COMPUTING RESEARCH NEWS

Computing Research Association
Uniting Industry, Academia and Government to
Advance Computing Research and Change the World.

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CRN At-A-Glance

CRA and CCC Announce New Computing Innovation Fellows Program for 2020

The Computing Research Association (CRA) and Computing Community Consortium (CCC) are pleased to announce a new Computing Innovation Fellows (CIFellows) Program for 2020. This program recognizes the significant disruption to the academic job search caused by the COVID-19 pandemic and associated economic uncertainty and aims to provide a career-enhancing bridge experience for recent and soon-to-be PhD graduates in computing.

The goal of the program is to create career growth opportunities that support maintaining the computing research pipeline. This effort takes inspiration from CRA/CCC's NSF-funded Computing Innovation Fellows Programs with cohorts starting 2009, 2010, and 2011.

The program will offer 2 year postdoctoral opportunities in computing, with cohort activities to support career development and community building for this group of Fellows. We will be hosting a one-hour CIFellow 2020 Informational Webinar on **Tuesday, May 26th at 3:00PM ET**. Please register for the webinar here.

2019 Taulbee Survey:

Total Undergrad CS Enrollment Rises Again, but with Fewer New Majors; Doctoral Degree Production Recovers from Last Year's Dip

This article and the accompanying figures and tables present the results from the 49th annual CRA Taulbee Survey, which documents trends in student enrollment, degree production, employment of graduates, and faculty salaries in academic units in the United States and Canada that grant the Ph.D. in computer science, computer engineering, or information.

After twelve years of sustained growth in undergraduate enrollment, there may be signs of a slowdown in that there are, on average, fewer new undergraduate majors in 2019-20 than there were in 2018-19. Nevertheless, the average number of CS majors continued its rise in 2018-19, both in U.S. CS departments and overall.

Check out the full article for a complete analysis of the 2019 CRA Taulbee Survey data.

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The goal of the program is to create career growth opportunities that support maintaining the computing research pipeline. Computing research is defined as any area included under the **National Science Foundation** (NSF) **Computing and Information Science and Engineering** (CISE) Directorate. This effort takes inspiration from **CRA/CCC's NSF-funded Computing Innovation Fellows Programs with cohorts starting 2009, 2010, and 2011**.

Pending anticipated funding by the National Science Foundation, the CIFellows 2020 program will offer 2 year postdoctoral opportunities in computing, with cohort activities to support career development and community building for this group of Fellows. Realizing the many unknowns we are currently dealing with in this pandemic and that situations are different across the nation, there will be some flexibility in the program. Applicants must create a career development plan and coordinate with one or more proposed mentors.

Details of the program are still being finalized and will be updated on our website. We anticipate applications being due around mid-June 2020, with decisions being made around mid-July 2020 for positions beginning this fall or winter.

JOIN OUR WEBINAR ON MAY 26

We will be hosting a one-hour CIFellow 2020 Informational Webinar on **Tuesday, May 26th at 3:00PM ET**. There will be a brief 10-minute presentation on the program, followed by a Q&A. Presenters will be CCC Chair Mark D. Hill and CRA Board Chair Ellen Zegura. Please register for the webinar here. Please note that the webinar will be recorded and posted on the CIFellow 2020 webpage after the event.

Please check the website regularly for application requirements and submission details.

2019 Taulbee Survey

Total Undergrad CS Enrollment Rises Again, but with Fewer New Majors; Doctoral Degree Production Recovers From Last Year's Dip

By Stuart Zweben and Betsy Bizot

This article and the accompanying figures and tables present the results from the 49th annual CRA Taulbee Survey.[1] The survey, conducted annually by the Computing Research Association, documents trends in student enrollment, degree production, employment of graduates, and faculty salaries in academic units in the United States and Canada that grant the Ph.D. in computer science (CS), computer engineering (CE), or information (I).[2] Most of these academic units are departments, but some are colleges or schools of information or computing. In this report, we will use the term "department" to refer to the unit offering the program.

CRA gathers survey data during the fall. Responses received by February 7, 2020 are included in the analysis. The period covered by the data varies from table to table. Degree production and enrollment (Ph.D., Master's, and Bachelor's) refer to the previous academic year (2018-19). Data for new students in all categories refer to the current academic year (2019-20). Projected student production and information on faculty salaries are also for the current academic year; salaries are those effective January 1, 2020.

We surveyed a total of 278 Ph.D.-granting departments and received responses from 181, for an overall response rate of 65 percent. Last year we had the same number of respondents, but included more departments in our survey and had a 61 percent response rate. The response rates from CE and Canadian departments in particular continue to be low. The U.S. CS response rate of 77 percent is, as usual, the highest of all of the categories, and is higher than last year's 73 percent and equal to the U.S. CS response rate of two years ago. Figure 1 shows the history of the survey's response rates. Response rates are inexact because some departments provide only partial data, and some institutions provide a single joint response for multiple departments. Thus, in some tables the number of departments shown as reporting will not equal the overall total number of respondents shown in Figure 1 for that category of department.

To account for the changes in response rate, we will comment not only on aggregate totals but also on averages per department reporting or data from those departments that responded to both 2018 and 2019 surveys. This is a more meaningful indication of the one-year changes affecting the data.

Degree, enrollment, and faculty salary data for the U.S CS departments are stratified according to: a) whether the institution is public or private; and b) the tenure-track faculty size of the reporting department. The faculty size strata deliberately overlap, so that data from most departments affect multiple strata. This may be especially useful to departments near the boundary of one stratum. Salary data is also stratified according to the population of the locale in which the institution is located.[3] These stratifications allow our readers to see multiple views of important data, and hopefully gain new insights from them. In addition to tabular presentations of data, we will use "box and whisker" diagrams to show medians, quartiles, and the range between the 10th and 90th percentile data points.

We thank all of the respondents to this year's questionnaire. The participating departments are listed at the end of this article. CRA member respondents will again be given the opportunity to obtain certain survey information for a self-selected peer group. Instructions for doing this will be emailed to all such departments.

Figure 1. Number of Respondents to the Taulbee Survey

Year	US CS Depts.	US CE Depts.	Canadian	US Information	Total
1995	110/133 (83%)	9/13 (69%)	11/16 (69%)		130/162 (80%)
1996	98/131 (75%)	8/13 (62%)	9/16 (56%)		115/160 (72%)
1997	111/133 (83%)	6/13 (46%)	13/17 (76%)		130/163 (80%)
1998	122/145 (84%)	7/19 (37%)	12/18 (67%)		141/182 (77%)
1999	132/156 (85%)	5/24 (21%)	19/23 (83%)		156/203 (77%)
2000	148/163 (91%)	6/28 (21%)	19/23 (83%)		173/214 (81%)
2001	142/164 (87%)	8/28 (29%)	23/23 (100%)		173/215 (80%)
2002	150/170 (88%)	10/28 (36%)	22/27 (82%)		182/225 (80%)
2003	148/170 (87%)	6/28 (21%)	19/27 (70%)		173/225 (77%)
2004	158/172 (92%)	10/30 (33%)	21/27 (78%)		189/229 (83%)
2005	156/174 (90%)	10/31 (32%)	22/27 (81%)		188/232 (81%)
2006	156/175 (89%)	12/33 (36%)	20/28 (71%)		188/235 (80%)
2007	155/176 (88%)	10/30 (33%)	21/28 (75%)		186/234 (79%)
2008	151/181 (83%)	12/32 (38%)	20/30 (67%)	9/19 (47%)	192/264 (73%)
2009	147/184(80%)	13/31 (42%)	16/30 (53.3%)	12/20 (60%)	188/265 (71%)
2010	150/184 (82%)	12/30 (40%)	18/29 (62%)	15/22 (68%)	195/265 (74%)
2011	142/185 (77%)	13/31 (42%)	13/30 (43%)	16/21 (76%)	184/267 (69%)
2012	152/189 (80%)	11/32 (34%)	14/30 (47%)	16/26 (62%)	193/277 (70%)
2013	144/188 (77%)	10/30 (33%)	14/26 (54%)	11/22 (50%)	179/266 (67%)
2014	143/188 (76%)	13/31 (42%)	12/26 (46%)	13/19 (68%)	181/268 (68%)
2015	146/190(77%)	8/32 (25%)	12/26 (46%)	12/18 (67%)	178/266 (67%)
2016	150/188 (80%)	8/33 (24%)	11/26 (42%)	14/21 (67%)	183/268 (68%)
2017	148/192 (77%)	8/35 (23%)	11/30 (37%)	14/24 (58%)	181/281 (64%)
2018	143/195 (73%)	5/34 (15%)	12/30 (40%)	14/24 (58%)	174/283 (61%)
2019	148/192 (77%)	7/35 (20%)	11/29 (38%)	15/22 (68%)	181/278 (65%)

Doctoral Degree Production, Enrollment, and Employment

(Tables 1, D1-D10; Figures D1-D6)

Degree Production

Doctoral degree production increased in 2018-19, recovering to levels more comparable to those of two years ago. This year's respondents produced 13.2 degrees per U.S. CS department, and 12.2 degrees per department overall. This compares with 12.6 and 12.1, respectively, reported last year, and 13.1 and 12.4, respectively, reported two years ago. More departments (160) reported their Ph.D. production this year than did so last year (156). Total Ph.D. production in 2018-19 was 1,860 compared with 1,787 degrees produced in 2017-18 and 1,834 in 2016-17 (Table D1).

Among all departments reporting both this year and last year, the number of total doctoral degrees rose by 2.7 percent. However, among U.S. CS departments reporting both years, the increase was 6.9 percent (Table 1).

In 2018-19, women received 20.3 percent of CS doctoral degrees and 20.8 percent of all doctoral computing degrees (Table D2). Last year, the respective percentages were 19.3 and 21.3. Non-resident Aliens comprised a smaller percentage of 2018-19 Ph.D. recipients in all three areas (CS, CE and I) compared with 2017-18 recipients. This is the reverse of what was experienced last year. In contrast, resident Asians comprised a larger percentage compared with last year among recipients in all three areas (Table D3). The combined percentage of CS doctoral graduates who were American Indian or Alaska Native, Black or African American,

Native Hawaiian/Pacific Islander, Hispanic, or Multiracial Non-Hispanic was only 3.1 percent; it was 3.8 percent in 2017-18.

Unlike in previous years, Non-resident Aliens comprised a somewhat smaller percentage of the CS female doctoral graduates than they did CS male graduates, and Whites comprised an equal percentage of the female and male graduates. In past years, Non-resident Aliens had a higher percentage of female than male CS graduates, while Whites had a higher percentage of male than female CS graduates (Table D9).

Doctoral Program Enrollment

Total doctoral enrollment increased by 1.4 percent, and increased 8.6 percent among programs that reported both years. If only U.S. computer science departments are considered, the respective increases were 4.2 and 8.5 percent (Table 1). For the fourth straight year, total doctoral enrollment by gender is more diverse. Across the three areas of CS, CE and I combined, the fraction of 2018-19 doctoral students who were women is 24.5 percent, versus 23.4 percent in 2017-18. In CS, women comprised 23.2 percent of the 2018-19 students currently enrolled, versus 22.3 percent the previous year (Table D7).

By contrast, doctoral enrollment by ethnicity was less diverse in 2018-19. The overall fraction of doctoral students who were neither Non-resident Aliens, Asian, nor White declined from 6.9 percent to 4.9 percent. In CS programs, the fraction declined from 7.0 to 4.5 percent (Table D8).

As has been true in previous years, Non-resident Aliens comprise a higher percentage of the enrolled CS women than they do the enrolled CS men, while a lower percentage of enrolled CS women than enrolled CS men are White. The same relationships hold for CE. In I, the same pattern holds for White students (they comprise a lower percentage of women than of men), but Non-resident Aliens also comprise a smaller percentage of enrolled women than of enrolled men (Table D10).

At U.S. CS departments, the average number of students per department who passed qualifier exams in 2018-19 was 17.0, similar to the 17.2 reported the previous year. Both public and private institutions reported slight declines this year, following two consecutive years of increases. The average number per U.S. CS department who passed thesis candidacy exams in 2018-19 (most, but not all, departments have such exams) also declined from 2017-18 at both public and private institutions (Table D1).

Table 1. Degree Production and Enrollment Change From Previous Year

	Total						Only Departments Responding Both Years					
	US CS Only			All Departments			US CS Only			All Departments		
PhDs	**2018**	**2019**	**% chg**	**2018**	**2019**	**% chg**	**2018**	**2019**	**% chg**	**2018**	**2019**	**% chg**
PhD Awarded	1,521	1,701	11.8%	1,787	1,860	4.1%	1,379	1,474	6.9%	1,584	1,626	2.7%
#Units PhD Awd	121	129	6.6%	148	153	3.4%	107	107		129	129	
PhD Enrollment	14,992	15,621	4.2%	17,110	17,355	1.4%	13,959	15,145	8.5%	15,502	16,832	8.6%
#Units PhD Enr	139	138	-0.7%	169	164	-3.0%	127	127		151	151	
New PhD Enroll	3,395	3,365	-0.9%	3,769	3,732	-1.0%	2,900	3,095	6.7%	3,321	3,574	7.6%
#Units New PhD	133	134	0.8%	162	161	-0.6%	117	117		145	145	
Bachelor's	**2018**	**2019**	**% chg**	**2018**	**2019**	**% chg**	**2018**	**2019**	**% chg**	**2018**	**2019**	**% chg**
BS Awarded	28,698	29,377	2.4%	33,853	35,298	4.3%	25,799	27,790	7.7%	30,474	33,551	10.1%
#Units BS Awd	130	134	3.1%	155	159	2.6%	117	117		139	139	
BS Enrollment	141,259	143,457	1.6%	163,735	172,264	5.2%	121,863	130,942	7.5%	142,667	158,879	11.4%
#Units BS Enr	131	135	3.1%	156	160	2.6%	118	118		140	140	
New BS Majors	35,245	33,184	-5.8%	40,774	39,226	-3.8%	27,786	25,338	-8.8%	33,052	30,839	-6.7%
#Units New BS	112	121	8.0%	133	142	6.8%	98	98		115	115	
BS Enroll/Dept	1,078.3	1,062.6	-1.5%	1,050	1,077	2.6%	1,033	1109.7	7.5%	1019.1	1134.9	11.4%

2019 Taulbee Survey *(continued)*

The number of new Ph.D. students per department reporting increased again this year compared with last year's reporting departments for both U.S. I and Canadian departments (Tables 1 and D5). There was a decline again for CE departments, and a slight decline among U.S. CS departments. Among departments that reported both years, the number of new Ph.D. students increased 7.6 percent overall and 6.7 percent among U.S. CS departments.

The proportion of new doctoral students from outside North America rose this year to 61.2% from 59.3% last year. There were increases at U.S. CS and U.S. CE departments, while there were decreases in U.S. I departments. Canadian department proportions were similar to those of last year (Table D5a).

Figure D5 shows a graphical view of the Ph.D. pipeline for U.S. computer science and Canadian departments, the main producers of CS doctoral degrees. The data in this graph are normalized

Table D1. PhD Production and Pipeline by Department Type

Department Type	# Depts	PhDs Awarded		PhDs Next Year		Passed Qualifier		Passed Thesis (if dept has)		
		#	Avg/ Dept	#	Avg/ Dept	#	Avg/ Dept	#	# Dept	Avg/ Dept
US CS Public	100	1,222	12.9	1,430	14.3	1,587	17.3	1168	76	15.4
US CS Private	34	479	14.1	603	17.7	576	16.5	246	24	10.3
US CS Total	134	1,701	13.2	2,033	15.2	2,163	17.0	1,414	100	14.1
US CE	5	23	4.6	48	9.6	14	4.7	12	3	4.0
US Info	12	55	5.5	105	8.8	113	9.4	92	11	8.4
Canadian	9	81	9.0	85	9.4	99	11.0	78	5	15.6
Grand Total	160	1,860	12.2	2,271	14.2	2,389	15.8	1,596	119	13.4

Table D2. PhDs Awarded by Gender

	CS		CE		I		Total	
Male	1,313	79.7%	99	83.9%	58	63.0%	1,470	79.2%
Female	334	20.3%	19	16.1%	34	37.0%	387	20.8%
Total Known Gender	1,647		118		92		1,857	
Gender Unknown	2		0		1		3	
Grand Total	1,649		118		93		1,860	

Table D3. PhDs Awarded by Ethnicity

	CS		CE		I		Total	
Nonresident Alien	906	61.7%	59	66.3%	26	31.0%	991	60.4%
Amer Indian or Alaska Native	2	0.1%	0	0.0%	0	0.0%	2	0.1%
Asian	151	10.3%	10	11.2%	12	14.3%	173	10.5%
Black or African-American	13	0.9%	3	3.4%	2	2.4%	18	1.1%
Native Hawaiian/Pac Islander	1	0.1%	0	0.0%	3	3.6%	4	0.2%
White	365	24.9%	13	14.6%	40	47.6%	418	25.5%
Multiracial, not Hispanic	9	0.6%	3	3.4%	0	0.0%	12	0.7%
Hispanic, any race	21	1.4%	1	1.1%	1	1.2%	23	1.4%
Total Residency & Ethnicity Known	1,468		89		84		1,641	
Resident, ethnicity unknown	52		4		4		60	
Residency unknown	129		25		5		159	
Grand Total	1,649		118		93		1,860	

Table D4. Employment of New PhD Recipients By Specialty

	Artificial Intelligence / Machine Learning	Computing Education	Databases / Information Retrieval	Graphics / Visualization	Hardware / Architecture	High-Performance Computing	Human-Computer Interaction	Informatics: Biomedical / Other Science	Information Science	Information Systems	Networks	Operating Systems	Programming Languages / Compilers	Robotics / Vision	Scientific / Numerical Computing	Security / Information Assurance	Social Computing / Social Informatics	Software Engineering	Theory and Algorithms	Other	Unknown	Total	
North American PhD Granting Depts.																							
Tenure-track	25	2	6	6	1	1	13	0	6	1	9	4	3	9	1	18	4	0	6	7	9	131	9.6%
Researcher	7	0	0	0	0	4	3	3	0	2	0	3	0	0	1	1	0	2	3	1	4	34	2.5%
Postdoc	29	1	8	5	4	2	5	15	4	2	7	6	7	11	2	11	8	4	25	5	11	172	12.6%
Teaching Faculty	4	5	4	2	2	2	7	1	2	1	1	3	0	3	2	1	1	5	3	1	4	54	4.0%
North American, Other Academic																							
Other CS/CE/I Dept.	0	4	4	2	1	0	4	1	0	0	1	2	0	3	1	0	0	4	3	0	2	32	2.3%
Non-CS/CE/I Dept	0	1	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	0	0	1	0	6	0.4%
North American, Non-Academic																							
Industry	180	4	55	33	32	19	28	18	9	6	35	28	16	58	4	40	16	52	38	46	59	776	57.0%
Government	4	0	2	0	0	3	0	4	0	0	0	0	0	5	3	5	0	1	0	3	2	32	2.3%
Self-Employed	6	0	0	1	0	1	1	0	0	0	1	0	0	0	0	1	0	1	0	0	1	13	1.0%
Unemployed	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1%
Other	0	1	0	1	0	0	0	1	0	1	0	0	0	2	0	0	1	0	0	0	2	9	0.7%
Total Inside North America																							
	255	18	79	50	40	33	62	44	22	13	54	46	26	91	14	77	31	69	78	64	94	1,260	92.5%
Outside North America																							
Ten-Track in PhD	4	0	4	2	0	1	0	2	3	2	2	1	0	0	0	6	0	1	3	0	2	33	2.4%
Researcher in PhD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0.1%
Postdoc in PhD	3	0	1	0	0	0	0	0	0	1	0	0	2	1	0	1	0	1	4	1	1	16	1.2%
Teaching in PhD	1	0	0	0	0	0	2	2	0	0	2	0	0	1	0	1	0	0	2	0	1	12	0.9%
Other Academic	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	1	0	0	0	5	0.4%
Industry	10	1	1	1	0	1	0	1	0	0	0	4	0	1	0	2	1	1	5	0	1	30	2.2%
Government	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	0.1%
Self-Employed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
Unemployed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%
Other	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	3	0.2%
Total Outside NA	19	1	6	3	0	2	2	5	3	4	5	6	2	3	1	12	1	4	15	1	7	102	7.5%
Total with Employment Data, Inside North America plus Outside North America																							
	274	19	85	53	40	35	64	49	25	17	59	52	28	94	15	89	32	73	93	65	101	1,362	
Employment Type & Location Unknown																							
	38	0	14	21	13	1	5	15	13	2	20	4	4	9	3	9	1	8	14	21	283	498	
Grand Total	**312**	**19**	**99**	**74**	**53**	**36**	**69**	**64**	**38**	**19**	**79**	**56**	**32**	**103**	**18**	**98**	**33**	**81**	**107**	**86**	**384**	**1,860**	

by the number of reporting departments. The graph offsets the qualifier data by two years from the data for new students, and offsets the graduation data by five years from the data for new students. These data have been useful in estimating the timing of changes in production rates. The graph predicts larger growth beginning next year, and departments are indeed forecasting a double-digit percent increase in production during 2019-20 (Table D1). Last year's departmental forecast double-digit percentage increase in production did not materialize; much more modest growth was obtained.

Table D4a. Detail of Industry Employment

	Artificial Intelligence / Machine Learning	Computing Education	Databases / Information Retrieval	Graphics / Visualization	Hardware / Architecture	High Performance Computing	Human-Computer Interaction	Informatics: Biomedical / Other Science	Information Science	Information Systems	Networks	Operating Systems	Programming Languages / Compilers	Robotics / Vision	Scientific /N umerical Computing	Security / Information Assurance	Social Computing / Social Informatics	Software Engineering	Theory and Algorithms	Other	Unknown	Total	
Inside North America																							
Research	122	3	28	21	22	12	19	11	8	4	21	9	8	41	3	18	11	18	19	28	17	443	57.1%
Non-Research	46	1	21	11	6	6	9	3	1	1	12	16	6	14	0	15	3	31	11	14	16	243	31.3%
Postdoctorate	2	0	0	0	0	0	0	3	0	0	0	0	1	2	0	1	1	0	1	0	4	15	1.9%
Type Not Specified	10	0	6	1	4	1	0	1	0	1	2	3	1	1	1	6	1	3	7	4	22	75	9.7%
Total Inside NA	180	4	55	33	32	19	28	18	9	6	35	28	16	58	4	40	16	52	38	46	59	776	
Outside North America																							
Research	8	1	0	1	0	1	0	1	0	0	0	2	0	1	0	2	1	0	3	0	1	22	73.3%
Non-Research	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	5	16.7%
Postdoctorate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	3.3%
Type Not Specified	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2	6.7%
Total Outside NA	10	1	1	1	0	1	0	1	0	0	0	4	0	1	0	2	1	1	5	0	1	30	

Table D5. New PhD Students by Department Type

	CS				CE				I				Total	
Department Type	**New Admit**	**MS to PhD**	**Total**	**Avg. per Dept.**	**New Admit**	**MS to PhD**	**Total**	**Avg. per Dept.**	**New Admit**	**MS to PhD**	**Total**	**Avg. per Dept.**	**Total**	**Avg. per Dept**
US CS Public	2,026	178	2,204	22.7	114	15	129	7.6	86	8	94	13.4	2,427	24.8
US CS Private	853	59	912	25.3	8	2	10	2.5	16	0	16	8.0	938	26.1
US CS Total	2,879	237	3,116	23.4	122	17	139	6.6	102	8	110	12.2	3,365	25.1
US CE	0	0	0	0.0	39	8	47	9.4	0	0	0	0.0	47	9.4
US Information	12	0	12	6.0	0	0	0	0.0	132	14	146	11.2	158	12.2
Canadian	136	26	162	18.0	0	0	0	0.0	0	0	0	0.0	162	18.0
Grand Total	3,027	263	3,290	22.8	161	25	186	7.2	234	22	256	11.6	3,732	23.2

Table D5a. New PhD Students from Outside North America

Department Type	CS	CE	I	Total New Outside	Total New	% outside North America
US CS Public	1,410	86	39	1,535	2,427	63.2%
US CS Private	523	7	12	542	938	57.8%
Total US CS	1,933	93	51	2,077	3,365	61.7%
US CE	0	37	0	37	47	78.7%
US Info	5	0	84	89	158	56.3%
Canadian	80	0	0	80	162	49.4%
Grand Total	2,018	130	135	2,283	3,732	61.2%

Table D6. PhD Enrollment by Department Type

Department Type	# Depts	CS		CE		I		Total	
US CS Public	100	10,149	66.2%	747	76.8%	364	35.0%	11,260	64.9%
US CS Private	38	4,263	27.8%	58	6.0%	40	3.8%	4,361	25.1%
Total US CS	138	14,412	93.9%	805	82.7%	404	38.8%	15,621	90.0%
US CE	5	0	0.0%	168	17.3%	0	0.0%	168	1.0%
US Info	12	102	0.7%	0	0.0%	636	61.2%	738	4.3%
Canadian	9	828	5.4%	0	0.0%	0	0.0%	828	4.8%
Grand Total	164	15,342		973		1,040		17,355	

Table D7. PhD Enrollment by Gender

	CS		CE		I		Total	
Male	11,527	76.8%	726	76.1%	579	55.8%	12,832	75.5%
Female	3,477	23.2%	228	23.9%	459	44.2%	4,164	24.5%
Total Known Gender	15,004		954		1,038		16,996	
Gender Unknown	338		19		2		359	
Grand Total	15,342		973		1,040		17,355	

Table D8. PhD Enrollment by Ethnicity

	CS		CE		I		Total	
Nonresident Alien	9,205	66.1%	685	72.1%	534	54.4%	10,424	65.8%
Amer Indian or Alaska Native	18	0.1%	0	0.0%	0	0.0%	18	0.1%
Asian	1088	7.8%	53	5.6%	60	6.1%	1201	7.6%
Black or African-American	222	1.6%	18	1.9%	45	4.6%	285	1.8%
Native Hawaiian / Pac Islander	9	0.1%	2	0.2%	9	0.9%	20	0.1%
White	2,995	21.5%	160	16.8%	294	29.9%	3,449	21.8%
Multiracial, not Hispanic	115	0.8%	10	1.1%	16	1.6%	141	0.9%
Hispanic, any race	269	1.9%	22	2.3%	24	2.4%	315	2.0%
Total Known	13,921		950		982		15,853	
Resident, ethnicity unknown	405		23		58		486	
Residency unknown	1016		0		0		1016	
Grand Total	15,342		973		1,040		17,355	

Table D9. PhDs Awarded by Gender and Ethnicity, From 153 Departments

	CS					CE					I					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	723	183	0	62	59	51	8	0	68	57	19	7	0	36	23	991	60.4
Amer Indian or Alaska Native	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0.1
Asian	112	39	0	10	13	8	2	0	11	14	8	4	0	15	13	173	10.5
Black or African-American	10	3	0	1	1	2	1	0	3	7	1	1	0	2	3	18	1.1
Native Hawaiian/ Pac Islander	1	0	0	0	0	0	0	0	0	0	3	0	0	6	0	4	0.2
White	289	76	0	25	25	10	3	0	13	21	21	19	0	40	61	418	25.5
Multiracial, not Hispanic	6	3	0	1	1	3	0	0	4	0	0	0	0	0	0	12	0.7
Hispanic, any race	17	4	0	2	1	1	0	0	1	0	1	0	0	2	0	23	1.4
Total Res & Ethnicity Known	1,160	308	0	0	0	75	14	0			53	31	0			1,641	
Resident, ethnicity unknown	42	8	2			4	0	0			3	1	0			60	
Not Reported (N/R)	111	18	0			20	5	0			2	2	1			159	
Gender Totals	1,313	334	2			99	19	0			58	34	1			1,860	
%	79.7%	20.3%				83.9%	16.1%				63.0%	37.0%					
* % of M and % of F columns are the percent of that gender who are of the specified ethnicity, of those whose ethnicity is known																	

Table D10. PhD Enrollment by Gender and Ethnicity, From 164 Departments Providing Breakdown Data

	CS					CE					I					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	6,939	2,154	112	66	68	493	183	9	70	82	306	228	0	56	52	10,424	65.8%
Amer Indian or Alaska Native	15	3	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0.1%
Asian	788	296	4	7	9	44	8	1	6	4	31	29	0	6	7	1201	7.6%
Black or African-American	147	75	0	1	2	13	4	1	2	2	16	28	1	3	6	285	1.8%
Native Hawaiian/ Pac Islander	3	5	1	0	0	0	2	0	0	1	5	4	0	1	1	20	0.1%
White	2,408	554	33	23	18	130	24	6	18	11	168	125	1	31	29	3,449	21.8%
Multiracial, not Hispanic	94	20	1	1	1	8	0	2	1	0	7	9	0	1	2	141	0.9%
Hispanic, any race	204	61	4	2	2	19	3	0	3	1	10	14	0	2	3	315	2.0%
Total Res & Ethnicity Known	10,598	3,168	155			707	224				543	437	2			15,853	
Resident, ethnicity unknown	292	113	0			19	4				36	22	0			486	
Not Reported (N/R)	637	196	183			0	0				0	0	0			1016	
Gender Totals	11,527	3,477	338			726	228				579	459	2			17,355	
%	76.8%	23.2%				76.1%	23.9%				55.8%	44.2%				0.0%	
* % of M and % of F columns are the percent of that gender who are of the specified ethnicity, of those whose ethnicity is known																	

Ph.D. Employment

Figure D6 shows the employment trend of new Ph.D.s in academia and industry within North America, those taking employment outside of North America, and those going to academia in North America who took positions in departments other than Ph.D.-granting CS and CE departments. Table D4 shows a more detailed breakdown of the employment data for new Ph.D.s. The percentage of new Ph.D.s who took positions in North American industry was 57.0 percent, the same as the percentage reported last year. Among those doctoral graduates who went to North American industry and for whom the type of industry position was known, about 63 percent took research positions (Table D4a). This also is the percentage reported last year. This year, definitive data was provided for over 90 percent of the graduates who went to North American industry, slightly lower than last year's 92 percent.

The percentage of Ph.D. graduates who took North American academic jobs in 2018-19 (31.5) also was similar in that reported for 2017-18 (31.2). Among those graduates taking academic positions in North America, the percentage who did not go to a doctoral-granting computing department was 8.9, compared to 5.7 in 2017-18. This number has oscillated for the last several years, so this rise should not be interpreted as any indication of a trend.

Among those whose employment is known, 7.5 percent of Ph.D. graduates reported taking positions outside of North America, similar to the reported values in each of the past two years. Slightly higher percentages of these persons went to an industry, tenure-track academic, and academic postdoctoral positions than did so last year. A slightly lower percentage went to academic researcher and government positions. However, most of the doctoral graduates who went to non-North American industry positions took research positions. Definitive data was provided for 93 percent of the graduates who went to non-North American industry positions.

When academic and industry postdocs are combined, the result is that 15.0 percent of 2018-19 doctoral graduates whose employment was known took some type of postdoctoral position. Last year, the reported percentage was 14.8. Approximately eight percent of these were industry postdocs.

Of those doctoral graduates for whom employment information was known, only one person was reported as unemployed. However, 26.8 percent of new Ph.D.s' employment status was unknown. The lack of information about the employment of more than one in four graduates may skew the real overall percentages for certain employment categories.

Table D4 also indicates the areas of specialty of new Ph.D.s. Artificial intelligence/machine learning continues to be by far the most popular area, comprising nearly 17 percent of all doctoral degrees awarded. However, this year, theory/algorithms and robotics/vision were next highest, replacing software engineering and networks. The fourth most popular specialty area both last year and this year is security/information assurance. Approximately one in five of the Ph.D.s are categorized into the area "unknown."

