Top 15 Reasons to do a PhD in Computer Science

Bhavani Thuraisingham, PhD
The University of Texas at Dallas
August 27, 2022 (Updated: September 3, 2022)

I. Reason for this Article

I am teaching a PhD student class this semester for Computer Scientists on Recent Advances in Computing for the first time. All the students in this class (around 26 of them with more wanting to register) are pursuing their PhD degrees in Computer Science. The first class was yesterday (August 26, 2022) and I decided to focus on the motivational aspects during the first class. I mentioned why I did a PhD and how it has benefitted me a great deal in my 42 year career and how I expect it to benefit me hopefully for another 18 yrs. (until I am 85! heath permitting – although I would like to do different things in around 5-8 yrs. with respect to my work). I have had a varied career from visiting faculty, to commercial software product development to commercial industry research to a federal research lab (research and consulting for a FFRDC) to program management for the government to tenured professor. I have also held a few management positions and have dabbled in a start-up. Because I have a PhD I was able to do all this. I still have some options should I decide to change jobs in around 5-8 yrs. and that could be another startup to government research to consulting for private companies and/or the federal government to giving motivational addresses. Again I believe my PhD will benefit me a great deal as I get older.

I did not follow the traditional path for a PhD and career. I finished my undergrad in 1975 at the age of 20 and marriage was very important in my culture (I am a Tamil of Sri-Lankan origin). So, I had an arranged marriage and then pursued my graduate education. I had two main reasons for a PhD: (i) Intellectual Challenge and (ii) I thought it would help me sometime somewhere. I had not planned on a career trajectory as marriage and motherhood were my top priorities. But then it all came together and now I have a 47+ yr. marriage, I am a mother and a grandmother and have a great career (touchwood). If my son needs babysitting for his children and he and my daughter-in-law have engagements, I fly to New York City sometimes for as short as for an evening or as long as for a week and juggle my work with babysitting. It is not effortless and it is hard work and takes planning and setting your priorities. More details of my work and background are given in [1].

So during class on August 26, I mentioned to the students how the PhD has benefitted me and I asked them the reasons why they are doing a PhD. Many of them shared my views: Intellectual Challenge, Job Opportunities, and Financial Rewards among others. I learnt a lot from them. While we all come from very different backgrounds and in my case a different era, we all have the same goal and that is to be intellectually challenged. So I decided to write this article (as part of the motivational articles I write) as to the reasons for doing a PhD. Initially (on August 27), I was able to find 12 reasons. However, I shared my article with my colleagues and also on September 2, 2022 I gave a short motivational talk to my MS students in the second class I teach on Big Data Security and Privacy (I have 85 students in that class, all doing an MS in CS). I got more ideas last night and added 3 more reasons today. There may be even more reasons. Therefore, as I get more ideas, I will continue to update this article.

I have written various motivational articles over the past several years. There is one on 10 Reasons for a Career in Cyber Security for a Woman [2]. Next, I will get back to the main theme of this current article and that is on the Top 15 Reasons for doing a PhD in Computer Science.

II. Top 15 Reasons for Doing a PhD in Computer Science.

1. **Creative Thinking and Intellectual Challenge**: A PhD makes a person think about the research problems, read vastly around the subject, interact with other researchers and develop breakthrough ideas and solutions to the problems. This will in turn enable the person to design and develop creative solutions to technical problems and challenges faced in industry, academia or government. Tackling intellectual challenges is one of the most rewarding benefits of doing a PhD.

2. **Holistic Solutions**: BS, MS and PhD will enable a person to develop programming skills. However, a PhD in a systems-oriented topic will enable a person to develop skills in creative system development and also think holistically about the system. For example, when developing say Machine Learning algorithms, it would enable the developer to integrate solutions for say Trustworthy Machine Learning where the algorithms have to be secure, maintain privacy, provide fairness, and be accurate. Such skills are obtained when thinking about the problem from all angles and that usually comes while working on a PhD. It should be noted that systems such as Ingres and Spark were developed by professors together with their PhD students (and a few MS students to assist with the programming) and systems such as Hadoop/MapReduce were developed mainly by PhDs working in the industry.

