

## 1 My International Status

I begin this document by addressing the elephant in the room. In the interest of candidness, I aim to keep this section short and to-the-point. My current status is that of an *international student*. Compared to a domestic student, an international student requires additional funds due to the large fee burden imposed by various universities. You will find this reflected in my academic transcripts.

Although I applied to and completed an M.A.Sc program at the University of Toronto, I was initially accepted in the M.Eng program. Irrespective of my research background and a strong interest towards academic innovation, my transfer to the M.Eng program was a result of my international status. My advisors and the Department of Electrical & Computer Engineering appropriately suggested that it would be more suitable to complete my first semester in the M.Eng program as it would help reduce the burden of funding at the international level. The first semester of M.A.Sc and M.Eng programs are equivalent in respects that the student is only required to undertake courses. Following the completion of coursework, the student can begin his/her research and work towards a thesis in the M.A.Sc program. Thus, with the objective of *alleviating extensive funding support* and reserving it for other deserving students, I agreed to the M.Eng admit for my first semester and later transferred to the M.A.Sc program. I firmly believe that my decision has helped my advisors and the department fund additional international students and provide them with better resources for undertaking graduate research.

With regards to future academic positions, I plan to **apply for a permanent residency status upon completion of my M.A.Sc program**. The reason behind this application is my long-term motivation to conduct research and at the same time alleviate the large funding requirements for my potential advisors. Additionally, I intend to and have applied for competitive scholarships and graduate awards. As time follows, I will be completing more applications which require a permanent residency status.

## 2 Why I do Research

*"Life isn't worth living if you have not found out the one thing it's worth dying for."* - Lee Child

This section highlights my beliefs and ideas towards research and why it is essential from an academic standpoint. The discussion provided here follows a philosophical tone so please feel free to skip it if in the interest of time.

People have a reason and a liking to do the things they do. Some people like to cook, so they become chefs. Some people like to play, so they become athletes. Some people like music, so they become musicians. Along similar lines, some people like to *solve problems*. And these people become *scientists*. *But why must people do what they like?* Consider a small example of a person with 24 hours of the day in his hand. A person spends 8 hours in his sleep to provide his body with rest. He then spends another set of 8 hours socializing and relaxing with other people. And lastly, he

spends the remaining 8 hours working on his job. Without loss of generality, the above cycle, on average, repeats every day in a person's life. Thus, a person spends **one-third of his entire life** working on his job. More specifically, an individual devotes a significant portion of his life; in the form of sweat, tears, blood, discipline and occasionally his mental stability; towards a set of tasks which are supposed to benefit the society and the person's wellbeing. At this point it is redundant to highlight the necessity of doing what a person likes the most.

My interest in academic research is built on the firm belief of making other people's lives better while I do what I like the most. A scientist forms a theory, conducts experiments and contributes to the community not because his day job asked him to, but because it brings him solace in the fact that his work will make a difference to other people's lives. Thomas Edison invented the light bulb not because his manager asked him to. He invented the light bulb to make his family's life better by removing the need for harmful incandescent material. Thus, a researcher invents novel technologies *not for the sake of a better pay-check, but for the sake of a better tomorrow.*

### 3 How I do Research

Academic research requires structure and concreteness from the learning perspective. To this end, I strictly follow a self-constructed plan which allows me to stay focussed towards novel ideas. My research methodology is based on the below listed 4 fundamental aspects of learning a new skill. These correspond to my self-study schedule which I follow on a day-to-day basis. [section 4](#) explains them in detail.

- **Concept Study-** Study & review theoretical concepts everyday.
- **Mini Projects-** Implement 1 novel project every month.
- **Reading-** Read 2 papers every week.
- **Writing-** Write 1 paper summary every week.

In addition to self-study, **I work towards a top-tier publication once every 6 months.** The reason behind this large time duration is my constant belief to improve our current methods and ideas. I firmly believe that a contribution which can make a significant impact on our research community is convalescent to 2-3 moderately rated papers.