Figure D1. PhD Production

CRA Taulbee Survey 2019

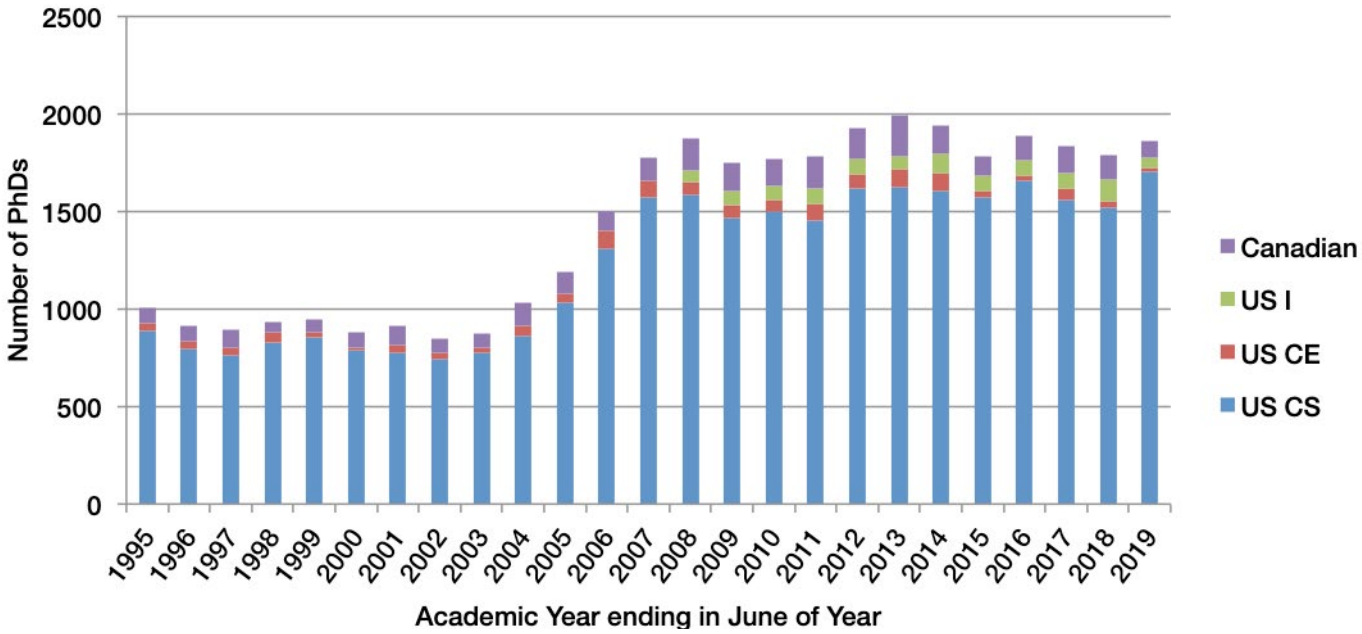


Figure D2. Nonresident Aliens as Fraction of PhD Enrollments

CRA Taulbee Survey 2019

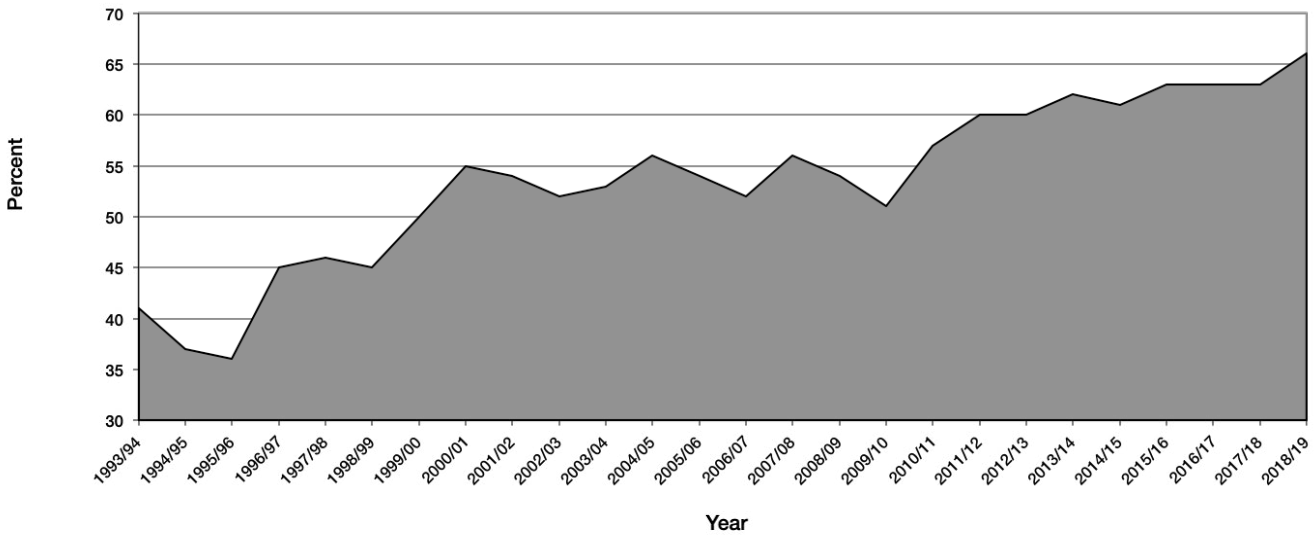


Figure D3. PhD Degrees Granted by Tenure-Track Size

CRA Taulbee Survey 2019

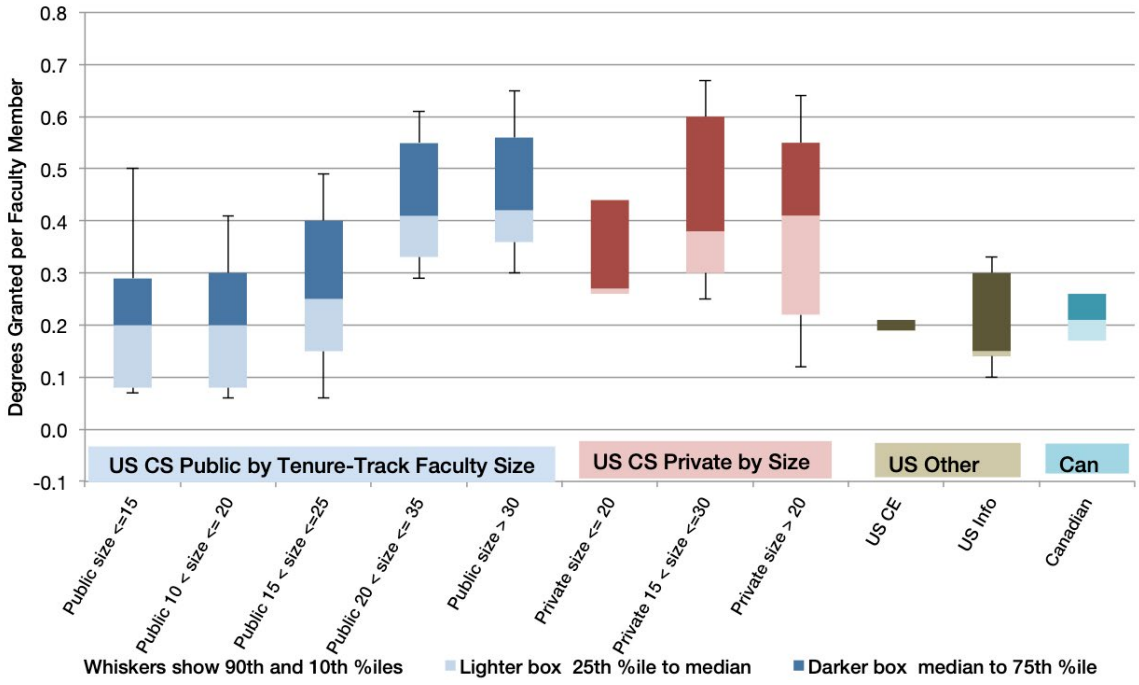


Figure D4. PhD Enrollment Normalized by Tenure-Track Size

CRA Taulbee Survey 2019

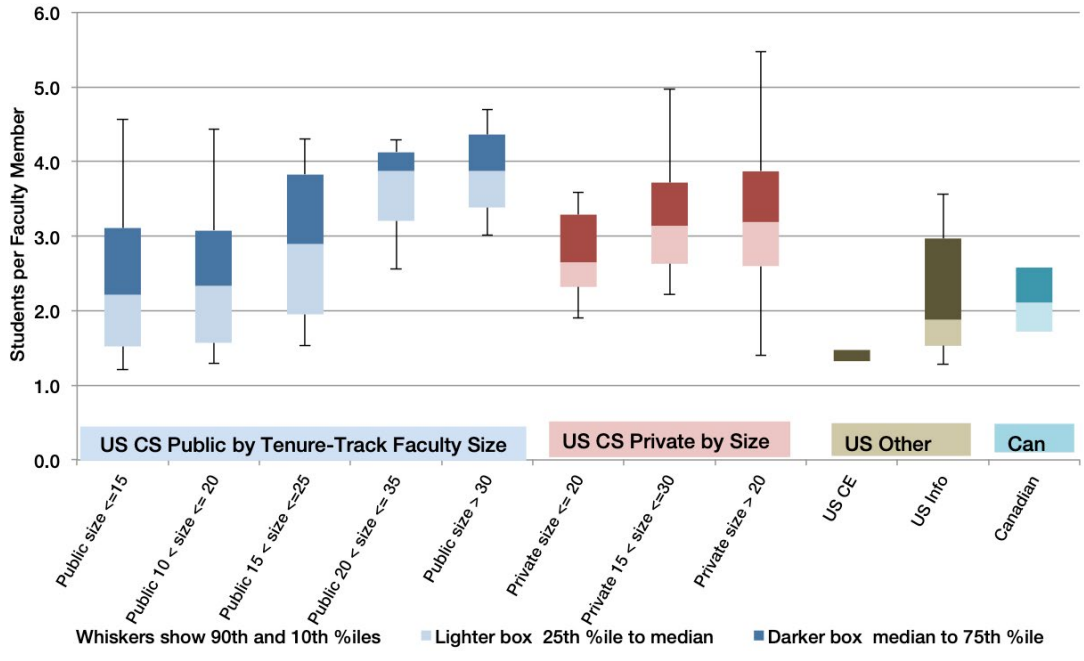


Figure D5. CS Pipeline corrected for year of entry

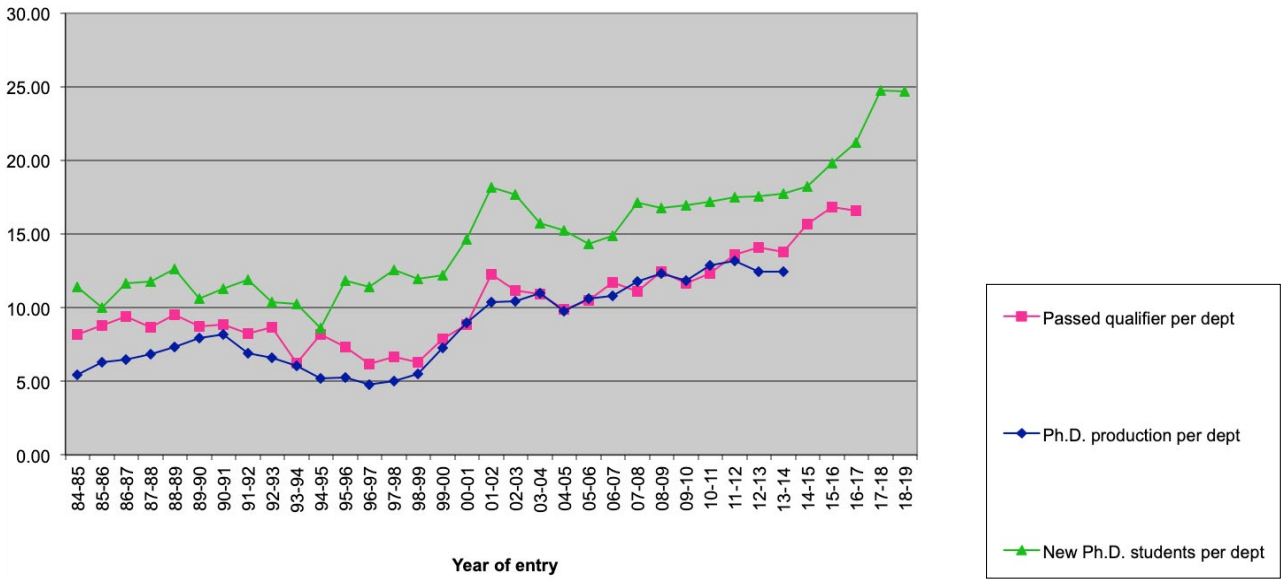
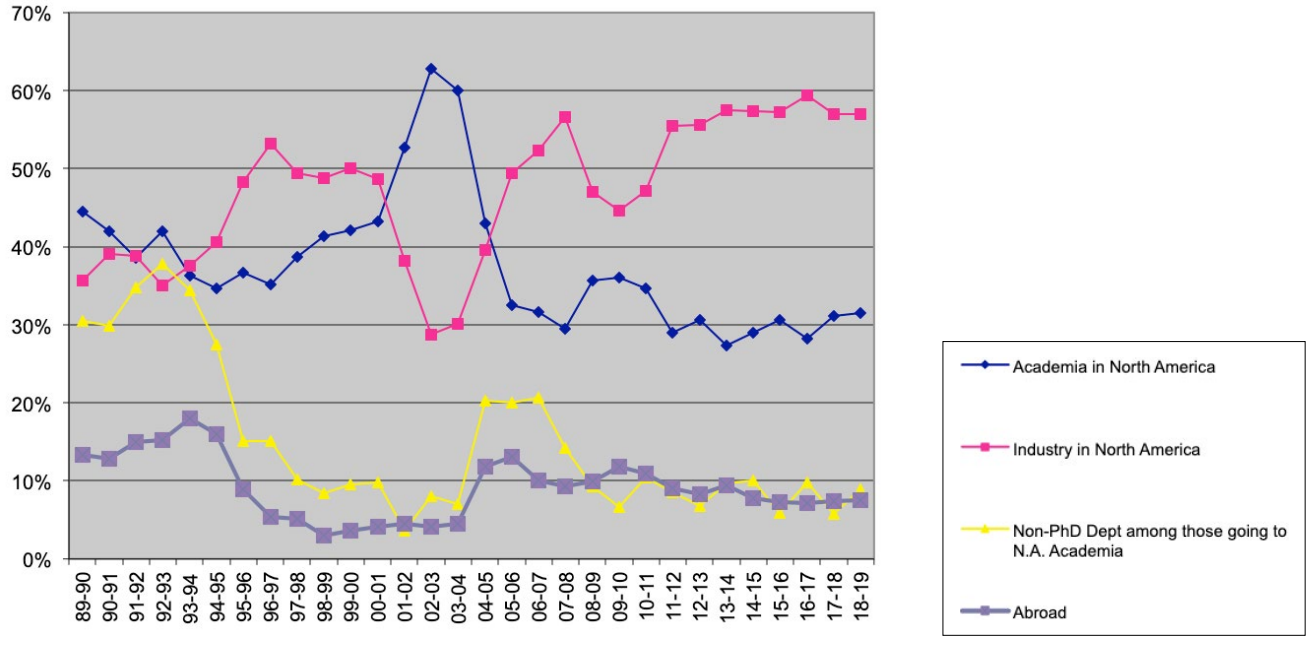


Figure D6. Employment Trends for New Ph.D.s



Master's and Bachelor's Degree Production and Enrollments

This section reports data about enrollment and degree production for master's and bachelor's programs in the doctoral-granting departments. Although the absolute number of degrees and enrolled students reported herein only reflect departments that offer the doctoral degree, the trends observed in the master's and bachelor's data from these departments tend to strongly reflect trends in the larger population of programs that offer such degrees.

Master's

(Tables M1-M8; Figures M1-M2)

On a per department basis, 2018-19 CS master's degree production in U.S. CS departments rose by 8.1 percent compared with 2017-18. The production at public institutions rose 16.7 percent, while that at private institutions declined by 6.4 percent. Each of these comparisons with 2017-18 is in the reverse direction of the year-to-year comparison reported in last year's survey.

Overall master's degree production per department in 2018-19 rose 7.1 percent aggregated over all departments, 6.1 percent at U.S. CS departments and 9.1 percent at Information departments. Canadian production per department showed a 46 percent increase, but with only nine departments reporting versus 11 last year, this comparison may well be skewed by the difference in departments reporting in the two respective years. No comparison is made for the CE area due to the even smaller number of departments reporting (Table M1).

The proportion of female graduates among CS master's degree recipients rose from 26.5 percent to 27.2 percent. Women comprised 24.6 percent of the CE graduates, down from 27.5 percent, and the I area graduated more women than men among those whose gender was reported (53.9 percent, versus 48.8 percent in last year's report). Aggregating all areas, the percentage of master's degrees to women increased from 30.6 to 31.2 percent (Table M2).

In CS, 68.8 percent of master's degrees went to Non-resident Aliens, slightly lower than the 70.0 percent in 2017-18. The percentage of Non-resident Aliens also dropped slightly in the I area, from 44.4 percent to 43.3 percent. The CE area statistics are more volatile due to the smaller number of units reporting; the percentage of CE degrees going to Non-resident Aliens increased from 70.8 to 79,8 percent. The aggregate percentage over all three areas dipped slightly, from 65.4 to 64.7 percent. The percentage of CS master's recipients among American Indian/Alaska Native, Black/African-American, Native Hawaiian/Pacific Islander, Hispanic, and Multiracial was approximately 4.0 percent in 2018-19 versus 3.6 percent in 2017-18 (Table M3).

Table M1. Master's Degrees Awarded by Department Type

Department Type	# Depts	CS		CE		I		Total	
US CS Public	100	8,621	58.5%	383	54.3%	487	15.7%	9,491	51.2%
US CS Private	36	5,235	35.5%	89	12.6%	615	19.9%	5,939	32.0%
Total US CS	136	13,856	94.0%	472	67.0%	1,102	35.6%	15,430	83.3%
US CE	5	0	0.0%	223	31.6%	0	0.0%	223	1.2%
US Info	12	47	0.3%	0	0.0%	1,992	64.4%	2,039	11.0%
Canadian	9	832	5.6%	10	1.4%	0	0.0%	842	4.5%
Grand Total	162	14,735		705		3,094		18,534	

Table M2. Master's Degrees Awarded by Gender

	CS		CE		I		Total	
Male	10,404	72.8%	483	75.4%	1,261	46.1%	12,148	68.8%
Female	3,888	27.2%	158	24.6%	1,473	53.9%	5,519	31.2%
Total Known Gender	14,292		641		2,734		17,667	
Gender Unknown	443		64		360		867	
Grand Total	14,735		705		3,094		18,534	

Table M3. Master's Degrees Awarded by Ethnicity

	CS		CE		I		Total	
Nonresident Alien	9,042	68.8%	497	79.8%	1,261	43.3%	10,800	64.7%
Amer Indian or Alaska Native	6	0.0%	0	0.0%	1	0.0%	7	0.0%
Asian	1,547	11.8%	28	4.5%	412	14.1%	1,987	11.9%
Black or African-American	155	1.2%	5	0.8%	133	4.6%	293	1.8%
Native Hawaiian/Pac Island	6	0.0%	0	0.0%	8	0.3%	14	0.1%
White	2,032	15.5%	72	11.6%	931	32.0%	3,035	18.2%
Multiracial, not Hispanic	86	0.7%	8	1.3%	62	2.1%	156	0.9%
Hispanic, any race	276	2.1%	13	2.1%	105	3.6%	394	2.4%
Total Residency & Ethnicity Known	13,150		623		2,913		16,686	
Resident, ethnicity unknown	477		9		168		654	
Residency unknown	1,108		73		13		1,194	
Grand Total	14,735		705		3,094		18,534	

Table M4. Master's Degrees Expected Next Year by Department Type

Department Type	# Depts	CS		CE		I		Total	
US CS Public	99	8,494	59.5%	296	51.4%	367	11.7%	9,157	50.9%
US CS Private	34	5,224	36.6%	96	16.7%	521	16.7%	5,841	32.5%
Total US CS	133	13,718	96.1%	392	68.1%	888	28.4%	14,998	83.4%
US CE	5	0	0.0%	179	31.1%	0	0.0%	179	1.0%
US Info	12	43	0.3%	0	0.0%	2,236	71.6%	2,279	12.7%
Canadian	9	517	3.6%	5	0.9%	0	0.0%	522	2.9%
Grand Total	159	14,278		618		3,124		17,978	

Table M5. New Master's Students by Department Type

Department Type	CS			CE			I			Total			Outside North America	
	Total	# Depts	Avg. per Dept.	Total	# Depts	Avg. per Dept.	Total	# Depts	Avg. per Dept.	Total	# Depts	Avg. per Dept.	# Depts	%
US CS Public	9,733	102	95.4	313	22	14.2	374	15	24.9	10,420	102	102.2	6,401	61.4%
US CS Private	5,292	35	151.2	21	4	5.3	447	6	74.5	5,760	35	164.6	3,810	66.1%
Total US CS	15,025	137	109.7	334	26	12.8	821	21	39.1	16,180	137	118.1	10,211	63.1%
US CE	0	0	0.0	194	5	38.8	0	0	0.0	194	5	38.8	157	80.9%
US Information	88	2	44.0	0	0	0.0	2,081	13	160.1	2,169	13	166.8	941	43.4%
Canadian	479	9	53.2	52	2	26.0	0	0	0.0	531	9	59.0	353	66.5%
Grand Total	15,592	148	105.4	580	33	17.6	2,902	34	85.4	19,074	164	116.3	11,662	61.1%

Table M6. Total Master's Students by Department Type

Department Type	CS			CE			I			Total		
	Total	# Depts	Avg. per Dept.	Total	# Depts	Avg. per Dept.	Total	# Depts	Avg. per Dept.	Total	# Depts	Avg. per Dept.
US CS Public	25,977	101	257.2	908	20	45.4	1,205	13	92.7	28,090	102	275.4
US CS Private	12293	37	332.2	181	5	36.2	1391	5	278.2	13865	37	374.7
Total US CS	38,270	138	277.3	1,089	25	43.6	2,596	18	144.2	41,955	139	301.8
US CE	0	0	0.0	373	5	74.6	0	0	0.0	373	5	74.6
US Information	121	2	60.5	0	0	0.0	4675	13	359.6	4796	13	368.9
Canadian	2850	9	316.7	39	1	39.0	0	0	0.0	2889	9	321.0
Grand Total	41,241	149	276.8	1,501	31	48.4	7,271	31	234.5	50,013	166	301.3

Table M7. Masters Degrees Awarded by Gender and Ethnicity, From 164 Departments Providing Breakdown Data

	CS					CE					I					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	6,213	2,607	222	66	75	362	135	0	77	88	600	525	136	51	38	10,800	64.7
Amer Indian or Alaska Native	4	1	1	0	0	0	0	0	0	0	0	1	0	0	0	7	0.0
Asian	1102	440	5	12	13	19	9	0	4	6	125	194	93	11	14	1987	11.9
Black or African-American	112	39	4	1	1	5	0	0	1	0	47	61	25	4	4	293	1.8
Native Hawaiian/ Pac Islander	5	1	0	0	0	0	0	0	0	0	5	0	3	0	0	14	0.1
White	1,705	310	17	18	9	64	8	0	14	5	319	540	72	27	39	3,035	18.2
Multiracial, not Hispanic	72	11	3	1	0	7	1	0	2	1	21	33	8	2	2	156	0.9
Hispanic, any race	206	68	2	2	2	12	1	0	3	1	55	42	8	5	3	394	2.4
Total Res & Ethnicity Known	9,419	3,477	254			469	154	0			1,172	1,396	345			16,686	
Resident, ethnicity unknown	323	151	3			5	2	2			86	75	7			654	
Not Reported (N/R)	662	260	186			9	2	62			3	2	8			1194	
Gender Totals	10,404	3,888	443			483	158	64			1,261	1,473	360			18,534	
%	72.8%	27.2%				75.4%	24.6%				46.1%	53.9%					
* % of M and % of F columns are the percent of that gender who are of the specified ethnicity, of those whose ethnicity is known																	

2019 Taulbee Survey *(continued)*

As has been the case in recent years, Non-resident Aliens again comprised a much larger proportion of female CS and CE degree recipients than male CS and CE degree recipients, while larger percentage of male CS and CE degree recipients than female CS and CE degree recipients were White (Table M7). In the I area, Non-resident Aliens again comprised a larger percentage of male master's graduates than female master's graduates, while a smaller percentage of male master's graduates than female master's graduates were White. These trends are likely to continue into the near future based on the current enrollment breakdown by gender and ethnicity (Table M8).

The average number of new master's students enrolled in U.S. CS departments dipped from 123.5 to 118.1. The decline is due to public departments; private departments actually experienced slight increases (Table M5).

The fraction of new master's students in U.S. CS departments that is reported to be from outside North America in 2019-20 was 63.1 percent, compared with 60.0 percent in 2018-19 (Table M5). The 2019-20 level is close to the level reported two years ago. Both public and private institutions saw an increase in this statistic. At U.S. Information departments, the fraction of new master's students from outside North America also rose, from 40.2 percent to 43.4 percent, ending a two-year decline.

Table M8. Masters Enrollment by Gender and Ethnicity, From 166 Departments Providing Breakdown Data

	CS					CE					I					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	15,752	6,682	155	59	73	704	288	0	70	84	1,427	1,281	3	44	37	26,292	59.2
Amer Indian or Alaska Native	19	4	0	0	0	0	0	0	0	0	5	6	0	0	0	34	0.1
Asian	2,880	983	61	11	11	55	13	0	6	4	295	319	0	9	9	4,606	10.4
Black or African-American	507	174	34	2	2	24	1	0	2	0	175	205	0	5	6	1,120	2.5
Native Hawaiian/ Pac Islander	15	1	0	0	0	1	0	0	0	0	5	0	0	0	0	22	0.0
White	6,314	1,007	131	24	11	160	23	0	16	7	1,075	1,408	3	33	41	10,121	22.8
Multiracial, not Hispanic	311	87	6	1	1	9	3	0	1	1	59	74	0	2	2	549	1.2
Hispanic, any race	1,028	203	9	4	2	51	14	0	5	4	186	156	0	6	5	1,647	3.7
Total Res & Ethnicity Known	26,826	9,141	396			1,004	342	0			3,227	3,449	6			44,391	
Resident, ethnicity unknown	1,000	287	21			11	4	1			154	159	0			1,637	
Not Reported (N/R)	1,866	833	871			27	12	100			1	0	275			3,985	
Gender Totals	29,692	10,261	1,288			1,042	358	101			3,382	3,608	281			50,013	
%	74.3%	25.7%				74.4%	25.6%				48.4%	51.6%					

* % of M and % of F columns are the percent of that gender who are of the specified ethnicity, of those whose ethnicity is known

Figure M1 . Master's Degrees Granted by Tenure-Track Size

CRA Taulbee Survey 2019

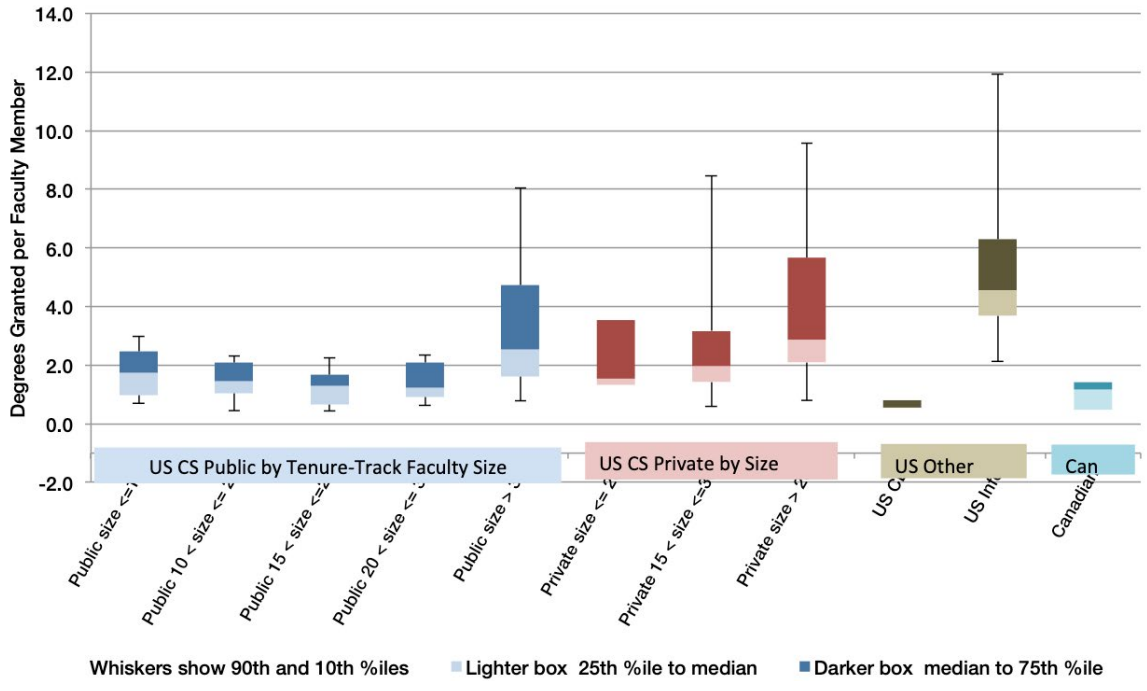
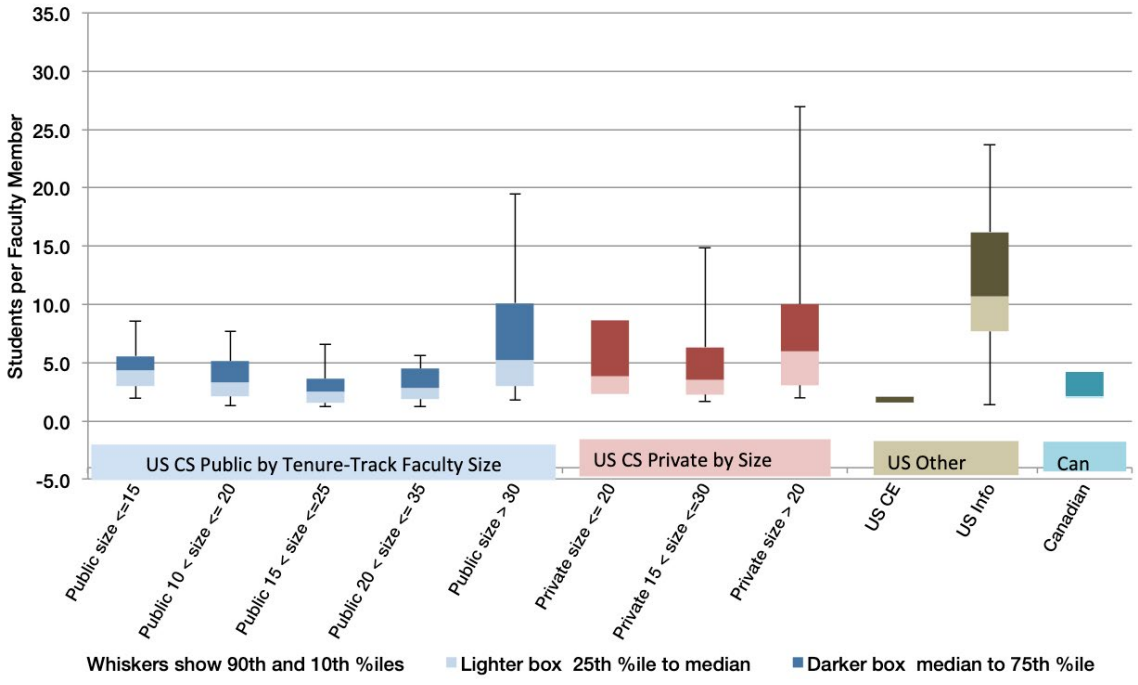


Figure M2. Master's Enrollment Normalized by Tenure-Track Size

CRA Taulbee Survey 2019



Bachelor's

(Tables 1, B1-B8; Figures B1-B4)

Growth in bachelor's degree production abated this year, ending a five-year run of double-digit percent increases. Total degrees produced across all three areas of computing was 4.3 percent higher among this year's reporting departments compared with last year's reporting departments. The increase in CS degrees produced was 6.8 percent. However, it is important to calibrate these changes based on the set of departments reporting each year. On a per-department basis, total degree production rose overall by 1.6 percent across all department types and declined by 0.7 percent in U.S. CS departments. Computer science degree production rose 2.4 percent in U.S. CS departments, but only 2.0 percent per department. When considering only those departments that reported both years, the increase in total degree production across the CS, CE and I areas was 10.1 percent among all departments and 7.7 percent among U.S. CS departments (Tables 1 and B1).

