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Employment and Salaries

of Recent Doctorates in Computer Science

This magazine recently published a first-person account of how one faculty position in computer science garnered 438 applicants [7]. One of us (Maisel) had a similar experience when his department posted an opening for an entry-level faculty position in a computer science department where doctoral degrees are not granted.

Are these experiences anomalies? We wondered what is happening to recent doctoral graduates in computer science. Where are they going? What are they doing? How much are they making? Are they taking temporary or part-time positions?

For a number of years, the Computer Research Association's (CRA) Taulbee Survey has done an excellent job surveying department chairs to determine faculty characteristics and the employment destinations of doctorates where known [1]. What has been missing to date is data on recent graduates for whom faculty had no knowledge. Moreover, more detailed information was needed from the recent doctoral graduates themselves, such as: What is the starting salary? How long did it take to find the job? What job search contacts/methods worked the best? Is it a temporary or permanent position? In what specific employment sector is the job (in what type of business or industry, in what type of faculty position)? What activities are performed as a part of the job?

These and other questions were addressed in a recent pilot study funded by the Alfred P. Sloan Foundation with a grant to the Commission on Professionals in Science and Technology (CPST).

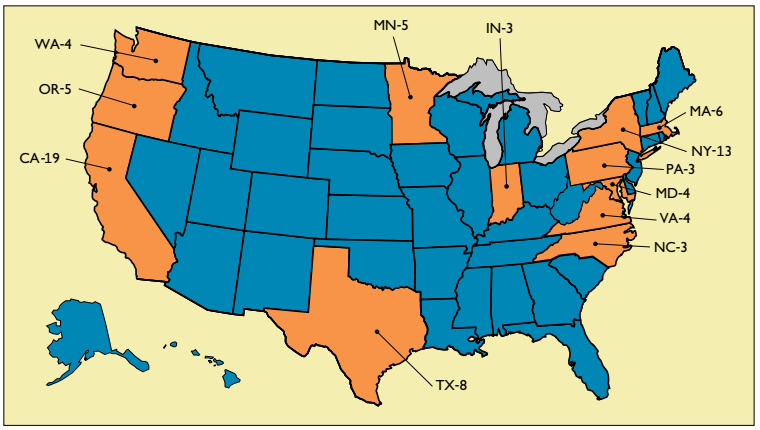
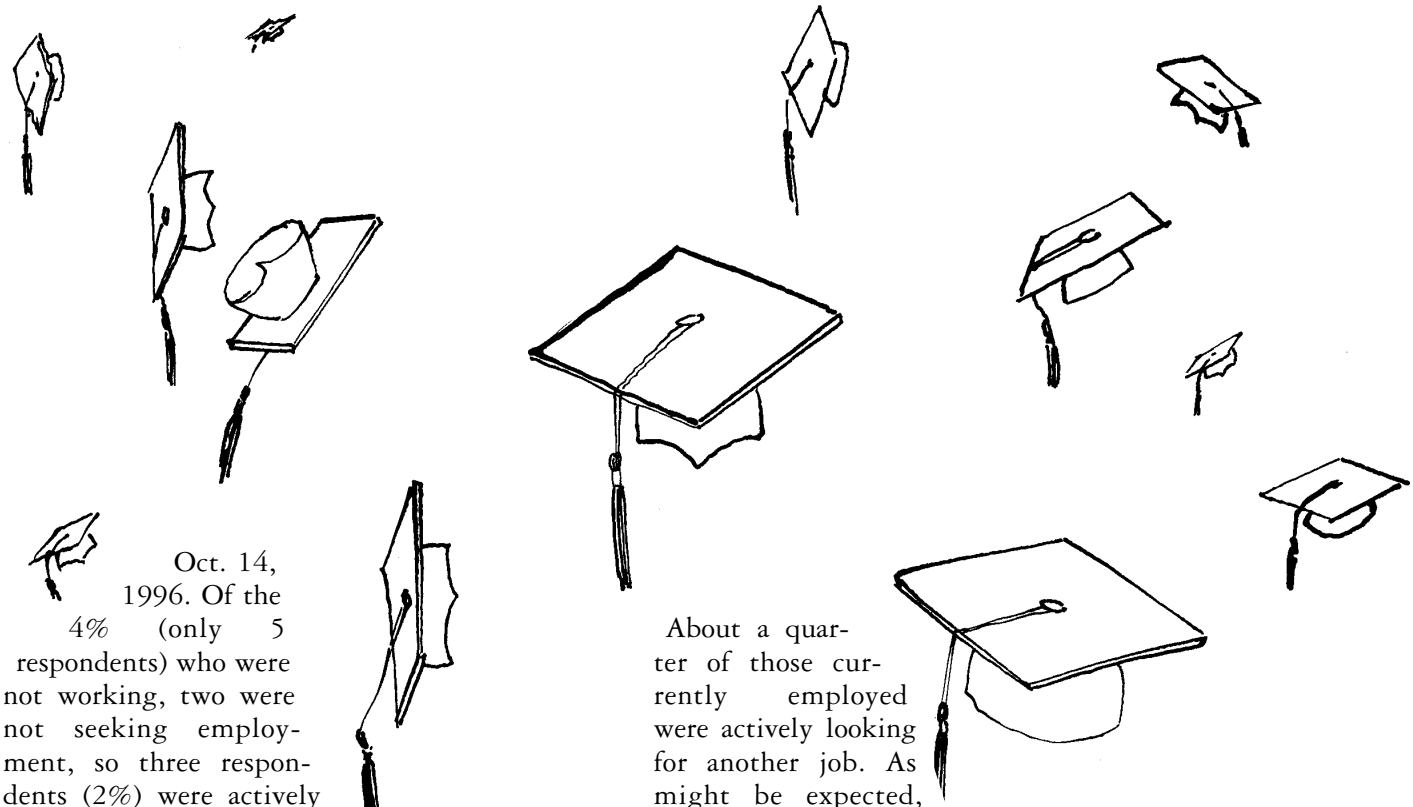


