REASONS FOR CS DECLINE: PRELIMINARY EVIDENCE

PANEL DISCUSSION

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ABSTRACT

Undergraduate enrollment in computer science in the U.S. has been declining since 2000, although there are some recent signs that it may have bottomed out. This decline has caused anxiety in some CS departments as their workload has decreased, and in business where shortages of CS talent have been forecast. This project is intended to gather data on some of the causes for this decline in the popularity of undergraduate CS education, and to propose some remedies based on facts. The method is to simply survey the students who are making such choices as to their reasons--as one of the authors did during a similar decline in the late 1980s. Some data is presented in this paper, and others are invited to collaborate by administering the same survey. Some findings are: (1) Since recruitment of freshmen into CS is a zero-sum game, it is not sufficient to ask why CS was not selected. One must find out what fields are popular, and ask why, to get a differential comparison. (2) Some of the fields that have grown as CS declined are also vocationally oriented: nursing, management, and political science (pre-law), particularly. (3) As in the earlier survey, preliminary results show that many students in such fields select them because of the perception that they offer better economic prospects than CS. In most cases this is not true, at least as far as entry-level salaries are concerned. Thus a potential remedy is better public relations information on CS career prospects, particularly its topside potential.

1. INTRODUCTION

The decline in computer science enrollments since 2001 has aroused concern in many quarters: businesses that depend on skilled information technology professionals, national innovation activists [1][2], and in computer science
departments in colleges and universities. While many have hypothesized reasons behind this decline and possible remedies for it, there has not been much organized survey work performed to test these hypotheses. The purpose of this paper is to present some preliminary results from a small sample at Loyola College in Maryland and to solicit collaboration with others to augment the sample at other universities. This builds on an earlier effort by one of the authors during a similar decline in the late 1980s.

Figure 1 shows one set of data illustrating the phenomenon. This curve comes from an annual nationwide survey of college freshmen by the Higher Education Research Institute at the University of California, Los Angeles [3]. The sample size was greater than 200,000 per year at more than 300 universities and colleges. Among many questions, the survey asks freshmen what is their intended major. The figure shows that the decline after 2001 in the percent of freshmen choosing CS was preceded by a similar decline in the late 1980s. The 2005 and 2006 values are the same (1.1%), suggesting that the decline might have bottomed out.

![Fig. 1. Percent of college freshmen choosing CS. From UCLA national survey [3].](image)

In 1985 one of the authors had just been hired as a CS chair when he was presented with a sharp local decline in enrollments. Fearing that he would be blamed for this collapse of enrollments, he found that it was a national phenomenon, and then surveyed freshmen at his school to find out the reason why freshmen had suddenly changed their preference from CS to other fields. He asked for collaboration to increase the sample size in a SIGCSE’88 panel session, “Are we facing a crisis or just a swing of the pendulum?” and in CACM [4]. Professors at six additional schools participated, and the sample size ultimately reached 2872, also permitting coverage of a wider variety of university environments [5]. Some of the results that might also be relevant in the present situation will be reviewed in the next section.

Other data on the phenomenon are available, most notably the Taulbee Survey of 188 PhD-granting CS and CE departments [6]. The 2006 undergraduate results from that survey provide an even more optimistic note; they are slightly higher than those for 2005.

Many CS professors have opinions about reasons for this recent decline. In this case it seems clear that one factor is the excesses of the dot-com boom when stories in
the late 1990s were seen in the media about CS grads expecting to retire wealthy before they reached 30--followed in 2001 by dismal press about unemployment in information technologies being greater than for the population as a whole--and of many IT jobs being outsourced abroad. Prospective students and their parents must have been influenced about this bad publicity. Other reasons for the decline were discussed in a special panel session at SIGCSE’07 [7] and in a presentation by one of the panelists to the American Association for the Advancement of Science [8]. However, to remedy the situation requires facts about the motivation of students in choosing majors, not just speculation.

One of the few such efforts that could be found in the literature was a study by Lori Carter [9]. She surveyed 836 high school students in calculus or pre-calculus courses in Arizona and California, and found that most students had no idea of what computer scientists did on the job. Those who thought they knew believed that computer scientists mostly wrote programs. Respondents did not like the idea of sitting in front of a computer all day, and many stated that they had already selected another field that they liked better. The high school students’ knowledge of the amount of money to be made did not seem to be a significant factor.

Actually, it is easy to gather facts on why college freshmen did not choose CS. You just ask them.

2. METHODS

The same survey form used in the late 1980s was recycled for use in 2007, so that two snapshots in time could be obtained. In the fall of 2006 it was brought up to date as an online form in the Survey Monkey application that automatically tabulated the results. Teachers of Loyola’s 12 sections of CS111 were requested to ask their classes to complete the survey online. CS111 is an introductory course for non-majors required by business majors, and elected by most other Loyola students. Because completing the survey was not required during class, however, very few students took the time to do so. In the spring of 2007 we went back to the tried-and-true method of paper forms filled out in class and obtained 223 useful responses in the same course. A ReMark application program was purchased that permitted automatic scanning of response forms into .pdf files and automatic tabulations of responses to individual questions. Statistical analysis can be performed within the same application. Additional sampling will continue at Loyola, and others are invited to use the same form; we will tabulate the results from the larger sample.