Table B1. Bachelor's Degrees Awarded by Department Type

Department Type	# Depts	CS		CE		I		Total	
US CS Public	97	18,987	66.6%	1,718	74.2%	1,863	41.8%	22,568	63.9%
US CS Private	37	6,231	21.8%	247	10.7%	331	7.4%	6,809	19.3%
Total US CS	134	25,218	88.4%	1,965	84.9%	2,194	49.2%	29,377	83.2%
US CE	5	0	0.0%	317	13.7%	0	0.0%	317	0.9%
US Info	11	355	1.2%	0	0.0%	2,263	50.8%	2,618	7.4%
Canadian	9	2,954	10.4%	32	1.4%	0	0.0%	2,986	8.5%
Grand Total	159	28,527		2,314		4,457		35,298	

Table B2. Bachelor's Degrees Awarded by Gender

	CS		CE		I		Total	
Male	20,991	79.0%	1,879	85.4%	3,216	72.2%	26,086	78.5%
Female	5,572	21.0%	320	14.6%	1,236	27.8%	7,128	21.5%
Total Known Gender	26,563		2,199		4,452		33,214	
Gender Unknown	1,964		115		5		2,084	
Grand Total	28,527		2,314		4,457		35,298	

Table B3. Bachelor's Degrees Awarded by Ethnicity

	CS		CE		I		Total	
Nonresident Alien	3,307	14.5%	194	9.9%	316	7.5%	3,817	13.2%
Amer Indian or Alaska Native	51	0.2%	5	0.3%	10	0.2%	66	0.2%
Asian	6,128	27.0%	352	17.9%	895	21.2%	7,375	25.5%
Black or African-American	755	3.3%	87	4.4%	346	8.2%	1,188	4.1%
Native Hawaiian/Pac Islander	36	0.2%	12	0.6%	10	0.2%	58	0.2%
White	9,939	43.7%	1,015	51.5%	1,958	46.3%	12,912	44.6%
Multiracial, not Hispanic	715	3.1%	88	4.5%	202	4.8%	1,005	3.5%
Hispanic, any race	1,800	7.9%	216	11.0%	490	11.6%	2,506	8.7%
Total Residency & Ethnicity Known	22,731		1,969		4,227		28,927	
Resident, ethnicity unknown	1,297		64		130		1,491	
Residency unknown	4,499		281		100		4,880	
Grand Total	28,527		2,314		4,457		35,298	

Table B4. Bachelor's Degrees Expected Next Year by Department Type

Department Type	# Depts	CS		CE		I		Total	
US CS Public	91	19,504	64.4%	1,572	64.6%	1,282	36.3%	22,358	61.7%
US CS Private	33	6,273	20.7%	315	12.9%	322	9.1%	6,910	19.1%
Total US CS	124	25,777	85.1%	1,887	77.6%	1,604	45.4%	29,268	80.8%
US CE	5	0	0.0%	357	14.7%	0	0.0%	357	1.0%
US Info	11	330	1.1%	0	0.0%	1,926	54.6%	2,256	6.2%
Canadian	9	4,170	13.8%	189	7.8%	0	0.0%	4,359	12.0%
Grand Total	149	30,277		2,433		3,530		36,240	

Table B5. New Bachelor's Students by Department Type

	CS				CE				I				Total	
Department Type	Major	Pre-Major	# Depts	Avg. Major /Dept	Total	Pre-Major	# Depts	Avg. Major /Dept	Total	Pre-Major	# Depts	Avg. Major /Dept	Total Major	Avg. Major /Dept
US CS Public	23,731	10,062	92	257.9	1,800	1,373	31	58.1	764	377	19	40.2	26,295	285.8
US CS Private	6,258	1,989	29	215.8	233	160	8	29.1	398	27	7	56.9	6,889	237.6
Total US CS	29,989	12,051	121	247.8	2,033	1,533	39	52.1	1,162	404	26	44.7	33,184	274.2
US CE	0	0	0	0.0	200	291	3	66.7	0	0	0	0.0	200	66.7
US Information	429	191	2	214.5	0	0	0	0.0	1,289	347	9	143.2	1,718	190.9
Canadian	3,987	1,388	9	443.0	137	0	3	45.7	0	0	0	0.0	4,124	458.2
Grand Total	34,405	13,630	132	260.6	2,370	1,824	45	52.7	2,451	751	35	70.0	39,226	276.2

Table B6. Total Bachelor's Enrollment by Department Type

	CS				CE				I				Total	
Department Type	Major	Pre-Major	# Depts	Avg. Major /Dept	Total	Pre-Major	# Depts	Avg. Major /Dept	Total	Pre-Major	# Dept	Avg. Major /Dept	Total Major	Avg. Major /Dept
US CS Public	97,260	19,722	97	1,002.7	8,948	2,572	33	271.2	7,033	990	20	351.7	113,241	1,155.5
US CS Private	27,590	3,949	37	745.7	893	438	7	127.6	1,733	51	6	288.8	30,216	816.6
Total US CS	124,850	23,671	134	931.7	9,841	3,010	40	246.0	8,766	1,041	26	337.2	143,457	1,062.6
US CE	0	0	0	0.0	1,699	609	5	339.8	0	0	0	0.0	1,699	339.8
US Information	1,382	447	2	691.0	0	0	0	0.0	8,366	794	11	760.5	9,748	886.2
Canadian	17,055	1,355	9	1,895.0	305	213	1	305.0	0	0	0	0.0	17,360	1,928.9
Grand Total	143,287	25,473	145	988.2	11,845	3,832	46	257.5	17,132	1,835	37	463.0	172,264	1,076.7

Figure B1 shows the trend in total computing bachelor's degree production since 1995 for all departments reporting to the Taulbee Survey. Based on current and recent enrollments, additional growth in CS bachelor's degree production seems likely for a little while.

The smaller increase in the number of bachelor's degrees last year is coupled with a decrease in the number of new undergraduate computing majors, ending an eleven year string of increases. While there were more new CS majors reported this year than last year, when the increased number of departments reporting this year is accounted for, there actually was a decrease in the average new CS majors per department. Across all departments, there was a 5.4 percent decrease, from 275.4 to 260.6. Among U.S. CS departments, the decrease was 7.1 percent, from 266.7 to 247.8 (Table B5). When CS, CE, and I majors are aggregated, the decrease in new majors per department is 3.8 percent among all departments and 5.8 percent among U.S. CS departments. The decrease in new majors

is 6.7 percent when considering only those departments reporting both this year and last year, and 8.8 percent when considering U.S. CS departments reporting both years (Table 1). Figure B2 illustrates the trend in the total number of newly declared computing undergraduate majors as reported in the Taulbee Survey.

Despite the decrease in new majors, more total majors were reported this year than last year. At U.S. CS departments, the total number of majors in CS, CE, and I combined increased 1.6 percent, while among all departments it increased 5.2 percent. However, when normalized for the number of departments reporting, enrollment decreased 1.5 percent at U.S. CS departments and increased only 2.6 percent among all departments. When only departments reporting both years are considered, the respective increases are 7.5 and 11.4 percent (Table 1). Looking only at CS enrollment, the increase in majors per department reporting is 7.9 percent for all departments combined, and 4.8 percent for U.S. CS departments (Table B6).

Per-department averages smooth out comparisons from year to year when there are differences in the number of reporting departments, but the averages include both very large and very small departments. Figures B3 and B4 show the distribution of number of degrees awarded (Figure B3) and total enrollment (Figure B4) per tenured or tenure-track faculty member, in department size groupings for the U.S. CS departments. Larger departments tend to produce more bachelor's degrees per tenure-track faculty member than do smaller departments at both public and private institutions. However, neither public nor private institutions show a clear relationship between faculty size and enrollment per tenure-track faculty member.

Figure B5 shows the enrollment trend from Taulbee Survey data since this surge began. It illustrates both the decline in average new majors per department in the current (2019-20) academic year and the twelve consecutive years of growth in average total majors per department through academic year 2018-19. The average enrollment per U.S. CS department increased over 380 percent during that period; that is nearly a quintupling from its level in fall 2006. For the past six years, it has exceeded the previous peak reached during the dot-com enrollment surge.

Another view of bachelor's enrollments can be gleaned from CS course-level data. Such data was first reported in CRA's Generation-CS report for the fall terms in 2005, 2010 and 2015. The Taulbee Survey began collecting follow-up data in the 2016 survey, and now does so annually. Table B9 shows four-year enrollment trends for the four types of courses for which data is collected (representative introductory course for non-majors, introductory course for majors, mid-level course, and upper-level course). For each type of course, only those departments are included that reported data for each of the four years and reported on the same course in each of the four years. The data indicate that median enrollment in the introductory course for non-majors, the introductory course for CS majors, and the mid-level course each is at its highest level in 2018 among the four years 2016-19. None of the courses show a steadily increasing median over the four-year period. The introductory course for non-majors had it lowest median enrollment in 2019, while the upper level course had its highest median level in 2019. The table further shows that, in the course for majors at each of the introductory, mid and upper levels, the median percent of majors in the course was lower in 2019 than in 2018. Finally, the table shows a steady increase over the four-year period in the representation of women in the introductory courses for both majors and non-majors, and a steady increase in the representation of underrepresented minority students in the upper-level.

Gender diversity among bachelor's graduates, both overall and in CS, rose very slightly in 2018-19. Women comprised 21.5 percent of all graduates and 21.0 percent of CS graduates in 2018-2019, compared with respective percentages of 21.2 and 20.9 in 2017-18. The percentage of women among I graduates also increased, from 26.8 percent to 27.8 percent, but the percentage of women among CE bachelor's graduates was 14.6 percent compared with the 15.6 percent reported last year (Table B2).

The percentage of CS bachelor's graduates who are White again declined, from 45.4 percent in 2017-18 to 43.7 percent in 2018-19, while the percentage awarded to Asians rose from 26.5 percent to 27.0 percent and the percentage awarded to Non-resident Aliens rose from 13.9 percent to 14.5 percent. All other ethnicities combined comprise 14.7 percent of those for whom ethnicity is known, up from 14.2 percent last year. Hispanics make up the largest share of these other ethnicities at 8.0 percent. In aggregate across the three areas of computing, 44.6 percent of the graduates were White, 25.5 percent Asian, 13.2 percent Non-resident Aliens, and 16.7 percent all other ethnicity categories combined. However, in I programs, the other ethnicity categories

Table B7. Bachelors Degrees Awarded by Gender and Ethnicity, From 159 Departments Providing Breakdown Data

	CS					CE					I					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	2,335	877	95	14	19	168	26	0	10	9	208	106	2	7	9	3,817	13.2
Amer Indian or Alaska Native	41	9	1	0	0	4	1	0	0	0	7	3	0	0	0	66	0.2
Asian	4,266	1,594	268	25	35	278	74	0	17	25	558	337	0	18	29	7,375	25.5
Black or African-American	566	160	29	3	4	71	16	0	4	5	239	107	0	8	9	1,188	4.1
Native Hawaiian/ Pac Islander	30	5	1	0	0	9	3	0	1	1	2	8	0	0	1	58	0.2
White	8,124	1,465	350	47	32	889	124	2	53	42	1,504	454	0	49	39	12,912	44.6
Multiracial, not Hispanic	543	140	32	3	3	76	12	0	5	4	136	66	0	5	6	1,005	3.5
Hispanic, any race	1,440	322	38	8	7	177	39	0	11	13	395	95	0	13	8	2,506	8.7
Total Res & Ethnicity Known	17,345	4,572	814			1,672	295	2			3,049	1,176	2			28,927	
Resident, ethnicity unknown	1,002	268	27			55	8	1			93	35	2			1,491	
Not Reported (N/R)	2,644	732	1,123			152	17	112			74	25	1			4,880	
Gender Totals	20,991	5,572	1,964			1,879	320	115			3,216	1,236	5			35,298	
%	79.0%	21.0%				85.4%	14.6%				72.2%	27.8%					
* % of M and % of F columns are the percent of that gender who are of the specified ethnicity, of those whose ethnicity is known																	

Table B8. Bachelors Enrollment by Gender and Ethnicity, From 160 Departments Providing Breakdown Data

	CS					CE					I					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	10,842	3,411	91	13	16	804	153	20	9	10	764	411	0	7	10	16,496	12.4
Amer Indian or Alaska Native	212	56	3	0	0	15	2	0	0	0	26	9	0	0	0	323	0.2
Asian	19,508	7,005	57	23	32	1,645	448	12	19	28	1,729	951	0	15	23	31,355	23.5
Black or African-American	3,767	1,276	20	4	6	528	114	7	6	7	999	444	0	9	11	7,155	5.4
Native Hawaiian/ Pac Islander	105	27	0	0	0	22	9	0	0	1	16	10	0	0	0	189	0.1
White	38,454	7,005	276	45	32	4,238	600	72	48	37	6,140	1,660	2	53	40	58,447	43.9
Multiracial, not Hispanic	3,206	950	24	4	4	376	63	5	4	4	471	221	0	4	5	5,316	4.0
Hispanic, any race	8,610	1,926	106	10	9	1,177	220	18	13	14	1,483	459	0	13	11	13,999	10.5
Total Res & Ethnicity Known	84,704	21,656	577			8,805	1,609	134			11,628	4,165	2			133,280	
Resident, ethnicity unknown	4,110	1,048	389			235	43	1			249	101	3			6,179	
Not Reported (N/R)	15,249	4,693	10,861			581	104	333			141	34	809			32,805	
Gender Totals	104,063	27,397	11,827			9,621	1,756	468			12,018	4,300	814			172,264	
%	79.2%	20.8%				84.6%	15.4%				73.6%	26.4%					
* % of M and % of F columns are the percent of that gender who are of the specified ethnicity, of those whose ethnicity is known																	

Table B9. Undergrad Representative Course Enroll 2016-2019, Department-Level Percentiles

Number of Students Reported					% Who Are Majors					% Who Are Women					% URM at Non-MSI				
Intro-Level for Non Majors																			
(N=51)	**2016**	**2017**	**2018**	**2019**	**(N=31)**	**2016**	**2017**	**2018**	**2019**	**(N=29)**	**2016**	**2017**	**2018**	**2019**	**(N=23)**	**2016**	**2017**	**2018**	**2019**
25	68.0	64.0	77.0	78.0	25	0.2	0.5	0.4	0.2	25	23.1	22.8	22.8	24.9	25	7.7	13.2	3.3	9.9
50	191.0	197.0	200.0	158.0	50	4.6	2.9	2.5	3.8	50	35.3	37.9	38.1	39.3	50	19.1	21.3	17.1	17.6
75	299.0	367.0	356.0	346.0	75	12.9	12.6	14.3	15.0	75	47.8	47.2	50.3	46.5	75	32.0	34.9	29.4	37.1
Intro for Majors																			
(N=61)	**2016**	**2017**	**2018**	**2019**	**(N=41)**	**2016**	**2017**	**2018**	**2019**	**(N=36)**	**2016**	**2017**	**2018**	**2019**	**(N=29)**	**2016**	**2017**	**2018**	**2019**
25	184.5	181.0	171.0	220.5	25	18.4	18.5	16.9	10.7	25	16.3	17.5	17.9	18.4	25	4.9	9.7	8.9	10.2
50	276.0	303.0	346.0	337.0	50	46.4	43.3	47.0	34.2	50	19.5	21.3	21.6	25.4	50	16.2	18.9	14.6	16.4
75	449.5	495.0	603.5	588.5	75	78.7	74.4	71.0	60.7	75	29.8	32.2	35.4	33.9	75	23.3	27.2	25.5	28.0
Mid-Level																			
(N=61)	**2016**	**2017**	**2018**	**2019**	**(N=43)**	**2016**	**2017**	**2018**	**2019**	**(N=36)**	**2016**	**2017**	**2018**	**2019**	**(N=26)**	**2016**	**2017**	**2018**	**2019**
25	88.0	103.5	109.0	117.5	25	41.5	37.9	50.0	43.5	25	14.0	13.5	16.9	16.6	25	7.9	9.6	8.6	10.1
50	147.0	158.0	189.0	181.0	50	69.4	60.6	74.8	64.6	50	19.6	19.5	21.8	19.7	50	13.0	16.2	12.9	14.6
75	267.5	336.0	326.0	355.0	75	86.1	87.0	88.9	87.9	75	28.8	30.8	29.5	31.0	75	29.9	28.6	29.0	20.2
Upper-Level																			
(N=61)	**2016**	**2017**	**2018**	**2019**	**(N=42)**	**2016**	**2017**	**2018**	**2019**	**(N=36)**	**2016**	**2017**	**2018**	**2019**	**(N=27)**	**2016**	**2017**	**2018**	**2019**
25	51.0	64.5	74.0	76.0	25	69.6	67.1	67.7	71.7	25	11.0	11.6	12.6	12.3	25	4.8	7.1	5.1	6.7
50	101.0	120.0	118.0	121.0	50	89.0	83.6	89.7	87.7	50	16.4	18.2	16.1	17.8	50	9.2	11.3	12.0	12.5
75	170.0	185.5	210.5	264.0	75	98.5	96.3	97.4	97.4	75	22.9	27.1	27.1	25.7	75	22.5	28.8	26.3	28.1

accounted for approximately 25 percent of the graduates, up from 23 percent last year (Table B3).

Gender and ethnicity distributions of enrolled students (Table B8) suggest that women comprise a larger fraction of the total CS enrollment in 2019-20 than they did in 2018-19 (20.8 percent vs 19.5 percent). The 20.8 percent of enrolled CS students who are women is almost identical to the 21.0 percent of 2018-19 CS graduates who were women. With respect to ethnic diversity, the fraction of total enrollment aggregated across all three computing areas, among ethnicities other than Non-resident Alien, Asian and White, is 20.2 percent. Last year it was 20.6 percent. In CS, these other ethnicities comprised 19.0 percent of total enrollment. These statistics suggest that the diversity of computing graduates is not likely to change much any time soon.

In all three computing areas (CS, CE, and I), Resident Asians and Non-resident Aliens continue comprise a larger fraction of female enrollment than male enrollment, while a larger fraction of male enrollment than female enrollment is White (Table B8). Table B7 indicates that the same comparisons continue to hold true for degree awardees in CS and I, although Non-resident Aliens are a slightly higher fraction of male than of female awardees in CE this year.

Figure B1. BS Production (CS & CE)

CRA Taulbee Survey 2019

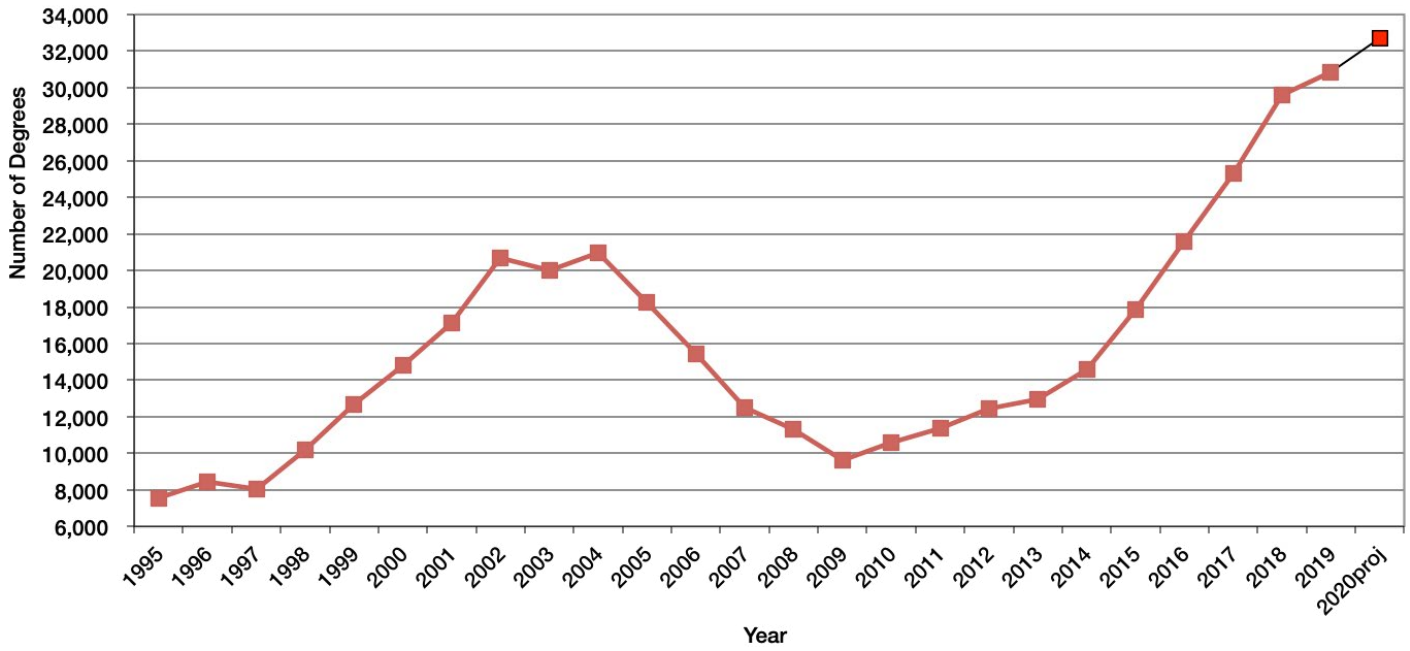


Figure B2. Newly Declared Undergraduate Majors: CS, CE, and I (beginning in 2008)

CRA Taulbee Survey 2019

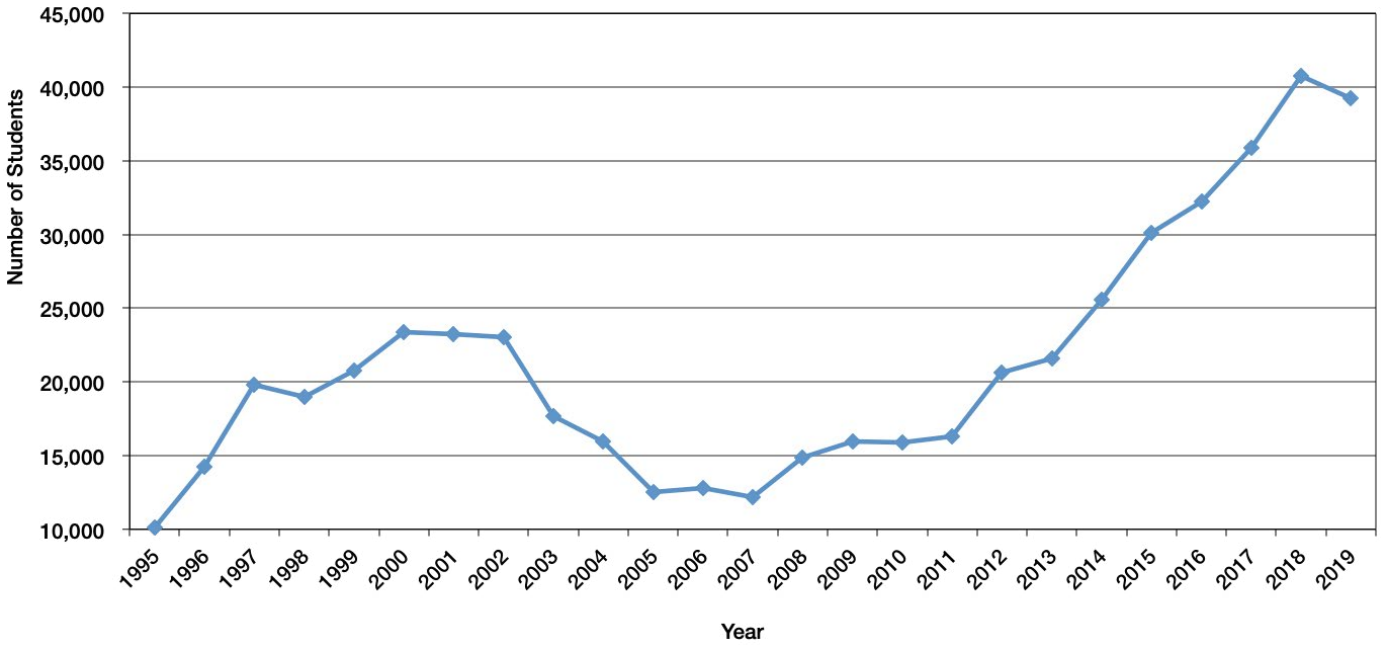


Figure B3. Bachelor's Degrees Granted by Tenure-Track Size

CRA Taulbee Survey 2019

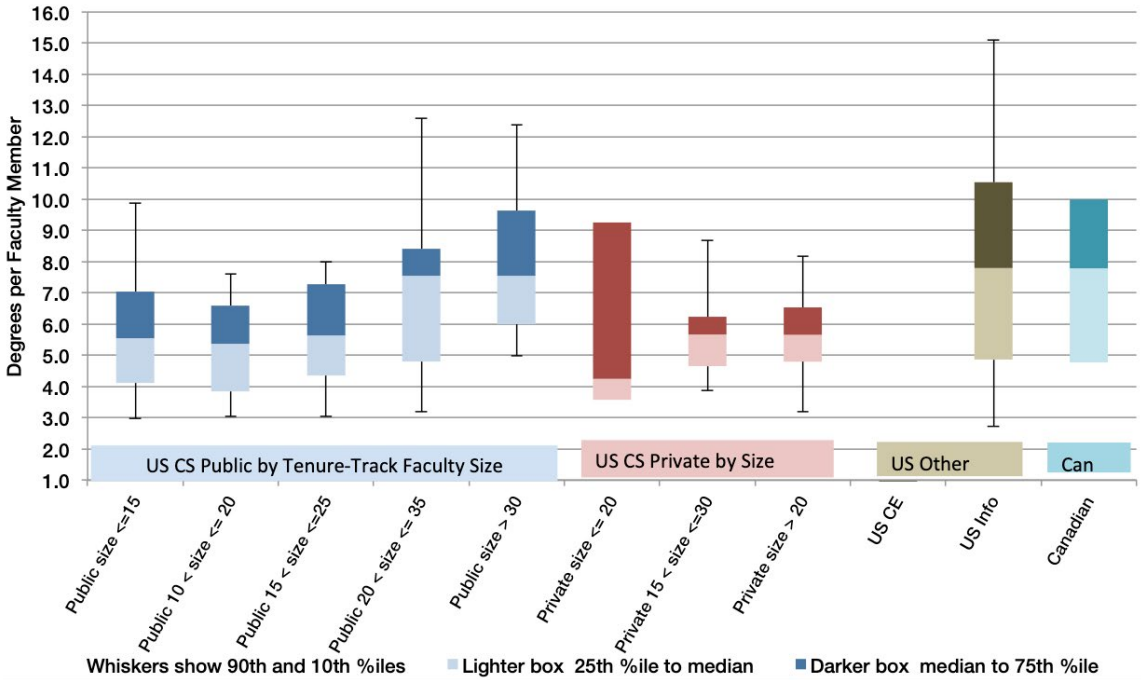


Figure B4. Bachelor's Enrollment Normalized by Tenure-Track Size

CRA Taulbee Survey 2019

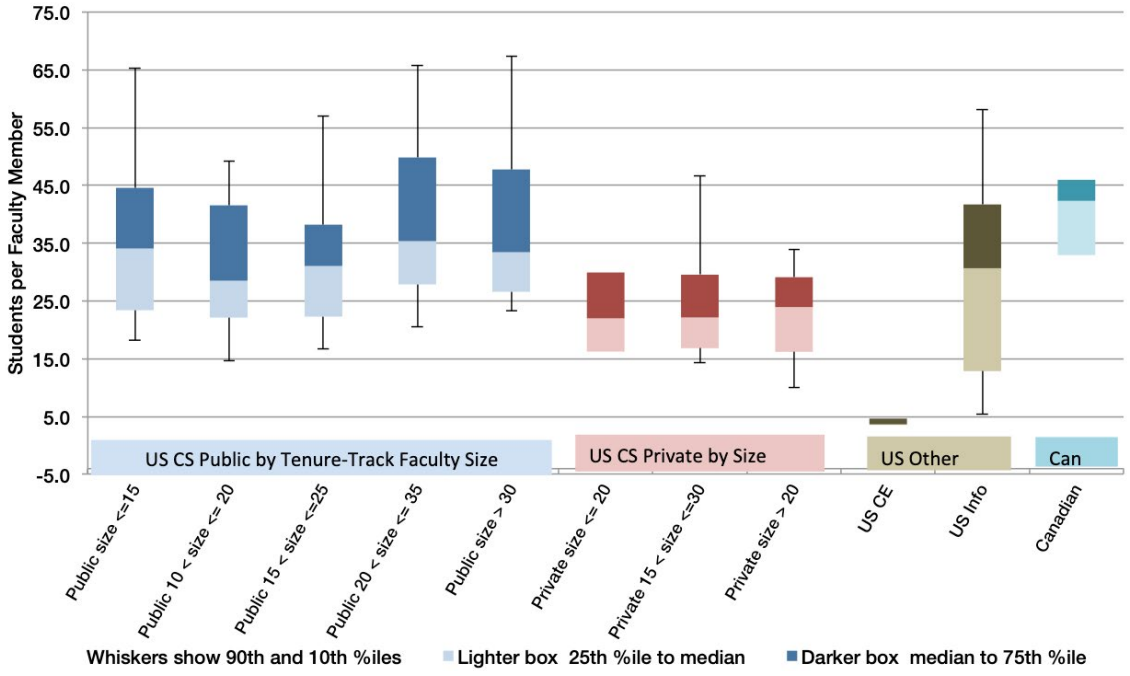
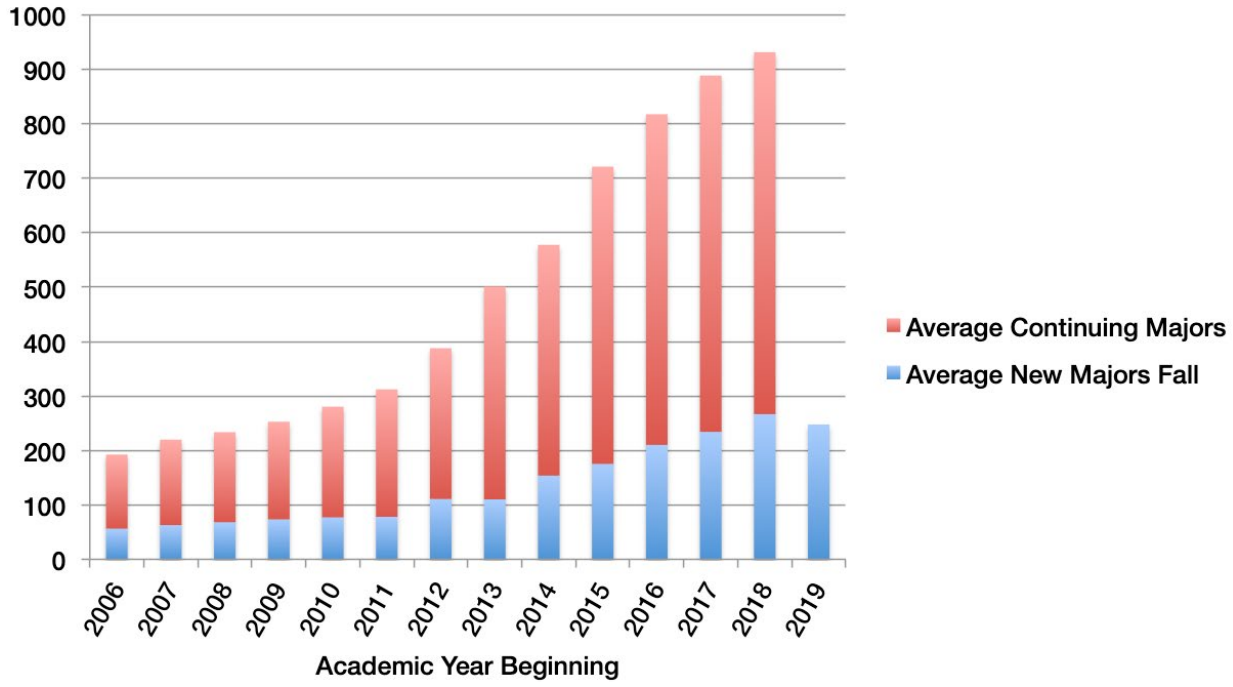


Figure B5. Average New and Continuing CS Majors per Academic Unit (U.S. CS Programs Only)

CRA Taulbee Survey 2019



Faculty Demographics

(Tables F1-F9; Figure F1)[4]

Table F1 shows the current and anticipated sizes, in FTE, for tenure-track, teaching, and research faculty, and postdocs. The total tenure-track faculty count in U.S. CS departments increased by less than one percent over last year, and the average tenure-track faculty size decreased slightly. In U.S. CS departments, the total teaching faculty count increased from 1107 to 1249 (12.8 percent), following a 16.9 percent increase last year.

Once again, we report teaching faculty in two categories, called "Teaching Professors" and "Other Instructors". "Teaching Professors" on average have more varied responsibilities in teaching, scholarship, service/governance, etc., and higher expectations for visibility outside the unit or the institution. "Other Instructors" are more focused on teaching introductory or mid-level courses and tend to have shorter contract lengths, though they are still full time faculty (Taulbee does not collect data on course-by-course adjuncts). In U.S. CS departments, the number of persons in these two categories again was split fairly evenly at public institutions, but decidedly in favor of Teaching Professors at private institutions. However, at private institutions, many more persons were classified as "Other Instructors" this year, while the number of "Teaching Professors" was similar to that reported last year. U.S. I departments and Canadian departments also again reported a decided preference for the Teaching Professor category of teaching faculty.

The total number of research faculty reported at U.S. CS departments dropped from 426 to 382, while the total number of postdocs dropped from 531 to 518. About 62% of the U.S. CS departments providing faculty data to this year's survey reported having any research faculty, including slightly more public (63%) than private (58%) universities. About two-thirds of public and 71% of private U.S. CS departments reported having any postdocs.