Figure 1. States in which three or more respondents were working.

Of the 123 respondents who answered the question on where they were employed, 103 were working in the U.S., 11 in Canada, and 9 outside the U.S./Canada. Figure 1 shows the U.S. states in which three or more respondents were employed. Here's what we found:

Employment. Some 96% of recent doctorates reported they were working during the week of



Oct. 14, 1996. Of the 4% (only 5 respondents) who were not working, two were not seeking employment, so three respondents (2%) were actively looking for employment. The finding of low unemployment among doctorates is consistent with national data on the sciences and engineering (S&E) that finds of all doctorates in S&E, about 1.5%, were unemployed in 1995. For recent S&E doctorates (1–3 years after degree), the number is almost 2% [8]. These low levels of unemployment should not be surprising, given the talent and persistence typical among doctorates. However, there is more to making a successful career than landing a job, so we looked at other variables to assess the quality of work life for these recent doctorates.

All the respondents had full-time positions. However, 28% reported the positions were temporary (that is, they had a definite end date), and of these, three-quarters were in postdoctoral positions. More than half (53%) of those in temporary positions said a suitable permanent job was not available.

About a quarter of those currently employed were actively looking for another job. As might be expected, most of these people were in temporary positions, but a quarter of them were in permanent positions.

The most effective job search method cited was an informal channel, such as a colleague or friend (36%), followed by faculty advisors (24%) and newsletters, magazines, or journals (12%). Electronic resources were the most effective method for 8% of the respondents. Those who had jobs had looked for employment for an average of 4.5 months, with a range of 1–12 months. Those not yet working but seeking work had been looking for about two months.

Most respondents worked in business/industry (48%) or education (46%). The primary work activities of respondents were research (35%), development or

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design (31%), and teaching (27%). Only a handful noted management/administration as their primary activity. The secondary work activities were research (44%), development or design (23%), and teaching (11%). Ten percent noted management/administration as their secondary work activity, and less than 7% noted professional services.

Salary. Table 1 contains a summary of salaries for those working in the U.S. As is obvious from the data, salaries in business/industry are highest, even when compared with full-year salaries in education. The differences may be even greater between education and business/industry, given that a few of those employed in education were at research institutes affiliated with universities, where they commanded salaries in the $60,000 to low $70,000 range. (They had duties similar to those in business/industry in that they had no teaching responsibility.)

		Range		
	Median	Low	High	Number of respondents
Sector				
Business	70,000	43,000	90,000	40
Education				
Permanent				
9–10 mos.	45,000	36,000	57,000	16
11–12 mos.	50,700	30,000	75,000	7
Temporary				
Post-doc	40,000	20,000	50,000	15
Other	42,000	37,000	60,000	7
All other	54,300	45,500	59,000	4

Table 1. Annual salaries for recent computer science doctorates employed in the U.S.

Dissertation topic. The major areas of research for dissertations were AI/robotics (28%) and software systems (22%); 26% said their dissertation was in an area other than the seven specified in the survey. One-third of these respondents listed databases or distributed systems. Each of the remaining five areas was chosen by 10% or fewer of the respondents: theory (10%), computer applications (5%), data structures/representations/encryption (4%), hardware systems/architecture (4%), and numerical analysis/scientific computing (2%).

