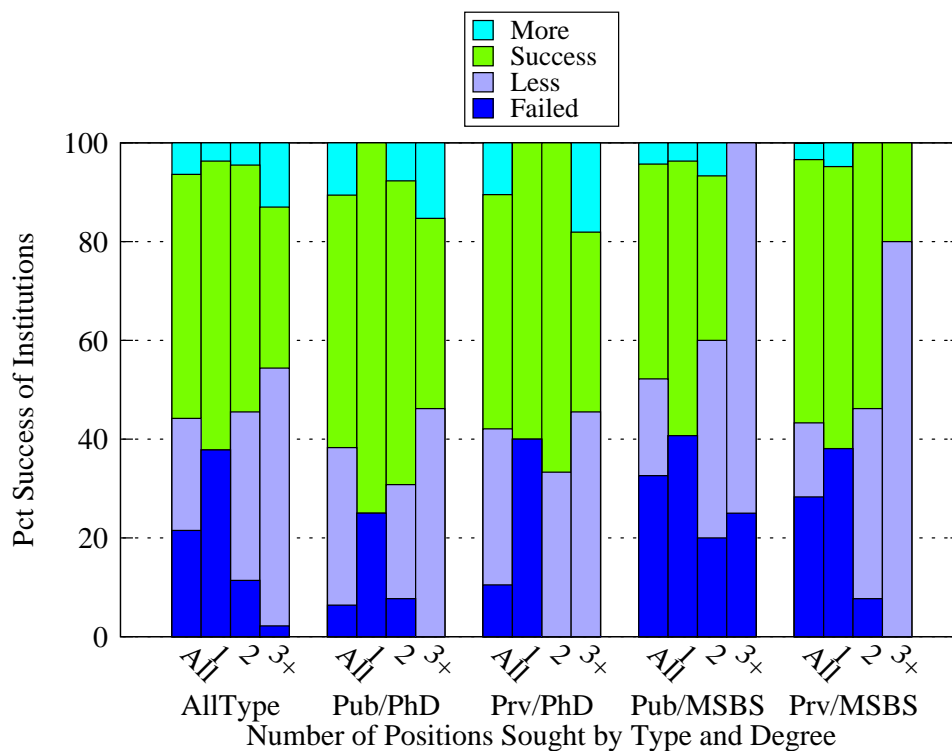
Figure 3: Percentages of Search Success by Institutuion Type and Highest Degree Offered

goals. The report goes on to provide gender and ethnicity information for new hires, which was not collected as part of our survey.

Many of the comments received from our survey respondents had to do with reasons why institutions were less than successful. These reasons included a reduced number of qualified applicants, lack of partner accommodation, higher than expected salary requests, increased competition for available candidates, and particularly competitive areas such as machine learning and security. Unlike the 2017 study, which was done in September, the June timeframe of this 2018 study did cause additional comments from roughly a half dozen respondents indicating that hiring was still in progress and that their responses were only estimates of the actual result.

3.4 Previous Position of Hired Faculty

Another question in the survey obtained the previous position held by each of the new faculty that were hired. Table 5 shows the proportion for each type of previous position for all institutions and for institutions based on highest degree offered. Previous positions are ordered based on numbers from most to least for all institutions. Note there are small inconsistencies in the total number of positions compared to Table 3 due to variations in survey responses for the number of filled positions for different questions.

The results show that 29% of all hired faculty start with a newly-earned PhD (31% in 2017). 27% were previously in a tenured or tenure-track position at another institution (26% in 2017). 23% were previously in post-doc/researcher positions (26% in 2017). These were the three primary

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Table 5: Summary of Previous Positions Held for Hired Faculty by Highest Degree Offered

Previous Position	All Types	Highest Degree			
		PhD100	PhDMore	MS	BS
PhD	80 (29%)	35 (30%)	16 (31%)	7 (22%)	22 (31%)
T/TT	74 (27%)	28 (24%)	15 (29%)	7 (22%)	24 (34%)
PostDoc/Researcher	62 (23%)	41 (35%)	11 (21%)	7 (22%)	3 (4%)
ABD	22 (8%)	6 (5%)	6 (12%)	4 (12%)	6 (9%)
NTT	20 (7%)	6 (5%)	2 (4%)	2 (6%)	10 (14%)
NonAcad	11 (4%)	2 (2%)	1 (2%)	5 (16%)	3 (4%)
Other	3 (1%)	0 (0%)	1 (2%)	0 (0%)	2 (3%)
All	272 (100%)	118 (100%)	52 (100%)	32 (100%)	70 (100%)

previous positions with the remaining options (non-tenure-track faculty, all-but-dissertation, non-academic and other) each less than 10%.

Results for different degrees offered showed some variation with PostDoc/Researcher positions for PhD100 institutions and new PhDs the most prevalent previous position for PhDMore institutions. There was more variation for the previous position of MS and BS institution hires with more than 30% of tenure-track faculty positions at these institutions filled with hires who were previously on a non-tenure track, an all-but-dissertation student or a non-academic. The most prevalent type of hire for BS institutions was a tenure-track position at another institution.