Figure F1 illustrates the comparative changes at U.S. CS departments in undergraduate enrollment, tenure-track faculty and teaching

Table F1. Actual and Anticipated Faculty Size by Position and Department Type

	Actual		Projected				Expected 2-Yr Growth		# Depts
	2019-2020		2020-2021		2021-2022				
US CS Public	Total	Average	Total	Average	Total	Average	#	%	
TenureTrack	3077	30.5	3244	32.1	3417	33.8	340	11.1%	101
Teaching Prof	491	4.9	538	5.3	595	5.9	103	21.0%	77
Other Instruc	421	4.2	451	4.5	468	4.6	46	11.0%	73
Research	237	2.4	250	2.5	266	2.6	28	11.9%	64
Postdoc	253	2.5	274	2.7	298	3.0	45	17.8%	68
Total	4,480	44.4	4,757	47.1	5,043	49.9	563	12.6%	
US CS Private									
TenureTrack	1307	34.4	1376	36.2	1418	37.3	110	8.5%	38
Teaching Prof	224	5.9	246	6.5	258	6.8	34	15.0%	31
Other Instruc	113	3.0	120	3.2	125	3.3	12	10.6%	25
Research	145	3.8	159	4.2	169	4.4	24	16.6%	22
Postdoc	265	7.0	282	7.4	294	7.7	29	10.9%	27
Total	2,054	54.1	2,183	57.4	2,263	59.6	209	10.2%	
All US CS									
TenureTrack	4,384	31.5	4,619	33.2	4,835	34.8	451	10.3%	139
Teaching Prof	715	5.1	784	5.6	852	8.8	137	19.1%	108
Other Instruc	534	3.8	571	4.1	593	8.2	58	11.0%	98
Research	382	2.8	409	2.9	435	7.5	52	13.7%	86
Postdoc	518	3.7	556	4.0	592	8.3	74	14.3%	95
Total	6,534	47.0	6,940	49.9	7,306	52.6	772	11.8%	
US CE									
TenureTrack	112	22.4	114	22.8	116	23.2	4	3.6%	5
Teaching Prof	7	1.4	7	1.4	7	2.3	0	0.0%	3
Other Instruc	8	1.6	8	1.6	8	4.0	0	0.0%	2
Research	24	4.8	24	4.8	24	12.0	0	0.0%	3
Postdoc	26	5.2	28	5.6	29	7.3	3	11.5%	4
Total	177	35.4	181	36.2	184	36.8	7	4.0%	
US I									
TenureTrack	394	28.2	432	30.9	464	33.2	70	17.8%	14
Teaching Prof	126	9.0	152	10.9	172	15.6	46	36.6%	12
Other Instruc	60	4.3	65	4.6	70	11.6	10	16.7%	12
Research	14	1.0	15	1.1	17	2.8	3	20.7%	9
Postdoc	32	2.3	42	3.0	47	4.2	15	47.6%	12
Total	625	44.7	706	50.4	769	55.0	144	23.0%	
Canadian									
TenureTrack	361	40.1	380	42.2	384	42.7	23	6.4%	9
Teaching Prof	47	5.2	46	5.1	45	7.5	-2	-4.3%	7
Other Instruc	15	1.7	15	1.7	15	3.0	0	0.0%	7
Research	5	0.6	5	0.6	5	5.0	0	0.0%	2
Postdoc	92	10.2	93	10.3	94	15.7	2	2.2%	6
Total	520	57.8	539	59.9	543	60.3	23	4.4%	9
Grand Total									
TenureTrack	5,252	31.4	5,546	33.2	5,799	34.7	547	10.4%	167
Teaching Prof	895	5.4	990	5.9	1,076	9.2	181	20.2%	130
Other Instruc	617	3.7	659	3.9	685	8.1	68	11.0%	119
Research	426	2.5	454	2.7	481	7.2	55	13.0%	100
Postdoc	668	4.0	718	4.3	762	8.3	95	14.2%	117
Total	7,857	47.0	8,366	50.1	8,803	52.7	946	12.0%	

2019 Taulbee Survey *(continued)*

faculty since 2006, when the current enrollment surge began. This figure updates with recent years' data a figure from the Generation-CS report. Although the graph shows that teaching faculty increases for the past two years are at a similar rate to growth in number of majors, that followed six consecutive years of increases that each fell far short of the growth in majors. This illustrates the continuing challenge to obtain sufficient instructional resources to deal effectively with the increased enrollments.

Canadian departments, on average, are larger than U.S. CS departments, in terms of both tenure-track and total faculty, although the gap is smaller this year for total faculty. U.S. I and CE departments, on average, continue to be smaller than U.S. CS departments on both counts, though the gap between U.S. CS and U.S. I also has narrowed. The observations about U.S. CE and I departments may reflect the fact that we ask departments to report only computing-related faculty, so departments with Library Science or EE programs may report only part of their faculty.

Among U.S. CS departments, those at private universities are on average larger than those at public universities in both tenure-track and total faculty size. This has been observed consistently for many years.

*T*able F2 summarizes faculty hiring this past year. The success rate for hiring tenure-track faculty at this year's reporting U.S. CS departments was 70.7 percent, a noticeable drop from last year's reported 77.5 percent. The success rate among departments at public universities was again higher than that at private universities (74.0 percent vs 62.4 percent), and the gap was larger this year. Canadian departments once again collectively had a lower success rate than U.S.CS departments. U.S. I departments' success rate was higher than U.S. CS departments, a change from last year's observation. In aggregate across all types of departments, the tenure-track hiring success rate during the three most recent recruiting cycles has decreased from 82.7 percent to 77.3 percent to 70.4 percent. The distribution of the reasons for lack of hiring success is similar to that last year, though there was a slightly larger percentage this year due to offers being turned down (55.9 percent compared with 51.1 percent reported last year (Table F2a).

Table F2. Vacant Positions 2018-2019 by Position and Department Type

	Tried to fill	Filled
US CS Public		
TenureTrack	312	231
Teaching Prof	85	70
Other Instruc	80	80
Research	29	33
Postdoc	102	107
Total	608	521
US CS Private		
TenureTrack	125	78
Teaching Prof	44	38
Other Instruc	24	25
Research	18	18
Postdoc	49	58
Total	260	217
All US CS		
TenureTrack	437	309
Teaching Prof	129	108
Other Instruc	104	105
Research	47	51
Postdoc	151	165
Total	868	738
US CE		
TenureTrack	6	2
Teaching Prof	0	0
Other Instruc	0	0
Research	1	1
Postdoc	8	6
Total	15	9
US I		
TenureTrack	54	44
Teaching Prof	21	20
Other Instruc	4	6
Research	5	2
Postdoc	11	11
Total	95	83
Canadian		
TenureTrack	41	24
Teaching Prof	5	5
Other Instruc	4	4
Research	0	2
Postdoc	11	38
Total	61	73
Grand Total		
TenureTrack	538	379
Teaching Prof	155	133
Other Instruc	112	115
Research	53	56
Postdoc	181	220
Total	1,039	903

2019 Taulbee Survey *(continued)*

Gender diversity among newly hired faculty improved in 2019-20 when all categories of academic positions (tenure-track, teaching faculty, research faculty, and postdoc) are considered collectively. This year the fraction of newly hired faculty who are women is 25.9 percent vs 22.9 percent last year (Table F3). Among those newly hired into tenure-track positions, the proportion of women was similar (23.5 percent this year to 22.9 percent last year). The percentage of women among new tenure-track faculty hires and the percentage of women among newly hired faculty overall both are once again higher than the percentage of new female Ph.D.s produced during the past year (20.8 percent).

Among new tenure-track faculty whose residency was known, White, Non-resident Alien or Asian hires collectively comprise 94.1

Table F2a. Reasons Positions Left Unfilled

Reason	# Reported	% of Reasons
Didn't find a person who met our hiring goals*	19	13.1%
Offers turned down	81	55.9%
Technically vacant, not filled for admin reasons	7	4.8%
Hiring in progress	34	23.4%
Other	4	2.8%
Total Reasons Provided	145	
***What hiring goals could not be met?**		**# Given**
Specific specialty area not found (cybersecurity and others)		6
Didn't meet criteria, weak candidates, too few candidates		6

Table F3. Gender of Newly Hired Faculty

	Tenure-Track		Teaching Professors		Other Instructors		Research		Postdoc		Total	
Male	322	76.5%	93	63.3%	68	70.8%	37	86.0%	111	77.1%	631	74.1%
Female	99	23.5%	54	36.7%	28	29.2%	6	14.0%	33	22.9%	220	25.9%
Unknown	1		0		1		0		7		9	
Total	422		147		97	0	43		151		860	

Table F4. Ethnicity of Newly Hired Faculty

	Tenure-Track		Teaching Professors		Other Instructors		Research		Postdoc		Total	
Nonresident Alien	59	15.6%	9	6.7%	10	11.6%	4	10.3%	21	15.7%	103	13.3%
American Indian/Alaska Native	0	0.0%	2	1.5%	2	2.3%	0	0.0%	0	0.0%	4	0.5%
Asian	143	37.8%	26	19.3%	13	15.1%	12	30.8%	52	38.8%	246	31.9%
Black or African-American	4	1.1%	5	3.7%	2	2.3%	0	0.0%	4	3.0%	15	1.9%
Native Hawaiian/Pacific Islander	0	0.0%	0	0.0%	0	0.0%	3	7.7%	0	0.0%	3	0.4%
White	154	40.7%	79	58.5%	51	59.3%	17	43.6%	49	36.6%	350	45.3%
Multiracial, not Hispanic	1	0.3%	0	0.0%	0	0.0%	0	0.0%	1	0.7%	2	0.3%
Hispanic, any race	5	1.3%	9	6.7%	4	4.7%	2	5.1%	3	2.2%	23	3.0%
Resident, race/ethnic unknown	12	3.2%	5	3.7%	4	4.7%	1	2.6%	4	3.0%	26	3.4%
Total known residency	378		135		86		39		134		772	
Residency Unknown	44		12		11		4		17		88	
Total	422		147		97		43		151		860	

percent. Among newly hired teaching and research faculty, these three categories comprise approximately 85 percent, while among postdocs it is slightly over 90 percent (Table F4).

Table F10 shows the sources of new faculty of each type. For newly hired assistant professors, the fraction who had been postdocs in the previous year was 97/342 (28 percent). Since we began collecting such information in 2015, this percentage has ranged from 21 to 31 percent. The percentage of these new assistant professors who were postdocs is about the same as the percentage who were new Ph.Ds, while 36 percent of new assistant professors were in other academic positions the previous year. Last year, 39 percent of new assistant professors were new Ph.D.s while 29 percent came from other academic positions. We don't know the previous academic rank of the new assistant professors who came from other academic positions; they might have been teaching faculty or research faculty as a transitional position, or they might have come from other tenure-track positions.

Of the 90 new full and associate professors whose source was reported, 82 percent came from other academic institutions and 12 percent from industry. This is similar to last year's respective 78 and 13 percent. Among teaching faculty, 35 percent were hired without a Ph.D, while this fraction was 42 percent for Other Instructors. Last year's respective percentages were 25 and 74 percent. This year, 55 percent of new research faculty did not have a Ph.D., compared with only 34 percent reported last year.

Table F5. Faculty Losses

Died	5
Retired	103
Took Academic Position Elsewhere	139
Took Nonacademic Position	43
Remained, but Changed to Part Time	11
Other	20
Unknown	6
Total	327

Table F6. Gender of Current Faculty

	Full		Associate		Assistant		Teaching Professors		Other Instructors		Research		Postdoc		Total	
Male	2,064	84.3%	1,010	77.4%	1,082	76.1%	679	70.7%	489	70.2%	317	77.7%	493	72.6%	6,134	77.4%
Female	385	15.7%	295	22.6%	340	23.9%	282	29.3%	208	29.8%	91	22.3%	186	27.4%	1,787	22.6%
Unknown	41		6		22		5		12		0		35		121	
Total	2,490		1,311		1,444		966		709		408		714		8,042	

Table F7. Ethnicity of Current Faculty

	Full		Associate		Assistant		Teaching Professors		Other Instructors		Research		Postdoc		Total	
Nonresident Alien	10	0.4%	17	1.5%	195	14.8%	51	6.0%	36	5.4%	22	5.6%	151	24.9%	482	6.6%
American Indian/ Alaska Native	5	0.2%	1	0.1%	4	0.3%	2	0.2%	4	0.6%	0	0.0%	5	0.8%	21	0.3%
Asian	677	29.9%	361	31.3%	460	34.8%	111	13.0%	66	9.9%	93	23.8%	168	27.7%	1,936	26.7%
Black or African-American	23	1.0%	24	2.1%	38	2.9%	15	1.8%	23	3.5%	10	2.6%	15	2.5%	148	2.0%
Native Hawaiian/ Pacific Islander	1	0.0%	6	0.5%	0	0.0%	0	0.0%	10	1.5%	0	0.0%	0	0.0%	17	0.2%
White	1,403	61.9%	664	57.6%	544	41.1%	610	71.2%	444	66.9%	240	61.5%	222	36.6%	4,127	56.9%
Multiracial, not Hispanic	16	0.7%	6	0.5%	5	0.4%	4	0.5%	7	1.1%	1	0.3%	4	0.7%	43	0.6%
Hispanic, any race	47	2.1%	34	3.0%	26	2.0%	29	3.4%	28	4.2%	14	3.6%	14	2.3%	192	2.6%
Resident, race/ ethnic unknown	83	3.7%	39	3.4%	50	3.8%	35	4.1%	46	6.9%	10	2.6%	28	4.6%	291	4.0%
Total known residency	2,265		1,152		1,322		857		664		390		607		7,257	
Residency Unknown	225		159		122		109		45		18		107		785	
Total	2,490		1,311		1,444		966		709		408		714		8,042	

Table F8. Current Tenured and Tenure-Track Faculty by Gender and Ethnicity, From 162 Departments

	Full Professor					Associate Professor					Assistant Professor					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	9	1	0	1	0	15	2	0	2	1	155	39	1	16	13	222	5
Amer Indian or Alaska Native	2	3	0	0	1	0	1	0	0	0	0	4	0	0	1	10	0
Asian	582	95	0	32	28	271	90	0	32	35	361	99	0	37	33	1,498	33
Black or African-American	18	5	0	1	2	16	8	0	2	3	20	18	0	2	6	85	2
Native Hawaiian/ Pac Islander	1	0	0	0	0	6	0	0	1	0	0	0	0	0	0	7	0
White	1,183	220	0	64	66	520	144	0	61	57	409	134	1	42	45	2,611	57
Multiracial, not Hispanic	16	0	0	1	0	4	2	0	1	1	2	3	0	0	1	27	1
Hispanic, any race	35	12	0	2	4	26	8	0	3	3	22	4	0	2	1	107	2
Total Res & Ethnicity Known	1,846	336	0			858	255	0			969	301	2			4,567	
Resident, ethnicity unknown	55	11	17			27	9	3			28	19	3			172	
Not Reported (N/R)	163	38	24			125	31	3			85	20	17			506	
Gender Totals	2,064	385	41			1,010	295	6			1,082	340	22			5,245	
%	84.3%	15.7%				77.4%	22.6%				76.1%	23.9%					
* %M and %F columns are the percent of that gender who are of the specified ethnicity, of those whose ethnicity is known																	

Table F9a. Current Non-Tenure-Track Teaching Faculty by Gender and Ethnicity, From 157 Departments

	Teaching Professors					Other Instructors					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	38	13	0	7	5	23	12	1	5	7	87	6
Amer Indian or Alaska Native	1	1	0	0	0	4	0	0	1	0	6	0
Asian	70	41	0	12	17	39	27	0	9	15	177	12
Black or African-American	12	3	0	2	1	12	11	0	3	6	38	3
Native Hawaiian/ Pac Islander	0	0	0	0	0	6	4	0	1	2	10	1
White	437	173	0	75	72	321	123	0	74	68	1,054	73
Multiracial, not Hispanic	3	1	0	1	0	7	0	0	2	0	11	1
Hispanic, any race	22	7	0	4	3	23	5	0	5	3	57	4
Total Res & Ethnicity Known	583	239	0			435	182	1			1,440	
Resident, ethnicity unknown	22	12	1			31	15	0			81	
Not Reported (N/R)	74	31	4			23	11	11			154	
Gender Totals	679	282	5			489	208	12			1,675	
%	70.7%	29.3%				70.2%	29.8%					
* %M and %F columns are the percent of that gender who are of the specified ethnicity, of those whose ethnicity is known												

Table F9b. Current Non-Tenure-Track Research Faculty and Postdocs by Gender and Ethnicity, From 132 Depts

	Non-Tenure-Track Research					Postdocs					Ethnicity Totals	
	Male	Fem	N/R	% of M*	% of F*	Male	Fem	N/R	% of M*	% of F*	Total	%
Nonresident Alien	18	4	0	6	5	118	30	3	28	20	173	18
Amer Indian or Alaska Native	0	0	0	0	0	5	0	0	1	0	5	1
Asian	73	20	0	25	23	122	42	4	29	29	261	27
Black or African-American	6	4	0	2	5	11	4	0	3	3	25	3
Native Hawaiian/ Pac Islander	0	0	0	0	0	0	0	0	0	0	0	0
White	184	56	0	63	64	151	65	6	36	44	462	48
Multiracial, not Hispanic	0	1	0	0	1	3	1	0	1	1	5	1
Hispanic, any race	12	2	0	4	2	8	5	1	2	3	28	3
Total Res & Ethnicity Known	293	87	0			418	147	14			959	
Resident, ethnicity unknown	9	1	0			17	7	4			38	
Not Reported (N/R)	15	3	0			58	32	17			125	
Gender Totals	317	91	0			493	186	35			1,122	
%	77.7%	22.3%				72.6%	27.4%					
* %M and %F columns are the percent of that gender who are of the specified ethnicity, of those whose ethnicity is known												

There were 7.9 percent more faculty losses reported this year as compared with last year (Table F5). Increases were present in retirements, persons taking academic positions elsewhere, and persons taking nonacademic positions. Fewer people moved to part-time status than did so in last year's report.

The proportion of women currently at the full professor and assistant professor ranks is higher this year than last year, while the proportion at the associate professor rank is slightly lower. This is the reverse of what was reported last year at all three ranks. There again is an increase in the proportion of women among teaching faculty, with only a one-half of a percentage point difference in the proportion of women between the two teaching faculty categories. The proportion of women among research faculty and postdocs also are higher than their respective values reported last year, with the biggest jump being among postdocs, where the proportion of women went from 19.0 to 27.4 percent (Table F6).

Table F7 shows the breakdown of ethnicity among current faculty in each category. The proportion of current faculty who are American Indian, Black, Native Hawaiian, Multiracial or Hispanic collectively totals between 4.0 and 6.5 percent except for "other instructors", where these ethnicities total 10.9 percent.

Again this year, the vast majority of departments reported gender by ethnicity breakdowns of their faculty, Table F8 shows, for each ethnicity at each tenure-track rank, the percentage of total men at that rank represented by that ethnicity and the percentage of total women at that rank represented by that ethnicity. Tables F9a and F9b do likewise, respectively, for teaching faculty and for research faculty and postdocs. While there are fluctuations in these percentages from year to year, the basic picture did not change much from last year.

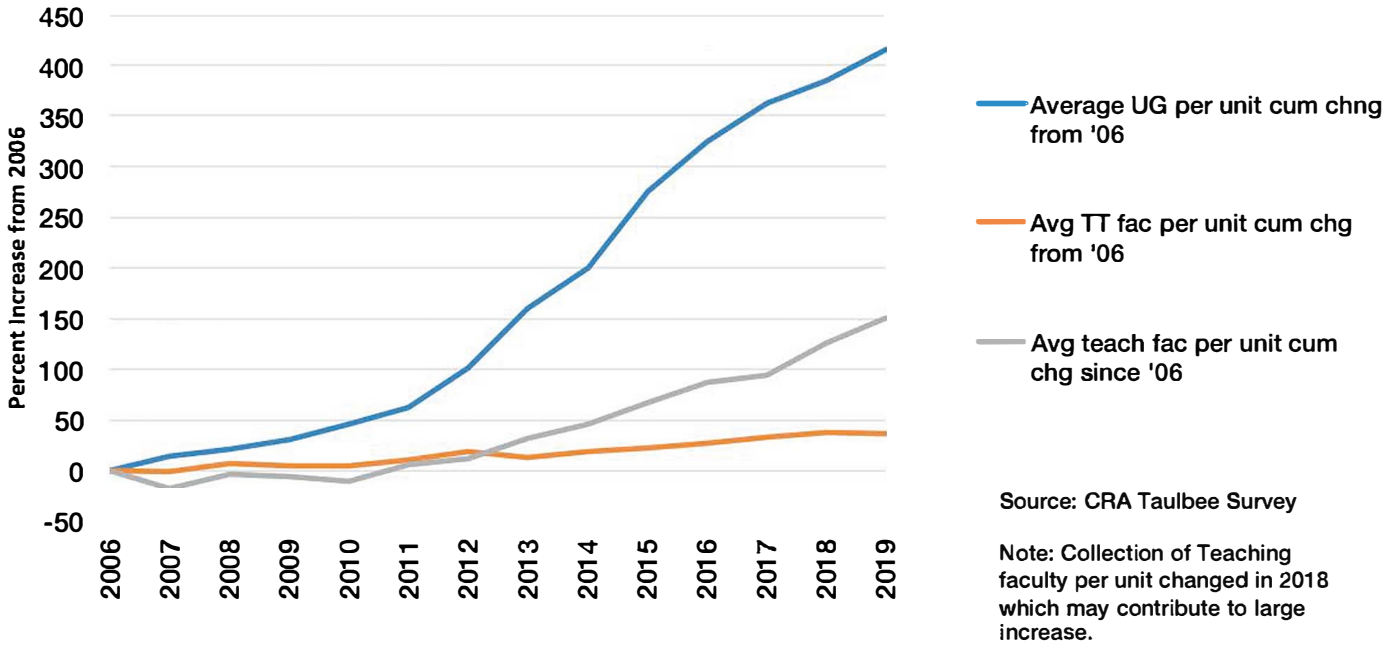
U.S. CS departments anticipate an average 5.4 percent growth in tenure-track faculty next year but an 8.5 percent growth in teaching faculty (Table F1). The tenure-track forecast is lower than that made last year, while the teaching faculty forecast is higher than last year's forecast. Departments also forecast an average 7.3 percent growth in postdocs, lower than the forecast last year. Actual hiring was fairly close in aggregate to last year's expectations for teaching faculty hiring, falling short for teaching professors and exceeding expectations for other instructors. Actual hiring fell short of expectations for postdocs and far short of expectations for tenure-track faculty.

Table F10. Source of New Faculty

Source	Full	Associate	Assistant	Teaching Prof	Other Instruc	Research	Postdoc	Total	% Total from Source
New PhD	2	3	95	20	11	5	70	206	29%
From Postdoc	0	0	97	6	4	5	10	122	17%
From Other Academic	36	38	123	30	25	12	32	296	41%
From Industry	5	6	27	25	19	7	1	90	13%
Total With Hire Source	43	47	342	81	59	29	113	714	
Hired Without PhD	1	0	7	28	25	16	0	77	
% Hired Without PhD				35%	42%	55%			

Figure FI. Comparative Change in Majors and instructional Resources per Unit

CRA Taulbee Survey 2019



Source: CRA Taulbee Survey

Note: Collection of Teaching faculty per unit changed in 2018 which may contribute to large increase.

Table R1. Total Expenditure from External Sources for Computing Research

Department Type	# Depts	10th	25th	50th	75th	90th
US CS Public	82	$758,700	$2,054,122	$4,715,479	$9,620,511	$15,940,989
US CS Private	30	$1,693,735	$3,307,449	$6,165,610	$14,235,123	$18,240,686
US CE	3	*	*	*	*	*
US Information	14	$1,232,838	$2,418,270	$3,026,459	$5,107,540	$6,074,615
Canadian	4	*	*	$3,592,278	*	*

Research Expenditures

(Table R1; Figures R1-R2)

Table R1 shows the distribution of departments' total research expenditure (including indirect costs or "overhead" as stated on project budgets) from external sources of support. Figures R1 and R2 show the per capita expenditure, where capitation is computed two ways. The first (Figure R1) is relative only to the number of tenure-track faculty members. The second (Figure R2) is relative to research faculty and postdocs as well as tenure-track faculty. Canadian levels are shown in Canadian dollars.

Reported research expenditures in U.S. departments were substantially lower this year compared with those reported last year. Overall median research expenditures for 2018-19 at U.S. CS public departments decreased 11 percent, while they declined nearly 35 percent at U.S. CS private departments and 28 percent at U.S. I departments. However, this follows substantial increases reported last year. Canadian departments showed a 75 percent increase in median expenditure over last year, but the small Canadian sample size makes these comparisons a less reliable indicator of the country-wide situation.

The U.S. CS data show a tendency for larger departments to have more external funding per capita than smaller departments among both public and private institutions. This has been the trend consistently at public institutions, but not as consistently at private institutions.

Figure R1. Research Expenditures Normalized by Tenure-Track Size

CRA Taulbee Survey 2019

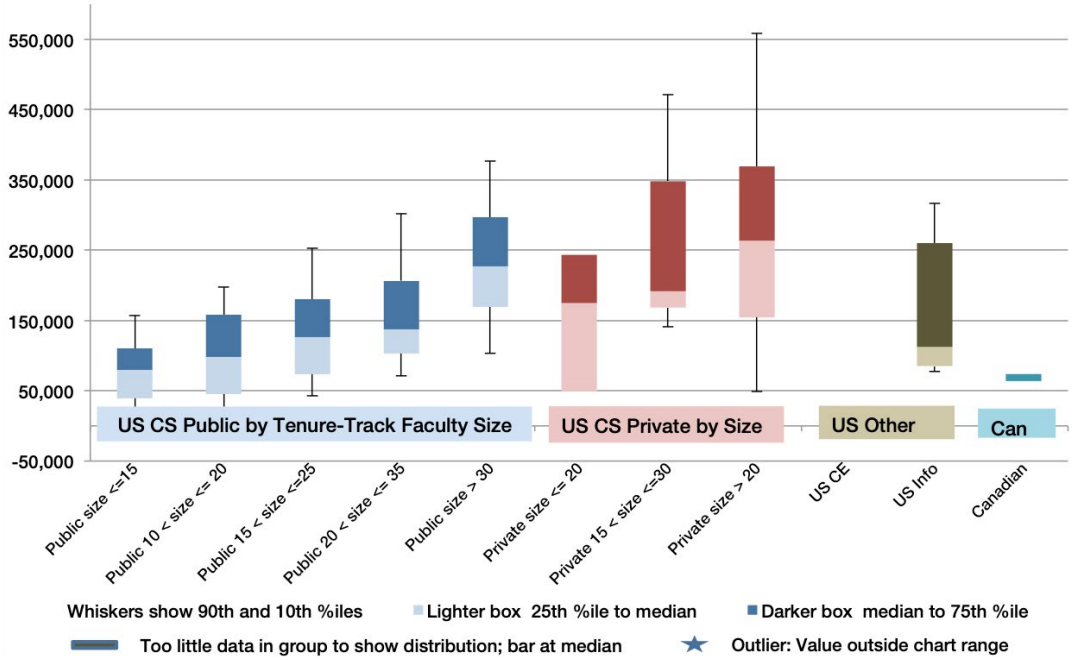
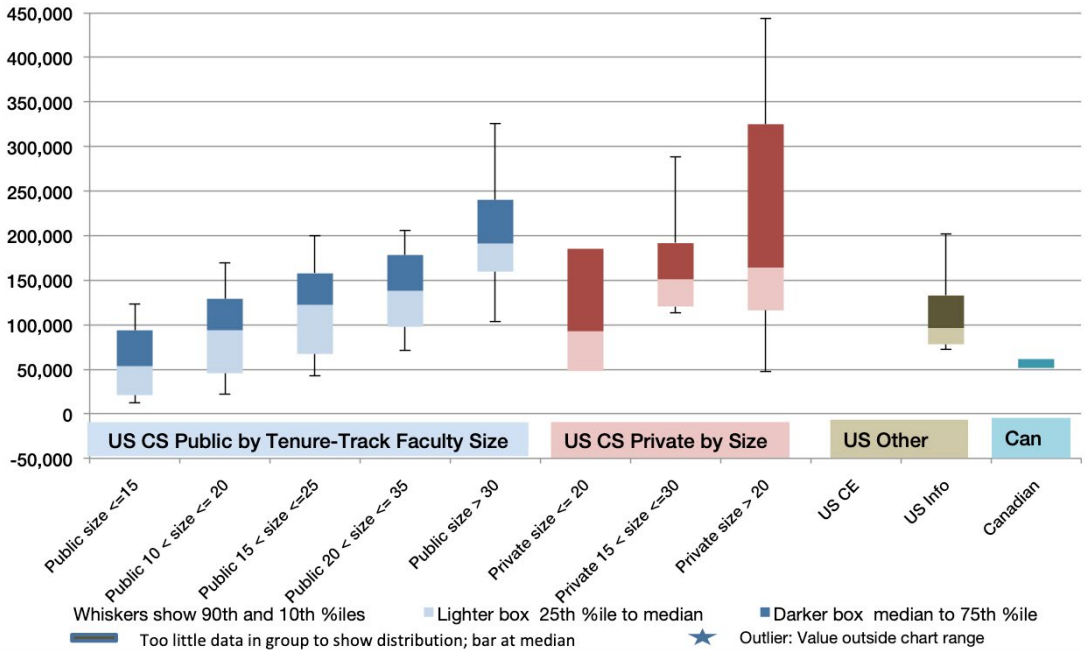


Figure R2. Research Expenditures Normalized by Tenure-Track + Research Faculty + Postdoctorates

CRA Taulbee Survey 2019



Graduate Student Support

(Tables G1-G2; Figures G1-G3)

Table G1 shows the number of doctoral students supported as full-time students as of fall 2019, further categorized as teaching assistants (TAs), research assistants (RAs), and full-support fellows. The table also shows the split between those on institutional vs. external funds. Table G1a shows similar data for supported master's students.

The average number of TAs on institutional funds among doctoral students in U.S. CS departments is similar to last year's value (35.0 vs 33.8 last year). Public universities reported an increase, private universities reported a decline for the second straight year. The small number of CE, I, and Canadian departments also make these comparative averages subject to considerable volatility.

Among research associates, the average number per department on external funding was lower this year in U.S. CS departments at both public and private universities, while the average number of RAs supported on institutional funds increased at both public and private universities. The average number of full-support fellows on internal funds declined in U.S. CS departments, mainly due to decreases at private universities. The average number of full-support fellows on external funds increased at U.S. CS departments, again mainly due to private universities.

Among master's students, 67.9 percent of support is for TAs, an increase over the 66.8 percent reported last year. Conversely, 29.2 percent of support is for RAs, compared with last year's 29.8 percent. The 108 U.S. CS departments that provided master's support data had an average number of TAs per department on institutional funds of 23.2, compared to the 19.4 average reported in last year's survey and 16.7 reported two years ago (Table G1a). This suggests that the use of master's students continues to increase to help departments cope with the CS enrollment surge. Note, however, that master's students are not eligible for assistantships in several departments (Table G1b).

Table G1. Doctoral Students Supported as Full-Time Students by Department Type

		On Institutional Funds						On External Funds						Total
Department Type	# Dept	Teaching Assistants		Research Assistants		Full-Support Fellows		Teaching Assistants		Research Assistants		Full-Support Fellows		
US CS Public	91	3,625.3	39.6%	1,267.9	13.9%	383.9	4.2%	64.0	0.7%	3,547.6	38.8%	258.5	2.8%	9,147.2
US CS Private	32	675.7	17.1%	1,285.8	32.5%	285.5	7.2%	0.0	0.0%	1,542.9	39.0%	169.0	4.3%	3,958.9
US CS Total	123	4,301.0	32.8%	2,553.7	19.5%	669.4	5.1%	64.0	0.5%	5,090.5	38.8%	427.5	3.3%	13,106.1
US CE	4	85.0	30.9%	10.0	3.6%	14.0	5.1%	0.0	0.0%	164.0	59.6%	2.0	0.7%	275.0
US I	14	251.6	41.0%	117.2	19.1%	27.5	4.5%	1.6	0.3%	197.2	32.1%	19.0	3.1%	614.1
Canadian	6	224.0	42.9%	201.0	38.5%	4.0	0.8%	3.0	0.6%	90.0	17.2%	0.0	0.0%	522.0
Grand Total	147	4,861.6	33.5%	2,881.9	19.9%	714.9	4.9%	68.7	0.5%	5,541.7	38.2%	448.5	3.1%	14,517.2

Table G1a. Master's Students Supported as Full-Time Students by Department Type

		On Institutional Funds						On External Funds						Total
Department Type	# Dept	Teaching Assistants		Research Assistants		Full-Support Fellows		Teaching Assistants		Research Assistants		Full-Support Fellows		
US CS Public	85	1,971.2	71.6%	146.5	5.3%	42.0	1.5%	36.0	1.3%	527.8	19.2%	31.0	1.1%	2,754.5
US CS Private	23	533.2	85.6%	20.3	3.3%	7.0	1.1%	2.5	0.4%	45.0	7.2%	15.0	2.4%	623.0
US CS Total	108	2,504.4	74.1%	166.8	4.9%	49.0	1.5%	38.5	1.1%	572.8	17.0%	46.0	1.4%	3,377.5
US CE	3	5.0	71.4%	1.0	14.3%	0.0	0.0%	0.0	0.0%	1.0	14.3%	0.0	0.0%	7.0
US I	13	128.9	56.8%	18.4	8.1%	32.0	14.1%	0.2	0.1%	45.3	20.0%	2.0	0.9%	226.8
Canadian	4	294.5	37.8%	269.0	34.5%	0.0	0.0%	8.0	1.0%	208.5	26.7%	0.0	0.0%	780.0
Grand Total	128	2,933	66.8%	455	10.4%	81	1.8%	47	1.1%	828	18.8%	48	1.1%	4,391

Table G2 shows the distribution of stipends for TAs, RAs, and full-support fellows. U.S. CS data are further broken down in this table by public and private institution. Figures G1-G3 further break down the U.S. CS data by size of department and by geographic location of the university.

The median TA salaries at U.S. CS departments increased 2.5 percent at public universities and increased 4.1 percent at private universities. Median salaries of RAs rose 1.5 percent at public universities and 4.8 percent at private universities. For full-support fellows, median salaries rose 2.9 percent at U.S. public universities and 2.1 percent at U.S. private universities.

