

Notes on a PhD Degree

Over the last year or so I have been involved in review of PhD applicants as well as thesis topic review and supervision of PhD students at CHARUSAT. This experience has highlighted a significant lack of basic understanding about the nature of a PhD Degree.

Hence I have decided to circulate this document in the hope that it will enable students at Indian institutes of higher education to appreciate the basic requirements for a PhD degree. The document is based on the original written by Dr Douglas E Comer for the US applicants (and available at <http://www.cs.purdue.edu/homes/dec/essay.phd.html> - accessed 23rd July 2013)

The Basics

A Doctor of Philosophy degree, abbreviated PhD, is the highest academic degree anyone can earn. Because earning a PhD requires extended study and intense intellectual effort, a very small percent of the population attains this degree. Society shows respect for a person who holds a PhD by addressing them with the title "Doctor".

To earn a PhD, one must accomplish two things. First, one must master a specific subject completely. Second, one must extend the body of knowledge about that subject.

Mastering a Subject

To master a subject, a student searches the published literature to find and read everything that has been written about the subject. In scientific disciplines, a student begins by studying general reference works such as text books. After that, the student must also search scholarly journals (and increasingly available research findings online), the publications that scientists use to exchange information and record reports of their scientific investigations.

Each university establishes general guidelines that a student must follow to earn a PhD degree, and each college or department within a university sets specific standards by which it measures mastery of a subject. Usually, in preparing for PhD work in a given field, a student must earn both a Bachelor's and Master's degree (or their equivalent) in that field or in a closely related field. To demonstrate complete mastery of the subject, a student may be required to complete additional graduate-level courses, maintain a high grade average, or take special examinations. In many institutions, students must do all three.

Because examinations given as part of a PhD curriculum assess expert knowledge, they are created and evaluated by a committee of experts, each of whom holds a PhD degree.

Extending Knowledge

The essence of a PhD, the aspect that distinguishes PhD study from other academic work, can be summarized in a single word: research. To extend knowledge, one must explore, investigate, and contemplate. The scientific community uses the term *research* to capture the idea.

In scientific disciplines, research often implies experimentation, but research is more than mere experiments - it means interpretation and deep understanding. For Computer Scientists, research means searching to uncover the principles that underlie digital computation and communication. A

researcher must discover new techniques that aid in building or using computational mechanisms. Researchers look for new abstractions, new approaches, new algorithms, new principles, new mechanisms or new applications.

To complete a PhD, each student must present results from their research to the faculty in a lengthy, formal document called a dissertation or a thesis. The student must then submit their dissertation for an oral (ie, viva voce) examination. The examiners can include selected faculty member of the host as well as faculty member of other Universities (or leading professional).

Relationship to New Products or Services

In some cases, the results of PhD thesis research can be used to develop new products or improve those that exist. However, scientists do not use commercial success or potential commercial profits as a measure of their work; they conduct investigations to further human understanding and the body of knowledge humans have compiled. Often, the commercial benefits of scientific research are much greater in the long-term than in the short-term.

Research Activities

Computer Science research can include such diverse activities as designing and building new computer systems, proving mathematical theorems, writing computer software (systems or applications), measuring the performance of a computer system, using analytical tools to assess a design, or studying the errors programmers make as they build a large software system. Because a researcher chooses the activities appropriate to answer each question that arises in a research investigation, and because new questions arise as an investigation proceeds, research activities vary from project to project and over time in a single project. A researcher must be prepared to use a variety of approaches and tools.

Why do YOU want to do a PhD? A Few Questions to Ask

If you are trying to decide whether to pursue a PhD degree, then you should ask yourself the following questions.

1. Do you want a research career?

Before enrolling in a PhD programme, you should carefully consider your long-term goals. A PhD is training for research, so if your long-term career goal does not involve research then maybe a PhD is NOT for you.

2. Do you want an academic position?

A PhD is more or less a requirement for a faculty position at most Institutes of Higher Education in India and around the world. This requirement ensures that the faculty engages in research activities or at the very least keeps itself informed about the latest research in their field as well as to have sufficient expertise to teach advanced courses.

3. Do you have what it takes?

Time: Are you prepared to tackle a project larger than any you have undertaken before? You must commit to multiple years of hard work. Are you willing to reduce or forego other activities?

Creativity: Research discoveries often arise when one looks at old facts in a new way. Do you enjoy solving problems or taking on intellectual challenges? Do you like ``brain teasers'' and similar

puzzles? Are you good at solving them? At University or College, did you find advanced mathematics enjoyable or difficult?

Intense curiosity: Have you always been compelled to understand the world around you and to find out how things work? A natural curiosity makes research easier. Do you like reading on and around topics of interest? Do you enjoy the adventure of seeking out new knowledge and to learn? Remember, an ability to learn or acquire knowledge to pass examinations or gain qualification is not necessarily the same as an ability to sustain the level of curiosity and self motivation often required for PhD research.