Table 6 shows the same results based on institution type and highest degree offered. The largest percentage of public PhD institution hires were new PhDs at 34%. Private PhD institutions hired the most PostDoc/Researchers at 41%. Public MS&BS institutions made the most hires (34%) who were previously in a tenure-track position at another institution. Private MS&BS institutions made the most hires (33%) from new PhDs.

Table 6: Summary of Previous Positions Held for Hired Faculty by Type and Highest Degree

Previous Position	All Types	Type/Degree			
		Pub/PhD	Prv/PhD	Pub/MSBS	Prv/MSBS
PhD	79 (30%)	40 (34%)	10 (23%)	9 (22%)	20 (33%)
T/TT	71 (27%)	30 (25%)	10 (23%)	14 (34%)	17 (28%)
PostDoc	60 (23%)	32 (27%)	18 (41%)	6 (15%)	4 (7%)
ABD	21 (8%)	6 (5%)	5 (11%)	6 (15%)	4 (7%)
NTT	20 (8%)	7 (6%)	1 (2%)	2 (5%)	10 (16%)
NonAcad	11 (4%)	3 (3%)	0 (0%)	4 (10%)	4 (7%)
Other	3 (1%)	1 (1%)	0 (0%)	0 (0%)	2 (3%)
All	265 (100%)	119 (100%)	44 (100%)	41 (100%)	61 (100%)

The 2017 Taulbee Survey does not provide any data on where new faculty hires come from, but Table F5 in that report does provide data on faculty losses. 34% of those losses are due to retirement and another 36% took academic positions elsewhere, which is the other side of the 27% of new hires in our survey results that came from a tenured/tenure-track at another institution.

3.5   Areas in Which Faculty Were Hired

Our previous report on faculty hiring [2] clustered topics into 18 areas. The table defining these areas and the constituent topics for each is reproduced in Table 7 from the previous report. These same areas (along with a link to this table) were provided to survey respondents to identify the area in which new faculty members were hired.

Table 7: Topics Grouped in Each Clustered Area

Area	Constituent Topics
AI/DM/ML	Artificial Intelligence, Computational Linguistics, Data Mining, Deep Learning, Machine Learning, Natural Language Processing
Arch	Architecture, Hardware
Bioinfo	Bioinformatics
Compiler/PL	Compilers, Programming Languages
CompSci	Biodesign, Biomedical, Computational Biology, Computational Life Science, Computational Neuroscience, Computational Science, Network Science, Numerical Analysis, Scientific Computation
DataSci	Big Data, Data Analytics, Data Science, Visualization, Visual Analysis/Computing
DB	Database, Data Management, Information Retrieval, Information Systems
Games	Animation, Games
HCI	Augmented Reality, Cognitive Science, Disability Technology, HCI, Immersive Systems, Interactive Applications, Virtual Reality
ImageSci	Graphics, Medical Imaging, Pattern Recognition, Vision
Mobile	Human-Centered Computing, Mobile Systems
Robotics/CPS	Autonomous/Vehicular Systems, Cyber-Physical Systems, Embedded Systems, Intelligent Systems, Internet of Things, Robotics, Smart Systems
Security	Cryptography, Forensics, Information Assurance, Privacy, Security, Trusted Computing
SoftEngr	Dependable Software, Software Assurance, Software Design, Software Deveopment, Software Engineering, Software Systems
Sys/Net	Cloud Computing, Computer Systems, Distributed Computing, High Performance Computing, Network/System Administration, Networking, Operating Systems, Parallel Computing, System Analysis, Systems
Theory/Alg	Algorithms, Computational Geometry, Formal Methods, Logic, Theory
OtherCS	CS Education, Data Structures, Information Technology, Internet, Introductory CS, Modeling, Optimization, Quantum Computing, Simulation, Social Computing, Software, Verification, Web Technologies
OtherInter	Applications, Climate Informatics, Computational Engineering, Design Theory, Digital Computation Studies, Digital Health, Digital Libraries, Economic Computing, Ethics, Financial Technology, Interdisciplinary Applications, Journalism Learning Science/Technology, Materials, Operations Research, Statistics, Sustainability

Table 8 shows the numbers and percentages of hires for all institutions and based on highest degree offered. Table rows are ordered based on the number of hires in each area (save for Other) with 58 hires in AI/DM/ML, which constitutes 19% of the 299 total positions. Again the total positions shown is slightly different than Tables 3 and 5 due to inconsistencies in survey responses.

The table shows that Security accounts for 42 (12%) of all filled positions with Systems/Networking for 24 (8%) and Theory/Alg accounting for 23 (8%) of filled positions. AI/DM/ML was the most popular area for all offered degrees except for MS for which DataSci was the most popular. Security was the second-most popular area for all types except BS, which had OtherCS as second.