Compared with public U.S. CS departments, median stipends are higher at private U.S. CS departments in each of the three stipend categories, and based on the changes observed in the previous paragraph, the gap grew this year for TAs and RAs. Median stipends for TAs and RAs at U.S. I schools fall in between those at public and private U.S. CS departments. These relationships are unchanged from previous years. Median stipends for full-support fellows at I schools are the same as that for public U.S. CS departments. They also were nearly the same last year.

Median salaries of RAs are 3.7 percent higher than those of TAs at U.S. CS public departments, less than one percent higher at U.S. CS private departments, and 2.4 percent higher U.S. I departments. Full support fellow median salaries are considerably higher than RA salaries at U.S. CS public departments, but only modestly higher at U.S. CS private and U.S. I departments.

At U.S. CS departments, larger departments have higher salaries than do smaller departments for both TAs and RAs, except that the smallest public departments (those of size 15 or less) have higher TA (but not RA) stipends than those of size 16-25. Stipends of full support fellows exhibit no clear relationship among public departments, while private departments continue to show a positive correlation between size and stipend.

Table G1b. Master's Students Eligibility for Assistantship Support

	# Depts	% of Depts
All master's students are eligible for assistantships	88	62.0%
No master's students are eligible for assistantships	12	8.5%
Students in some master's programs but not others are eligible for assistantships	28	19.7%
Other*	14	9.9%

* Other responses divided between individual student qualifications (e.g. GPA or training) and department needs or resources (research needs, funds availability)

Table G2. Fall 2019 Academic-Year Graduate Stipends by Department Type and Support Type

Teaching Assistantships						
		Percentiles of Department Averages				
Department Type	**# Depts**	**10th**	**25th**	**50th**	**75th**	**90th**
US CS Public	100	$12,000	$16,568	$19,484	$21,911	$24,168
US CS Private	28	$19,995	$23,776	$26,760	$30,858	$32,651
US CE	5			$16,857		
US Information	12	$17,809	$20,834	$23,486	$26,044	$27,114
Canadian	8		$7,790	$14,073	$16,438	
Research Assistantships						
		Percentiles of Department Averages				
Department Type	**# Depts**	**10th**	**25th**	**50th**	**75th**	**90th**
US CS Public	99	$14,815	$17,934	$20,212	$22,850	$25,534
US CS Private	35	$22,056	$23,675	$27,000	$31,600	$33,497
US CE	5			$24,633		
US Information	12	$20,118	$21,780	$24,045	$25,765	$26,158
Canadian	7		$8,989	$11,000	$16,377	
Full-Support Fellows						
		Percentiles of Department Averages				
Department Type	**# Depts**	**10th**	**25th**	**50th**	**75th**	**90th**
US CS Public	64	$17,650	$20,188	$25,000	$30,000	$34,031
US CS Private	33	$23,129	$25,292	$27,670	$32,520	$34,000
US CE	4			$25,334		
US Information	9		$21,779	$25,000	$26,000	
Canadian	3					

Figure G1. Teaching Assistantship Stipends

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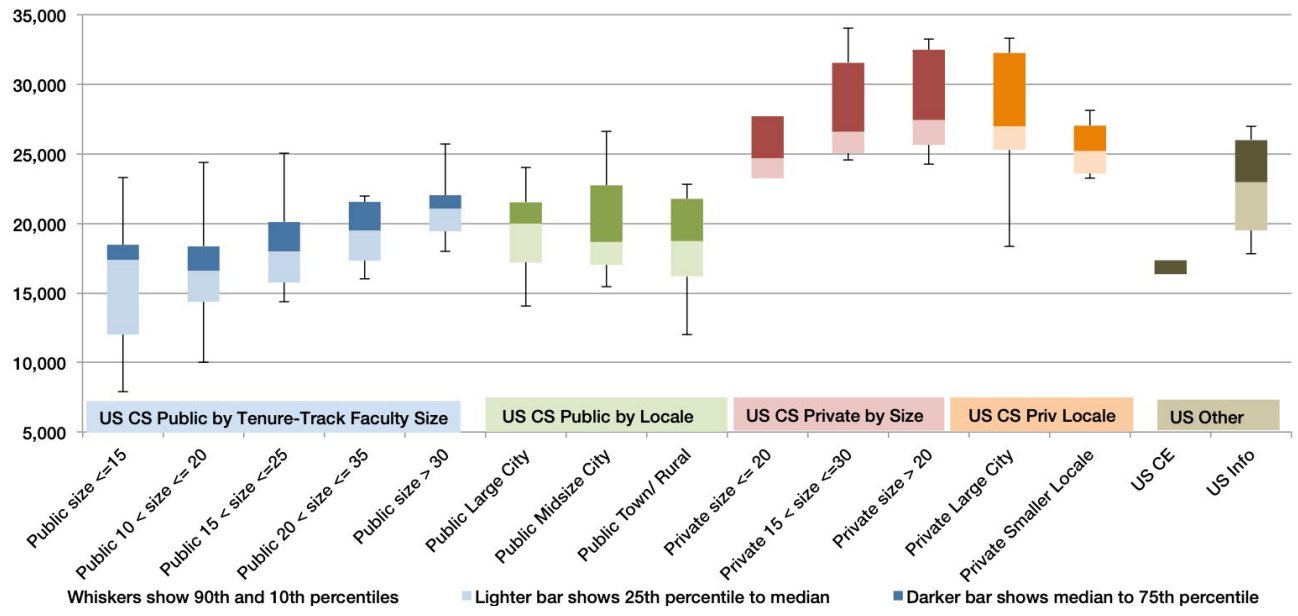


Figure G2. Research Assistantship Stipends

CRA Taulbee Survey 2019

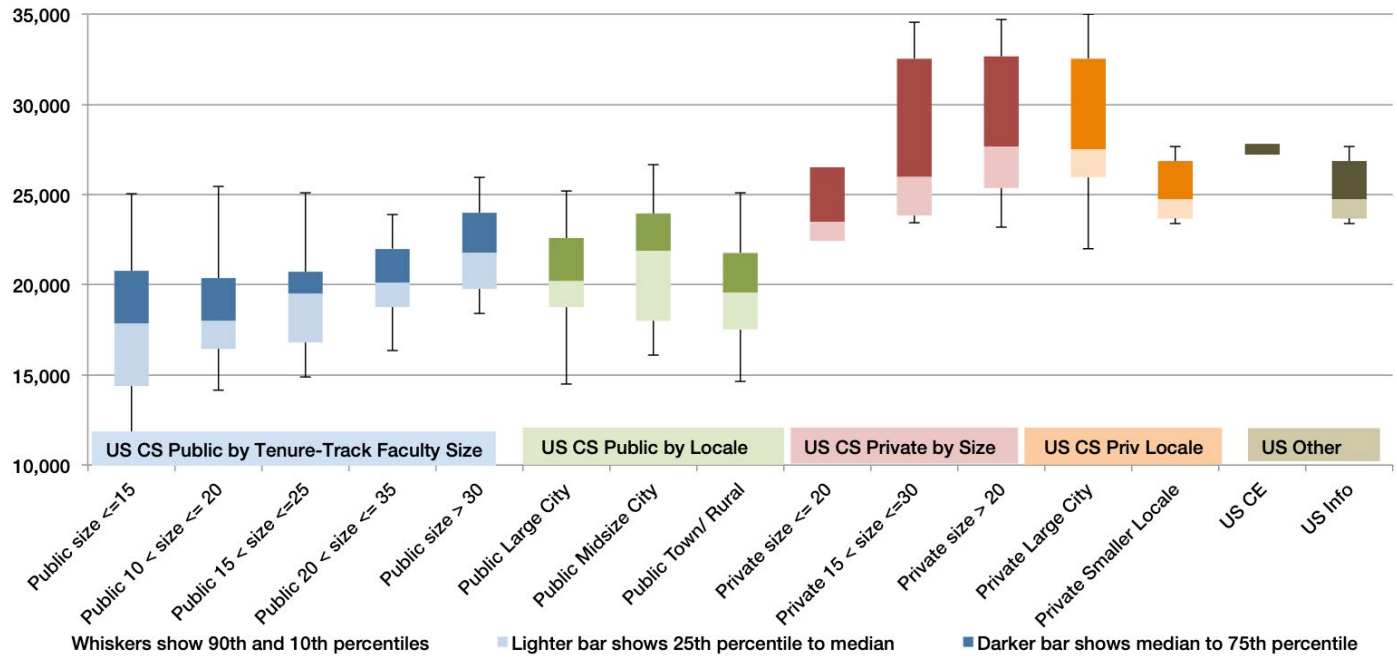
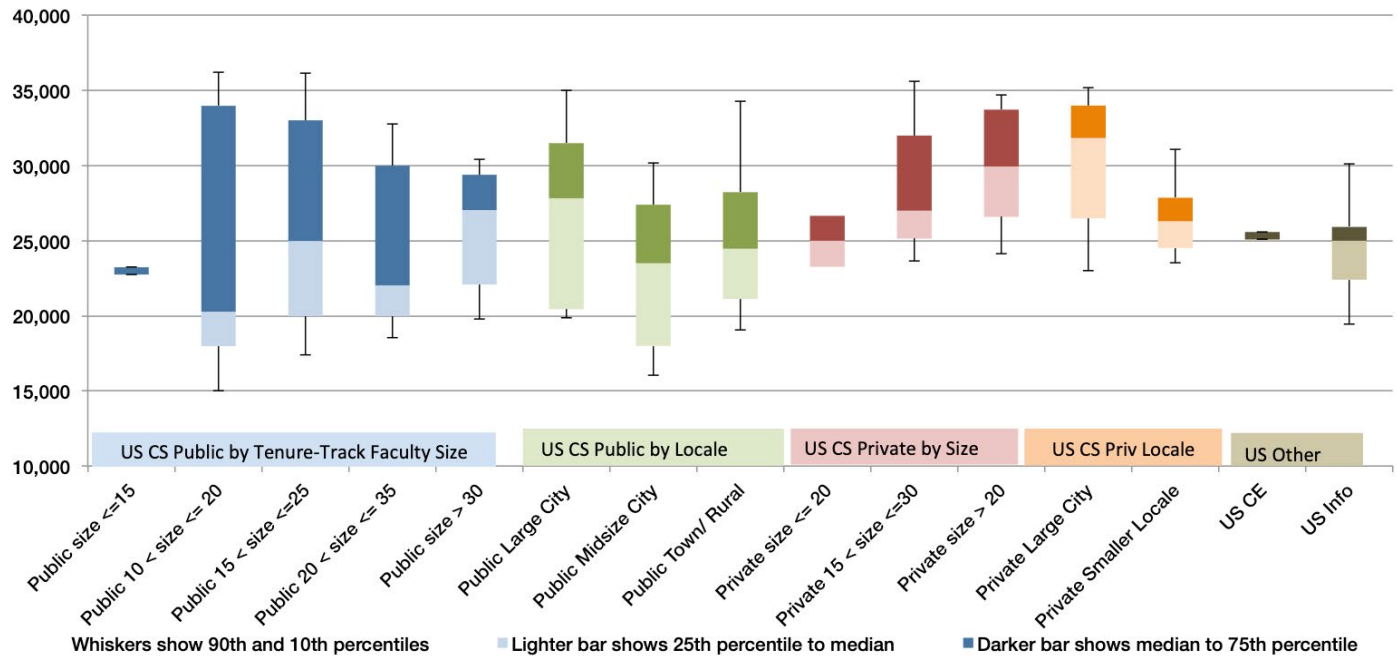


Figure G3. Full Support Fellows Stipends

CRA Taulbee Survey 2019



Faculty Salaries

(Tables S1-S21; Figures S1-S9)

Each department was asked to report individual (but anonymous) faculty salaries if possible; otherwise, the department was requested to provide the mean salary for each rank (full, associate, and assistant professors and non-tenure-track teaching faculty, research faculty, and post-doctorates) and the number of persons at each rank. The salaries are those in effect on January 1, 2020 for U.S. departments; nine-month salaries are reported in U.S. dollars. For Canadian departments, twelve-month salaries are reported in Canadian dollars. Respondents were asked to include salary supplements such as salary monies from endowed positions.

U.S. CS data is reported in Tables S1-S16 and in the box and whiskers diagrams. Data for CE, I, Canadian, and new Ph.D.s are reported in Tables S17-S20. The tables and diagrams contain distributional data (first decile, quartiles, and ninth decile) computed from the department averages only. Thus, for example, a table row labeled "50" or the median line in a diagram is the median of the averages for the departments that reported within the stratum (the number of such departments reporting is shown in the "depts" row). Therefore, it is not a true median of all of the salaries.

We also report salary data for senior faculty based on time in rank, for more meaningful comparison of individual or departmental faculty salaries with national averages. We report associate professor salaries for time in rank of 7 years or less, and of more than 7 years. For full professors, we report time in rank of 7 years or less, 8 to 15 years, and more than 15 years. We also disaggregate teaching faculty salaries into the two subclasses, for teaching professors and other instructors. Within each subclass, there is further breakdown into persons with time in rank of less than 3 years, 3-5 years, 6-8 years, and 9 or more years. The teaching faculty salary disaggregations are in Tables S1a to S19a.

Those departments reporting salary data are normally provided a summary report in December; this year, the salary report was distributed in April when the early version of this report was made available to participating departments and CRA members. Next

Table S1. Nine-month Salaries, 142 Responses of 192 US CS Departments, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	120	117	124	141	110	125	141	139	117	45	47
Indiv	713	556	718	2,068	403	604	1,072	1,228	1,105	311	327
10	$130,980	$135,374	$121,646	$127,443	$102,984	$109,657	$106,206	$92,663	$63,556	$60,973	$44,701
25	$153,698	$151,481	$139,637	$149,007	$110,633	$116,866	$113,722	$100,252	$73,691	$73,860	$53,893
50	$178,611	$170,794	$161,285	$168,867	$116,719	$124,786	$121,547	$107,553	$85,717	$100,000	$57,217
75	$208,495	$199,546	$178,392	$190,332	$129,199	$141,000	$135,536	$119,819	$100,241	$122,209	$67,055
90	$236,524	$221,550	$198,757	$208,257	$142,139	$152,122	$153,051	$129,157	$118,372	$146,281	$70,315

Table S1a. Nine-month Salaries, 142 Responses of 192 US CS Departments, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	43	40	56	63	91	29	14	30	41	72
Indiv	111	64	148	192	644	79	41	90	124	461
10	$74,538	$73,389	$69,606	$68,486	$72,437	$60,535	$61,165	$59,625	$52,734	$52,826
25	$88,773	$82,097	$79,802	$80,000	$82,200	$70,382	$72,359	$67,981	$66,083	$65,672
50	$103,371	$93,234	$90,838	$88,020	$89,500	$81,396	$75,193	$75,703	$72,513	$72,877
75	$124,000	$108,413	$110,287	$101,088	$107,677	$96,697	$87,351	$86,830	$87,267	$85,690
90	$140,817	$133,848	$132,563	$116,213	$123,325	$123,822	$103,332	$104,383	$97,218	$108,928

year will return to the earlier distribution of the salary report to participants. In the salary report, those departments that provided individual salaries were additionally provided more comprehensive distributional information based on these individual salaries.

The response rates from U.S. CS, U.S. CE, U.S. Information, and Canadian departments increased over last year's rates. This year's respective response rates for those departments were 73, 20, 68 and 31 percent; last year's respective rates were 70, 15, 60 and 27 percent. The total number of respondents this year was 172, while last year we had 164 respondents. The number of respondents this year was exactly the same as two years ago. As always, we urge caution in drawing conclusions from those categories with low response rates.

This year, 63 percent of those reporting salary data provided salaries at the individual level. This is down from last year's 68 percent.

Salaries at private institutions tend to be higher than those at public institutions for all faculty types (Tables S2 and S3). This pattern is consistent with data from previous years.

When viewed relative to faculty size, salaries tend to be higher for larger departments at both public and private institutions (perhaps best seen in Figures S1-S9). This pattern holds for all tenure-track ranks. It also holds for teaching faculty, research faculty and postdoc salaries, with the exception of research faculty at public institutions.

When viewed relative to type of locale, public institution salaries appear to be generally lower in smaller locales than in mid-size or large cities for all tenure-track faculty ranks. Private institution salaries exhibit the opposite pattern, except for associate professors with 0-7 years in rank. Teaching faculty salaries at both public and private institutions tend to be higher in large cities than in smaller locales (Figures S1-S7).

Our analysis of faculty salary changes from one year to the next uses only those departments that reported both years; otherwise, the departments that reported during only one year can skew the comparison. Because some departments that reported both years provided only aggregate salaries for their full and associate

Table S2. Nine-month Salaries, 105 Responses of 139 US CS Public (All Public), Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	87	86	94	104	83	89	104	103	85	30	30
Indiv	485	392	513	1462	302	404	761	911	764	183	158
10	$127,609	$128,701	$119,650	$126,791	$100,764	$105,715	$104,612	$91,628	$62,276	$53,385	$43,800
25	$146,244	$147,994	$132,495	$143,998	$107,937	$115,639	$111,185	$97,690	$72,270	$69,242	$53,870
50	$172,696	$165,267	$151,569	$163,142	$115,973	$123,583	$119,560	$104,026	$82,400	$82,404	$55,852
75	$193,340	$190,046	$171,892	$179,190	$126,530	$133,452	$130,990	$114,900	$90,162	$111,275	$62,898
90	$212,502	$204,833	$185,195	$196,732	$138,688	$143,514	$143,228	$124,130	$109,882	$130,929	$68,650

Table S2a. Nine-month Salaries, 105 Responses of 139 US CS Public (All Public), Percentiles from Department Averages

	Teaching Professor					Other Instructor				
Non-Tenure Track	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	28	28	40	44	63	25	11	23	28	54
Indiv	65	40	102	129	429	67	29	73	87	335
10	$72,079	$72,577	$67,708	$63,742	$69,109	$59,826	$58,129	$60,627	$36,175	$51,240
25	$84,123	$80,714	$78,444	$78,703	$78,619	$66,972	$70,162	$67,526	$60,770	$63,276
50	$94,636	$89,674	$85,166	$86,125	$87,500	$76,128	$73,452	$71,287	$70,000	$69,890
75	$108,435	$104,173	$95,071	$91,191	$100,180	$89,159	$78,982	$82,749	$80,786	$79,586
90	$135,920	$118,243	$115,693	$105,108	$117,181	$100,881	$85,714	$88,184	$87,416	$86,669

professors during one year and in the other year reported them by years in rank, we only report salary changes for all full professors and for all associate professors in the year-to-year comparison. Similarly, we do not disaggregate teaching faculty by years in rank in the year to year comparison, though we do distinguish teaching professors from other instructors. Table S21 shows, by type of faculty and type of department, the change in the median of the average salaries from departments that reported both years (the number of departments being compared is indicated in parentheses in each column heading). Using the cell showing full professors at U.S. CS departments as an example, the table indicates that the median of the 129 average salaries for full professors was 3.7 percent higher in 2019-20 than was the median of the average full professor salaries in 2018-19 from these same 129 departments.

When interpreting these changes, it is important to remember the effect that promotions have on the departmental data from one year to the next, since a promotion causes an individual faculty member to move from one rank to another. Thus, a department with a small number of faculty members in a particular rank can have its average salary in that rank change appreciably (in either direction) by a single promotion to or from that rank. Departures via resignation or retirement also impact these figures, particularly in the non-tenure-track categories. Because of the small number of Canadian schools, Information schools, and Computer Engineering departments reporting, the values in those columns are considerably more volatile; this is evident in several of the entries in Table S21.

For new Ph.D.s in tenure-track positions at U.S. computer science, computer engineering and I-school departments, the median of the averages was $112,555, an increase of 5.5 percent over last year (Table S20). Again this year, there was an insufficient response from Canadian institutions to report any results regarding Canadian salaries for new Ph.Ds.

Table S3. Nine-month Salaries, 37 Responses of 53 US CS Private (All Private), Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	33	31	30	37	27	36	37	36	32	15	17
Indiv	228	164	205	606	101	200	311	317	341	128	169
10	$157,813	$156,404	$146,136	$139,493	$110,395	$118,203	$114,788	$102,882	$79,451	$95,364	$46,867
25	$180,060	$175,097	$162,540	$169,667	$112,875	$122,768	$120,998	$110,292	$84,459	$102,500	$54,996
50	$217,020	$199,525	$177,531	$194,991	$118,728	$142,100	$138,667	$119,150	$101,209	$115,000	$61,980
75	$238,950	$220,725	$197,940	$211,541	$133,262	$151,889	$148,760	$128,443	$110,717	$145,828	$68,763
90	$255,329	$234,338	$207,052	$232,976	$153,342	$167,268	$161,404	$132,715	$126,052	$162,626	$70,875

Table S3a. Nine-month Salaries, 37 Responses of 53 US CS Private (All Private), Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	15	12	16	19	28	4	3	7	13	18
Indiv	46	24	46	63	215	12		17	37	126
10	$95,956	$81,181	$82,081	$79,190	$84,377				$69,550	$67,930
25	$104,616	$90,997	$92,512	$87,026	$89,004			$77,214	$83,500	$77,331
50	$121,090	$106,686	$111,612	$94,389	$103,992	$126,098		$91,503	$88,000	$89,687
75	$131,875	$121,143	$119,635	$112,850	$121,485			$102,717	$99,000	$105,174
90	$140,443	$142,791	$136,619	$139,668	$129,081				$105,262	$110,215

Table S4. Nine-month Salaries, 20 Responses of US CS Public With <=15 Tenure-Track Faculty, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	12	9	16	19	15	12	19	18	13	0	1
Indiv	19	17	40	86	39	30	80	67	52		
10	$113,283		$112,384	$114,466	$93,871	$101,126	$94,784	$87,162	$58,782		
25	$117,229	$114,358	$116,630	$122,476	$96,516	$102,590	$100,915	$89,693	$62,697		
50	$133,253	$129,223	$122,372	$127,305	$101,345	$111,466	$107,535	$95,548	$74,461		
75	$148,265	$150,008	$127,991	$140,164	$112,516	$116,462	$115,869	$98,275	$79,518		
90	$193,732		$163,021	$153,209	$133,789	$119,690	$122,435	$101,018	$87,895		

Table S4a. Nine-month Salaries, 20 Responses of US CS Public With <=15 Tenure-Track Faculty, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	4	3	4	8	10	2	0	3	4	7
Indiv	5		10	13	32				6	20
10					$59,770					
25				$64,709	$68,524					$59,161
50	$77,956		$89,074	$78,135	$82,010				$59,412	$63,823
75				$85,438	$87,861					$68,939
90					$89,951					

Table S5. Nine-month Salaries, 36 Responses of US CS Public With 10 < Tenure-Track Faculty <=20, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	24	26	31	36	27	29	36	35	26	4	4
Indiv	54	66	90	232	80	86	185	159	125	19	6
10	$113,653	$112,349	$112,065	$114,874	$94,741	$102,687	$101,280	$89,702	$59,046		
25	$123,131	$128,439	$116,260	$125,846	$102,256	$105,706	$105,565	$92,414	$62,350		
50	$140,535	$150,229	$126,083	$141,770	$107,700	$112,072	$110,850	$97,291	$72,062	$95,925	$56,000
75	$160,837	$170,924	$141,455	$154,452	$112,885	$116,899	$117,337	$102,779	$79,189		
90	$188,751	$204,667	$149,985	$173,059	$118,350	$125,079	$123,830	$108,611	$87,056		

Table S5a. Nine-month Salaries, 36 Responses of US CS Public With 10 < Tenure-Track Faculty <=20, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	6	7	8	9	16	7	2	8	10	19
Indiv	8	9	9	17	47	12		20	22	78
10					$63,281				$26,056	$41,149
25		$68,043	$69,690	$74,542	$69,601	$60,004		$61,413	$53,301	$54,641
50	$80,557	$81,600	$75,909	$80,000	$75,408	$71,067		$69,929	$59,540	$63,823
75		$85,245	$85,141	$84,750	$85,075	$85,343		$77,758	$68,456	$72,231
90					$87,741				$80,333	$82,635

Table S6. Nine-month Salaries, 34 Responses of US CS Public With 15 < Tenure-Track Faculty <=25, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	26	29	29	34	24	29	34	34	26	6	4
Indiv	71	78	109	288	71	79	178	211	154	24	7
10	$125,744	$119,309	$112,486	$133,608	$104,441	$105,052	$105,694	$91,728	$61,709		
25	$138,469	$140,719	$127,408	$142,673	$109,786	$110,000	$110,142	$96,289	$64,940		
50	$159,049	$158,149	$142,672	$152,717	$114,758	$116,866	$115,484	$101,567	$73,502	$91,859	$55,770
75	$178,374	$190,000	$151,770	$171,139	$120,506	$124,600	$123,608	$107,295	$81,611		
90	$200,367	$207,016	$168,494	$178,421	$127,033	$129,446	$131,355	$113,989	$87,956		

Table S6a. Nine-month Salaries, 34 Responses of US CS Public With 15 < Tenure-Track Faculty <=25, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
Non-Tenure Track	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	6	7	10	9	15	8	4	10	9	20
Indiv	8	9	16	23	62	13	6	25	23	92
10			$62,754		$63,141			$60,125		$42,682
25		$71,961	$66,069	$74,542	$71,250	$65,450		$65,793	$57,080	$62,933
50	$88,753	$81,600	$75,909	$80,000	$75,818	$72,104	$70,850	$75,703	$67,825	$68,292
75		$85,245	$81,827	$84,063	$86,603	$77,648		$79,508	$80,000	$78,523
90			$94,461		$90,076			$85,991		$85,035

Table S7. Nine-month Salaries, 24 Responses of US CS Public With 20 < Tenure-Track Faculty <=35, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	22	21	21	24	20	21	24	24	20	7	6
Indiv	92	60	86	271	67	62	155	206	179	15	18
10	$138,649	$136,459	$131,910	$143,426	$107,941	$113,109	$110,915	$97,738	$67,405		
25	$150,279	$143,305	$149,663	$153,752	$110,723	$116,677	$115,665	$101,571	$72,075	$51,881	
50	$169,597	$156,408	$153,015	$164,740	$117,828	$124,057	$119,462	$104,935	$74,460	$69,144	$55,560
75	$187,576	$174,523	$167,667	$181,213	$126,148	$131,630	$125,364	$108,781	$84,197	$88,439	
90	$199,309	$203,501	$177,976	$187,520	$132,953	$142,500	$132,866	$116,602	$89,435		

Table S7a. Nine-month Salaries, 24 Responses of US CS Public With 20 < Tenure-Track Faculty <=35, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	6	6	9	9	13	7	5	8	8	17
Indiv	11	8	27	26	100	15	7	16	23	79
10					$72,471					$53,195
25			$77,351	$68,107	$75,496	$66,971		$68,328	$58,143	$63,382
50	$88,773	$83,031	$78,948	$83,276	$80,790	$73,140	$73,452	$71,869	$67,027	$68,752
75			$92,708	$88,000	$89,154	$80,290		$81,800	$74,411	$80,000
90					$95,617					$85,206

Table S8. Nine-month Salaries, 41 Responses of US CS Public With Tenure-Track Faculty >30, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	40	40	41	41	35	40	41	41	38	21	22
Indiv	352	275	335	973	159	260	423	549	491	153	142
10	$161,515	$148,001	$144,365	$159,699	$107,936	$120,668	$116,660	$102,634	$75,650	$66,873	$42,200
25	$169,619	$158,095	$153,055	$166,581	$112,814	$123,589	$119,360	$104,824	$85,102	$70,000	$47,810
50	$179,841	$176,306	$170,983	$177,294	$123,775	$133,426	$127,608	$115,204	$91,241	$81,930	$55,394
75	$202,937	$193,489	$181,310	$194,367	$135,269	$141,646	$141,831	$123,632	$106,964	$106,128	$64,044
90	$223,458	$211,575	$207,427	$202,335	$143,146	$151,929	$153,051	$129,720	$120,381	$119,300	$69,848

Table S8a. Nine-month Salaries, 41 Responses of US CS Public With Tenure-Track Faculty >30, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	15	16	23	24	33	12	4	7	11	20
Indiv	45	25	66	89	304	41	18	37	46	187
10	$92,070	$87,287	$79,779	$81,040	$85,254	$70,446			$66,083	$57,035
25	$94,636	$90,113	$84,291	$86,653	$88,122	$74,851		$69,519	$70,313	$68,338
50	$107,619	$99,520	$91,055	$90,500	$99,290	$86,538	$81,050	$80,545	$72,513	$71,589
75	$131,313	$112,165	$103,604	$102,301	$113,119	$91,044		$94,977	$85,494	$83,947
90	$146,018	$131,094	$145,870	$114,123	$125,380	$120,950			$91,125	$94,607

Table S9. Nine-month Salaries, 11 Responses of US CS Private With <=20 Tenure-Track Faculty, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	8	6	7	11	10	10	11	11	8	2	4
Indiv	25	15	19	64	24	25	50	40	42		6
10				$125,912	$108,400	$114,397	$112,113	$95,880			
25	$174,449		$144,740	$142,817	$111,043	$118,363	$114,484	$103,309	$78,357		
50	$191,892	$186,093	$170,000	$179,809	$116,521	$120,134	$120,484	$107,835	$84,405		$53,098
75	$238,538		$180,631	$198,202	$124,071	$134,983	$124,577	$122,050	$93,224		
90				$207,500	$132,162	$141,835	$138,667	$127,500			

Table S9a. Nine-month Salaries, 11 Responses of US CS Private With <=20 Tenure-Track Faculty, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
Non-Tenure Track	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	4	2	5	5	8	0	0	0	1	2
Indiv	4		9	18	38					
10										
25					$82,235					
50	$106,284		$86,600	$82,250	$87,752					
75					$93,224					
90										

Table S10. Nine-month Salaries, 16 Responses of US CS Private With 15 < Tenure-Track Faculty <=30, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	14	14	12	16	11	16	16	16	15	8	8
Indiv	68	57	57	188	24	65	90	99	100	36	58
10	$181,865	$172,742	$162,516	$172,768	$111,750	$118,656	$119,760	$109,068	$79,328		
25	$192,896	$185,621	$163,341	$182,712	$114,625	$130,292	$128,145	$115,577	$86,759	$96,704	$55,713
50	$211,088	$201,251	$174,181	$195,330	$118,728	$140,600	$139,071	$119,150	$102,200	$105,063	$60,990
75	$240,658	$217,679	$183,816	$202,175	$132,938	$149,040	$144,005	$126,988	$109,409	$132,486	$68,471
90	$253,483	$224,307	$194,806	$220,155	$138,900	$167,030	$161,613	$136,132	$117,882		

Table S10a. Nine-month Salaries, 16 Responses of US CS Private With 15 < Tenure-Track Faculty <=30, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	8	6	7	11	15	1	0	2	6	8
Indiv	14	8	14	32	75				17	25
10				$75,948	$85,598					
25	$102,427		$110,190	$84,588	$88,971					$75,168
50	$107,931	$96,835	$112,800	$87,401	$102,200				$93,000	$86,601
75	$115,049		$120,590	$101,570	$113,675					$94,689
90				$116,433	$121,954					

Table S11. Nine-month Salaries, 26 Responses of US CS Private With Tenure-Track Faculty >20, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	25	25	23	26	17	26	26	25	24	13	13
Indiv	203	149	186	542	77	175	261	277	299	122	163
10	$160,335	$157,078	$150,310	$155,124	$111,221	$120,784	$120,757	$110,105	$83,722	$94,599	$47,578
25	$191,292	$182,267	$162,580	$177,823	$114,395	$134,850	$131,268	$116,312	$93,122	$105,000	$60,000
50	$218,574	$199,525	$183,733	$196,624	$123,714	$147,904	$144,092	$121,377	$104,015	$115,000	$68,616
75	$238,950	$220,356	$201,236	$222,110	$138,900	$158,791	$155,820	$129,079	$112,106	$148,092	$69,278
90	$267,363	$231,900	$211,440	$237,434	$157,974	$171,297	$164,201	$135,828	$127,908	$166,138	$70,958

Table S11a. Nine-month Salaries, 26 Responses of US CS Private With Tenure-Track Faculty >20, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	11	10	11	14	20	4	3	7	12	16
Indiv	42	22	37	45	177	12		17	35	122
10	$103,371	$79,819	$94,482	$87,208	$93,690				$76,525	$71,758
25	$107,931	$90,321	$107,017	$93,091	$98,325			$77,214	$84,625	$83,093
50	$121,275	$106,686	$112,800	$101,713	$111,966	$126,098		$91,503	$89,000	$91,065
75	$131,875	$116,617	$118,050	$124,157	$122,416			$102,717	$99,618	$107,154
90	$141,191	$144,764	$127,576	$143,665	$136,077				$105,736	$110,309

