Navigating the Challenges of Studying Computer Science: A Guide for Students at Babol Noshirvani University of Technology

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Abstract

This paper offers a comprehensive guide for students pursuing a degree in computer science, with a specific focus on studying at Babol Noshirvani University of Technology. The author shares his personal experiences and observations from studying computer science for nine years, including insights into common misconceptions about the field and strategies for success. The paper is divided into several sections, beginning with an introduction that sets the stage for the reader. It then delves into student classifications and provides guidance for each classification. A strategy for effective studying is proposed, along with resources and materials for courses. Finally, a section of tips and advice is offered specifically for students, covering topics such as seeking consultation and remaining patient and consistent in their studies. By following the advice and guidance presented in this paper, students can better navigate the challenges of studying computer science and position themselves for success in this exciting and dynamic field.

1. Introduction

When I began my journey as a computer science student in 2014, the path ahead seemed unclear. Despite seeking the advice of well-known school counselors in my hometown, few regarded computer science as a good major, and even fewer considered Babol Noshirvani University of Technology (BNUT) to be a reputable institution. To make matters worse, many individuals believed that computer science and programming were one and the same, further adding to the confusion surrounding this field. Given Iran's unstable economic conditions, it was difficult to discern the best course of action.

However, in recent years, it has become increasingly evident that computers have had a significant impact on virtually every aspect of our lives. Even so, some people still hold simplistic and unrealistic views of computer science. For instance, I have been advised to steer clear of university courses and instead learn computer programming on my own, based on a few exceptional cases of high-earning programmers who did not study computer science in college.

Having studied computer science for nine years now, I can confidently say that such advice is misguided and infrequent, and therefore, it is my hope to offer guidance to students interested in pursuing this field. In this paper, I will provide an overview of studying computer science in Iran and discuss the fundamentals of this field. Additionally, I will categorize students and offer tailored strategies for success, along with tips to overcome challenges that may arise. Finally, I will conclude by offering some key takeaways for those considering a career in computer science.

2. Preliminaries

This section provides some preliminary information about computer science in Iran, including the process of university admission and the economic situation in the country. The section then moves on to discuss the basics of computer science, including key components of computers and the theoretical and practical aspects of the field. Finally, the section offers an overview of the computer science program at BNUT, including the quality of courses, the support provided by professors, and opportunities for research and admission to top universities. This section aims to provide students with a better understanding of the context in which they will be studying computer science and the basics of the field itself, as well as an overview of what to expect from the program at BNUT.

2.1. Iran's status

2.1.1. Regulations- In Iran, the Ministry of Science (MoS) ranks mathematics and engineering high school students' performances before assigning them to universities based on their preferences and ranking. There are different types of universities in Iran, including public and non-public ones. Generally, public universities are considered of higher quality than non-public ones, according to Iranian opinions, well-known rankings such as Quacquarelli Symonds rankings, and local rankings published in Iran. As a result, students often aspire to attend top public universities by showing high academic performance in high school. Public universities provide two approaches for students to pursue their studies: a scholarship for high-performing students and tuition payment for others.

Students who are awarded the scholarship are required to serve in Iranian organizations after they graduate. This means that they must work in Iran for a number of years, or else they will have to cancel their commitment. There are two ways to cancel this commitment. The first method involves appealing to organizations for jobs with specific conditions, such as a desired salary. If the organization is unable to find a job that meets the specified conditions within a certain period of time, the student's commitment can be canceled. The second approach involves paying a relatively large sum of money to release the degree and thus break the commitment. It should be noted that male students are obligated to attend military service for two years after graduation. The first approach cannot be applied to those who have not yet completed their military service.

2.1.2. Computer science in Iran universities- Previously, Iranian universities offered Bachelor of Science (BSc) programs in computer science, hardware engineering, and software engineering. However, in recent years, the available options have been changed to computer science and computer engineering. Although these two programs have distinct focuses, there are still some areas of overlap between them. To maintain a broad scope for this paper, the author chooses not to explore any specific major in depth. Instead, I will discuss general points that students may encounter during their studies. For the sake of simplicity, the author uses the term "computer science" to refer to both computer science and computer engineering throughout the paper.