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Table 8: Summary of Areas for Hired Faculty by Highest Degree Offered

	All	Highest Degree			
Area	Types	PhD100	PhDMore	MS	BS
AI/DM/ML	58 (19%)	30 (25%)	13 (18%)	4 (12%)	11 (15%)
Security	42 (14%)	18 (15%)	11 (15%)	5 (15%)	8 (11%)
Sys/Net	24 (8%)	11 (9%)	5 (7%)	2 (6%)	6 (8%)
Theory/Alg	23 (8%)	8 (7%)	6 (8%)	2 (6%)	7 (9%)
DataSci	19 (6%)	5 (4%)	4 (6%)	6 (18%)	4 (5%)
Robotics/CPS	17 (6%)	6 (5%)	4 (6%)	2 (6%)	5 (7%)
SoftEngr	17 (6%)	5 (4%)	6 (8%)	2 (6%)	4 (5%)
HCI	16 (5%)	6 (5%)	2 (3%)	1 (3%)	7 (9%)
Arch	9 (3%)	5 (4%)	2 (3%)	1 (3%)	1 (1%)
ImageSci	9 (3%)	3 (2%)	1 (1%)	1 (3%)	4 (5%)
Compiler/PL	8 (3%)	4 (3%)	4 (6%)	0 (0%)	0 (0%)
DB	8 (3%)	3 (2%)	4 (6%)	1 (3%)	0 (0%)
CompSci	7 (2%)	2 (2%)	2 (3%)	2 (6%)	1 (1%)
Games	7 (2%)	3 (2%)	1 (1%)	2 (6%)	1 (1%)
Bioinfo	5 (2%)	4 (3%)	1 (1%)	0 (0%)	0 (0%)
Mobile	5 (2%)	0 (0%)	3 (4%)	1 (3%)	1 (1%)
OtherCS	22 (7%)	8 (7%)	2 (3%)	1 (3%)	11 (15%)
OtherInter	3 (1%)	0 (0%)	0 (0%)	0 (0%)	3 (4%)
All	299 (100%)	121 (100%)	71 (100%)	33 (100%)	74 (100%)

Table 9 shows the same numbers and percentages of hires based on classifying institutions by type and degree offered. Again the AI/DM/ML area was most popular for all combinations except for public MS&BS institutions, which shows Security has most popular.

Table 9: Summary of Areas for Hired Faculty by Institution Type and Highest Degree Offered

| | All | Type/Degree | | | |
Area	Types	Pub/PhD	Prv/PhD	Pub/MSBS	Prv/MSBS
AI/DM/ML	53 (18%)	24 (17%)	14 (32%)	2 (4%)	13 (21%)
Security	42 (14%)	21 (15%)	8 (18%)	7 (16%)	6 (10%)
Sys/Net	23 (8%)	13 (9%)	2 (5%)	4 (9%)	4 (6%)
Theory/Alg	23 (8%)	12 (9%)	2 (5%)	4 (9%)	5 (8%)
DataSci	19 (7%)	7 (5%)	2 (5%)	5 (11%)	5 (8%)
Robotics/CPS	17 (6%)	7 (5%)	3 (7%)	3 (7%)	4 (6%)
HCI	16 (5%)	7 (5%)	1 (2%)	3 (7%)	5 (8%)
SoftEngr	16 (5%)	8 (6%)	2 (5%)	4 (9%)	2 (3%)
Arch	9 (3%)	6 (4%)	1 (2%)	1 (2%)	1 (2%)
ImageSci	9 (3%)	4 (3%)	0 (0%)	3 (7%)	2 (3%)
Compiler/PL	8 (3%)	7 (5%)	1 (2%)	0 (0%)	0 (0%)
DB	8 (3%)	6 (4%)	1 (2%)	1 (2%)	0 (0%)
CompSci	7 (2%)	4 (3%)	0 (0%)	1 (2%)	2 (3%)
Games	7 (2%)	1 (1%)	3 (7%)	1 (2%)	2 (3%)
Bioinfo	5 (2%)	3 (2%)	2 (5%)	0 (0%)	0 (0%)
Mobile	5 (2%)	3 (2%)	0 (0%)	1 (2%)	1 (2%)
OtherCS	22 (8%)	8 (6%)	2 (5%)	5 (11%)	7 (11%)
OtherInter	3 (1%)	0 (0%)	0 (0%)	0 (0%)	3 (5%)
All	292 (100%)	141 (100%)	44 (100%)	45 (100%)	62 (100%)

3.6 Areas Sought Compared with Areas Filled

While important to understand where hires were made, linking survey results to areas specified in faculty ads allows us to compare the areas for positions that were sought with the areas for positions that were filled. This analysis was done by filtering the ads dataset to include only the 176 institutions that responded to the survey. We then repeated analysis that was done in [2] to determine the percentage of positions sought in each of the 18 areas. As was previously done, institutions not identifying specific areas in their original ad did not contribute to this analysis. Ads for the survey institutions identified specific areas for 76% of the advertised positions, which is comparable to the 2018Ads dataset.