Adaptability: Most students are unprepared for PhD study. They find it unexpectedly different than course work. Suddenly thrust into a world in which no one knows the answers, students sometimes flounder. Can you adapt to new ways of thinking? Can you tolerate searching for answers even when no one knows the precise questions?

Self-motivation: By the time a student finishes undergraduate education, they have become accustomed to receiving grades or marks for each course, each term/semester/year. In a PhD program, work is not divided neatly into separate courses, professors do not partition tasks into little assignments, and the student does not receive a grade for each small step. Are you self-motivated enough to keep working toward a goal without day-to-day encouragement?

Intelligence and Competitiveness: If you choose to do a PhD Degree, you will compete with others at the top which will include some of the brightest people in the world. Are you intelligent enough? You will be measured and judged in comparison to them. Are you willing to compete at the PhD level?

Maturity: Compared to university coursework, which is carefully planned by a teacher, PhD study has less structure. You will have more freedom to set your own goals, determine your daily schedule, and follow interesting ideas. Are you prepared to accept the responsibility that accompanies the additional freedoms? Your success or failure in PhD research depends on it.

A few warnings:

Students sometimes apply for a PhD degree for the wrong reasons. After a while, such students find that the requirements overwhelm them. Before starting one should realize that a PhD is NOT:

Prestigious in itself - Almost everyone who has obtained a PhD is rightly proud of their efforts and the result. However, you should understand that once you graduate, you will work among a group of scientists who each hold a PhD degree.

A guarantee of respect for all your opinions - Many students believe that once they earn a PhD people will automatically respect all their opinions. You will learn, however, that few people assume a PhD in one subject automatically makes you an authority on others. It is especially true in the science community; **respect must be earned.**

A goal in itself - A PhD degree prepares you for research. If all you want is a certificate to hang on the wall, there are much easier ways to obtain one. After you graduate, you will have occasion to compare your record of accomplishment to those of other scientists. You will realize that the research work done after a scientist finishes their PhD counts for a lot more!

A job guarantee – This is rarely true. A PhD will get you a research job but it won't help you keep it forever. As in most professions, continued employment depends on continued performance.

Furthermore, once a person earns a PhD, many companies will not consider them for a non-research position.

A practical way to impress your family or friends - Your family may be proud and excited when you start a PhD Degree. However, a desire to impress others is insufficient motivation for the effort required: it is hard work!

Something you can "try" to find out how smart you are - Sorry, but it just doesn't work that way. Unless you make a total commitment, you will fail. You will need to work long hours, face many disappointments, stretch your mental capabilities, and learn to find order among apparently chaotic facts. Unless you have adopted the long-range goal of becoming a researcher, the day-to-day demands may defeat you. Standards will seem unnecessarily high; rigour will seem unwarranted. If you only consider it a test, you will eventually give up.

The only research topic you will always pursue - Many students make the mistake of viewing their PhD topic as a research area for life. They assume each researcher only works in one area, always pursues the same topic within that area, and always uses the same tools and approaches. Experienced researchers know that new questions arise constantly, and that old questions can become less interesting as time passes or new facts are discovered. The best people change topics and areas. It keeps them fresh and stimulates thinking. Plan to move on; prepare for change.

Easier than getting a job - You will find that the path to successful completion of a PhD becomes much steeper after you begin. The faculty impose constraints on your study, and do not permit unproductive students to continue with their PhD degree.

Better than the alternatives – Not really, many students find that a PhD degree is often no better than a highly regarded Masters degree (or two). Being a mediocre researcher is not going to help you gain high status or respect in academia. While everyone should be free to decide what career they wish to pursue, potential PhD students should be realistic about their capabilities. If you really cannot determine where you stand, ask faculty members for their frank and full assessment of your capabilities.

A way to make more money - While this may be true for some students and/or areas of research for most students the average time required to obtain a PhD probably does not compensate for seniority gained in a salaried job after completion of Masters or Bachelors' degree. So one must choose research because one loves it; a PhD is not the best way to become wealthy.

The good news:

Despite all our warnings, we are proud that we earned PhD degrees and proud of our research accomplishments. If you have the capability and interest, a research or academic career can be a very rewarding profession. You will meet and work with some of the brightest people on the planet. You will explore new concepts and reach for ideas beyond your grasp, and in so doing extend your intellectual capabilities. You will be part of a long and glorious tradition of learning and have an opportunity to contribute to human knowledge and civilisation. And above all (for me at least) you will be able to impart that knowledge to eager learners and ignite minds!

Compiled and edited by Dr Mukesh J Patel
Adjunct Professor, Changa University of Science and Technology (CHARUSAT)
mjpatel222@gmail.com or mukeshpatel.mca@charusat.ac.in

See also <http://www.economist.com/node/17723223>