Preface

I remember romanticizing the prospects of working all night in a research laboratory ever since I was a child. I did end up in research but that was owing to serendipity more than anything else. Another thing I clearly remember almost a year ago is when and how I received funding for my study at CMU after I deferred my admission - the circumstances under which I received my funding are something I will never probably be able to forget ever. I constantly told myself that I would do everything humanly possible to make the best possible use of the opportunity provided to me and I would really supplement my Prof in his work. Having said that, over the last year I don’t believe I have been able to work anywhere near my full potential which was the reason why I started retrospection in December 2016. I have done a study of my work ethic in the previous semester and have documented the findings. However, I still feel that I am not doing enough and giving my 100%. I still find myself finishing things poorly and working till last minute to almost every meeting in the week. I want to make a significant improvement to this going forward considering that I want to stay relevant for over the next 4 decades. I want to kickstart this improvement by approaching this semester in a different fashion in the sense that I want to aggressively plan the semester schedule to the last half hour and stick to it as opposed to retrospection which I did for the previous two semesters. I am considering this similar to the way governments kickstart growth in the economies by manipulating interest rates. In addition, I am going to consider research like a business and aim to be ruthless in terms of professionalism and quality going forward. In the full report which I plan to write at the end of semester evaluating my progress, I will cover the following in addition to objectives:

1) **Theme and Motto:** I will try to associate every quarter with a theme that highlights the objectives for that quarter.

2) **A Construct to guide the process of topic/algo selection:** I want to treat energy and time similar to how a business considers capital. In other words, I want to introduce a nice construct that might help in choosing (a) what project to work on, given the prospects and constraints (b) how to design algorithms in the chosen project.

3) **Milestones:** These refer to the deliverables(in terms of number of work hours, etc) I need to meet irrespective of the outputs.
Theme and Motto

Theme - Endurance
The framework I am going to use to help visualize the progress through research in general and PhD in particular is what I call a triple E - Emergence, Endurance and Excellence.

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Table 01: Framework to visualize research and PhD

That said, I am going to use this semester to transition from the state of emergence to the state of endurance in PhD. The endurance phase I feel is characterized by extreme levels of commitment to the long term goal and a stubborn sense of discipline in terms of efforts put in to accomplish the short term goals. One example that comes to mind when I think of endurance is that of Virat Kohli, during the period of 2012 - 2015. Other examples include Infosys during the dotcom bubble and Elon Musk during 2008. I believe that having a 2-3 year endurance phase during PhD is absolutely critical to a successful research career.

Motto - “Run faster than you can fall.”

Motto I believe is something that is going to drive my work ethic during the semester. The source for this particular motto comes from a Netflix documentary I saw, where the athlete states that the key to win the endurance competition he was in was to make sure he runs faster than he could fall. It was a seemingly simple statement which increasingly started making sense the more time I spent thinking about it. The basic intuition that explains the statement has a grounding in the concept of inertia. Therefore the hypothesis is that once we spend a significant amount of time with a demanding schedule, that becomes our new normal and we converge to a performance at that level. This can also be understood from the growth pattern of countries. A technological innovation(Japan) or a government policy affecting capital either directly (Singapore in terms of mandatory savings) or indirectly (Australia in terms of birth control) leads to a boost in the economy in the short term which is almost always sustained in the long run, yielding high growth for at least a couple decades. I aim to imbibe this motto by working towards accomplishing one thing this semester which I currently feel is a near impossible task.
Current Alpha Objective

In this section, I will cover the objective I am setting myself to achieve by the end of this semester. The term alpha signifies that this objective was outcome of a quality control process of objective selection which I will describe later as a part of the report. My alpha objective for this semester is a submission to present a tutorial session at a premier conference next year.

Tutorial Session at Interspeech 2018

This was in the list of long term objectives in January this year and I am happy that it is making a transition into current objectives. The initial motivation for this objective was imitation - I observed that people like Richard Socher have given tutorial sessions during their PhDs and I have decided to blindly follow that. I believe that under constraints, imitation is a good way to learn things when we are ignorant of the path ourselves, (which is always the case with me !!). I believe that we keep innovating along the way, redefining the goals and hence will necessarily accomplish a disparate yet meaningful objective even if all we start with is blind imitation, and I have found this to be true in my case over past many years.