Figure 4 shows the results of scatter plotting each of the 18 areas based on their percentages of positions sought vs. positions filled for all 176 institutions regardless of type. Areas further from the origin represent the most popular areas. Areas close to the diagonal (a line is drawn for reference) are areas in which the percentage of positions filled is roughly the same as positions sought. Areas plotted above the diagonal indicate a higher percentage of positions were filled

than were sought. Areas plotted below the diagonal indicate a higher percentage of positions were sought than were reported to be filled.
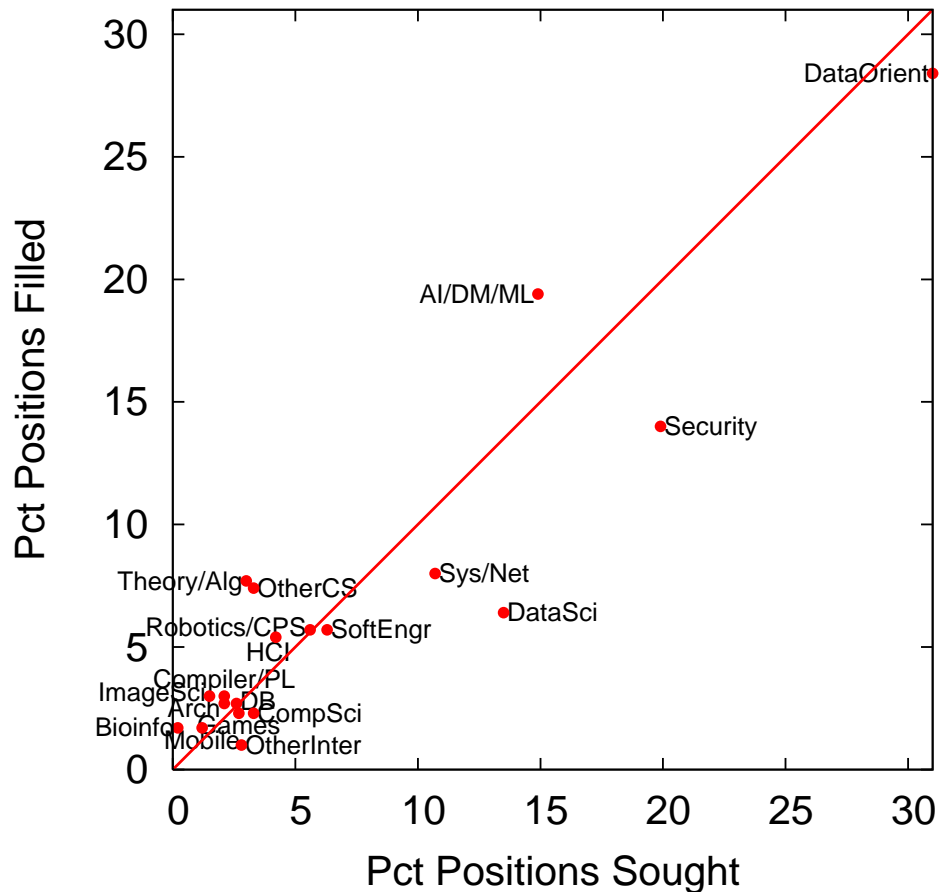

Figure 4: Percentages of Areas Sought vs. Areas Filled for All Institutions

Below the diagonal, Security was sought for 20% of positions, but only 14% of positions were filled in this area. Similarly DataSci was sought for 14% of positions, but reported to be filled for only 6% of positions. Above the diagonal, the Theory/Alg, AI/DM/ML and OtherCS areas each have 4-5% net more filled than sought positions.

Many factors contribute to the areas with the largest discrepancies between percentages of positions sought and filled. These factors include:

1. A fraction (24%) of positions filled were from institutions not identifying areas of interest in their ad. It is possible that areas being sought by these institutions did not match the same distribution of areas as discerned from ads that did identify areas of interest.

2. Institutions simply did not hire in the areas of interest. These institutions either could not find candidates in an area of interest or they found better candidates in other areas.

3. A filled position was actually in a sought area, but the area discerned from the ad simply did not match the identified area of the hire in the survey. For example, an institution could

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have advertised for a hire in Data Analytics (in the area of DataSci as shown in Table 7), but identified the hire in the survey as being in the area of AI/DM/ML. In [2] we addressed this specific issue by further clustering the AI/DM/ML, DataSci and DB areas into a data-oriented "DataOrient" area. As shown in Figure 4, this aggregated area accounted for 31% of sought positions and 28% of filled positions.