2.1.3. Iran's economic situation- The country's economy is highly unstable, with the Rial being one of the least valuable currencies worldwide, and its value fluctuates constantly. While graduates of computer science programs are likely to find related jobs, it is unlikely that their salaries will make the economic situation bearable. Additionally, due to sanctions, many graduates cannot participate in projects or companies outside of Iran remotely.

2.2. Computer Science

2.2.1. Computers- Throughout history, humans have always been interested in achieving more with less time and greater accuracy. The industrial revolution saw the development of sophisticated tools that automated mechanical tasks, but the quest for increased efficiency continued. This led to the creation of computers, which are electronic devices capable of solving computational problems using an algorithmic approach. Computational problems involve well-defined steps that can be executed by computer programs, such as finding the shortest path between two points on a map or generating images using machine learning algorithms. Objective concepts, such as determining the meaning of life, cannot be formulated as computational problems.

Common computers consist of several internal parts that work together to execute computational tasks. The most essential component of a computer is the Central Processing Unit (CPU), which performs instructions specified by computer programs. The Hard Drive (HD) is another critical component that stores data permanently, even after the computer is turned off. There are two primary types of HDs: Hard Disk Drives (HDDs) and Solid-State Drives (SSDs). While HDs are relatively cheap, they are also slow, so faster devices are required for more speed. Random-Access Memory (RAM) is a type of volatile memory that stores data temporarily but is faster than HDs. In addition to these core components, modern computers have built-in devices like Network Interface Cards (NICs) for communication with other devices and Graphics Processing Units (GPUs) for accelerating certain computations. Other input and output devices, such as keyboards, monitors, and sound cards, allow efficient communication between end-users and computers. All these components are physically connected using a primary circuit board known as the motherboard, allowing them to communicate.

2.2.2. Computer Science- Computer science is an academic field that deals with the theoretical and practical aspects of computing, providing a basis for creating new technologies and innovations that influence our world today. The study of computers and computational systems is the primary focus of computer science, which includes understanding how they function, how to program them for specific tasks, and how to use them to solve complex problems in various fields. In particular, computers are used to solve problems related to various topics such as biology, medicine, neuroscience, art, music, finance, management, law, etc. Because of its broad range of applications, computer science has the potential to attract students from diverse backgrounds and interests.

2.2.3. Relationship with other fields- In addition to the previous note, it is important to acknowledge that the relationship between computer science and other fields is a two-way street. This means that computer science students can work on solving problems in various areas of study, while students from other majors can also participate in solving computer science problems. Although this may seem like a given for many fields, it holds particular significance for computer science as there is a long history of interdisciplinary collaboration. For example, in computational biology, computer scientists have developed algorithms for analyzing genomic data and simulating biological systems, while biologists have contributed insights into the underlying mechanisms of biological processes that have informed the development of new computational models and techniques.

2.2.4. Computer science major concentrations- Numerous concentrations are available at universities worldwide, including but not limited to Artificial Intelligence, Data Science, Cybersecurity, Computer Architecture, Computer Science Theory, Game Design, Robotics, and Software Engineering. It appears that this list is continuously evolving every few years. As a result, if you have an interest

in any of these fields or related areas, you are likely to find a concentration that matches your interests. Furthermore, if such a concentration does not exist, you will probably be able to make connections between different concentrations to create something unique.

2.2.5. Type of work- Upon graduation, computer science students are typically presented with two primary career paths: engineering or research. The former often involves utilizing existing tools and knowledge to create new applications, software, or technology. In contrast, the latter seeks to push boundaries by discovering or creating things that have not been previously known or developed, or by improving upon current technology. However, top companies and universities recognize the importance of both paradigms, meaning students can choose their career path based on their interests without concern for job availability. It is important to note that being an engineer or a researcher does not necessarily dictate whether one will work on practical or theoretical aspects of problems. Engineers may work on either depending on their preferences and expertise, just as researchers may focus on one or both aspects.

