

# Statement of Purpose

Abbas Mehrabian

My general areas of interest are DISCRETE MATHEMATICS and THEORETICAL COMPUTER SCIENCE. I like to study mathematical problems that arise here and there in Computer Sciences. For example, the usage of probability in designing efficient algorithms has generated many interesting problems, whose study also helps us to have a deeper understanding about computational abilities of computers. I am also interested in studying GRAPH THEORY and DISCRETE GEOMETRY with the aim of using these tools in computer algorithms. I believe with a strong theoretical knowledge, I will be able to work on more applied subjects in the future as well. I wish to earn a Master's degree in Computer Science to expand my knowledge in the subject matter, to follow this up with a PhD, and a career in research and teaching.

In high school, I was a fan of math and one of my hobbies was solving mathematical problems. In 2003, I was among the ten students who received gold medal in the National Mathematical Olympiad and participated in a special six-month program at Young Scholar's Club (YSC). Its purpose was to train us for International Mathematical Olympiad (IMO) and its focus was on improving our problem-solving skills. Although I was not selected as an IMO team member, the program was an excellent experience for me, and the ability to solve difficult mathematical problems was a real advantage during my career. I still sometimes go to YSC as an instructor, and teach topics such as COMBINATORICS and PROBABILISTIC METHODS to talented high-school students. Teaching helps me keep my mind fresh and able to deal with abstract mathematical problems.

I was interested in PROBABILITY THEORY when entered university in 2004, and attended the STOCHASTIC PROCESSES course. The magnificent idea of generating an element of a set with a specific probability distribution, using Markov Chain Monte Carlo method, excited me greatly such that I implemented this algorithm to generate uniformly-distributed Self-Avoiding Walks. Since then, I become impressed whenever I see an application of PROBABILISTIC METHODS, in both devising RANDOMIZED ALGORITHMS and proving the existence of COMBINATORIAL STRUCTURES.

I am simultaneously studying in two fields. My two majors are Computer Engineering (CE) and Mathematics. In the CE Department, students are interested in ACM International Collegiate Programming Contest (ICPC). It was appealing to me too, and I practiced for ACM-ICPC for about two years. As a result, our team took 4<sup>th</sup> place in Tehran regional contest, 2006. Most of the ACM-ICPC problems are small optimization problems and the competitors should design and implement exact algorithms for

them. I have solved lots of problems and implemented their solutions when preparing for the competition, which has improved both my problem-solving and programming skills. Furthermore, the participants should work in three-person teams and the teamwork experience was precious to me.

In summer 2006, I had my first research experience. I took the COMPUTATIONAL GEOMETRY course because of my interest in DISCRETE AND COMPUTATIONAL GEOMETRY. I studied various versions of shortest path problems with visibility/meeting constraints and tried to solve a few special unsolved cases, but ended up with no major success.

I joined a team that was researching on Zero-Sum Flows in Undirected Graphs in fall 2006. This concept was recently introduced by S. Akbari as an approach to study Tutte's 5-flow conjecture (in GRAPH THEORY). We found a few results and submitted two journal papers. My programming skills came in handy to refute a conjecture that we were trying to prove. I was involved in preparing and formatting the camera-ready versions, too.

In summer 2007, I worked along with two other students to implement a software controller for Ms. Pacman game, which is a simple real-time game. We played, discussed and implemented a variety of approaches, and finally came up with a heuristic-based program, which is currently the best known agent for the game. It was a very pleasant experience. Even though this is not my main point of strength, I am also interested in COMPUTER GAMES and developing INTELLIGENT AGENTS for them, and I have implemented a few.

In fall 2007, I took the ADVANCED TOPICS IN GRAPH THEORY course, whose focus was mainly on Graph Homomorphisms. The students had to do some research activities for the course. I studied Cylindrical Construction, a concept introduced by A. Daneshgar in order to prove dichotomy results for Graph Homomorphism Problem. I was able to prove some results, but meanwhile stronger results were found by three Czech mathematicians. Nevertheless, the subject was inspiring and it became one of my interests.

As a CE student, I have taken many courses that have introduced me to various computer software concepts. Design and implementation of course projects have made me an experienced programmer with a good knowledge of coding techniques. On the other hand, I have taken many courses at Math Department that have provided me a strong mathematical background as a prospective Computer Science student. Having the experience of working as a teacher assistant for three courses, I greatly enjoy interacting with other students and feel happy whenever I can help one in her studies. I surely welcome similar opportunities in the future.

I believe the Department of Computer Science at University of Toronto, would be an excellent place for me to pursue my studies, because of its high reputation and numerous faculty members. Some friends of mine that have graduated from there, were very pleased with the scientific and friendly atmosphere of the department. I have also found that there are a few active professors with similar interests in the Theory Group, such as A. Magner and M. Molloy. I wish to have the chance to learn from them and take part in their research. Enrolling in your graduate program will be a great achievement in my career.