3.7 Areas Sought Compared with Areas Filled By Institution Type

Figure 5 repeats the same analysis after dividing all institutions into PhD-granting (PhD100 and PhDMore) and non-PhD-granting (MS and BS) institutions. As reference, results in Table 3 show that 63% of filled positions were done so by PhD-granting institutions.
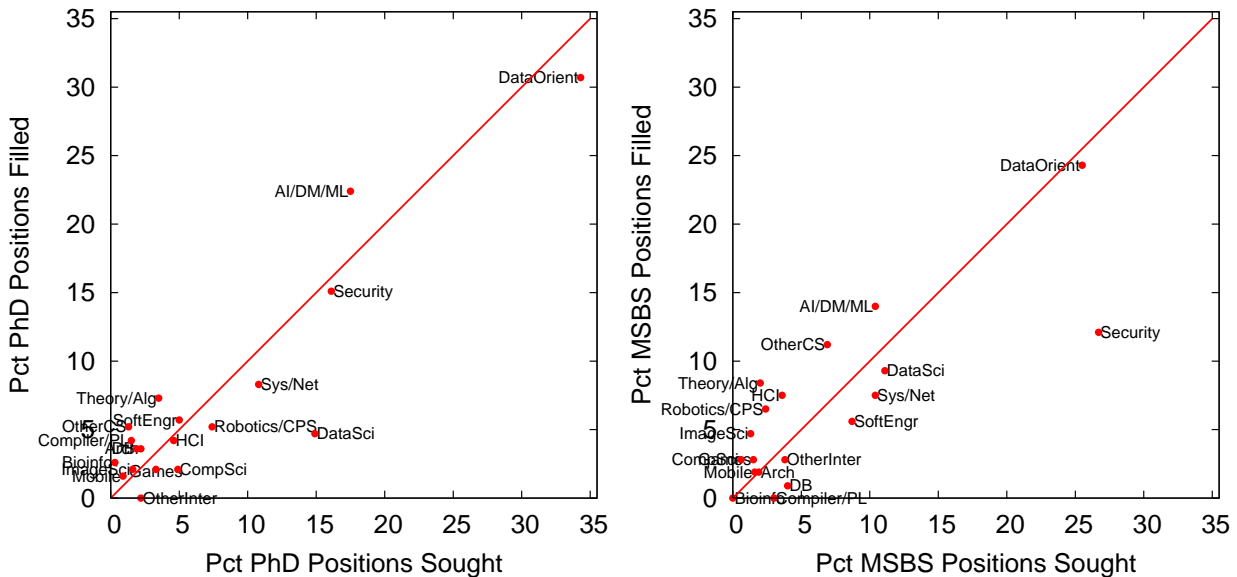
Figure 5: Percentages of Areas Sought vs. Areas Filled for PhD and MS&BS Institutions

The plot on the left for PhD institutions largely mimics the results shown in Figure 4. The figure shows that more than 30% of sought and filled positions are in data-oriented areas. The plot on the right for MS and BS institutions shows the percentage of sought and filled DataOrient positions close to the diagonal at roughly 25%. Above the diagonal, the Theory/Alg area has the largest net discrepancy with 2% of sought positions, but 8% of filled positions. Below the diagonal, Security has the largest difference with 27% of sought positions, but only 12% of filled positions.

Figure 6 repeats the same analysis after dividing institutions into public and private. As reference, results in Table 4 show that 61% of filled positions were done so by public institutions. The plot on the left for public institutions shows Security and DataSci as having the largest net discrepancy (8%) between sought and filled positions. DataOrient is also below the diagonal with 24% of filled positions. The right plot for private institutions shows DataOrient is closer to the diagonal and larger with 33% of filled positions. DataSci and Sys/Net each have a 6% smaller share of filled than sought positions. Above the diagonal, the percentage share of filled OtherCS positions is 7% more than sought.
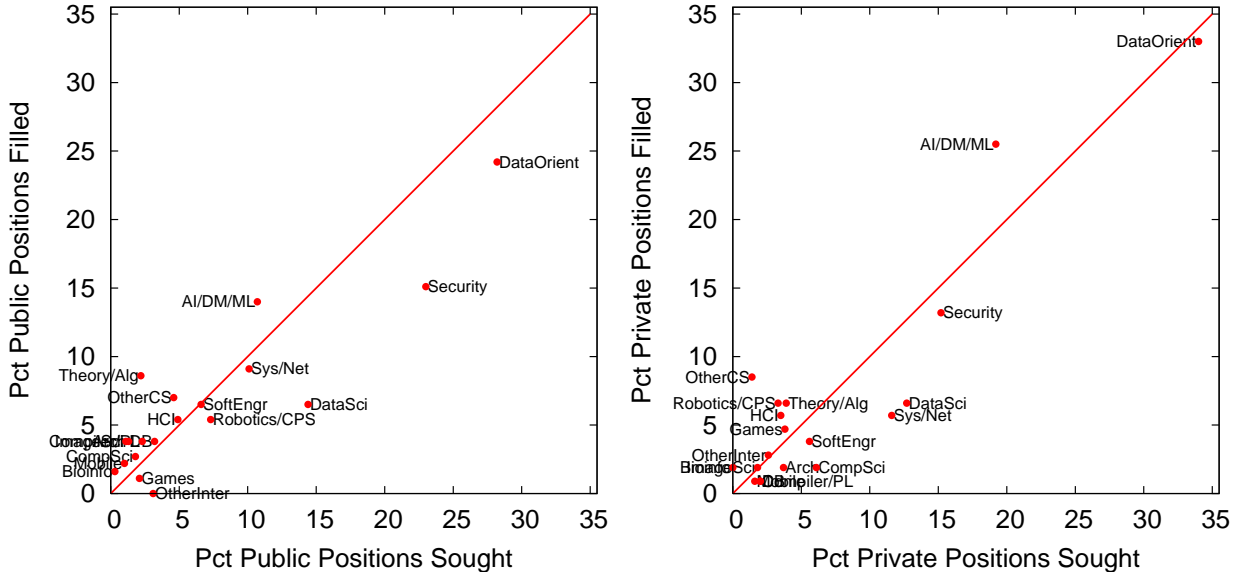
Figure 6: Percentages of Areas Sought vs. Areas Filled for Public and Private Institutions

3.8   Faculty Hiring and PhD Production

The 2017 Taulbee Survey [3] does not provide any information on areas in which faculty were sought or hired, but Table D4 in that report does provide information on "specialties" in which PhDs were produced as part of results on employment of new PhD recipients. These 2017 data are one year removed from the 2018 faculty hiring season, but provide a means to compare areas of PhD production with areas of faculty hiring.