I have divided the task into 4 sub tasks:
1) Identify the topic of interest
2) Develop the content required for the tutorial session
3) Do a couple of iterations with a fortnight between the iterations
4) Submit the work

I have presented the progress achieved as of today in figure 01. The intensity of darkness of the colour signifies the level of completion of the subtask. I aim to generate a first draft by the end of September and a second by the end of October. I have mentioned the topics for the tutorial session as Appendix A.

Current Beta Objectives

1) 3 submissions to ICASSP 2018 - 2 direct and 1 via signal processing letters.
Estimation of Time Allocation for each task

As I have mentioned before, I would like to consider my research as a business and be objective about the progress. In other words, I would like to treat my time as a business treats its capital and allocate it to maximize the goals both short and long term. Therefore, I want to come up with a portfolio of time allocations, similar to the equity portfolios that create wealth. In this section, I describe the procedure I followed to do the same: Come up with an algorithm to allocate time to each of the activities that span the semester. The aim here is to deduce a tangible and optimal allocation of time for each task that maximizes the experience at the end of the semester.

Let’s try to understand this using a simple 2D example. Consider a vector \( E \), that denotes the expertise of a person defined using two features: Work and Health. In some sense, \( E \) is represented as a linear combination of Work and Health of the individual. Note that we can use the term \( E \) to denote any other aspect, such as satisfaction, etc. Moving on with expertise in this case, we are aware that \( E \) spans a 2D plane and the maximum value of \( E \) is achieved at the point (1,1). For simplicity, let’s quantize the continuous space into a discrete one, with \( q = 16 \). Now, there are 16 levels for each of the components of \( E \) (w and h) from 0 through 1. We can assume that these denote the levels at which we currently perceive ourselves. For instance, a value of the vector at (0.25, 0.5) denotes that we are a 25% expert at what we do and are 50% physically fit. Obviously, we would want to be at the point (1,1).

How to do that? Simple: Make a transition from where we currently stand to where we want to be. This, once we look at in terms of computer science is a simple search or path traversal problem. But given that we live in a practical world, it is not feasible typically to instantly optimize this path from where we stand to where we want to be, due to the constraints. But this also means that we can use beautiful machine learning algorithms to approximate this journey of our self development. These algorithms guarantee a good way of giving us the optimal solutions provided we encode the constraints in a reasonably comprehensible manner.

Let’s try to bring down the complexity of the algorithms a little lower. Of course we realize we cannot outright move to (1,1) in our toy example due to our constraints and we already know this in real life. Hence we have goals in terms of what we want to achieve, etc. Now if we assume that we do have a goal, say: At the end of 6 months I want to be at the point (0.3,0.55) meaning I want to improve my work expertise to 30% while maintaining and pushing my fitness levels to 55. This is a nearest neighbour problem in our 2d plane and if we use a Gaussian Mixture Model with two components (because there are 2 features) to model the probability of that point being the nearest neighbour (because joint probability of us being at any point in the plane is always 1), we obtain as mixture weights the percentage of amount of effort we need to put in to achieve our goals. We can then translate this percentages into the number of hours or any other comprehensible framework.
Primary motivation for using Gaussians to model time is that different tasks take different amounts of time. Also, we can do things for task, say alpha at a time instant, say A to reduce the amount of total time it takes to finish alpha, at a later time A + x. I will cover the detailed motivation for using mixture models to model time given the compounding nature of learning and the exact math used in derivation in the report at the end of the semester. For the current semester, I have used a feature vector of 12 dimensions and have used 5 component GMM to estimate the amount of time required to spend on (a) Research and (b) different aspects within research.

**Time Objectives:** I plan to be working a total of 1000 hours this semester. This is not an arbitrary choice, but is motivated by the fact (may not be fact) that expertise requires 10000 hours of input effort. I want to be putting up 60% of that within my PhD, which hopefully increases incrementally. Based on this, I will need to work 1000 hours this semester, 1100 next, 1200 the next. I will reevaluate the input effort required next semester and come up with a number for the spring semester 2019.

![Figure 03: Allocation of time for different aspects of the career for Fall 2017](image1)

![Figure 04: Allocation of time for different learning procedures within research for Fall 2017](image2)

I conclude this abstract with the topics I will be covering in the full report: (a) Subjective framework to help choose a PhD topic. (b) Why I feel Endurance is important at this stage of career. I always felt that I was unable to remember the non fiction stuff I read. I am happy that I am taking this delayed approach to report writing with an abstract dictating the agenda because it forces me to read a particular type of non fiction and crystallize my ideas by the end of the semester.