2.3. Computer Science at BNUT

The computer group at BNUT is a department with limited resources that has a small number of professors relative to the student population. As a result, each professor has to teach several courses each semester. Students evaluate their professors based on two primary factors: their teaching ability and how easy it is to obtain a good grade in their classes. While some professors are popular among most students, others are not well-liked, and some receive mixed reviews. However, student opinions do not hold much weight as the university administrators do not take them into consideration. Unfortunately, the university has no plans to improve the quality of courses, leading to wasted time for many students.

Despite these challenges, BNUT's computer department compares favorably to most other universities in Iran. Some fundamental courses are taught with high quality, and some professors consistently provide students with helpful guidance through consultation sessions, despite their limited time. The professors' friendly behavior puts students at ease and makes these sessions productive. Moreover, some professors support students in gaining acceptance at top universities in Iran or abroad by helping them conduct research, write papers, and familiarize themselves with entrance exam resources. To the best of the author knowledge, this support has resulted in a significant increase in the number of students accepted into top universities. In summary, while this department has its shortcomings, it also provides several unique opportunities for students.

3. For students

This section is dedicated to providing advice and tips specifically for students pursuing a career in computer science. Pursuing a degree in this field can be challenging, but it also offers endless opportunities for growth and success. It is important for students to have a clear understanding of what they are getting into and to know how to navigate the challenges that may arise during their studies. This section aims to provide guidance on various aspects of studying computer science, from finding helpful resources and materials for courses, to developing effective study strategies, to seeking consultation when needed. By following these tips and advice, students can better position themselves for success in this exciting and dynamic field.

3.1. Student classification

This paper divides computer science students into four distinct groups based on their internal states:

- The first group, S1, consists of students who love to study computer science and possess the skills necessary to learn new things. These students are sure they want to pursue computer science further, and while they may face challenges, they possess the ability to overcome them. The paper provides additional strategies and advice for these students to help them succeed more easily.
- The second group, S2, includes students who have to study computer science but have the skill set to learn new things. They may be unsure about pursuing this field, but the paper provides background information about computer science and how it can relate to other fields, helping them find something that interests them. Strategies and advice are also provided throughout the paper to aid them in their studies.
- The third group, S3, comprises students who like to study computer science but lack the skills necessary to learn new things efficiently. While they possess the initial motivation to progress in their studies, they struggle due to a lack of familiarity with effective learning strategies, having disorders such as ADHD, etc. This paper offers helpful advice and strategies, but students are encouraged to use advisers such as professors, friends, or online resources to enhance their learning abilities.
- Finally, the fourth group, S4, is made up of students who have to study computer science but do not possess the skills to learn new things efficiently. The paper provides background information about computer science and how it can relate to other fields, encouraging students to find something interesting and change their group to S3. Then they can follow the instructions provided in S3.

3.2. Strategy for studying

The proposed strategy aims to help students pursue their studies more effectively. The strategy involves answering three questions for each course, and based on the selected answers, a different policy will be specified for the student.

- The first question (Q1) is about how much it is necessary to learn the course, and the student should choose an answer between "A. Must know in-depth," "B. Must be familiar with," and "C. It is not required" options. This will help the student categorize the courses into groups based on their level of importance, where the first group represents the courses that require in-depth knowledge, the second group represents courses that are beneficial to have familiarity with, and the last group represents courses that are not required.
- The second question (Q2) is about the quality of the course offered by the university, and the student should choose between "A. good quality" and "B. not good quality." This helps the student rely on the university for good-quality courses while avoiding low-quality ones.
- The third question (Q3) is about whether it is reasonable for the student to learn the course with the expected depth during the semester. Depending on the student's workload and background, they might not be able to learn the course during the semester with the depth they expected. The student should answer "A. YES" or "B. NO."

It is worth noting that the responsibility of specifying what course should be in what group is the student's, and this can differ from student to student based on their goals. Furthermore, having a consultation with experts or advisers would likely be beneficial for this purpose. With this regard, the proposed strategy suggests different approaches for each course category based on the answers to the three questions mentioned previously.