For this analysis we use the grand total of all PhDs produced regardless of their subsequent employment. Table 10 shows the number (and percentage) sorted in decreasing order for each specialty as given in [3]. No additional explanation for the content of each specialty beyond the name is provided in the text of that report. Based on text in previous reports, the "Artificial Intelligence" specialty includes Machine Learning and the Other category also includes unknown responses.

The last column in Table 10 shows the corresponding area from Table 7 that matches each specialty. In cases where a good match is not clear then no corresponding area is shown. Not all of the correspondences are an exact fit with "Robotics/Vision" a specialty where we define "Robotics/CPS" as an area with the topic of Vision in the ImageSci area. Similarly, the "Graphics/Visualization" specialty is mapped to the ImageSci area even though the topic of Visualization is clustered under the DataSci area. The result is that 12 of the 18 areas from Table 7 are associated with a specialty in Table 10.

The two graphs in Figure 7 plot the percentage of PhDs produced against the percentage of faculty positions sought and the percentage of faculty positions filled for all institutions (as previously shown in Figure 4). The 12 areas most clearly corresponding to specialties in Table 10 are shown in each graph.

In the left graph of Figure 7, Security is the area with most obvious discrepancy between percentage of PhDs produced (4%) and faculty positions sought (20%). Most other areas are

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Table 10: 2017 Taulbee Survey New PhD by Specialty

| Specialty	Cnt (%)	Corresponding Area
Artificial Intelligence	246 (13%)	AI/DM/ML
Software Engineering	126 (7%)	SoftEngr
Networks	111 (6%)	Sys/Net
Database/Information Retrieval	110 (6%)	DB
Graphics/Visualization x	93 (5%)	ImageSci
Theory and Algorithms	84 (5%)	Theory/Alg
High-Performance Computing	83 (3%)	Sys/Net
Security/Information Assurance	80 (6%)	Security
Robotics/Vision	80 (4%)	Robotics/CPS
Hardware/Architecture	79 (4%)	Arch
Human-Computer Interaction	58 (2%)	HCI
Programming Languages/Compilers	51 (3%)	Compiler/PL
Informatics: Biomedical/Other Science	49 (4%)	
Operating Systems	48 (3%)	Sys/Net
Information Science	40 (2%)	
Information Systems	28 (1%)	
Social Computing/Social Informatics	17 (1%)	
Scientific/Numerical Computing	15 (1%)	CompSci
Computing Education	14 (1%)	
Other	382 (22%)	
Total	1834 (100%)	
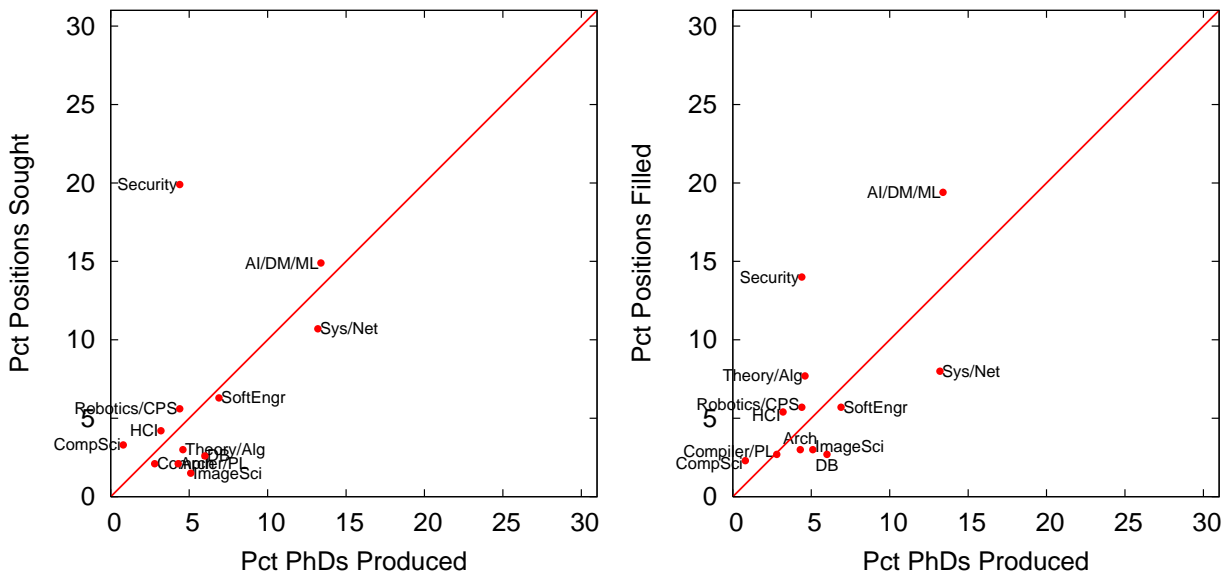
Figure 7: Percentages of Areas of PhDs Produced vs. Areas Sought/Filled for All Institutions

relatively close to the diagonal indicating similar percentages of PhDs produced and positions sought.