3. **Interdisciplinary Research**: Often PhD research topics in CS involve an application area such as healthcare, finance, social sciences, and economics among others. Therefore, you learn about the domain, investigate what types of algorithms would be appropriate and subsequently develop solutions. Such interdisciplinary research can be extremely intellectually stimulating. For example, when developing solutions to secure the cyber space, you examine the risks involved. Risk and decision sciences enable the design and developer to understand the risks one may encounter as well as enable one to quantify the risks. As a result you can develop adaptive solutions for security. Also, recently I have focused my attention on conducting software research for humanitarian causes such as AI for Good and Protecting Women and Children. Having a PhD has enabled me to carry out such research.

4. **Multiple Options and Job Opportunities**: The options available to a PhD are numerous. This includes high paying and high demand jobs in industry (both software development and research), academia, federal research labs, and government. Also, if the person is interested in software developed for commercial products which then those jobs are also available to him/her. Often (not always) the plum software design and development jobs are carried out by PhDs while testing and integration are carried out by those with BS and MS. In addition, one can also work for the government in technical program management as well as found start-up companies. Some of these opportunities are not available at the BS or MS level. Most rewarding for me is the pro-bono work I do for organizations such as Professors without Borders and teaching (virtually) at the University of Dschang in Cameroon, Africa. Having a PhD enables me to do paid work for a comfortable living as well as pro-bono work.

5. **Start-u**ps: One of the major benefits working in Computer Science is the possibility of founding start-ups. This is not unique to Computer Science, but most start-ups these days are

related to Computer Science. This does not mean one needs a PhD to found a start-up. We know that the none of the founders of Microsoft, Apple, Facebook, and Amazon have a PhD. Even Google's co-founders were PhD students when they founded the company and did not finish their PhD. Nevertheless, one usually needs a PhD if you want to get SBIR and STTRs via the federal government. Furthermore, having a PhD enables you to think creatively. Therefore, once a problem is identified, a PhD may come up with creative and unique solutions for the start-up.

6. **Pervasive Computing:** Computing is everywhere these days in every corner of the world. Furthermore, every industry needs computing. For example, financial traders are relying on computing to make lucrative trades. Numerous healthcare start-ups have been founded to give people better healthcare advice especially for serious ailments. Internet of Things from Internet to Transportation Things to Internet to Medical Things are being developed to connect almost everything in the cyber world. Smart city and now the smart work conveyed are getting a lot of attention. With so much going on, the demand of industry specific software design and development jobs are booming. You can do many of the jobs that require routing programming with a BS and MS. However, there is intense competition among the companies to develop the best producer integrated with software. For such highly complex products, companies are going after PhDs in CS to give them the edge.

7. **Financial Rewards:** A PhD usually takes three more years in addition to an MS degree. Almost all of the studies for a PhD are usually covered by grants or fellowships (e.g., either as a Teaching Assistant or a Research Assistant) in most research universities in the USA. Furthermore, the starting salary of a PhD is usually around 280-300K in the industry (including stock options and bonus) while that of a person with an MS degree is around 180-200K (that also included the perks). At least this is what I have heard from students – I have not reviewed their offer letters. However, in many industries a person with a PhD advances more rapidly in the job and within three years will make up for the earnings lost by spending the extra three years doing a PhD. After 10 years a person with a PhD would likely earn at a lot more than that of an MS. For example, most PhDs can expect to make seven figure salaries with Hedge Funds within 10 yrs. after PhD and I heard that some of our PhD students who graduated from our university have made it in the financial industry. But to my knowledge this has not been the case in general for our MS students. Maybe a few with MS make it if they are big stars in financial software development and/or get into senior management in Wall Street.