Opinions. On a scale of 1 to 5, with 5 representing "strongly agree," respondents gave answers averaging 4.6 to a question asking if they thought their job positions were at least somewhat related to their field (range 2–5). When asked if the position was commensurate with their education and training, they responded with a mean of 4.4 (range 1–5). When asked if the position was what they expected to be doing when they began their doctoral programs, respondents agreed less often (mean 3.7, range 1–5). The positions were thought to be professionally challenging with a mean of 4.2 (range 1–5).

Historical Perspective

The number of Ph.D.'s in computer science doubled between 1986 (399) and 1991 (800), and then increased more gradually until 1995, at which time there were 998 [6]. The average age of a computer science doctorate was 32.2 years in 1995 [4], which is essentially the same as in 1986 (32.0) [2]. In our survey, respondents averaged 33.7 years old, with a range from 27 to 60.

The percentage of women increased from 12% in 1986 to 19% in 1995 [6]. (This survey included 7% women.)

The percent of computer science doctorates who were non-U.S. citizens increased somewhat from about 46% in 1986 to 51% in 1995 [6]. This is comparable to the 50% who were not citizens in this survey.

In terms of race/ethnicity, the proportion of graduates who were black and Hispanic has historically been substantially smaller than the representation of these groups in the population. For example, in both 1986 and 1995, fewer than 1% were black [1, 3]. In 1986, 1% were Hispanic, and in 1995, 3% were Hispanic [1, 3]. In our survey, 4% of the respondents were of Hispanic origin, less than 2% were black, and 34% were Asian/Pacific Islanders.

To improve the data available on computer science graduates, data was collected from recent doctoral graduates themselves. As in a number of other scientific fields, this involved gathering names and most recent addresses of doctorates from the previous year and sending brief, confidential surveys to them. Requests were sent to 179 doctorate-granting departments. Ninety-nine departments provided 341 names and addresses of recent computer science doctorates (those who graduated from July 1, 1995 to June 30, 1996) for the pilot survey. The response rate was 42%, based on deliverable surveys (128/305).

Overview of Project

The goal of this pilot study was to initiate a series of surveys to fill in the gaps in the existing data. In addition, the National Science Foundation (NSF) and other agencies fund the Survey of Earned Doctorates (SED) each year and to date have tasked the National Research Council (NRC) with carrying out the data collection from doctorate-granting institutions regarding their graduates' definite plans for employment at the time of graduation [4]. While this data on plans is useful, many graduates do not know where they will be going and report no definite plans, while others change their plans along the way.

The NSF also funds the NRC to survey a sample (about 9%) of all the doctorates in the U.S. on a biennial basis (limited to those who received doctorates in the U.S.) [5]. While this survey also provides an excellent source of high-level information on the pool of doctorates in S&E in the U.S., if one is interested in the employment situation for Ph.D.'s in a specific field (especially a field such as computer science, which is often combined with math for analysis purposes), the sample sizes are so small they limit generalization.

For these and numerous other reasons, some of the major scientific professional associations have funded surveys of recent doctoral graduates (and, in some cases, graduates at other degree levels). The American Chemical Society, the American Institute of Physics, the American Mathematical Society, and the American Psychological Association each have long-standing programs to survey the populations of recent doctorates in their respective fields, within a year or so of graduation to find out more about their employment situations. With funding from the Sloan Foundation, representatives of these four fields are working together to improve the consistency of their questions and methods so they will produce comparable and, ideally, higher quality results.

A total of six major fields, whose associations had some experience collecting data from or about recent doctoral graduates, were included in the pilot study: chemistry/chemical engineering, computer science, earth/space sciences, mathematics, physics, and psychology. Funding from the NSF was received recently to allow the pilot study to expand to include six additional S&E fields and to improve the methodology even further.

The data will be compiled for each field to distribute to faculty and students, among others. On a higher level, the Commission on Professionals in Science and Technology will study the results for a broader perspective across the fields. The ultimate goal is to have consistent and dependable job market indicators for recent graduates on an annual basis. This information will complement and supplement the data collected by the NSF for federal-level decision-making. While the participating fields have agreed on a relatively small draft, core set of questions to ask, each field plans to add field-sensitive inquiries. The field-specific results will have a depth of information that only current experts in these fields can provide, achieved by asking timely questions of graduates. And, as more graduates in all the S&E fields find employment in nonacademic settings, we will be able to track these dramatic changes in the job market for scientists in their early careers.

Using our experiences from this study, we will conduct another this fall. Efforts are underway to arrange for support in the years that follow. *We urge computer science departments and graduates to participate.* For further information on the project, contact Catherine Gaddy at CPST at 202-326-7080 or cgaddy@aaas.org. C

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