In the right graph of Figure 7, Security and AI/DM/ML are the areas with the highest discrepancy between PhDs produced and positions filled with a net of 10% and 6% more positions filled. On the other side of the diagonal, Sys/Net has the highest net percentage discrepancy (5%) of PhDs produced more than positions filled.

4   Summary and Future Work

This work directly follows previous work that analyzed current and future Computer Science needs via advertised tenure-track faculty searches for 2018. This follow-on work looked to understand the relative success of institutions in hiring the tenured/tenure-track faculty in the areas of Computer Science that were being sought. The primary tool used for this work was a survey.

An email message with a link for the survey was sent to a search contact at 456 institutions. Survey responses were obtained from 176 institutions that reported seeking tenure-track faculty in 2018. The distribution of survey responses based on institutional type was in roughly the same proportion as for all institutions that were searching for tenure-track faculty. Survey respondents reported seeking a total of 363 faculty positions.

Survey respondents reported filling a total of 269 tenure-track faculty for an aggregate success rate of 74%. Examination on the success of the search for each of the 176 institutions found that 22% of institutions failed to hire any faculty, while 54% succeeded in hiring at least as many faculty as were being sought. These percentages are comparable to survey results from 2017. In terms of results for different types of institutions, the top-100 PhD institutions had the smallest failed search rate of 7% while BS institutions had the highest failed search rate of 31%. Public PhD (62%) and private PhD (58%) institutions had the highest rate of hiring at least as many faculty as were being sought. Public MS&BS (48%) institutions had the lowest reported rate in hiring as many faculty as were being sought.

Reported results on the previous position for hired faculty show that three types of such positions predominant. 29% of hired faculty start with a newly-earned PhD, 27% were previously in a tenured or tenure-track position at another institution and 23% were previously in a post-doc/researcher position. These results are similar to those in 2017.

Survey respondents reported on the number of hires in each of 18 clustered areas. The clustered area of AI, Data Mining and Machine Learning (AI/DM/ML) accounted for 19% of the filled positions. Security accounted for the next most with 14% of the filled positions while Systems/Networking and Theory/Algorithms were next with each at 8% of filled positions. Further clustering of results for the AI/DM/ML, Databases and Data Sciences areas finds that 28% of hires were "Data Oriented."

In comparing the areas of filled positions with the areas in which positions were sought, the Theory/Alg, AI/DM/ML and OtherCS areas showed the biggest net positive net difference percentage of positions filled and sought. In contrast, the area of Security showed the biggest negative difference with 14% of filled positions, but 20% of sought positions. The area of DataSci had a 8% negative net percentage difference between filled and sought positions. Data-oriented areas accounted for 31% of sought positions and 28% of filled positions. In general, the net percentage differences between areas sought and filled were smaller than similar results in 2017.

A final analysis uses Taulbee Survey results to compare areas for PhD production with area of faculty positions sought and filled. Security is the area with most obvious discrepancy between percentage of PhDs produced (4%) and faculty positions sought (20%). Security and AI/DM/ML are the areas with the highest discrepancy between PhDs produced and positions filled with a net of 10% and 6% more positions filled than PhDs produced.

In summary, the results show a mix of success with just over 50% of institutions hiring at least the number of faculty they were seeking. In terms of areas, AI/DM/ML, Databases and Data Science collectively represent 28% of positions filled, although PhD production in these areas was not this high. There was much stronger demand for positions in Security than PhD production or positions actually filled. Each of these results is comparable to results from a similar study in 2017.

A direction for future work is to continue to improve the survey instrument. Continued collection of ad data and subsequent surveys allows the success of faculty hiring to be tracked over time. Better integration with the Taulbee Survey could help to understand why searches succeed or fail.

Acknowledgment

References

[1] Craig E. Wills. Outcomes of advertised computer science faculty searches for 2017. *Computing Research News*, 29(10), November 2017. Full report at
http://web.cs.wpi.edu/~cew/papers/outcomes17.pdf.

[2] Craig E. Wills. Analysis of current and future computer science needs via advertised faculty searches for 2018. *Computing Research News*, 30(1), January 2018. Full report at
http://www.cs.wpi.edu/~cew/papers/CSareas18.pdf.

[3] Stuart Zweben and Betsy Bizot. 2017 CRA Taulbee Survey. *Computing Research News*, 30(5), May 2018.
https://cra.org/wp-content/uploads/2018/05/2017-Taulbee-Survey-Report.pdf.

A   Survey

The following shows the instructions and questions used for the survey completed by respondents. All numeric questions are answered with a radio-button selection of 0, 1, 2, 3, 4, 5-6, 7-8, or 9+. No response for a question is mapped to 0.

A.1   Questions

Q1 Please complete the following short survey concerning your department's outcome in hiring of tenured/tenure-track Computer Science (or closely related program) faculty in 2018. At the end of the survey you will be able to see tabulated results from other respondents. An analysis of the results will be made available to the community similar to the report on hiring outcomes from 2017 available at `https://web.cs.wpi.edu/~cew/papers/outcomes17.pdf`. Again this survey is only for the hiring of tenured/tenure-track faculty. Thank you

Q2 How many tenured/tenure-track faculty were you seeking to hire in 2018 (to begin in 2018 or 2019)?