8. **Job Security**: With a PhD in CS, there is near 100% job security. Industry jobs favor youth especially in CS. Therefore, as one gets older the job prospects and advancement are slim except for a few who have made it to the top. This is because the younger developers often have more up to date skills especially in programing and knowledge of the latest technologies. There is also the tendency to replace the executives in the industry with younger employees. With a PhD, one has the option to move to academia as a tenured professor or at least as a professor of practice. Furthermore, respected jobs in federal labs and the government are also available to those with PhDs (e.g., program director with the federal government) who are older. When you are 25, you do not think about being 65 someday as it seems so far away. So, of my students say that the job opportunities they have at 25 or the work they do at 25 will be there for them at 65. They say their experience would count. However, I know of many 55 year olds (forget about 65) struggle in their jobs and are often

laid off. Some of them end up with contract jobs with no benefits and seem frustrated. And at that time they say "if only I had done my PhD." When they seek my advice, I say it's not too late if you can afford it as it will likely help you in your 60s. One of my colleagues mentioned to me recently that he has never heard anyone say "I wish I had not done my PhD". I am so thankful I did my PhD 42 yrs. ago as not a day goes by where I do not look forward to my work. An important point to note, with Job Security comes Financial Security. I often speak to various women's groups in computing and I stress that "Financial Security is a Must for Every Person, Especially for a Woman" (as she can walk out of an abusive marriage if she chooses to).

9. **Consulting and Lecture Circuit**: Because of the numerous opportunities in Computer Science, one could make a career out of consulting and contract work. While such jobs may not provide benefits such as health coverage and retirement, one could get paid a lot that could compensate for not having benefits. Consulting including Expert Witness cases is also a great way for professors to complement their academic salaries. Some professors make more in consulting than their regular academic salaries. While one does not need a PhD for many consulting software development jobs, for providing creative solutions and consulting at the highest levels, a PhD is highly desirable (e.g., for expert witness in patent infringement). Closely related is one's earnings by giving lectures such as keynote addresses at technology conferences. If you are very good in what you do, then you can command thousands of dollars for a keynote address. Again having a PhD is highly desirable for such prominent lectures.

10. **Combining Career with Family**: There is no job better than that of a tenured professor to raise a family and have a fulfilling career. This s not limited to a PhD in Computer Science. It also applies to say a tenured professor in History. Your hours are flexible and you have to show up at work only to teach and be present for office hours (usually a couple of hours a week). It does not mean you work only 10 hrs. a week. Every professor is required to work at least 40 hours. And, many of us put in 60 hours many weeks. But it's done at our convenience. So, we can give a lot of attention to the needs of our children which must be our number one priority. In an industry job (regardless of whether you have a BS, MS or PhD) you have to show up at work and also meet the deliverables. It should be noted that with the pandemic many had the flexibility to stay at home and work. So they were also able to take care of their children's needs. But now, since the pandemic is not as severe as it used to be, many of us are back to in-person work and companies and universities what their employees to show up at work more often.

11. **Overqualified? – No:** While some say that with a PhD one may be considered to be overqualified, this is no longer the case. Having a PhD will rarely hurt a person's prospects in today's economy. That is, a PhD can usually do a MS level job (I did it early on in my career when I worked as a senior software developer at Control Data Corp. and many of my colleagues had just BS and MS; just a handful had PhDs). But without a PhD one will not be hired for a PhD level job (this happened to me after my software developer job when I joined Honeywell, which employed many PhDs, to conduct government contract research as well as product oriented research). Also, you need not volunteer the information that you have a PhD if not needed (although I won't want to do this). But if you don't have a PhD, you cannot say that you have one. So getting that PhD will likely give you a tremendous advantage at some point in your life even though it may not be immediate.

12. **Having a Fulfilling and Productive Time**: After hearing what my students say and based on my experience, conducting research for a PhD thesis is one of the most fulfilling, productive and enjoyable times in one's education. There is no pressure of exams as one would have completed the courses. Therefore, reading research papers, thinking about research problems, developing solutions, writing programs and publishing papers can be so exciting. I tell my students to cherish this time.

13. **Happiness to Parents**: By the time a student starts his/her PhD he/she is around 22 years old. The parents of the students have worked hard to put the students through undergraduate education. Doing a PhD brings so much happiness to the parents. I have seen so much joy in their eyes when their sons and daughters graduate with a PhD. While we cannot live for our parents, giving them such happiness and pride can be very rewarding.

14. **Doctor! and Role Model**: Last but not least, with a PhD one gets to be called doctor. In fact it is the PhDs who are the real doctors (comes from Latin: Philosophiae Doctor; in fact the Merriam Webster Dictionary states that "*Doctor* comes from the Latin word for "teacher"). With the word doctor comes lot of respect from the community. This is a boost to the ego of a person. While one should not be affected by such things, feeling good is important for one's self esteem. More importantly, we can be role models for our children, family and friends and all the students out there.

