

A Reflection about the Proportion of Women in Information Technology Degrees at the Universidad de Buenos Aires

Viviana Cotik¹, Natalia Debandi² and Rosana Matuk¹

¹Departamento de Computación, FCEyN, Universidad de Buenos Aires, Argentina, {vcotik, rmatuk}@dc.uba.ar

²Instituto Gino Germani, FSOc, Universidad de Buenos Aires, Argentina, nataliadebandi@gmail.com

Abstract

In the beginning of computer science (CS) history, many programmers were women. The proportion of women CS students has been decreasing since then. We present a brief survey about the gender proportion of computer scientists in different parts of the world, elaborate some hypothesis of the reason for this situation, and present some preliminary proposals to change it.

1 Introduction

There appears to be very little participation of women in Computer Science (CS) and in Artificial Intelligence (AI). Nevertheless women are present in other AI aspects, for instance ACM Technews comments that "A disproportionate percentage of artificial intelligence (AI) systems have female personas" and asks why this could be¹.

Many of the first programmers of the history were women. What led to the situation seen today, where men proportion is much higher than female proportion? This appear to be a trend that not only happens in Argentina [Zuckerfeld *et al.*, 2015], but also in other parts of the world [Dean, 2007; Fisher and Margolis, 2000]. Why is world-wide female participation in AI and CS in general dwindling instead of increasing?

In order to think about this question, we present some studies that have been done about this issue, and some hypothesis and possible solutions that have been found.

2 Background

In 1946 six brilliant young women programmed the first all-electronic, programmable computer, the ENIAC, a project run by the U.S. Army in Philadelphia as part of a secret World War II project [ENI, 2015b; 2015a]. See [Borensztein, 2014] for a recount of the job performed and the recognition given to the programmers.

Nowadays, only 15-20% of undergraduate computer science majors at leading U.S. departments are female [Fisher and Margolis, 2000]. Why did this happen? In the beginnings there might have been more women than men because men

where fighting in second world war. Nowadays the "nerd factor" might be a problem. Dean mentions that "According to a 2005 report by the National Center for Women and Information Technology, an academic-industry collaborative formed to address the issue, when high school girls think of computer scientists they think of geeks, pocket protectors, isolated cubicles and a lifetime of staring into a screen writing computer code" [Dean, 2007].

Lin; Fischer and Margolis [Lin, 2013; Fisher and Margolis, 2000; Fischer and Margolis, 2003] explain how Fisher, the Associate Dean of Computer Science at Carnegie Mellon University and Margolis, a social scientist, tried to figure out what they could do to increase the ratio of women in CS career. They increased it from 7% to 42% in five years. Two of the main activities performed were 1) teaching computer science high school teachers how to provide gender equity instruction and 2) changing the admission process in a way that it doesn't only give preference to people with previous programming experience, but also to people with other academic or non-academic strengths (like leadership).

Barr [2014] does an analysis of the report *Women, Minorities, and Persons with Disabilities in Science and Engineering* [National Science Foundation and Statistics, 2013] and the 2013 *Digest of Education Statistics* of the US National Center for Education Statistics [for Education Statistics, 2013] and states that the gender disparity ratio in CS went from 3 in 1966 to 6 in 2012. That is: in 2012 men earned CS degrees at 6 times women's rate. It is interesting to notice that gender disparity ratio of Engineering decreased 30 times, the one of Physics and Biology about 2 times and Earth Sciences 3.5 times. The only other discipline with a growing disparity of gender ratio was Math, with a 1,2 increase. Barr also states that women had consistently between 19% and 23% of computer science PhD degrees between 2002 and 2012.

There exist some organizations such as ACM Women (ACM-W²) and Anita Borg Institute for Women and Technology³ that promote the engagement of women in all aspects of the computing field. Some of the goals of ACM-W are to educate women about the opportunities in the computing field, to engage women students in exciting computing activities, to connect students with women leaders in the field, to en-

¹<http://cacm.acm.org/news/183789-rise-of-the-fembots-why-artificial-intelligence-is-often-female/fulltext>

²<http://women.acm.org/>

³<http://anitaborg.org/>

courage students to promote the field of computing to young girls and extend the conversation about why its important to increase the number of women in computing⁴. ACM-W provides scholarships for women, among others.

3 Situation in Argentina

In Argentina women represent 18% of the information technology students -11 % of CS students-, but they were more than 50% until the 80's and even 75% in the 70's [Zuckerfeld *et al.*, 2015]. Fundación Sadosky is working in bringing students to Computer Science careers. Among others, it has focused on the low quantity of women and did a study guided by sociologists in order to understand this situation [Zuckerfeld *et al.*, 2015]. The study states that among women it is more relevant that they really like their career than the salary they will get. They also say that stereotypes should be changed.

Table 1 shows the amount of male and female students in the different careers related with Information Technology taught at the University of Buenos Aires (UBA), the largest university of Argentina with currently more than 260000 students and the second best university of Latin America according to a Ranking of World Universities done in 2014^{5,6}. The Data is taken from a student census performed by the university in year 2004 [Secretaria de Asuntos Academicos, 2004].