For Q1.C ^ Q2.B courses, the strategy is to spend the minimum time required to pass them regardless of the final grade. For Q1.C ^ Q2.A courses, a trade-off between spending the minimum time to pass and trying to maximize the final score, should be made if it is affordable according to your interests, workload, and situations. For Q1.B courses, follow the professor's lectures, slides, etc., during the semester and try to maximize your final grade. For Q1.A courses, do your best to learn the course regardless of the grades (i.e., intermediate rewards). Different strategies should be adopted depending on the answers given to Q2 and Q3.

- If the answers are Q1.A ^ Q2.A ^ Q3.A, follow the professor's lectures, slides, etc., during the semester, and do your best to learn the course regardless of the final grade.
- If the answers are Q1.A ^ Q2.A ^ Q3.B, follow the professor's lectures, slides, etc., during the semester, and do your best to learn the course regardless of the final grade. However, keep planning to study this course more in your free time after the semester.
- If the answers are Q1.A ^ Q2.B ^ Q3.A, choose appropriate resources and materials for the course, even if those materials are not the ones that the professor uses. Follow the professor's lectures and classes alongside studying the materials chosen.
- If the answers are Q1.A ^ Q2.B ^ Q3.B, do the same as Q1.A ^ Q2.B ^ Q3.A or drop the course, study, and prepare yourself until you can change Q3.B to Q3.A (except when you have to take it).

The subsection outlined a strategy for students to achieve a high GPA, which is important for applying to higher-level universities and impressing potential employers. The strategy emphasizes that true learning of the material in Q1.A courses should be prioritized over achieving a high grade. While grades are important, unexpected circumstances such as non-standard questions or homework assigned by professors can threaten their validity. Instead, students should adopt different metrics, such as the ability to apply course concepts to real-world problems.

For Q1.B and Q1.C courses, the author suggests implementing policies to improve one's GPA but also cautions that this should be done in a dynamic manner. Each student's educational career is unique and requires monitoring and adaptation to changing circumstances. The proposal should serve as a guide, not a static plan, and students should customize it based on their individual circumstances. Finally, balancing the pursuit of a high GPA with a genuine desire to learn and adapt to academic challenges is key to success.

3.3. Resources and materials for courses

Typically, the most convenient materials for students to use in their courses are those that have been recommended by their professors. Students can either attend lectures or consult a reference book suggested by their instructor. However, this approach may not be applicable to all courses since some professors recommend multiple reference books instead of just one. Even in cases where there is only one recommended text, students may find it difficult to understand because of its length or writing style. Therefore, it is important for students to be aware of all the resources available to them. The following section outlines some of the main materials that students can utilize.

- *M1. Reference textbook-* There are various materials that students can use to supplement their learning in university courses. One such material is the reference textbook, which is often designated as the main course material by professors. While these books are beneficial for students, they are usually lengthy and may not be manageable to read within a single semester. Therefore, it may be wise to limit reading textbooks to some of the more essential Q1.A courses. The paper later recommends some books and corresponding courses to consider.
- *M2. Exam books-* Another useful material is exam preparation books, which are published by various companies to help students prepare for specific exams, such as entrance exams for higher education. These books are generally shorter than reference textbooks and provide practice exercises to reinforce learning. However, they may not cover all necessary information or real-world problems, so it is still important to read textbooks for courses that require more in-depth learning.
- *M3. External classes-* External classes, including those focused on exam preparation, can also be valuable in supplementing course materials. However, attending such classes can add to a student's workload and expenses. As such, students should carefully evaluate whether an external class is necessary and beneficial.
- *M4. Online materials-* Finally, there are many high-quality online materials available for students to access, including courses from top universities and independent educators. While this can provide a wide range of resources, it may also make it challenging to choose the most suitable material. To address this, students should set clear learning goals and seek advice from peers or academic advisors to ensure they select the most appropriate resources.