Table S12. Nine-month Salaries, 41 Responses of US CS Public In Large City or Suburbs, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	35	35	38	41	34	36	41	40	33	11	15
Indiv	199	154	216	602	130	188	345	347	336	114	97
10	$135,258	$140,112	$125,248	$139,444	$105,187	$105,712	$108,017	$94,878	$62,255	$60,616	$44,918
25	$159,049	$149,220	$135,579	$150,903	$111,667	$115,650	$111,389	$101,403	$73,691	$68,952	$53,893
50	$177,875	$170,641	$153,585	$165,519	$119,779	$124,693	$121,920	$107,239	$83,843	$104,712	$55,204
75	$193,173	$190,829	$171,591	$182,767	$128,414	$133,390	$130,814	$116,447	$90,162	$129,211	$58,662
90	$211,580	$203,532	$184,664	$194,851	$138,569	$143,119	$141,831	$120,223	$107,363	$141,300	$63,707

Table S12a Nine-month Salaries, 41 Responses of US CS Public In Large City or Suburbs, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
Non-Tenure Track	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	12	15	16	19	25	9	5	11	11	22
Indiv	29	23	41	69	205	21	11	29	28	131
10	$91,398	$73,476	$77,683	$72,117	$72,198			$60,000	$52,734	$53,236
25	$93,768	$84,914	$81,419	$78,273	$79,240	$71,019		$65,218	$63,720	$63,897
50	$96,048	$93,805	$87,506	$88,335	$88,122	$86,262	$74,000	$77,667	$71,500	$71,676
75	$110,788	$105,873	$93,281	$90,739	$96,848	$89,290		$83,133	$80,000	$79,586
90	$132,322	$119,762	$106,641	$107,998	$114,971			$105,000	$83,327	$86,239

Table S13. Nine-month Salaries, 25 Responses of US CS Public In Midsize City or Suburbs, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	21	21	21	25	19	24	25	25	19	7	4
Indiv	131	108	148	395	69	91	169	238	168	34	27
10	$140,629	$126,480	$127,408	$146,590	$105,787	$110,000	$108,961	$93,526	$62,789		
25	$157,978	$155,484	$146,402	$156,323	$109,300	$116,605	$115,707	$97,291	$72,522	$80,256	
50	$176,833	$165,000	$164,800	$171,200	$116,363	$126,162	$121,179	$103,647	$85,681	$94,000	$60,234
75	$199,591	$185,917	$174,000	$184,790	$124,299	$139,394	$135,052	$117,500	$95,134	$112,419	
90	$224,380	$199,546	$185,544	$200,416	$141,915	$150,316	$156,810	$139,277	$147,905		

Table S13a. Nine-month Salaries, 25 Responses of US CS Public In Midsize City or Suburbs, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	7	6	9	8	11	5	3	3	4	9
Indiv	21	9	22	21	77	18			18	91
10					$72,437					
25	$85,714		$74,000	$76,479	$75,939					$67,833
50	$108,494	$89,279	$79,250	$81,276	$89,500	$71,067			$85,246	$75,228
75	$139,100		$113,264	$92,907	$110,939					$85,681
90					$144,560					

Table S14. Nine-month Salaries, 39 Responses of US CS Public in Small City, Town, or Rural, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	31	30	35	38	30	29	38	38	33	12	11
Indiv	155	130	149	465	103	125	247	326	260	35	34
10	$121,300	$127,426	$112,587	$123,570	$100,245	$106,488	$102,535	$89,130	$63,733	$54,536	$42,000
25	$132,568	$143,994	$124,404	$130,542	$105,079	$114,210	$106,930	$95,520	$71,078	$67,235	$50,972
50	$154,380	$158,197	$144,365	$150,076	$111,350	$119,163	$115,541	$102,958	$78,200	$71,930	$55,584
75	$183,634	$188,742	$172,233	$172,618	$124,518	$131,630	$124,639	$108,281	$89,250	$83,909	$64,560
90	$201,368	$211,575	$181,132	$188,777	$132,419	$136,839	$135,358	$123,819	$101,373	$110,391	$69,998

Table S14a. Nine-month Salaries, 39 Responses of US CS Public in Small City, Town, or Rural, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	9	7	15	17	27	11	3	9	13	23
Indiv	15	8	39	39	147	28		25	41	113
10			$69,206	$64,484	$68,693	$59,117			$40,000	$51,211
25	$73,497	$73,510	$77,104	$80,000	$76,599	$65,099		$67,751	$57,080	$62,969
50	$82,414	$82,262	$86,928	$84,750	$86,664	$76,128		$69,858	$67,825	$68,666
75	$86,345	$95,630	$96,594	$91,000	$96,044	$84,105		$71,287	$70,625	$73,310
90			$103,629	$102,369	$108,041	$89,423			$80,741	$84,574

Table S15. Nine-month Salaries, 24 Responses of US CS Private in Large City or Suburbs, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	21	19	20	24	19	24	24	23	22	12	11
Indiv	148	99	155	409	85	152	238	230	293	119	112
10	$147,845	$152,110	$147,022	$136,992	$110,508	$115,524	$114,043	$101,812	$79,451	$97,895	$45,168
25	$178,221	$163,578	$161,837	$167,586	$111,560	$123,885	$122,379	$110,820	$85,778	$107,594	$56,107
50	$214,187	$186,056	$180,799	$190,266	$118,728	$139,834	$137,856	$118,500	$101,209	$121,897	$61,980
75	$235,231	$219,786	$196,647	$205,598	$135,314	$149,743	$146,549	$128,446	$110,968	$145,696	$70,035
90	$243,996	$229,462	$205,940	$229,834	$156,406	$167,813	$159,291	$133,004	$123,233	$167,894	$71,000

Table S15a. Nine-month Salaries, 24 Responses of US CS Private in Large City or Suburbs, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
Non-Tenure Track	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 v	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	12	11	13	14	19	4	3	6	11	14
Indiv	40	23	40	48	176	12		16	32	117
10	$94,515	$80,645	$82,253	$87,208	$86,159				$68,000	$67,836
25	$105,239	$94,642	$94,482	$93,143	$91,647				$80,375	$74,003
50	$123,907	$107,669	$110,423	$105,814	$102,200	$126,098		$96,312	$88,000	$89,687
75	$136,834	$125,135	$118,680	$125,948	$122,260				$95,670	$105,174
90	$141,004	$143,866	$126,561	$143,665	$128,602				$106,210	$110,049

Table S16. Nine-month Salaries, 13 Responses of US CS Private in Other than Large City, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	12	12	10	13	8	12	13	13	10	3	6
Indiv	80	65	50	197	16	48	73	87	48		57
10	$164,652	$163,642	$143,400	$156,668		$118,417	$116,900	$105,925	$82,685		
25	$188,484	$182,312	$162,887	$175,870	$117,354	$120,819	$120,998	$107,835	$85,507		
50	$229,979	$209,130	$173,967	$208,257	$122,234	$143,623	$141,096	$119,800	$100,524		$64,520
75	$246,840	$221,767	$196,870	$214,326	$132,009	$157,208	$154,883	$126,500	$107,958		
90	$272,089	$234,829	$210,676	$238,489		$163,273	$161,198	$131,489	$164,608		

Table S16a. Nine-month Salaries, 13 Responses of US CS Private in Other than Large City, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	3	1	3	5	9	0	0	1	2	4
Indiv				15	39					9
10										
25					$89,037					
50				$82,250	$105,784					$92,486
75					$110,931					
90										

Table S17. Nine-month Salaries, 7 Responses of 35 US Computer Engineering Departments, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	7	7	7	7	7	7	7	7	4	2	2
Indiv	41	19	37	103	17	32	49	47	15		
10											
25	$167,235	$132,705	$133,008	$142,821	$104,414	$108,909	$106,057	$95,728			
50	$173,254	$147,187	$154,494	$163,759	$107,835	$129,084	$111,327	$101,756	$94,237		
75	$188,898	$169,336	$158,623	$184,582	$115,573	$131,632	$129,201	$114,075			
90											

Table S17a. Nine-month Salaries, 7 Responses of 35 US Computer Engineering Departments, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	1	1	0	2	3	2	1	1	1	2
Indiv										
10										
25										
50										
75										
90										

Table S18. Nine-month Salaries, 16 Responses of 23 US Information Departments, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	10	13	16	16	13	16	16	16	14	5	5
Indiv	44	55	79	178	55	106	161	176	186	31	19
10	$168,531	$149,049	$120,127	$129,120	$102,006	$104,469	$101,952	$87,315	$69,930		
25	$179,380	$159,300	$132,658	$144,597	$107,431	$118,406	$116,622	$98,463	$76,929		
50	$190,659	$166,253	$153,863	$167,411	$116,891	$125,272	$125,015	$106,151	$89,870	$69,149	$54,318
75	$205,510	$190,557	$163,966	$174,940	$134,417	$134,813	$139,205	$109,971	$98,335		
90	$218,362	$194,446	$178,414	$185,193	$142,663	$149,101	$147,287	$125,151	$107,117		

Table S18a. Nine-month Salaries, 16 Responses of 29 US Information Departments, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
Non-Tenure Track	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	6	3	5	7	12	6	4	5	7	8
Indiv	17		8	23	93	20	9	24	40	93
10					$65,207					
25				$68,470	$84,248				$73,482	$74,914
50	$92,694		$99,640	$82,072	$94,279	$89,977	$78,919	$80,330	$77,800	$85,379
75				$87,045	$113,388				$88,589	$92,852
90					$130,366					

Table S19. Twelve-month Salaries, 9 Responses of 29 Canadian Departments, Percentiles from Department Averages

	Full Professor				Associate			Assistant	Non-Tenure Track		
	In rank 16+ yrs	In rank 8-15 yrs	In rank 0-7 years	All years in rank	In rank 8+ years	In rank 0-7 years	All years in rank		Teach	Research	Postdoc
Depts	7	9	8	9	8	8	9	9	7	4	5
Indiv	52	58	62	172	58	41	99	78	69	13	57
10											
25	$195,448	$181,895	$150,586	$178,470	$144,944	$116,107	$132,706	$105,944	$88,287		
50	$216,856	$188,935	$180,807	$183,498	$156,517	$146,943	$161,370	$126,905	$102,970	$77,695	$55,667
75	$220,489	$210,084	$198,255	$202,212	$169,341	$170,008	$169,307	$135,623	$112,737		
90											

Table S19a. Twelve-month Salaries, 9 Responses of 30 Canadian Departments, Percentiles from Department Averages

	Teaching Professor					Other Instructor				
Non-Tenure Track	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years	Teaching 9+ years	Teaching 6-8 years	Teaching 3-5 years	Teaching <3 years	All years
Depts	4	2	3	4	6	1	1	1	1	3
Indiv	19			6	44					
10										
25										
50	$129,626			$80,484	$106,355					
75										
90										

Table S20. Nine-month Salaries for New PhDs (Twelve-month for Canadian)

	US (CS, CE, and Info Combined)						Canadian					
	Tenure-Track	Teaching Prof	Other Instructor	Non-ten Teach All	Non-ten Research	Postdoc	Tenure-Track	Teaching Prof	Other Instructor	Non-ten Teach All	Non-ten Research	Postdoc
Depts	83	34	17	45	9	29	3	2	0	2	1	2
Indiv	180	45	41	86	48	143	13	3		3	2	14
10	$94,500	$70,000	$36,250	$51,759		$45,737						
25	$100,600	$78,666	$45,000	$66,250	$29,000	$45,737						
50	$112,555	$85,008	$68,383	$79,333	$59,158	$61,439						
75	$120,690	$93,333	$78,000	$85,006	$74,000	$68,300						
90	$135,139	$104,770	$91,260	$99,000		$74,568						

Table S21. Change in Salary Median for Departments that Reported in Both 2018 and 2019

	U.S. CS	U.S. CE	U.S. I	Canadian
Departments	129	4	13	8
Full Profs	3.70%	22.70%	-0.50%	2.40%
Assoc. Profs.	2.70%	5.40%	1.80%	13.20%
Asst. Profs.	2.80%	3.30%	4.10%	3.70%
Teaching Prof	7.00%	1.70%	8.70%	1.80%
Other Instructors	4.00%	-5.30%	-6.30%	1.90%
Research faculty	11.10%	-1.90%	-25.90%	17.30%
Post doctorates	3.00%	-12.70%	8.10%	-3.10%

Adjunct Per-Course Payments

(Tables S22-S23)

This year, for the first time, we asked for the rate typically paid adjuncts for a single course, divided by whether the course was taught to undergraduate or graduate students, and whether the adjunct had a Ph.D. or a Masters degree. Table S22 shows the median course rate for different types of institutions. In general, among U.S. CS departments, adjunct rates are higher per course a) when the adjunct has a Ph.D. rather than an MS degree, b) at private than at public institutions, and c) in smaller than in larger locales. Table S23 summarizes the primary reasons for which adjunct rates might be adjusted.

Table S22. Median value for an adjunct teaching a single course.

Group	Median PhD teaching undergrad	N PhD teaching undergrad	Median PhD teaching grad	N PhD teaching grad	Median MS teaching undergrad	N MS teaching undergrad	Median MS teaching grad	N MS teaching grad
US CS	$7,750	92	$7,750	84	$6,750	84	$6,000	63
US CE	$8,500	5	$9,297	4	$8,500	5	$9,297	4
US IN	$6,000	10	$6,000	10	$5,100	11	$6,250	10
Canadian	$7,500	5	$8,222	4	$8,250	4	$6,445	3
US CS Public	$6,500	70	$6,000	63	$6,250	68	$6,000	49
US CS Private	$8,847	22	$8,694	21	$9,299	16	$8,200	14
Pub large city	$6,000	37	$5,818	32	$6,000	36	$5,550	25
Pub mid city	$6,500	13	$6,500	11	$6,000	10	$6,000	7
Pub small/rurl	$8,250	20	$8,750	20	$7,500	22	$7,500	17
Priv large city	$8,847	14	$9,146	14	$8,382	12	$7,763	11
Private other	$10,000	8	$8,000	7	$12,678	4	$11,000	3

Table S23. Adjunct rate adjustments. Department Averages

Group	% Adj for Time at Dept	% Adj for Specific Expertise
US CS	44%	55%
US CE	50%	67%
US IN	73%	64%
Canadian	25%	50%
US CS Pub	35%	52%
US CS Priv	71%	67%

Table S23a. Other reasons for adjunct rate adjustments.

# Depts	Reason
8	Prior research or industry experience
7	Course enrollment
5	Prior teaching experience at other institutions
3	Course difficulty/level
2	Relationship with department outside of teaching
1	Number of times teaching the same course
1	Demand vs. availability for the subject
1	Fraction of base salary for adjuncts who are researchers or faculty in other departments at the institution
1	High performance evaluations
1	Dependent on academic rank
1	Additional duties other than teaching, e.g. course development
1	Number of projects required in course

Figure S1. US CS Department Average Salary, Full Professor in Rank 16+ Years

CRA Taulbee Survey 2019

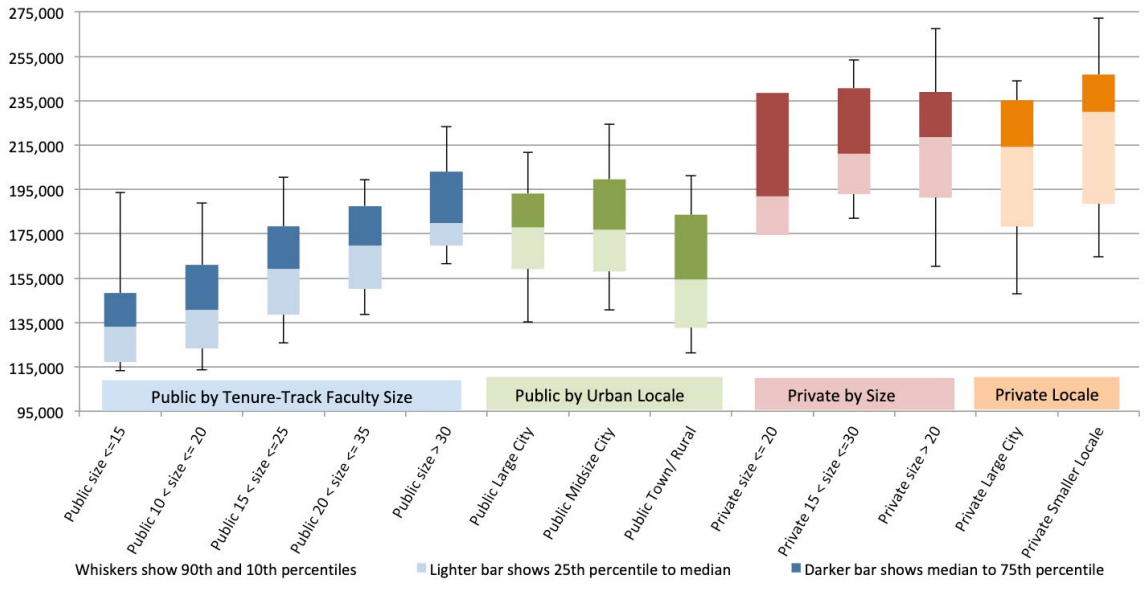


Figure S2. US CS Department Average Salary, Full Professor in Rank 8-15 Years

CRA Taulbee Survey 2019

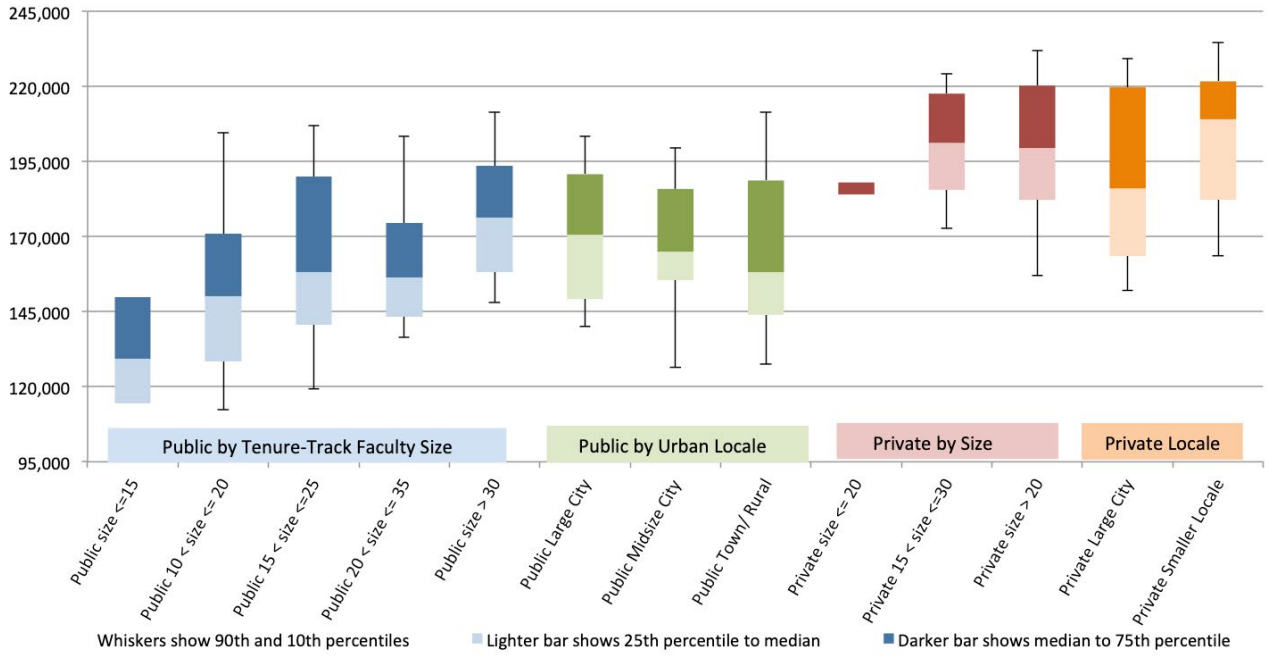


Figure S3. US CS Department Average Salary, Full Professor in Rank 0-7 Years

CRA Taulbee Survey 2019

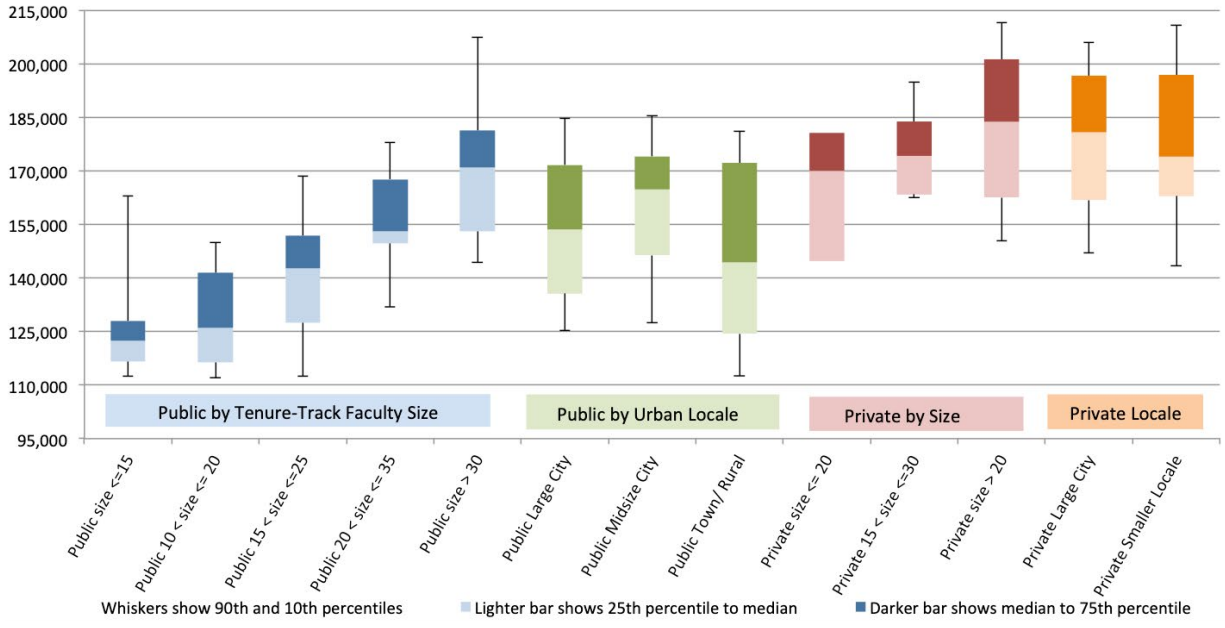


Figure S4. US CS Department Average Salary, Associate Professor in Rank 8+ Years

CRA Taulbee Survey 2019

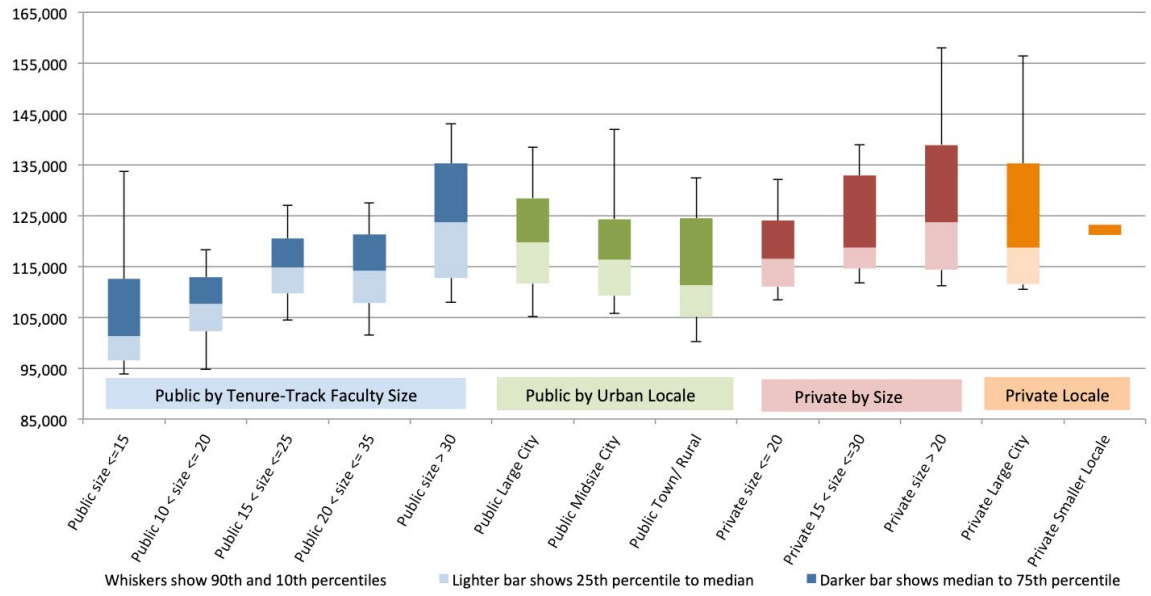


Figure S5. US CS Department Average Salary, Associate Professor in Rank 0-7 Years