### 4 Self Study

Independent research requires discipline and commitment towards a rigorous study schedule. Towards this goal, I constructed a self-study scheme which allows me to incorporate all the necessary components of research and build on my ideas simultaneously. [Table 1](#) presents my self-study scheme for independent research.

Table 1: Self-study scheme for independent research

Day	Description	Tasks
Monday	project day	concept study + mini project
Tuesday	reading day	concept study + reading
Wednesday	project day	concept study + mini project
Thursday	reading day	concept study + reading
Friday	project day	concept study + mini project
Saturday	writing day	concept study + mini project + writing
Sunday	review day	concept study + mini project + weekly review

## 4.1 Concept Study

As highlighted in [section 3](#), my concept study involves **learning new theoretical concepts and techniques every day of the week**. Concepts are reviewed and learned from literature in the form of review papers, textbooks, course notes and video lectures. While most of the study centers around theory from textbooks, I additionally solve exercise problems in the form of derivations and proofs. Following is a list of rigorous book concept studies completed from their respective resources-

- Data Structures & Algorithms- whole book ([notes + solutions](#))
- Pattern Recognition & Machine Learning (PRML)- Chapters 8-13
- Reinforcement Learning: An Introduction- whole book
- Neuro-Dynamic Programming- Chapters 1-6 ([notes](#))
- Abstract Dynamic Programming- Chapters 1-2 ([notes + solutions](#))
- Machine Learning: A Probabilistic Perspective- Chapters 21-28 ([notes + solutions](#))
- Neural Network Training Dynamics- whole book
- Convex Optimization- whole book
- High-Dimensional Statistics: A Non-Asymptotic Viewpoint- whole book
- Planning Algorithms- whole book
- Programming Robots with ROS- whole book ([practice scripts](#))

## 4.2 Mini Projects

As highlighted in [section 3](#), my projects involve *building up on an idea for one month*. This process consists of understanding a large code base, redesigning the program by implementing my own ideas, carrying out experiments and evaluating my scheme while I build on the code. Each project can be broken down into 2 components, (1) *predefined programs* and (2) *novel contributions*. Firstly, predefined programs correspond to all the scripts which are shipped with the code base, for instance,

author-provided implementations or library executables. And secondly, novel contributions consists of all scripts and experiments implemented by me during the course of the project. The central goal of projects is to **maximize the novel contributions while maintaining consistency with predefined programs**. Following is a complete list of projects undertaken during my self study-

- Advice-based Conservative  $Q$ -learning
- Reinforcement Learning in Lua
- Deep Matrix Games
- EBMs/Hopfield-Nets
- Bullet environments
- RBMs and MAP
- Accelerating Offline RL
- Deep Learning with ROS

### 4.3 Reading

As highlighted in [section 3](#), my self study consists of **2 readings each week**. These readings consist of modern research papers in the broad field of Deep Learning. While I aim to center my paper selection towards Reinforcement Learning, my reading time frequently extends towards other areas such as Probabilistic Learning, Energy-based Learning, Bayesian Optimization, Computer Vision, Unsupervised Representation Learning. Occassionally, I read three papers a week depending on the availability of time. This section does not provide a complete list of papers I have read so far as there are simply way too many.

### 4.4 Writing

As highlighted in [section 3](#), my self study consists of **1 writing component each week**. The writing is a summary of one of the papers which I understood while doing my reading for a given week. In the interest of conciseness and quality, length of the summary is restricted to 1 page with its content focussing on the technical depth of the approach.

Over the course of my studies, my writing projects accumulated and evolved into a long-term project which I now call the [mini-arXiv](#). mini-arXiv has not only helped other students/researchers improve upon their research writing, but it has also provided me the opportunity to collaborate with people across the globe. This collection of summaries has allowed me to learn from the writing style of other authors and instilled a sense of discipline towards my research. Of all my academic accomplishments and learning experiences, I am most proud of mini-arXiv. I sincerely hope that this will continue as a side-project and enable me to learn new facets of literature.

My writing summaries are available at [mini-arXiv](#) with the name of collaborator as `@karush17`.