3.4. Courses

Computer science students are required to take several courses during their university studies. Some of these courses are essential and provide a foundation for further study. The following list highlights some of the critical courses, but note that it is not comprehensive:

- *Programming-* Typically, universities offer one or two introductory programming courses that cover basic programming concepts and introduce a language such as Python or Java. While these courses are critical for building foundational programming skills, many students find them insufficient for practical application. Students should seek out additional resources like textbooks, online classes, and coding practice sites to supplement their learning. So, remember to consult with an adviser and use M1, M3, M4, or a combination of them accordingly. Also, make sure that you do enough practice in those courses. Finally, just as a recommendation, if you want to learn Python, you can watch videos provided by Alireza Aghamohammadi.
- *Discrete mathematics-* This course covers topics such as counting, number theory, graph theory, and set theory. These topics are essential for understanding algorithms and data structures, making discrete mathematics an important foundational course in computer science. Students can learn from textbooks like Discrete Mathematics and Its Applications by Kenneth Rosen, or use online resources and videos provided by Hadi Yousefi to supplement their coursework.
- *Data structure and algorithms-* universities typically divide this into two courses named data structure and algorithms. The first one aims to familiarize you with well-known data structures such as arrays, linked lists, dictionaries, stacks, queues, and graphs and how they can be implemented efficiently. The second one aims to familiarize you with well-known algorithms, how to analyze and classify algorithms and problems, and finally, how to develop your own efficient algorithms. For these two courses, you can read well-known books such as Introduction to Algorithms by Leiserson et al. if you wish to learn this course in depth. Also, you can use books and videos provided by Hadi Yousefi. Moreover, using both materials mentioned might be great if you have enough time.
- *Logical circuits and computer architecture-* the first course familiarize you with logical gates, how to use them to build something useful such as a half-adder, and so on. And the second course teaches you how to use the learned basic blocks to build a CPU. Both of these courses are easy and interesting courses. However, many students struggle to learn the second one. For these courses, I strongly recommend using **both** books and videos provided by Hadi Yousefi.
- *Formal languages and automata-* this course provides a theoretical foundation to understand other courses such as compilers. For this course, the book written by Fardin Shapouri is recommended.

Other important computer science courses include operating systems, compilers, artificial intelligence, software engineering, database design, computer networks, microcontrollers, statistics and probability, etc. However, these courses focus on more specific aspects of computer science, so they are not included in this discussion. Additionally, English and research and presentation courses are also critical for computer science students, but appropriate resources differ depending on each student's level. As a result, no particular resources are recommended for these courses, and students should search for suitable materials independently.

3.5. Advice and tips

This section aims to give some tips that are helpful for students. The following advice and tips are provided:

- ***Seek consultation when encountering dilemmas and confusion. It is important to consult with professors, friends, or other people to help you make informed decisions.***

  If you want to follow only one tip in this list, follow this one. Do not deprive yourself of good advisers. During your study, inevitably, you will encounter dilemmas, confusion, and so on. Having other people's opinions can help you make your decisions more easily and with more awareness. Do not be shy; find some professors, some friends, or others for this purpose, and have consolation with them in important decisions.

- ***Familiarize yourself with the laws and regulations of your environment. This will enable you to understand the requirements needed to pursue your academic goals in a particular country or institution.***

  Familiarize yourself with the laws and rules of your environment. For example, if you want to apply to universities abroad, you must familiarize yourself with that process. If you want to study in Iran, you should read the educational chart provided by the MoS. If you want to study at a particular university, you should know the rules applied there.

- ***The third tip is to not be disappointed and to always look for solutions when faced with challenges. One should use consultation, make trade-offs, find or develop solutions, practice consistently and exercise patience to overcome obstacles.***

  The university might not be perfect, and even sometimes, it might be far from acceptable. You also may doubt your abilities in between. Remember, most of the challenges are not destroying. So, most of the time, there should be one or more than one solutions to deal with challenges. Using consultation, making a trade-off, finding or developing solutions, practicing consistently, and being patient are keys to success. If it is impossible or hard to find a good solution, you can still do a trade-off and find a partially suitable solution.

- ***Be patient and consistent in developing your skills. You cannot expect to see improvements overnight, but with patience and consistent practice, you will steadily improve until you achieve your desired level of proficiency.***

  Skills are not intrinsic abilities; instead, you must develop them. Do not expect to see your improvement in a short period of time. But you should be patient and practice consistently. Monitor your steady improvement until you find that your new skills are developed.