3. FINDINGS

While the pendulum has clearly swung back to the south, some things have changed in this latest decline. One of the key findings in the 1980s was that competing for a percentage of college freshmen or slots in a freshman class is clearly a zero-sum game. As Carter found, potential CS students who have stopped being interested in our field have chosen another one that they like better. And what are those fields?

One can do time series correlations between the CS row in the UCLA data and those of all other fields to find which ones are counter-cyclical compared to CS. A large negative correlation coefficient quickly identifies those that have increased while CS has decreased, and vice versa. Table 1 presents some of that data.
Table 1. Correlations with CS Percentages in UCLA Data

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Chemistry</td>
<td>-0.49</td>
<td>-0.73</td>
</tr>
<tr>
<td>Mathematics</td>
<td>-0.50</td>
<td>-0.74</td>
</tr>
<tr>
<td>Physics</td>
<td>-0.71</td>
<td>-0.45</td>
</tr>
<tr>
<td>Nursing</td>
<td>0.16</td>
<td>-0.86</td>
</tr>
<tr>
<td>Political Science</td>
<td>-0.36</td>
<td>-0.77</td>
</tr>
<tr>
<td>Social Work</td>
<td>-0.66</td>
<td>0.21</td>
</tr>
<tr>
<td>Language and Literature (except English)</td>
<td>-0.59</td>
<td>-0.79</td>
</tr>
<tr>
<td>Biochemistry or Biophysics</td>
<td>-0.38</td>
<td>-0.56</td>
</tr>
<tr>
<td>Management</td>
<td>0.49</td>
<td>-0.34</td>
</tr>
<tr>
<td>Elementary Education</td>
<td>-0.60</td>
<td>0.86</td>
</tr>
</tbody>
</table>

The table identifies some of the fields that increased their share during the two periods of large declines in CS enrollments. The data processing vocational field (not shown) has a very strong positive correlation with CS--more than +0.96 in both intervals. Note that the results in the earlier period are rather different from recent ones. As discussed in the 1988 paper, education was one of the fields that benefited most from the CS decline, perhaps because of young women returning to their traditional field. The correlation for Social Work tends to agree with that hypothesis. It's not surprising that chemistry, physics and math tended to go up when CS went down because there are quite a few students who choose between these fields. Figure 2 illustrates some of these trends.

![Fig. 2. Fields that increased their percentage share of the freshman class during the first CS decline from 1983 to 1989. From the UCLA national survey [3].](image)

In the second period after 2000 the fields that grew while CS declined include some of these same fields of science, nursing, political science, language and literature (except English), and management. One common thread in some of these latter fields is that they attract many women students, as the number of women students in CS has sharply declined. Several have a similar vocational orientation to CS--political science, because it is an entry into the law. Figure 3 illustrates these trends.
Fig. 3. Some fields that increased their percentage share of the freshman class during the recent CS decline from 2000 to 2006. From the UCLA national survey [3].

What would be really interesting and valuable would be to get data from schools that have a significant number of these majors. Loyola College can provide data from a fair number of business majors. The Loyola spring 2007 sample (223), does permit some analysis. Most (79%) of the sample were freshmen; 52% were female. National curriculum recommendations call for one-half year of CS in high school, but 30% of these students had none. Over 47% of the students intended to major in business.

There were a scattering of other fields, but these numbers are too small to permit analysis of the national competing fields. Only six were political science majors, a handful of other science majors, and there is no nursing program at Loyola.

On the question about why students selected their present field over CS, where students could choose more than one response: 40% said that they thought they would make more money over time, 35% thought that they would have a greater impact on society, and 33% thought that it would be easier to find a job. Only 16% thought that they would make more money to start than in CS, so there is some indication that they are aware of the fact that starting salaries in CS are second only to engineering. Unlike Carter’s survey, these students (mostly business majors) are motivated by money, since they think that their major has better long-range potential than CS.

The leading reason female students gave for choosing other majors is that the chosen fields offered greater opportunities to help people. They also stated that they did not select CS because they believe that computer scientists do not interact with people much.

Further testing could refine these findings. If verified, this does suggest a remedy: more publicity about how innovation in information technology can help people as well as fill the pocketbook.

4. CONCLUSIONS

While the pendulum of computer science enrollments is hopefully starting to swing north again, survival of some CS programs and professors may call for a more immediate remedy. The first step is to find out the facts about what is needed to make CS the top choice of more students. Surveys can shed considerable light on the issue, and preliminary data gathered in the spring of 2007 suggest that more needs to be done...
to publicize the opportunities in the field for great rewards for innovators who have the professional tools to make their ideas a reality. We need to talk more about success stories like those of Bill Gates and Larry Ellison. Publicity on the altruistic things that computer science does to protect the environment, slow global warming, and stop genocide wouldn’t hurt. Indeed, current coverage of the relationship between CS and society in the curriculum is often cast in negative terms: ethical dilemmas about avoiding dire consequences of information technology. Filling college bulletin boards with lots of job openings in CS might reach more than the CS majors who are too busy to apply.

Others are invited to gather more data using the form posted at www.wtec.org/research/Computer_Science_Survey.pdf, which could make for a much more complete picture, and suggest further remedies.

5. REFERENCES