CRA Taulbee Survey 2019

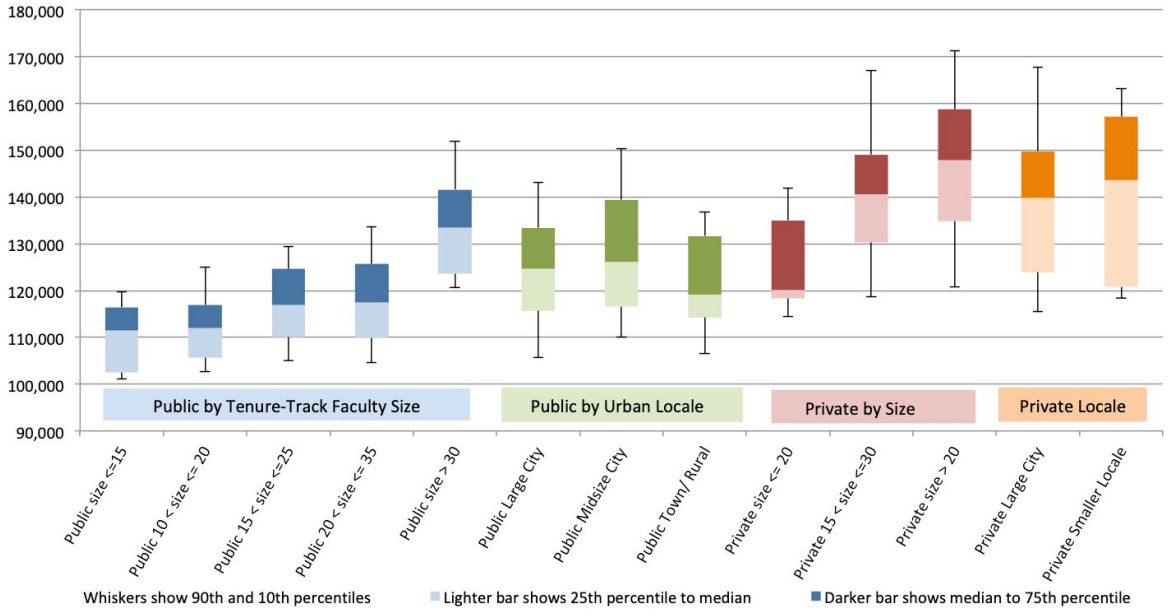


Figure S6. US CS Department Average Salary, Assistant Professor

CRA Taulbee Survey 2019

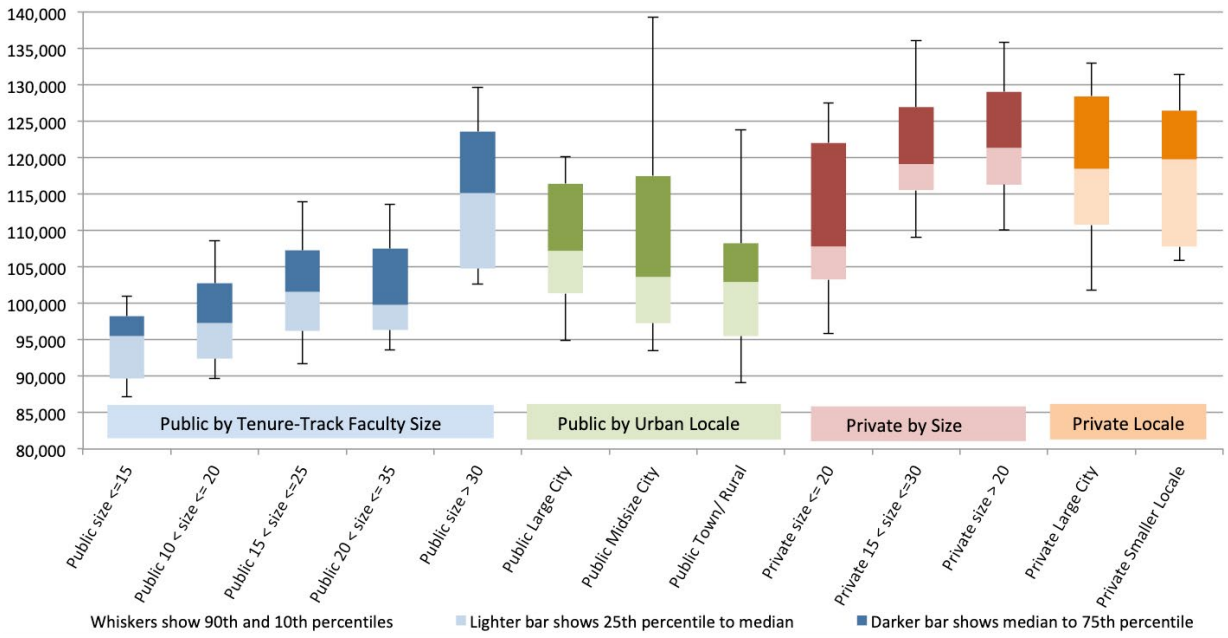


Figure S7. US CS Department Average Salary, Non-Tenure Track Teaching Faculty

CRA Taulbee Survey 2019

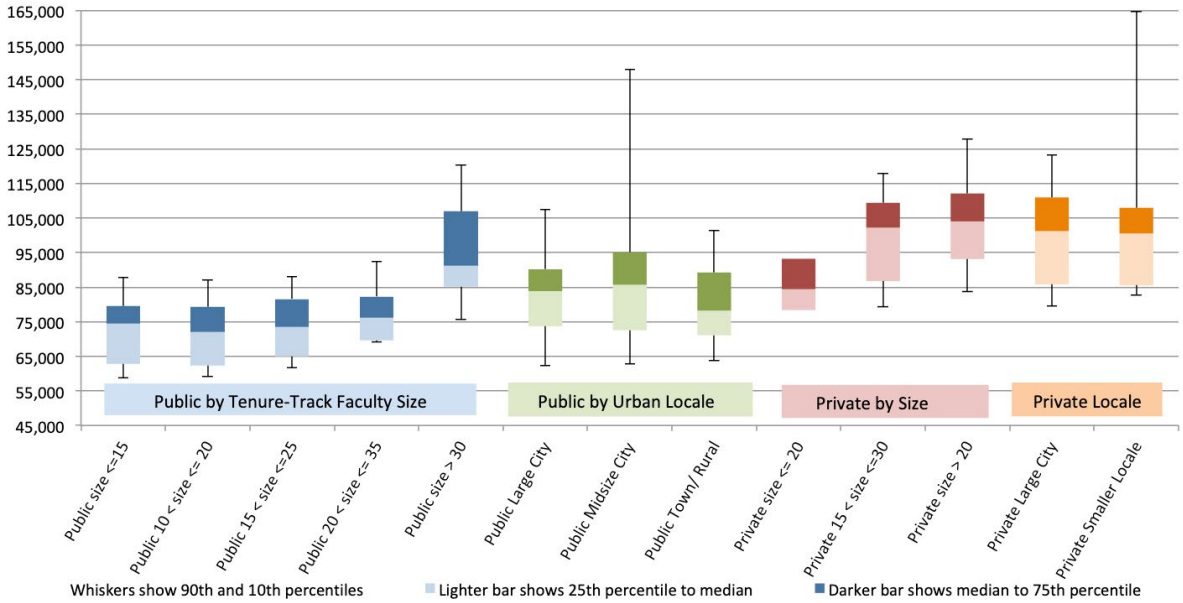


Figure S7a. US CS Department Average Salary, Teaching Professors

CRA Taulbee Survey 2019

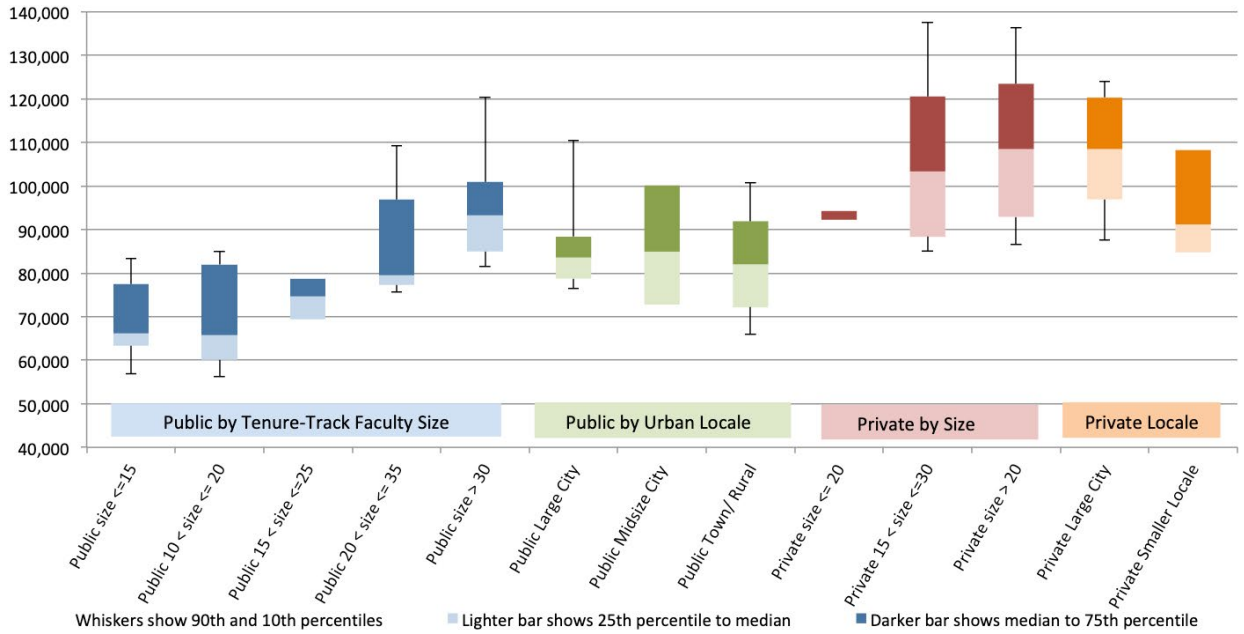


Figure S7b. US CS Department Average Salary, Other Instructors

CRA Taulbee Survey 2019

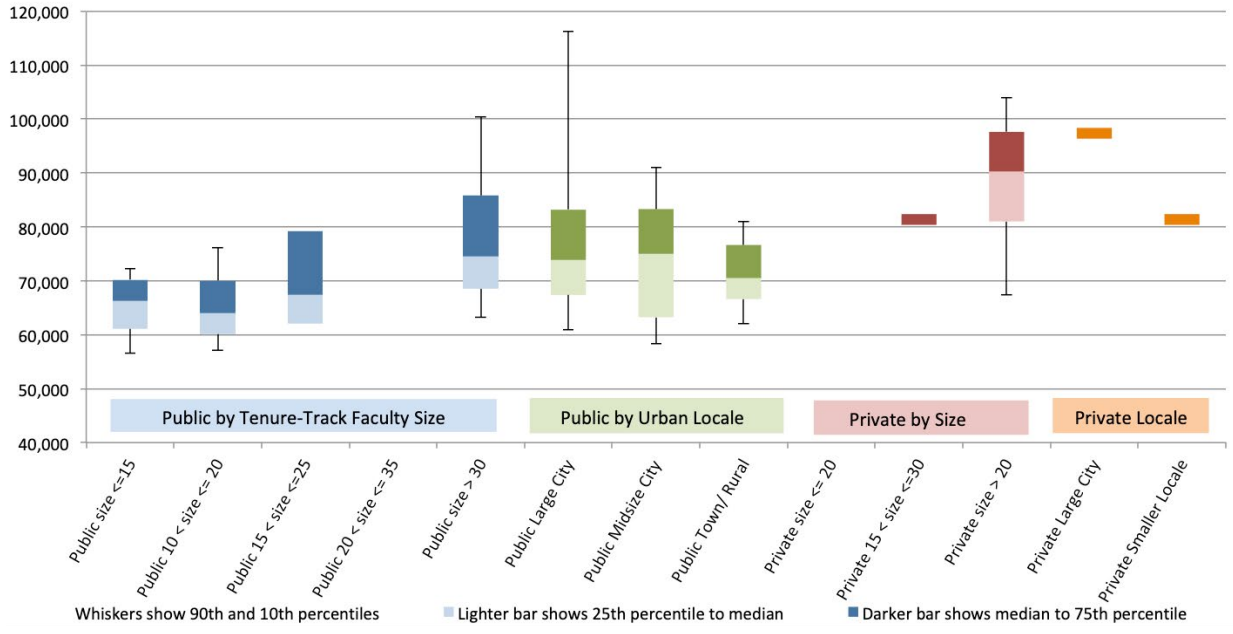


Figure S8. US CS Department Average Salary, Non-Tenure Track Research Faculty

CRA Taulbee Survey 2019

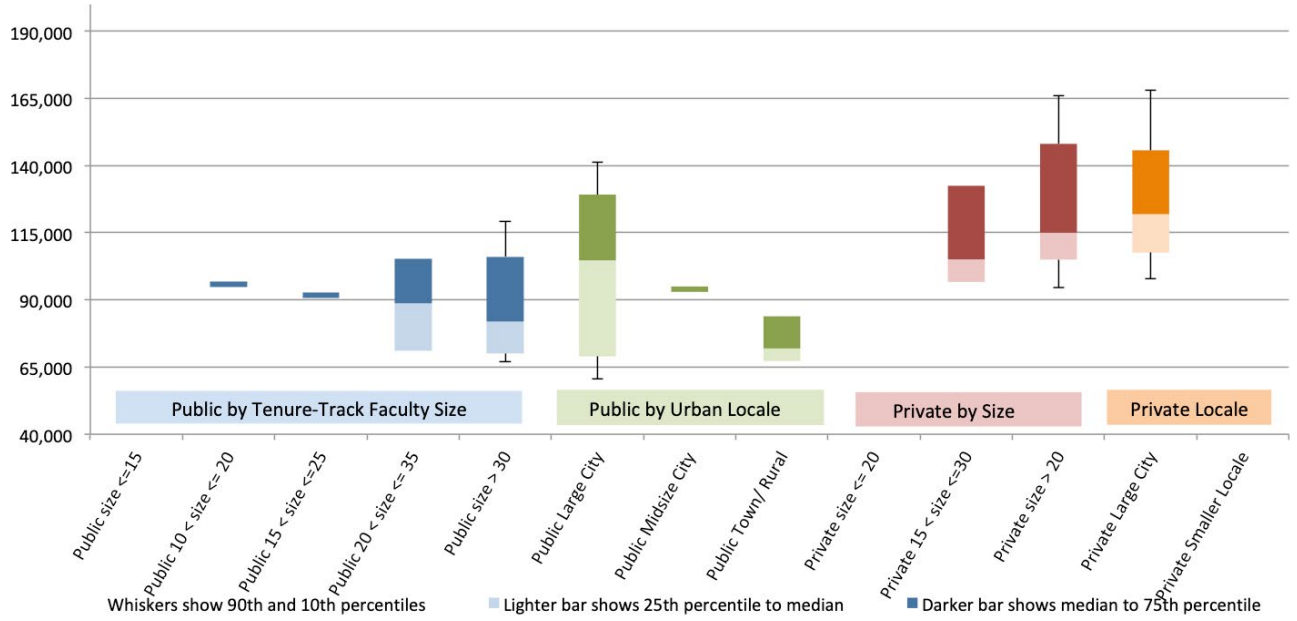
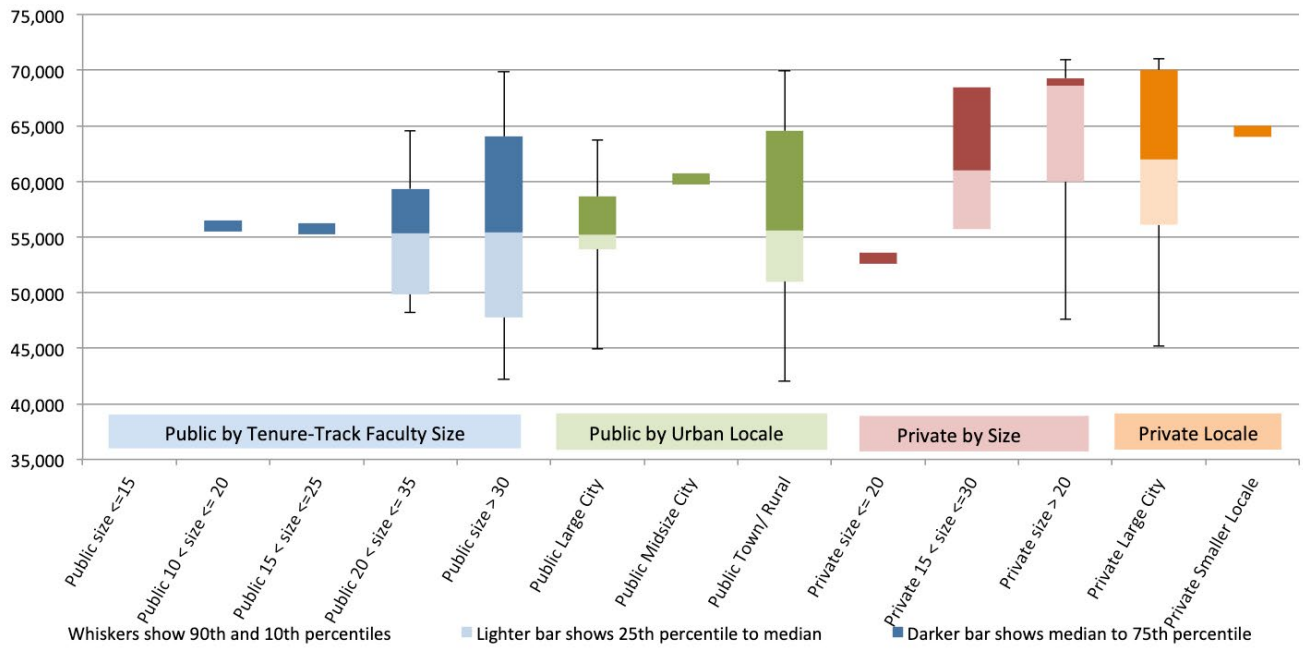


Figure S9. US CS Department Average Salary, Postdoctorates

CRA Taulbee Survey 2019



Concluding Observations

After twelve years of sustained growth in undergraduate enrollment, there may be signs of a slowdown in that there are, on average, fewer new undergraduate majors in 2019-20 than there were in 2018-19. Nevertheless, the average number of CS majors continued its rise in 2018-19, both in U.S. CS departments and overall.

Growth in tenure-track faculty size was small in the academic departments in 2018-19, but there again was double-digit percentage increase in full-time teaching faculty and an increased number of supported TAs. We don't track part-time faculty; it is possible that departments also were continuing to increase this category of instructional assistance.

Doctoral program activity, both enrollment and completions, saw healthy increases. Master's degree production also was up in U.S. CS departments in 2018-19, but as was the case for bachelor's programs, the number of new master's students was down in 2019-20.

The COVID-19 restrictions in place in spring 2020 will, no doubt, have significant effects on what gets reported in next year's survey. CRA already is monitoring the impact on departments in a supplementary survey, and those who have responded to the supplementary survey were provided with a report summarizing the early findings.

Next year will mark 50 years of the Taulbee Survey. To commemorate this milestone, we expect to provide some retrospective on the historical Taulbee Survey data, probably as a separate report from the annual report.

Participating CS, CE, I and Canadian Departments

(Departments marked with * have participated in all 5 of the most recent Taulbee surveys)

U.S. CS Public (109): Arizona State*, Auburn*, Clemson*, College of William & Mary*, Colorado School of Mines*, Colorado State*, Florida International*, George Mason*, Georgia Tech*, Georgia State*, Indiana*, Indiana University Purdue University Indianapolis, Iowa State*, Kansas State*, Kent State*, Michigan State*, Michigan Technological University, Missouri University of Science and Technology, Montana State*, Naval Postgraduate School*, New Jersey Institute of Technology*, New Mexico State, North Carolina A&T, North Carolina State*, North Dakota State*, Ohio State*, Ohio*, Oklahoma State*, Old Dominion, Oregon State*, Pennsylvania State*, Portland State*, Purdue*, Rutgers, Southern Illinois (Carbondale), Stony Brook (SUNY)*, Temple, Tennessee Tech, Texas A&M*, Texas Tech*, University at Buffalo*, 41Universities of: Alabama (Birmingham)*, Arizona, Arkansas*, Arkansas at Little Rock*, California (Berkeley*, Davis*, Irvine*, Los Angeles, Riverside*, San Diego, Santa Barbara*, and Santa Cruz*), Central Florida*, Colorado (Boulder)*, Connecticut*, Delaware*, Florida*, Georgia*, Houston*, Idaho, Illinois (Chicago* and Urbana-Champaign*), Iowa*, Kansas*, Kentucky, Louisiana at Lafayette*, Maine, Maryland (College Park* and Baltimore County*), Massachusetts (Amherst*), Memphis, Minnesota*, Missouri (Columbia), Nebraska (Lincoln*), Nevada (Las Vegas and Reno*), New Hampshire*, New Mexico, North Carolina (Chapel Hill* and Charlotte*), 80North Texas*, Oklahoma*, Oregon*, Pittsburgh*, Rhode Island*, South Carolina*, South Florida*, Tennessee (Knoxville)*, Texas (Arlington*, Austin*, Dallas*, El Paso*, and San Antonio), Utah*, Vermont, Virginia*, Washington*, Washington Human Centered Design & Engineering, Wisconsin (Madison* and Milwaukee*), Wyoming, Utah State, Virginia Commonwealth, Virginia Tech*, Washington State*, Wayne State*, Western Michigan, and Wright State*.

U.S. CS Private (41): Boston University*, Brandeis, Brown*, Carnegie Mellon*, Case Western Reserve*, Clarkson, Columbia, Cornell*, DePaul*, Drexel*, Duke*, Emory*, Florida Institute of Technology, George Washington, Harvard*, Illinois Institute of Technology, Johns Hopkins*, Lehigh*, MIT*, New York University*, Northeastern*, Northwestern*, NYU Tandon School of Engineering, Pace, Princeton*, Rensselaer*, Rice*, Rochester Institute of Technology*, Stanford*, Stevens Institute of Technology*, Toyota Technological Institute at Chicago*, Tufts*, Universities of: Chicago*, Notre Dame, Pennsylvania*, Rochester*, Southern California*, and Tulsa*, Washington in St. Louis*, Worcester Polytechnic Institute*, and Yale.

U.S. CE (7): Boston University, Case Western Reserve, North Carolina State*, Northwestern, Universities of: Central Florida*, Illinois (Urbana-Champaign), and New Mexico*.

U.S. Information (16): Cornell*, Drexel*, Indiana*, Penn State*, Syracuse, Universities of: Arizona, California (Berkeley), Cincinnati, Colorado (Boulder), Illinois (Urbana-Champaign), Maryland (College Park ISchool and Baltimore County*), Michigan*, North Carolina (Chapel Hill)*, Pittsburgh*, and Washington*.

Canadian (11): Concordia*, McGill, Simon Fraser*, Universities of: British Columbia*, Calgary*, Manitoba*, New Brunswick, Toronto*, Waterloo, Western Ontario, and York*.

[1]The title of the survey honors Orrin E. Taulbee of the University of Pittsburgh, who conducted these surveys for the Computer Science Board until 1984, with retrospective annual data going back to 1970.

[2]Information (I) programs included here are Information Science, Information Systems, Information Technology, Informatics, and related disciplines with a strong computing component. Surveys were sent to CRA members, the CRA Deans group members, and participants in the iSchools Caucus (www.ischools.org) who met the criteria of granting Ph.D.s and being located in North America. Other I programs who meet these criteria and would like to participate in the survey in future years are invited to contact survey@cra.org for inclusion.

[3]Classification of the population of an institution's locale is in accordance with the Carnegie Classification database. Large cities are those with population >= 250,000. Mid-size cities have population between 100,000 and 250,000. Town/rural populations are less than 100,000.

[4]All faculty tables: The survey makes no distinction between faculty specializing in CS vs. CE programs. Every effort is made to minimize the inclusion of faculty in electrical engineering who are not computer engineers.

Update on 2020 CRA Conference at Snowbird

CRA
Computing Research Association

Dear CRA members,

After careful consideration of the current and projected situation surrounding the pandemic, CRA's 2020 Conference at Snowbird planning committee has unfortunately decided to cancel the in-person conference scheduled to take place at Snowbird, Utah, July 21-23, 2020.

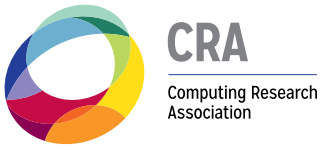
We trust you find this decision as disappointing as we do. For nearly 50 years, we have had the honor of bringing the leadership of the computing research community together every other year at Snowbird for the benefit of the community. But given the uncertainty surrounding travel and large gatherings this summer, and the need to come to a decision in sufficient time to allow our participants to make plans, we cannot commit to holding the in-person portion of the conference this year.

In place of the in-person event, we are currently exploring options to provide a virtual conference during the dates of July 21-23. The virtual conference agenda will be specialized to include content we feel is necessary for the community to hear and engage with, useful in understanding and operating in the current environment, or of sufficient general interest to merit inclusion. We are now moving forward with plans to hold a full in-person Conference at Snowbird in late July/early August 2021 and will resume our regular conference pattern of every other year with a conference in 2022 and subsequent even number years. Future dates are subject to change.

We'll share additional details on our plans in the coming weeks. In the meantime, thanks for your patience and understanding during this unprecedented time.

If you have any questions about the conference, please direct them to snowbird@cra.org

What's Happening with the Federal Budget, Particularly with the Research Agencies, During the Pandemic?



By Brian Mosley, CRA Policy Analyst

It should come as no surprise that the normal operations of official Washington have been heavily disrupted by the COVID-19 pandemic. Current events have derailed almost every aspect of the usual budget process. Adding to that, the situation remains very fluid as to when legislation, or any official business, will be acted upon by Congress; case in point, at the beginning of April, the House was telling its members they **wouldn't reconvene until the beginning of May**, at the earliest (that obviously didn't happen, as the House reconvened to pass H.R.266, the Paycheck Protection Program and Health Care Enhancement Act, on April 23rd).

There are some official actions that are happening. In terms of emergency funding, the CARES Act, **passed at the end of March**, has about $180 million dollars in emergency research funding for NIH, NSF, DOE Office of Science, and NIST. As well, there was about another $86 million for three agencies (NASA, NOAA, and NIST) to support "continuity of operations;" i.e., any operations that were disrupted by the pandemic, such as rescheduling a space science mission at NASA. Additionally, there was support for higher education, in the form of about $14 billion; however, that isn't set aside for research and by all reports is being used by colleges and universities for administrative purposes (meaning, keeping the lights on). All that funding was directly related to responding to the pandemic. If you would like a more detailed breakdown, **Science Magazine** has a good one (Science even has a **good collection** of science news and other articles related to the pandemic that they are offering for free).

While there was a follow-up to the CARES Act (the before mentioned **HR.266**), it only contained money for NIH and it is directly tied to responding to the COVID-19 pandemic. Additionally, on May 15th, the House passed **H.R.6800, the Heroes Act**, which called for more than $3 trillion in emergency funding for the pandemic crisis. In that bill, NSF would receive $125 million to, "prevent, prepare for, and respond to coronavirus," and NIH would received $4.745 billion to, "expand COVID-19-related research on the NIH campus and at academic institutions across the country and to support the shutdown and startup costs of biomedical research laboratories nationwide." However, that bill as currently written is unlikely to be considered by the Senate, and has even drawn a veto threat from the President. There is likely to be more emergency legislation in the future, but any timing is uncertain; research funding, or even funding to restart the country's research enterprise, could be included in any new legislation, but that is not a given.

With regard to the regular **Fiscal Year 2021 (FY21) appropriations**, things are just as unclear. We had heard that the House Appropriations Committee had planned to act on its FY21 bills in May. Unfortunately, that has not happened, as the House has been sidetracked by other emergency legislation. They are likely to get back to their individual FY21 bills later in the summer, though exactly when is unclear. Its Senate counterpart has been less vocal about their plans, but the expectation is they will take action late in the summer, in the late-June-July timeframe. However, all this is still very tentative; Congress has not fully settled on how it will physically operate while remaining in compliance with social distancing guidelines (for example, the House only settled on remote voting rules **in the middle of May**). This, and other changes, could become the norm for the duration of this emergency, which only adds to the uncertainty on when legislative actions will be taken.

Despite being several months into pandemic, Washington is still feeling it's way through how to operate. That means certainty about what will happen, and when, is in high demand but low supply. We are still monitoring what's happening, even while safely at home; please check back for more updates.

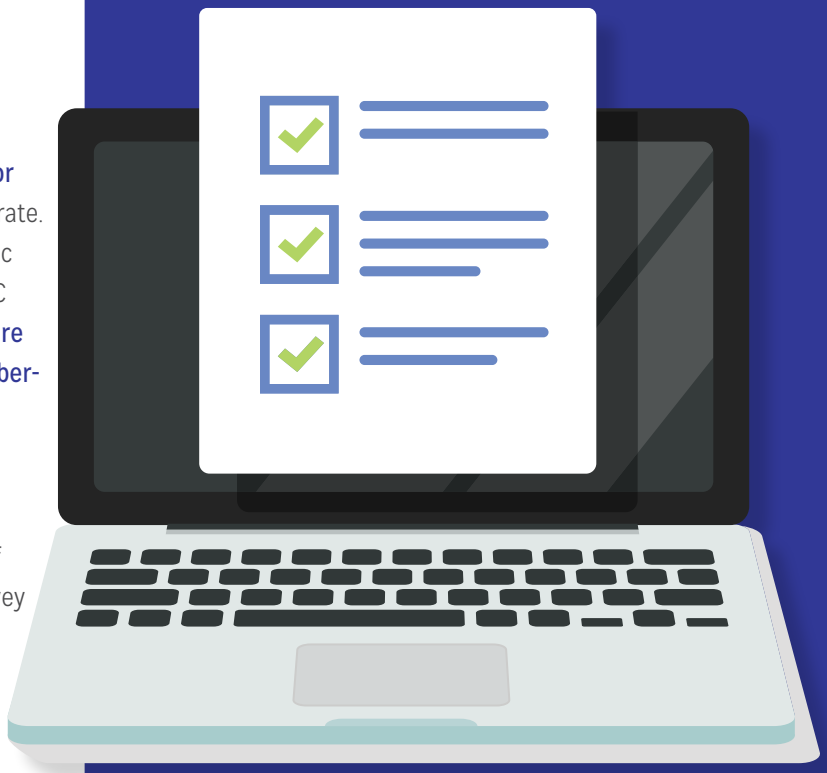
CRA Survey on NSF CISE Departmental BPC Plans

The Computing Research Association (CRA) invites the academic computing community to complete a brief survey about the **broadening participation in computing (BPC) plans required for proposals** submitted to some programs of the NSF CISE Directorate. Specifically, we are interested in learning whether your academic department has created, or plans to create, a Departmental BPC Plan to assist faculty PIs submitting **Medium and Large CISE Core Programs**, **Secure and Trustworthy Cyberspace (SaTC)**, and **Cyber-Physical Systems (CPS)** project proposals, which all require an approved BPC plan by the time of award.

Your participation will help inform the NSF about Departmental BPC Plans at large. Even if your department has no intentions of creating a Departmental BPC Plan, your participation in this survey will be helpful. The survey has already been sent to department chairs for whom we have contact information, but we'd like to reach as many as possible.

- To see if your department has already completed the survey, as CRA is promoting this survey through multiple channels, please visit our **live-updated Google Sheet**.*
- To view the full survey before you complete it, visit our **flat version in a Google doc**.

The deadline for completion is 9:00 AM ET, June 5, 2020.



SURVEY LINK:
Click here to begin the survey.

Or, copy and paste the full URL into your browser:
https://crasurvey.col.qualtrics.com/jfe/form/SV_4PFgvMLYmovpIY5?source=anon

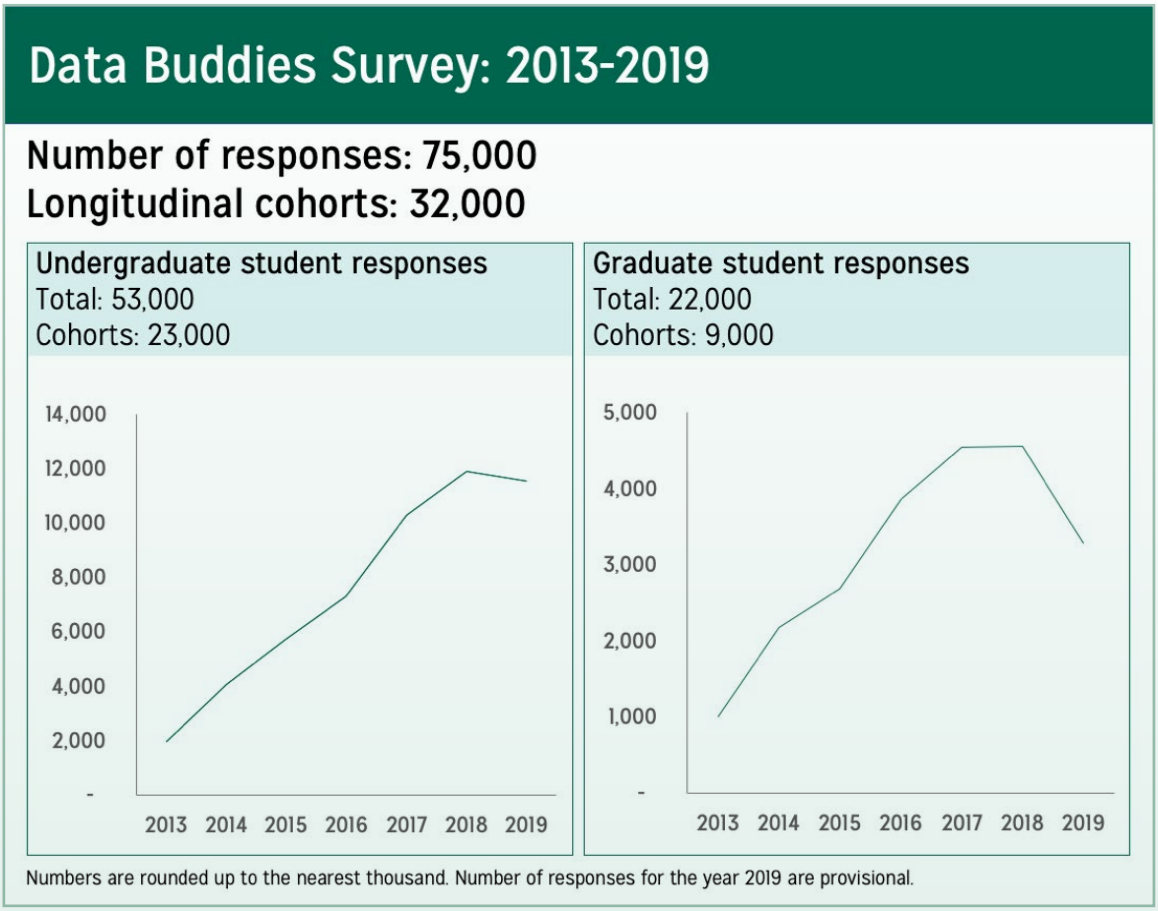
Please direct all inquiries related to this survey to Heather Wright at heather@cra.org.

Notes:
The purpose of the live-updated Google Sheet is for departments to check if this survey has been completed. The only data displayed in this Google Sheet will be date of completion, along with institution name and department name. No other survey responses will be displayed.

Data Buddies Survey Collected 75,000 Responses Over the Past Seven Years

CERP
Computing Research Association
Evaluation

By CERP Staff



The CRA Data Buddies Survey (DBS), managed by the CRA Center for Evaluating the Research Pipeline (CERP), is a rich data source providing important information to the community on the state of computing in higher education from the students' perspective. Undergraduate and graduate students in computing-related degree programs across the United States and Canada have been recruited by participating Data Buddy departments since 2013, after two years of piloting. In 2014, CERP added a longitudinal component to its data collection efforts and started recruiting cohorts of students who take the DBS to follow-up with them in an annual basis.

The 2019 DBS survey came to a close at the beginning of February 2020, concluding CERP's seventh year of data collection for DBS. This graphic provides an overview of the amount of data collected over these seven years. The survey collected approximately 75,000 total responses, and 32,000 of these respondents are part of CERP's longitudinal cohorts.

Participating departments gain insight into their students' experiences in their computing degree programs at their institutions compared to students at similar institutions. Departments are also able to track their departments' progress over time through customized department reports that they receive every spring. Visit **https://cra.org/cerp/data-buddies/** to find out more about the Data Buddies project, view **sample department reports**, and sign-up to **become a data buddy**.

This analysis is brought to you by the CRA's Center for Evaluating the Research Pipeline (CERP). CERP provides social science research and comparative evaluation for the computing community. Subscribe to the CERP newsletter **here**. Volunteer for Data Buddies by signing-up **here**.

This material is based upon work supported by the National Science Foundation under grant numbers CNS-1246649, DUE-1431112, and/or DUE-1821136. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Education Committee Showcases Stories of Undergraduate Researchers

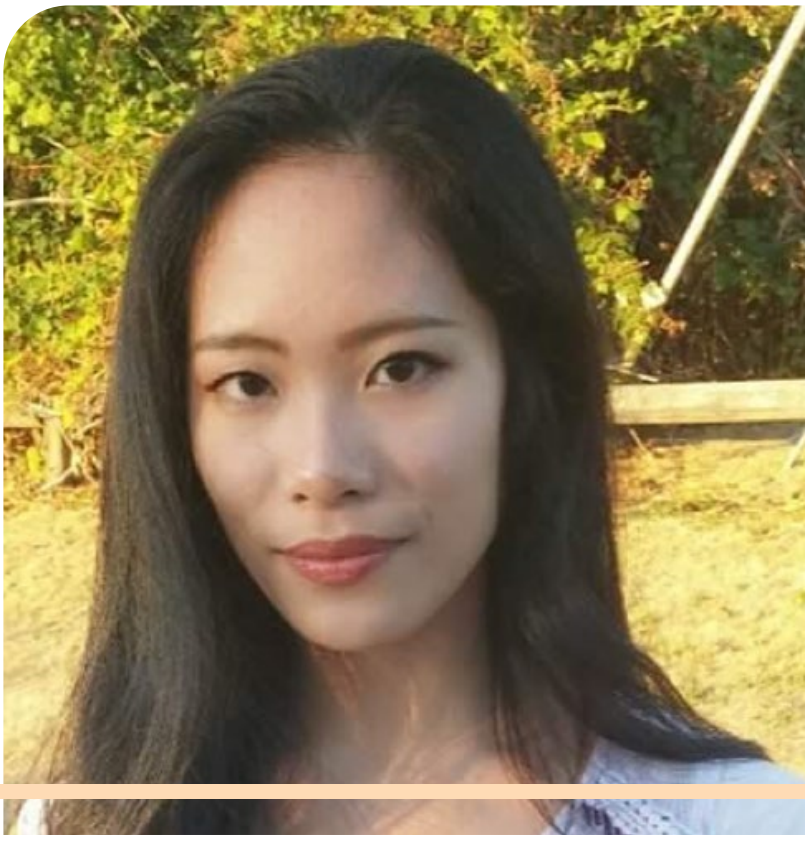
CRA-E
Computing Research Association
Education

Since 2018, the CRA Education Committee's "Undergraduate Research Highlights" series has been showcasing outstanding research done by undergraduate students at universities and colleges across North America. It is one of a number of CRA-E's activities that foster and recognize talented computing researchers with the goal of increasing the research pipeline, promoting graduate education, and advocating research-based careers.

Each article features the story of a successful undergraduate researcher and offers personal insights into their experiences with finding an advisor, undertaking new research projects, and discovering how research can impact their personal and professional futures. In addition to helping students understand the process of getting involved in research, the articles also serve as a venue for students to pass along advice to others who aspire to become involved in research themselves. Students selected for the research highlights include those receiving recognition in the CRA Outstanding Undergraduate Researcher Award competition. This series is written and edited by CRA-E Graduate Fellows.

The latest article in the series, "From COMP105 to Programming Languages Research in Haskell," highlights the work of Tufts University graduate Marilyn Sun, who collaborated with her research advisor Kathleen Fisher, a CRA board member.

New additions to this series are posted regularly on the Conquer website available at http://conquer.cra.org/undergrad-research-highlights. We encourage you to share these stories with your students and those considering a research career.



Reflecting on her research experience, Marilyn asserts, "Ask questions! ...I always felt I was the most junior and inexperienced". She realized that instead of holding in questions, it would have been easier to build her confidence by asking questions as soon as they materialized. Marilyn believes that this kind of advice is important to share with other current and potential undergraduate researchers. Sometimes it's scary and one does not feel confident, but the rewards are worthwhile.