- ***Not be swayed by propaganda or biased opinions from other students. Instead, seek advice from a trusted adviser who understands your unique situation and can offer unbiased advice.***

  Each semester, you may hear from some students that, for example, a professor of a course is terrible, the other one is great, that course is useless, and so on. This information is spread from a group of students and might be partially valid. However, it is more likely that such information is biased toward the opinion of that particular group. As a result, if your characteristics are different from that group, their opinion might not be valid for you. Do not make your important decisions solely based on such information. Instead of that, consolidate with an adviser for such decisions. Note that you should find an adviser that fits your characteristics; for example, one whose thoughts seem reasonable to you generally.

3.6. Common misconceptions

First-year computer science students often have misconceptions about the field that can hinder their progress and lead to frustration. While the paper covers some of the most common misunderstandings, it's important for students to recognize that there may be other areas where they need guidance and support. Seeking advice from experts in the field, such as professors or academic advisors, can help students overcome any misconceptions and develop a better understanding of what it takes to succeed in computer science. This guide provides a starting point for students to develop a solid foundation in the field, but it's always best to seek out additional resources and support when needed. Some of such misconceptions are as follows:

- *Assuming that computer science is only about programming-* One of the most common misunderstandings among first-year computer science students is the belief that computer science is solely about programming. While coding is certainly an important aspect of the field, it's just one component of a much larger discipline that spans across various areas, including algorithms and data structures, computer architecture and organization, databases, artificial intelligence, operating systems, software engineering, and more. It's important for students to understand that programming is only one tool among many that computer scientists use to solve complex problems and develop new technologies.

- *Thinking that computer science is only for techies-* Another misconception is that computer science is only for those who are naturally skilled in technology or who have prior programming experience. In reality, anyone can learn computer science with dedication and persistence. While having some aptitude towards math and logic may be helpful, there is no need to be a "techie" in order to excel in the field. Students who are curious and motivated to learn can achieve great success in computer science by working hard and seeking help when needed. It's important for students not to sell themselves short and to approach the field with an open mind and a willingness to learn.

- *Belief that professors must know everything about every computer science-related topic-* It is not uncommon for students to believe that professors should have a complete and comprehensive understanding of all aspects of computer science. However,

this expectation is unrealistic and unfair. Computer science is an incredibly broad field with countless subfields and specializations, and it's impossible for any one person to have expertise in all of them. Professors are experts in their particular areas of focus, but they may not have in-depth knowledge of every topic within the field. It's important for students to recognize that professors are there to guide them through the material, provide support and resources, and help them learn the course.

- *Thinking that professors should be experts in programming-* Another common misconception is that professors should be experts in programming. While programming is one aspect of computer science, it's not the only one. Professors specialize in different areas of computer science, and some may not have as much experience in programming as others. However, they are still highly qualified to teach the subject matter and can offer valuable insights and guidance. It's also worth noting that programming languages evolve and change rapidly, so even professors with extensive programming experience may not be familiar with every language or framework. Instead of focusing on whether a professor is an expert in programming, students should look for instructors who are knowledgeable, approachable, and supportive. They should also take advantage of other resources such as teaching assistants, peer tutors, and study groups to get help in this regard.

4. Conclusion

In conclusion, and to put it differently, learning computer science can be compared to learning how to drive a car. Just as you learn how to drive in order to go anywhere you want, learning computer science gives you the freedom to use it to achieve a variety of goals. Although there are other tools available to reach your destination, just like cars are one of the most efficient means of transportation, computer science is a highly useful tool for solving many problems and performing various tasks. Therefore, once you gain proficiency in computer science, you will have the ability to apply it for different purposes.

With this in mind, although, pursuing a career in computer science can be a challenging but rewarding journey. It is important to clearly understand what computer science is and what studying this field entails, especially at a specific university like BNUT. This paper provided insight into the different student classifications and offered tips and advice to help students overcome challenges they may face. A comprehensive study strategy was also proposed, along with resources and materials that can assist students in their courses. Remember to be patient consistent, and seek consultation when necessary, and do not make important decisions solely based on hearsay or propaganda. Dedication, perseverance, and determination make success achievable in this exciting and dynamic field.

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