UBA had at that time four careers related with Information Technology (IT): Computer Science, taught at the *Facultad de Ciencias Exactas y Naturales* (FCEyN), Organization Information Systems (*Facultad de Ciencias Económicas*, FCE) and Systems Analysis and Computer Engineering (*Facultad de Ingeniería*, FI). At that time they had 23%, 24%, 20% and 33% of the IT students respectively. Systems Engineering (FI) had the lower proportion of women (12%) followed by Computer Science (FCEyN) with 17%. Information Systems (FCE) is the one with the greater proportion of female students (32%) and it is followed by Systems Analysis. Proportions of students that are entering the careers (not shown) is similar to the male/female proportion of the careers.

Degree	Male	Female	Total
Computer Science	971 (83%)	199 (17%)	1170
Computer Engineering	1485 (88%)	201 (12%)	1686
Systems Analysis	736 (71%)	306 (29%)	1042
Information Systems	852 (68%)	393 (32%)	1245

Table 1: Students of IT degrees at Universidad de Buenos Aires in year 2004 [Secretaria de Asuntos Academicos, 2004].

Table 2 shows the proportion of female/male students of the CS degree at UBA.

In Argentina a local chapter of *Girls in Tech*, a non-profit organization based in Silicon Valley, that works on the empowerment of women in technology and entrepreneurship

⁴<http://women.acm.org/chapter>

⁵<http://www.shanghai ranking.com/>

⁶http://www.uba.ar/comunicacion/detalle_notas.php?id=16699

Year	Male	Female	Total
1988	1158 (58%)	837 (42%)	1995
1992	953 (61%)	600 (39%)	1553
1996	821 (67%)	404 (33%)	1225
2000	880 (77%)	270 (23%)	1150
2004	971 (83%)	199 (17%)	1170

Table 2: Students of the Computer Science degree at Universidad de Buenos Aires [de Buenos Aires, 2015].

and that has more than 40 chapters worldwide, has been created this year^{7,8}.

4 Discussion

In its origins, computers were primarily used for complex numerical computations. Therefore, the computer science degree was linked in its origins with mathematics (particularly at the UBA the Computer Science Degree of the University of Buenos Aires (UBA) was a detachment of the career of mathematics). The proportion of female students of mathematics has been decreasing but is higher than the one of CS students (61 % in 1988 and 48% -223 female students- in 2004). In our opinion, this might explain the great proportion of female students in computer science at the early decades of the existence of the degree. When computers evolved the computer science degree got more independence from mathematics degree, including subjects of study different than just numerical computation and inclined mathematics students might have not been that attracted for this field of study. In our theory this could explain, at least in part, the dwindling of computer science female students.

We also have the hypothesis that the fact that math has nowadays a greater proportion and amount of female students than computer science, might obey to the fact that math is associated with a more relaxed and less payed work and that still today many women think that they won't be the one's in charge of taking money home.

Computer science seems indistinguishable from many other scientific and technical careers in the fact that knowledge is largely abstract part and research work often occurs in isolation. Physics, Chemistry, Mathematics and other sciences could be described in similar ways. However, Computer Science seems to be marked by a stigma of coldness and isolation. Current low proportions of female students in computer science, could be explained by the misconception of programming as an isolated activity with a computer, the lack of knowledge of programming, and the lack of women socially recognized associated with computer activities.

We believe that the proportion of female students could be increased, taking into account some of following actions: the creation of a humanistic orientation in the computer science degree, the creation of programming courses at schools and of female prototypes in computer games, the availability of films

⁷<http://www.girlsintech.org/about/>

⁸<http://www.startupbuenosaires.com/evento/lanzamiento-girls-in-tech-argentina>

and commercials with women (as "beautiful" and as "smart" as others and with the same social skills) that work in CS or AI, and the availability for girls of toys that traditionally are thought for boys⁹ and that could enhance girls interest in CS and Engineering.

We also believe that CS could be presented as an opportunity for the female gender, since there are opportunities for flexible working (eg. part-time or from home), where the development or role can be based on the skills or interests of each one (for example more communication and less isolation, theoretical or practical work).

As women computer scientist we can say that we have not experienced many gender-discrimination episodes during our studies or our professional careers. There have been some issues of lower salaries. We also have heard of some other discrimination case because of motherhood. But none of these problems are exclusively of this area.

Computer Scientist and Information Science jobs, as many others, are not mechanical and have constant challenges. We think that some characteristics that are usually present in women, can present advantages in Information Technology jobs. One of this characteristics consists in the multitasking ability. This probably explains why, in the industry, many functional analysis, project management and information system design tasks, where multiple aspects and variables have to be taken into account, are usually taken by women. On the contrary, programming is mostly done by men.

These ideas come from our analysis of the situation and the studies performed by the referenced material. In order to deepen the understanding of the situation and further courses of action we think a survey should be elaborated.

5 Conclusions and Future Work

In this reflection, we review briefly the decrease of women studying Computer Science in Argentina and in some other countries. We explain some actions that have been taken (not in Argentina) in order to revert this situation. We draw some non-proven hypothesis about the decreasing female participation, proposed some lines to revert this situation and we commented some experiences and opinions as women computer scientists.

As future work, we plan to interview women that are involved at computer science and AI, at different levels (students, professors, researchers), in order to make a sociological analysis from the female perspective of the participation in the field and write stories of life. We also plan to do a survey of men and women that are entering the CS career.

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⁹<http://www.goldieblox.com/>