15. **That Priceless Highly Coveted Greencard**!: For those of us born outside the US, getting that priceless and highly coveted Greencard is one of the most important events of our life. I remember back in Spring 1980 how thrilled I was to get that Greencard. I now see the joy in the eyes of my students when they get their Greencard. All of them get it either just before their graduation with a PhD in CS, or when they are doing their postdocs or start their jobs as assistant professors. I have written many letters for those in other universities to get their Greencard (as the letter writer has to be at arm's length). Similarly, my colleagues have written letters for my students. These students with PhD in CS get their Greencards under the EB-1 category. For this category, a PhD alone is not sufficient. They should have published papers in top tier venues, received many citations for their work, and awards (e.g., best paper awards). My students have gotten their Greencard usually within a year of applying. Unfortunately this is not the case for the MS in CS students. Most of the MS in CS students in the US are from India (and I believe most of the PhD in CS students are from countries like China and there are also quite a few from countries like Iran). When the MS in CS students graduate, the various companies hire them as there is so much demand for the programming jobs and apply for their H1-B visa. Most of them get their H1-B and this is for 3 yrs. and can be renewed for another 3 years. At the end of the 6 yrs. the companies apply for a Greencard for them. They can then get their H1-B renewed indefinitely until they get their Greencard. But here is the twist. If they are from India, then it takes around 30 years for them to get that coveted Greencard (as of today, may be longer in future years). I was shocked when I heard that from my MS students yesterday (September 2, 2022). I took around 20 minutes out of my Big Data Security and Privacy class (around 85 students in all and all of them doing their MS in CS) and was explaining the benefits of doing a PhD. So, I asked them why you would want to wait 30 yrs. for a Greencard. Would you not be anxious? One student said, it has worked for others and so you live with it. I asked what if the US Government changes its policy. They had no answer (to be it is unimaginable – living in the

US on an H1-B for several years and say my son is 12 yrs. old and then the US Government says no more H1B and then we have to uproot the family and go I don't know where). I then added would it not be great if you do the PhD and get the Greencard within a year? So, at the end of my short motivational talk I asked my students how many of you would at least consider doing a PhD. I believe around 7students raised their hands. While I was disappointed, I look at the positives all the time. To be 7 is better than 0. I really hope that more of our MS students will think about doing their PhD in CS. I would have thought the Greencard situation alone would be enough for them to think about it very seriously.

III. Some Key Points to Note

I have given 12 reasons for a PhD in Computer Science and while many of them are related to intellectual advancement, job opportunities and financial rewards, some of them are related to emotional advancements such as bringing happiness to parents and the pride in being called a Doctor. The main points I am trying to make are that one is far better off doing a PhD and not stopping with a BS or MS. Also, it takes two years to complete a MS. The question is why not spend three more years to complete the PhD and enjoy all the benefits mentioned above?

The reason for my article is to motivate the students to pursue a PhD. Many of my MS students want to get jobs as soon as possible. Many of them take out loans to pursue a MS degree. A PhD degree is usually paid for by grants and fellowships in most universities. Therefore, why not take advantage of this and do a PhD? If you start your PhD from the beginning, you will likely get funding for the five years. You can also do your MS (possibly via a loan) and then go on for a PhD (via grants) and then once you get the job pay off the loans. The latter approach only if you really want to stop at MS and then change your mind. My advice is to take the first option and finish the PhD in five years. I have benefitted by doing a PhD in so many ways and have had such a varied and fulfilling career.

I hope that this article will benefit the reader. I will write another article in the future about how to go about doing a PhD. This is assuming that one has decided to do a PhD.

References:

[1] Bhavani Thuraisingham, The Role of Mentoring for Successful Careers in Computer Science for Women and Underrepresented Communities, https://www.computer.org/publications/tech-news/build-your-career/the-role-of-mentors-for-successful-careers , June 2022.

[2] Bhavani Thuraisingham, Keynote: Why a Cyber Security Career for a Woman? CyberW '17: Proceedings of the 2017 Workshop on Women in Cyber Security, October 2017 (at ACM CCS 2017).