Q3 How many tenured/tenure-track faculty have you hired in 2018 (to begin in 2018 or 2019)?

Q4 How many tenure/tenure-track faculty were hired in each of these area clusters (total across all areas should reflect the total number of hired faculty)? As reference, constituent topics for each area are available at `https://web.cs.wpi.edu/~cew/papers/topicareas18.pdf`
AI/Data Mining/Machine Learning
Architecture
Bioinformatics
Compilers/Prog Languages
Computational Science
Data Science
Databases
Games
Human Computer Interaction
Image Science
Mobile/Ubiquitous Computing
Robotics/Cyber-Physical Systems
Security
Software Engineering
Systems/Networking
Theory/Algorithms
Other CS
Other Interdisciplinary

Q5 How many tenure/tenure-track faculty were hired with the immediately-preceding position (total across all previous positions should reflect the total number of hired faculty)?
All, But Dissertation
Newly Completed PhD

Post Doc/Researcher
Other Non-Tenure-Track Faculty Position
Tenured/Tenure Track Position at Another Institution
Non-Academic Position
Other

Q6 Please provide any additional feedback you would like to provide on hiring tenured/tenure-track faculty in 2018. Any feedback will not be shared in the public survey tabulation.
[Open Text Response]

Q7 After continuing from this page you are done with the survey and will be redirected to a link showing numerical tabulation of results received thus far. Thank you for your contribution.
[Respondents redirected to page showing aggregated responses for Q2-Q5.]

B Participating Institutions

The following 176 institutions provided responses to the survey. They are listed based on highest degree offered with PhD institutions sub-divided if they have a top-100 U.S. ranking. Institutions are further denoted as public U.S. (no designation), private U.S. (designated with *), or non-U.S. (designated with †).

B.1 PhD100

Arizona, Auburn, Boston*, Brandeis*, Brown*, Cal Tech*, California Irvine, California Santa Barbara, California Santa Cruz, Carnegie Mellon*, Clemson, Colorado School Mines, Delaware, Florida, Florida St, George Mason, George Washington*, Georgia Tech, Harvard*, Iowa, Johns Hopkins*, Maryland Baltimore County, Massachusetts, Minnesota, Nebraska, New Mexico, North Carolina, North Carolina Charlotte, North Carolina St, Notre Dame*, Ohio State, Oregon, Pennsylvania*, Princeton*, Rochester Institute of Technology*, Rutgers, Southern California*, Stevens Institute of Technology*, SUNY Stony Brook, Tennessee, Texas Arlington, Texas Dallas, Tufts*, Utah, Worcester Polytechnic Institute*

B.2 PhDMore

Alabama, Alabama Birmingham, Alabama Huntsville, Alberta†, Bern†, Depaul*, KAIST Korea†, Massachusetts Boston, Memphis, Miami*, Missouri, Montclair St, New Hampshire, Oakland, Oklahoma, Oklahoma St, Ryerson†, South Alabama, SUNY Binghamton, Texas St, Toyota Technological Institute*, Utah St, Virginia Commonwealth, Wayne St, Wyoming

B.3 MS

American*, Austin Peay St, Bowling Green St, California St Fullerton, California St San Marcos, Central Arkansas, Central Connecticut St, Christopher Newport, CUNY John Jay College, Eastern Michigan, Fitchburg St, Fordham*, Illinois Springfield, Loyola U Chicago*, Minnesota Duluth, Monmouth*, Nebraska Omaha, North Florida, San Diego St, San Francisco St, Southern Oregon, SUNY Oswego, Tennessee Tech, Villanova*, West Chester, Western Washington, Wisconsin River Falls, Wisconsin Whitewater, Youngstown St

B.4 BS

Air Force Academy, Alaska Anchorage, Albright College*, Amherst College*, Augsburg*, Augustana College*, Baldwin Wallace*, Bard College*, Bates College*, Bemidji St, Benedictine College*, Berry College*, Bloomsburg, Boston College*, Bucknell*, Carleton College*, Coastal Carolina, Colby College*, Colgate*, College of New Jersey, College of Saint Benedict & Saint John's*, College of Saint Rose*, Creighton*, DePauw*, Dickinson College*, Eckerd College*, Elmhurst College*, Elon*, Evansville*, Furman*, Gordon College*, Hartford*, Illinois St, Illinois Wesleyan*, Indiana Pennsylvania, Indiana Wesleyan*, James Madison, John Carroll*, Kettering*, Lake Superior St, Macalester College*, Mary Washington, Massachusetts College Liberal Arts, Mercer*, Merrimack College*, Middlebury College*, Millersville, Montana Tech, New College*,

Oberlin College*, Otterbein*, Ramapo College, Rhodes College*, Richmond*, Rider*, Roanoke College*, Rocky Mountain College*, Rose-Hulman Institute*, San Diego*, Simmons College*, Simpson College*, Sioux Falls*, Smith College*, Sonoma St, St Lawrence*, St Olaf College*, SUNY Brockport, SUNY Fredonia, SUNY Oneonta, Wentworth Institute Technology*, Western St Colorado, Westminster College*, Wheaton College*, Whittier College*, Wisconsin Oshkosh, Worcester St, Yeshiva*