Computing Researchers Respond to COVID-19

CCC
Computing Community Consortium
Catalyst

By CCC Staff

At the Computing Community Consortium (CCC), we know that everyone is dealing with a lot in these unprecedented times. We are continuing to work on behalf of the computing research community to catalyze research, but we also want to support the ongoing impact of that community's work. To that end, we have been publishing a series of posts on the CCC Blog about ways in which computing researchers are working to adapt and help to the current challenges. We hope that you find something that may inspire you in these blog posts, either now or in the future:

- **Running a Virtual Conference**
  - Blair MacIntyre, a professor in Georgia Tech's School of Interactive Computing, contributed to this post.
  - Working with Kyle Johnsen, an associate professor in the University of Georgia's College of Engineering, Professor MacIntyre "transitioned the IEEE VR 2020 Conference to an all-virtual event…Working non-stop for two weeks, with the help of the entire conference committee and support from Mozilla and dozens of volunteers, they pulled together the technology to support a full scale virtual conference."
- **Misinformation**
  - This post was written by CCC Senior Program Associate, Helen Wright
  - Recognizing and responding to misinformation during this emergency: "Rumoring can help to alleviate anxiety during information voids and acts as a form of collective sensemaking, but it can also lead to the spread of misinformation. False rumors (or misinformation) are dangerous, because they can cause people to make the wrong decisions, including decisions that endanger themselves or others."
- **Staying Connected**
  - The following is a guest blog post from CCC council member Jennifer Rexford from Princeton University.
  - "As difficult as the current Covid-19 situation is, at least we can use the Internet to support the global collaboration of scientists, keep abreast of the latest developments, teach our students and children, stay in touch with friends and family, and even find much-needed moments of levity."
- **Decontaminating N95 Masks**
  - Former CCC Council Member Kevin Fu from the University of Michigan provided contributions to this post.
  - "Fu is a co-organizer of N95DECON, a volunteer-based organization made up of esteemed scientists, engineers, clinicians, and students seeking to provide information and develop guidance for medical facilities that need to decontaminate face masks for reuse by healthcare workers. Fu explains that the group's overarching mission is to provide a rigorous scientific assessment of decontaminating N95 masks for reuse by healthcare professionals during this crisis shortage."
- **Personal Protective Equipment Fabrication**
  - Authors of this blog post are Kristin Osborne, Communications Manager at Paul G. Allen School of Computer Science & Engineering, at the University of Washington (UW) and CCC Council member Shwetak Patel, Washington Research Foundation Entrepreneurship Endowed Professor in Computer Science and Engineering and Electrical Engineering, at UW.
  - "Recently, UW Medicine launched an effort to harness the University of Washington's extensive network of maker spaces and fabrication expertise to address the shortage of PPE."

Respond to COVID-19 *(continued)*

- **Voxel51; A Means of Tracking Social Distancing**
  - The Voxel51 team contributed to this post.
  - Leveraging the startup's existing video analysis technology, Voxel51 developed the Physical Distancing Index to help track how COVID-19 and preventative measures to contain its spread have impacted human activity around the globe in real time."
- **Automated Contact Tracing for Fighting the Coronavirus: A Short-Tem Effort with Long-Term Repercussions**
  - The following is a guest blog post from Ran Canetti, a professor of Computer Science at Boston University and the Director of the Center for Reliable Information System and Cyber Security.
  - Automated contact tracking uses "Bluetooth Low Energy phone-to-phone transmission. Phones constantly broadcast a system-provided identifier, and collect identifiers received from nearby phones. Once a user tests positive, their phone uploads its transmitted and collected identifiers to a central database along with other location information. The center then contacts users who were collocated with the infected individuals for potential quarantine and treatment."
  - While automated contact tracing for fighting the Coronavirus might seem simple it "is anything but" and "it opens a number of new and exciting research directions: in low energy wireless, cryptography, computational epidemiology, ethics, law, public policy, and the intimate relationships between them."

If you know of additional topics and think they might be helpful for the community during this time, please email Helen Wright (hwright@cra.org).

CCC Announces New Council Members

CCC
Computing Community Consortium
Catalyst

By CCC Staff

The Computing Research Association (CRA), in consultation with the National Science Foundation (NSF), has appointed six new members to the Computing Community Consortium (CCC) Council:

- Kathleen Fisher, Tufts University
- William D. Gropp, University of Illinois Urbana-Champaign
- Brian LaMacchia, Microsoft Research
- Melanie Moses, University of New Mexico
- Helen Nissenbaum, Cornell Tech
- Holly Yanco, UMass Lowell

Beginning July 1, the new members will each serve three-year terms. The CCC Council is comprised of 20 members who have expertise in diverse areas of computing. They are instrumental in leading CCC's visioning programs, which help catalyze and enable ideas for future computing research. Members serve staggered three-year terms that rotate every July.

The CCC and CRA thank those council members whose terms end on June 30 for their exceptional dedication and service to the CCC and to the broader computing research community:

- Juliana Freire, New York University
- Keith Marzullo, University of Maryland
- Greg Morrisett, Cornell Tech University
- Jen Rexford, Princeton University
- Ben Zorn, Microsoft Research

The CCC encourages participation from all members of the computing research community in our various activities. Each year, the CCC issues a call for proposals for visioning activities. Each spring, the CCC issues a call for nominations for Council members effective the following July. For more information, please visit the CCC website or contact Dr. Ann Schwartz Drobnis, CCC Director, at adrobnis@cra.org.

Full Bios of New CCC Council Members

Kathleen Fisher

Kathleen Fisher is Chair of the Computer Science Department at Tufts University. Previously, she was a program manager at DARPA where she started and managed the HACMS and PPAML programs, a Consulting Faculty Member in the Computer Science Department at Stanford University, and a Principal Member of the Technical Staff at AT&T Labs Research. She received her PhD in Computer Science from Stanford University. Kathleen is an ACM Fellow and a Hertz Foundation Fellow. Service to the community has been a hallmark of Kathleen's career. She has served as Chair of the ACM Special Interest Group in Programming Languages (SIGPLAN) and as Program Chair for three of SIGPLAN's marquee conferences: PLDI, OOPSLA, ICFP. She has also served as an Associate Editor for TOPLAS and as an Editor of the Journal of Functional Programming. Kathleen has long been a leader in the effort to increase diversity and inclusion in Computer Science: she was Co-Chair of the Computing Research Association's Committee on the Status of Women in Computing Research (CRA-W) for three years, and she co-founded SIGPLAN's Programming Language Mentoring Workshop (PLMW) Series. Kathleen is a recipient of the SIGPLAN Distinguished Service Award. She is Chair of DARPA's ISAT Study Group, a member of the Board of Trustees of Harvey Mudd College, and a CRA board member.

William D. Gropp

William Gropp received his B.S. in Mathematics from Case Western Reserve University in 1977, a MS in Physics from the University of Washington in 1978, and a Ph.D. in Computer Science from Stanford in 1982. He held the positions of assistant (1982-1988) and associate (1988-1990) professor in the Computer Science Department at Yale University. In 1990, he joined the Numerical Analysis group at Argonne, where he was a Senior Computer Scientist in the Mathematics and Computer Science Division, a Senior Scientist in the Department of Computer Science at the University of Chicago, and a Senior Fellow in

the Argonne-Chicago Computation Institute. From 2000 through 2006, he was also Deputy Director of the Mathematics and Computer Science Division at Argonne. In 2007, he joined the University of Illinois at Urbana-Champaign as the Paul and Cynthia Saylor Professor in the Department of Computer Science. From 2008 to 2014 he was the Deputy Director for Research for the Institute of Advanced Computing Applications and Technologies at the University of Illinois. In 2011, he became the founding Director of the Parallel Computing Institute. In 2013, he was named the Thomas M. Siebel Chair in Computer Science. In 2016, he was appointed as Acting Director of the National Center for Supercomputing Applications (NCSA), and in 2017, became Director of NCSA. His research interests are in parallel computing, software for scientific computing, and numerical methods for partial differential equations. He has played a major role in the development of the MPI message-passing standard. He is co-author of the most widely used implementation of MPI, MPICH, and was involved in the MPI Forum as a chapter author for MPI-1, MPI-2, and MPI-3. He has written many books and papers on MPI including "Using MPI" and "Using MPI-2". He is also one of the designers of the PETSc parallel numerical library and has developed efficient and scalable parallel algorithms for the solution of linear and nonlinear equations. With the other members of the PETSc core team, he was awarded the SIAM/ACM Prize in Computational Science and Engineering in 2015. Gropp is a Fellow of AAAS, ACM, IEEE, and SIAM, and a member of the National Academy of Engineering. He received the Sidney Fernbach Award from the IEEE Computer Society in 2008, the SIAM-SC Career Award in 2014, and the Ken Kennedy Award from the ACM and the IEEE Computer Society in 2016.

Brian LaMacchia

Brian LaMacchia is a Microsoft Corporation Distinguished Engineer and heads the Security and Cryptography team within Microsoft Research (MSR). His team's main project at present is the development of quantum-resistant public-key cryptographic algorithms and protocols. Brian is also a founding member of the Microsoft Cryptography Review Board and consults on security and cryptography architectures, protocols and implementations across the company. Before moving into MSR in 2009, Brian was the Architect for cryptography in Windows Security, Development Lead for .NET Framework Security and Program Manager for core cryptography in Windows 2000. Prior to joining Microsoft, Brian was a member of the Public Policy Research Group at AT&T Labs—Research.

In addition to his responsibilities at Microsoft, Brian is an Adjunct Associate Professor in the School of Informatics and Computing at Indiana University-Bloomington and an Affiliate Faculty member of the Department of Computer Science and Engineering at the University of Washington. Brian also currently serves as Treasurer of the International Association for Cryptologic Research (IACR) and as a Vice President of the Board of Directors of Seattle Opera. Brian received S.B., S.M., and Ph.D. degrees in Electrical Engineering and Computer Science from MIT in 1990, 1991, and 1996, respectively.

Melanie Moses

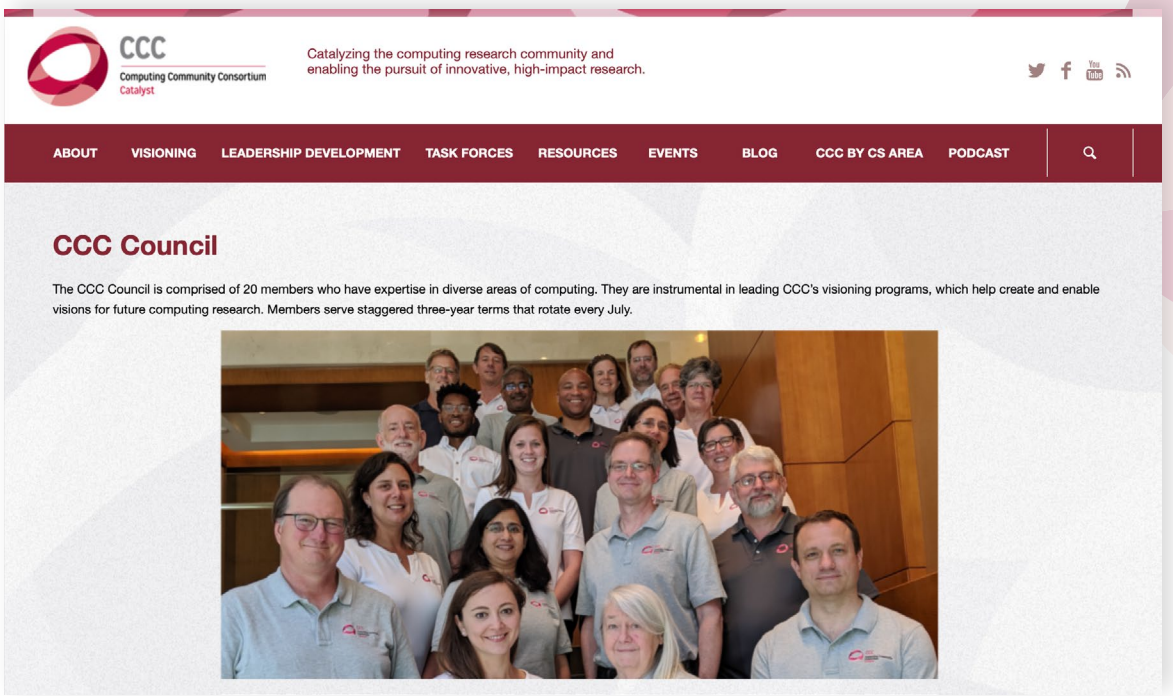
Melanie Moses is a Professor of Computer Science at the University of New Mexico and an External Faculty Member at the Santa Fe Institute. She studies complex biological and information systems, the scaling properties of networks, and the general rules governing the acquisition of energy and information in complex adaptive systems. She models distributed search processes in ant colonies and immune systems, and she designs bio-inspired, scalable swarms of robots that can autonomously cooperate and adapt to environmental conditions. She draws insights, tools, and approaches from different disciplines in an effort to find unifying principles in nature and computation.Her Ph.D is in Biology from the University of New Mexico and she has a B.S. in Symbolic Systems from Stanford University with a concentration in Agent Based Modeling. She has led the NASA Swarmathon and NM CSforAll to engage thousands of women and underrepresented minority students in computer science research and education.

Helen Nissenbaum

Helen Nissenbaum is a Professor of Information Science at Cornell Tech, Cornell University, where she is director of the Digital Life Initiative. Her research takes an ethical perspective on policy, law, science, and engineering relating to information technology, computing, digital media, and data science. Topics have included privacy, trust, accountability, security, and values in technology design. Her books include Obfuscation: A User's Guide for Privacy and Protest, with Finn Brunton (MIT Press, 2015), Privacy in Context: Technology, Policy, and the Integrity of Social Life (Stanford, 2010), and Values at Play in Digital Games, with Mary Flanagan (MIT Press, 2014). Grants from the NSF, AFOSR, and the U.S. DHHS-ONC have supported her work. Recipient of the 2014 Barwise Prize of the American Philosophical Association, Nissenbaum has contributed to privacy-enhancing software, including TrackMeNot and AdNauseam. Nissenbaum holds a Ph.D. in philosophy from Stanford University and a B.A. (Hons) in philosophy and mathematics from the University of the Witwatersrand, South Africa.

Holly Yanco

Holly Yanco is a Distinguished University Professor, Professor of Computer Science, and Director of the New England Robotics Validation and Experimentation (NERVE) Center at the University of Massachusetts Lowell. Her research interests include human-robot interaction, evaluation metrics and methods for robot systems, and the use of robots in K-12 education to broaden participation in computer science. Application domains for her research include assistive technology, urban search and rescue, manufacturing, and exoskeletons. Yanco's research has been funded by NSF, including a CAREER Award, the Advanced Robotics for Manufacturing (ARM) Institute, ARO, CCDC-SC, DARPA, DOE-EM, ONR, NASA, NIST, Google, Microsoft, and Verizon. Yanco is Co-Chair of the Massachusetts Technology Leadership Council's Robotics Cluster, served as Co-Chair of the Steering Committee for the ACM/IEEE International Conference on Human-Robot Interaction from 2013-2016, and was a member of the Executive Council of the Association for the Advancement of Artificial Intelligence (AAAI) from 2006-2009. Yanco has a PhD and MS in Computer Science from the Massachusetts Institute of Technology and a BA in Computer Science and Philosophy from Wellesley College.



Learn more about the CCC Council and its members on our webpage!

Former CRA Board Member and CRA-W Co-Chair Leah H. Jamieson Receives the IEEE James H. Mulligan, Jr. Education Medal

CRA-WP
Computing Research Association
Widening Participation

The Computing Research Association extends a heartfelt congratulations to former board member and CRA-W Co-Chair Leah H. Jamieson for receiving the **IEEE James H. Mulligan, Jr. Education Medal** to honor her "contributions to the promotion, innovation, and inclusivity of engineering education."

The IEEE James H. Mulligan, Jr. Education Medal (formerly the IEEE Education Medal) was established in 1956 by the American Institute of Electrical Engineers and continued by the Board of Directors of IEEE. It is through this medal that IEEE recognizes the importance of the educator's contributions to the vitality, imagination, and leadership of the members of the engineering profession.

Jamieson's engagement with, and support of, the **Computing Research Association's Committee on Widening Participation in Computing Research** (CRA-WP), formerly known as CRA-W, over many years, serves as a testament to her unwavering dedication and genuine desire to truly make a positive difference in the lives of others. She also served on the CRA board of directors from 1998 to 2007.

CRA-WP is humbled to receive a generous contribution from Jamieson's award as she looks to highlight "organizations that played [a] significant role in enabling and shaping the contribution" she is recognized for today. This contribution to CRA-WP programs will be used to support the success and participation of women, underrepresented minorities, and persons with disabilities in computing research and education at all levels.

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Evelyn Yarzebinski, CERP Research Associate

Column Editor

Expanding the Pipeline
Patty Lopez, Intel

Professional Opportunities

Georgia Institute of Technology

Postdoctoral Fellow - Cybersecurity

The School of Electrical and Computer Engineering at the Georgia Institute of Technology has an immediate new opening for a full-time Postdoctoral Researcher in the area of Cybersecurity. The position will begin in the summer or fall semester of 2020.

The successful applicant will work with Prof. Brendan Saltaformaggio and the Cyber Forensics Innovation (CyFI) Laboratory at Georgia Institute of Technology in Atlanta, GA. Applicants should be motivated to both join existing projects as well as propose new opportunities and directions.

More information about the CyFI Lab's research can be found here: *https://cyfi.ece.gatech.edu/*

Georgia Tech prides itself on its technology resources, collaborations, high-quality student body, and its commitment to diversity, equity, and inclusion. Georgia Tech is an equal education/employment opportunity dedicated to building a diverse community. We strongly encourage applications from women, underrepresented minorities, individuals with disabilities, and veterans. Georgia Tech has policies to promote a healthy work-life balance.

Minimum Qualifications:

- Background in research focusing on cybersecurity, cyber forensics, malware analysis, program analysis, mobile security, IoT security, or a similar domain.
- Excellent written communication skills demonstrated by prior publications.
- Creative experience in asking and answering important research questions by leading on prior research activities.
- Completed or near completion of a PhD in computer science, computer engineering, or related area.

Preferred Qualifications:

1. Experience in cyber attack forensics, web application security, and automated vulnerability/malware analysis.

2. Breadth of background knowledge of IoT devices, mobile apps, cloud backends, and network security using active and passive techniques.

Apply here: *https://academicjobsonline.org/ajo/jobs/16139*

Imperial College London

Faculty of Engineering

Chair (Professor) in Medical Robotics and Co-Director of the Hamlyn Centre for Robotic Surgery

Salary commensurate with the seniority of the role

Imperial College London, one of the world's most important centres for research and teaching in the natural and physical sciences, medicine, engineering, and business, seeks an outstanding academic to join the *Faculty of Engineering* and the cross-Faculty *Hamlyn Centre* for Robotic Surgery. The postholder will be a joint appointment between the Hamlyn Centre and the appropriate host Engineering Department, agreed with the appointee.

We invite applications for a full-time Professor who will contribute to research and teaching in the areas of Imaging, Sensing and Robotics applied to Healthcare, and take a leadership role for the Hamlyn Centre jointly with the existing Co-Director and Co-Founder of the Centre, Professor the Lord Darzi of Denham – Faculty of Medicine. The Centre is one of several research centres that make up the *Institute for Global Health Innovation* at Imperial, which is chaired by Lord Darzi. The Institute is one of six Global Challenge Institutes, reporting to the Vice-Provost (Research), Professor Nick Jennings.

The Hamlyn Centre was established for developing safe, effective and accessible technologies that can reshape the future of healthcare for both developing and developed countries. The Centre focuses on technological innovation with a strong emphasis on clinical translation, resulting in direct patient benefits with global impacts. The Centre is at the forefront of research in imaging, sensing and robotics for addressing global health challenges associated with demographic, environmental, social and economic changes. Its central goal is to address the different needs of healthcare challenges with a common ground for technological innovation. The Centre facilitates a fully-integrated clinical approach to achieve

its ambitions, playing an active role in international collaboration and outreach activities, as well as in the training of surgeons and engineers in robotic technologies.

This is a position of strategic importance for the College and requires leadership in terms of engaging and bringing together Imperial's academic community in this area and in persuading funders of the value of the proposition. In addition to these strong leadership skills, the Co-Director will also be an internationally recognised researcher with expertise and visibility in the fields of Imaging, Sensing and/or Robotics. In addition, you will contribute to undergraduate and postgraduate teaching and PhD supervision in your field.

How to apply:

Our preferred method of application is online, on our website at the following link: *https://www.imperial.ac.uk/jobs/description/ENG01250/chair-professor-medical-robotics-and-co-director-hamlyn-centre-robotic-surgery* (select "Job Search" and search using vacancy reference number ENG01250).

In addition to completing the online application, candidates should attach the following supporting documents:

- A full CV including a publication list;
- A list of the candidate's four most significant publications. For each of the four publications, please include a short statement (100 words maximum) highlighting the key contributions made by the applicant in that work;
- A research statement that describes your previous research contributions and future research plans (no more than two pages);
- A teaching statement that describes your previous teaching experience and potential contributions to teaching (no more than two pages).

Applicants should contact three referees before applying to ensure their willingness, if required, to provide a reference for the present post.

Should you have any queries about the post, please contact Professor Daniel Rueckert, Head of Department of Computing, Email: *d.rueckert@imperial.ac.uk*

For queries on the application process, please contact: Maria Monteiro, Senior Appointments Manager, Email: *m.monteiro@imperial.ac.uk* Telephone: +44 (0)207 594 5498

For technical issues when applying online, please contact: *recruitment@imperial.ac.uk*

Closing date: 20 May 2020

Johns Hopkins Institute for Assured Autonomy

Executive Director, JHU Institute for Assured Autonomy &Bloomberg Distinguished Professor
The Johns Hopkins University Whiting School of Engineering &
The Johns Hopkins University Applied Physics Laboratory

The Whiting School of Engineering (WSE) at Johns Hopkins University and the Johns Hopkins University Applied Physics Laboratory (APL) invite nominations and applications for the newly created role of Executive Director of the Institute for Assured Autonomy (IAA) and Bloomberg Distinguished Professor (BDP). Building upon current strengths in artificial intelligence, autonomous systems, cybersecurity, and data science, Hopkins is making significant investments in order to take a clear leadership role in assurance, security, and privacy practices for a world that is increasingly shaped by autonomous machines and systems. The University's distinctive resources and these broad commitments are converging in a new enterprise, jointly established by the University, WSE, and APL: The Institute for Assured Autonomy, or "IAA." IAA activities span the breadth of the research spectrum from fundamental research and advanced technology development to fielding and validating real-world systems. The Executive Director & BDP will be an employee of the University with appointments at both WSE and APL.

For more information about IAA, visit *https://www.jhuapl.edu/iaa/*. To access a full account of the Institute and the Executive Director position, *see here.*

Candidates for the Executive Director & BDP role will have extensive research and applied experience with autonomous systems and assurance. They will possess an earned doctorate in computer science, engineering, applied mathematics, statistics, or a closely related field and

a record deserving appointment as a Bloomberg Distinguished Professor with tenure at the rank of full professor. A mix of senior-level experience in academia, industry, and government is particularly welcome. The selectee will be subject to a government security clearance investigation and must meet the requirements for access to classified information. Eligibility requirements include U.S. citizenship.

*

*Johns Hopkins University has retained Opus Partners (**www.opuspartners.net**) to support this recruitment. Craig Smith, Partner, and Jeffrey Stafford, Senior Associate, are leading the search. Applicants should submit a single PDF containing a letter of interest outlining their research and leadership experience, their CV, and a two or three-page statement of research interests to **craig.smith@opuspartners.net**. Nominations, recommendations, expressions of interest, and inquiries should go to the same address. Review of credentials will begin promptly and will continue until the appointment is finalized. Target appointment date is January 2, 2021.*

The Whiting School of Engineering and the Applied Physics Laboratory are committed to building a diverse educational environment, and women and minorities are strongly encouraged to apply. Across its divisions, Johns Hopkins University is an equal opportunity employer and does not discriminate on the basis of gender, marital status, pregnancy, race, color, ethnicity, national origin, age, disability, religion, sexual orientation, gender identity or expression, veteran status, other legally protected characteristics or any other occupationally irrelevant criteria. The University promotes Affirmative Action for minorities, women, individuals who are disabled, and veterans. Johns Hopkins University is a drug-free, smoke-free workplace.

Milwaukee School of Engineering

Computer Science and Software Engineering Faculty

The Electrical Engineering and Computer Science (EECS) department at the Milwaukee School of Engineering (MSOE) seeks applicants to fill multiple Computer Science (CS) and Software Engineering (SE) faculty positions at all ranks. MSOE expects, rewards, and supports a strong primary commitment to excellence in teaching. Faculty enjoy small class sizes and hands-on labs as well as continuous improvement and sustained professional development. Among the department's strengths are strong partnerships with numerous businesses and academic institutes, which guide applied projects, undergraduate research, and curriculum development.

To view the full advertisement, receive application instructions, and apply, please visit ***http://www.milwaukeejobs.com/j/39659781***

It is the policy of MSOE to provide equal employment opportunity to all individuals regardless of their race, ethnicity, color, creed, religion, sex, age, national origin, physical or mental disability, military and veteran status, sexual orientation, gender identity, genetic characteristics, marital status or any other characteristic protected by local, state or federal law. This policy applies to all jobs at the University and to all the terms, benefits, and conditions of employment/enrollment.

Stanford University

Postdocs – Stanford Artificial Intelligence Laboratory

The Stanford Artificial Intelligence Laboratory (SAIL; ***https://ai.stanford.edu/***) invites applications for multiple postdoctoral scholar positions enabling free-ranging innovative research, potentially working with multiple Stanford AI faculty. They are funded for two years with a possible start date from September 2020 to April 2021.

Full advertisement with instructions is at ***https://ai.stanford.edu/postdoctoral-applications/***

Apply online at: ***https://stanforduniversity.qualtrics.com/jfe/form/SV_5nGRcvbUUJrt6HX***

Review of applications begins May 13, 2020; applications accepted until May 31, 2020.

Stanford University is an affirmative action and equal opportunity employer, committed to increasing the diversity of its workforce.

Universidad del Rosario in Bogotá – Colombia

Full-time Faculty Positions in Applied Mathematics

The School of Engineering, Science and Technology at Universidad del Rosario in Bogotá – Colombia – is opening multiple Assistant Professor positions. Successful candidates should hold a Ph.D. degree in Applied Mathematics, Computer Science, Engineering or related fields, have teaching experience, and conduct research in one or more of the following fields or related areas:

- Cyber Security
- Computer Graphics
- Software Development
- Data Science
- Artificial Intelligence
- Robotics
- Embedded and Cyberphysical systems
- Communication networks
- Actuarial Sciences
- Digital transformation
- Logistics
- Decision sciences
- Industry 4.0
- Service industry
- Agricultural industry
- Renewable energy
- Energy markets
- Energy resources management
- Energy systems planning and operation
- Smart cities

Faculty Director for the UC San Diego Design Lab

We seek a new director for the recently-established https://designlab.ucsd.edu/, an international center where design can contribute to many issues and disciplines. This search is part of a major commitment by the University to weave design into the fabric of UCSD academic, research, and community life.

The Director will be expected (1) to oversee a program of impactful research, sustainable via educational programs, external funding, and/or other means; (2). to engage communities beyond the university; and, (3) to contribute to a climate of diversity, equity and inclusion.

Candidates are expected to demonstrate capacity to lead and build strong organizations and communities related to design, with credentials supporting appointment at the rank of Associate or Full Professor (tenured) in an appropriate academic department at the University of California, San Diego.

The candidate must have completed a terminal degree such as a PhD, MD, EdD, Dr.PH, PsyD, MBA, MFA, MDes, or equivalent, in their area of expertise and have a record of accomplishment in education, service, and research.

The position is a full-time, 12-month administrative appointment accompanied by a full-time appointment of Associate or Full Professor, either with tenure as a ladder-rank faculty member or with security of employment in the teaching professor series, and eligible for full university benefits. Applicants with dual career considerations, please see the https://aps.ucsd.edu/services/pop/index.html web page.

The University of California is committed to creating and maintaining a community dedicated to the advancement, application, and transmission of knowledge and creative endeavors through academic excellence, where all individuals who participate in University programs and activities can work and learn together in a safe and secure environment, free of violence, harassment, discrimination, exploitation, or intimidation. With this commitment, UC San Diego requires all candidates for academic appointments with tenure or security of employment to complete, sign, and upload the form entitled "Authorization to Release" as part of their application.

Salary: Salary is commensurate with qualifications and based on University of California pay scales.

All applications must be submitted to: **https://apptrkr.com/1890662**

Applications will be considered on a continuing basis until the position is filled.

The University of California is an Equal Opportunity/Affirmative Action Employer. All qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability, or status as a protected veteran.

To apply, please visit: **https://apptrkr.com/1890662**

We will consider candidates with a strong international background and experience in research as well as teaching at the undergraduate and graduate levels.

Further information can be found at: *https://bit.ly/3assGLi*

Questions and documents can be sent to *ict@urosario.edu.co.*

Applications are due by April 30th, 2020.

University of Illinois at Chicago

College of Liberal Arts and Sciences Department of Mathematics, Statistics, and Computer Science

The Department has active research programs in a broad spectrum of centrally important areas of pure mathematics, computational and applied mathematics, combinatorics, mathematical computer science and scientific computing, probability and statistics, and mathematics education. See *https://mscs.uic.edu/* for more information.

Applications are invited for two non-tenure track Clinical Assistant or Clinical Associate Professor positions. The positions are effective August 16, 2020. Final authorization of positions is subject to the availability of funding.

The first position will be responsible for the coordination of courses and programs for undergraduates majoring in Mathematics and Computer Science. This major is designed for students who seek careers in computer science or related fields requiring a strong mathematical background, with concentrations in Algorithms and Theory or Computational Mathematics. Applicants should hold a Ph.D. in Computer Science, Mathematics, or a closely related field.

The second position will be responsible for the coordination of courses and programs for undergraduates majoring in Statistics. This major is designed for students who seek a wide variety of data-oriented careers, with concentrations in Statistical Theory and Methods or Applied Statistics. Applicants should hold a Ph.D. in Statistics, Mathematics, or a closely related field.

Responsibilities for both positions include teaching, coordination of courses, curricular development and reform, and oversight of placement. Applicants must

Applications should include a cover letter that specifies whether the application is for Mathematics and Computer Science coordination, Statistics coordination, or both; vita; teaching statement; a description of teaching, leadership, and organizational experiences; and at least three (3) letters of recommendation focusing primarily on teaching, curriculum development, organization, and leadership. Applications should be submitted through *https://www.mathjobs.org/jobs/jobs/15737.* To ensure full consideration, application materials must be received by April 3, 2020, but applications will be accepted through May 1, 2020.

The University of Illinois at Chicago is a Minority Serving Institution, an HSI, and an AANAPISI. UIC is an affirmative action, equal opportunity employer, dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment. We strongly encourage applications from women, minorities, individuals with disabilities and covered veterans. The University of Illinois may conduct background checks on all job candidates upon acceptance of a contingent offer. Background checks will be performed in compliance with the Fair Credit Reporting Act.

University of New Haven

Assistant/Associate Professor or Lecturer of Computer Science

The University of New Haven invites applications for an Assistant/Associate Professor or Lecturer of Computer Science with a focus on game development for August 2020. For full description *http://apply.interfolio.com/74302*

University of Virginia

Open Rank Professor of Data Science – Data Analytics and Data Systems Engineering

The School of Data Science at the University of Virginia (UVA) seeks applicants for Open Rank Tenured/Track faculty, starting with the August 2020 academic year, who will excel in research, teaching and service in one or more of the following areas:

- Data analytics and machine learning: foundational machine learning, statistics,

operations research, unstructured data, image analysis, social and digital media, game theory, mechanism design, learning theory; and

- Data Intensive Applications and Systems: Infrastructure design, data management and supporting architectures, dynamic resource allocation and scheduling, design of hybrid cloud architectures, mobile cloud computing, and collaborative methods for cloud federations.

Duties include research, teaching (residential and online), mentoring and advising students, and service to the school and university. The new faculty may conduct research and teach courses throughout the curricula in data science.

Candidates must have earned or be on track to earn a PhD in Engineering or Computer Science or a closely related field. By June 2020, candidates must be on track to graduate with degree conferral by the appointment start date. Candidates must have a record of excellence in research in applications of data science to problems in appropriate domain(s), as appropriate for the candidate's rank. A demonstrated commitment to teaching excellence to is required. Evidence of an explicit commitment and activities promoting diversity and advancing understanding and outcomes for underrepresented groups is essential. Appointment with tenure requires documented excellence in research and teaching and a proven national reputation.

TO APPLY:

Please visit the School of Data Science hiring page: ***https://datascience.virginia.edu/pages/join-our-team.***

For questions about this position, please contact Don Brown at ***deb@virgina.edu.*** For questions about the application process, please contact Rhiannon O'Coin at ***rmo2r@virginia.edu***

The selected candidate will be required to complete a background check at time of offer per University Policy.

The University of Virginia, including the UVA Health System and the University Physician's Group are fundamentally committed to the diversity of our faculty and staff. We believe diversity is excellence expressing itself through every person's perspectives and lived experiences. We are equal opportunity and affirmative action employers. All qualified applicants will receive consideration for employment without regard to age, color, disability, gender identity or expression, marital status, national or ethnic origin, political affiliation, race, religion, sex (including pregnancy), sexual orientation, veteran status, and family medical or genetic information.

Wayne State University

Lecturer

The Department of Computer Science is seeking qualified candidates for open non-tenure track lecturer positions. Positions are anticipated as one-year renewable positions to start in Fall Semester of 2020.

More information about this opportunity, including how to apply, is available at the following link: ***https://engineering.wayne.edu/cs/about/opportunities.php.***

Wayne State University is a premier, public, urban research university located in the heart of Detroit where students from all backgrounds are offered a rich, high-quality education. Our deep-rooted commitment to excellence, collaboration, integrity, diversity and inclusion creates exceptional educational opportunities preparing students for success in a diverse, global society. WSU encourages applications from women, people of color, and other underrepresented people. Wayne State University is an affirmative action/equal opportunity employer.