Thomas Edison once boasted, “I have not failed. I’ve just found 10,000 ways that won’t work”. The venturous attitude expressed by one of the world’s greatest innovators is consistent with today’s semiconductor industry. Each microprocessor chip eventually packaged and sold comes hand in hand with hundreds of failures, but these defective chips provide invaluable data for fabricating future healthy chips. A hundred chips are fabricated simultaneously on a circular “wafer” which is one of 25 other wafers in a “lot”. As each lot is fabricated, errors in the fabrication process can cause electrical malfunctions in the circuitry that may systematically take out multiple chips on the wafer. By measuring and recording electrical data through each fabrication process step, we can predict the final yield of good chips but more importantly, we can identify and prevent defects from reoccurring. My responsibilities as an electrical engineer at IBM is to scrutinize over these measured data parameters to diagnose chip defects and maximize SRAM yield. Through this experience, I have established confident utilization of data, allowing me to diagnose up to 12 fail signatures resulting in over 40% yield increase for SRAM memory and earning me two Manager’s Choice awards in two years.

As a diagnostician of chip defects, my daily routine involves tracking SRAM chip yield as well as monitoring bit fail maps to identify obvious fail signatures. Last year, we were losing 20% of chips per wafer due to dense clusters of single cell fails (SCF). On close inspection, I noticed that the clusters of SCF vaguely formed parallel stripes going across each chip. To further investigate, I pulled the coordinates of each failed cell and discovered that they can be bucketed into groups of 64 word lines where each group of 64 alternates between clean and dense fails. After presenting this data and consulting design engineers, I learned that the physical layout of each memory cell is mirrored after 64 word lines. This suggested misalignment on one of the metal levels. In response, I data mined all the tools used for metal deposition and discovered that wafers with high queue times in the CB2 deposition tools had lower yield. When all the data was put together, we understood that sometimes due to imperfections, the contact metal is misaligned slightly away from the gate. Because every other 64 Word lines is mirrored, this is only a problem for half of each chip. On top of this, if the queue time for the wafer is too long, oxidation occurs on the metal contacts which increases the resistance between the metal contact and the gate. The high resistance was causing many cells to fail resulting in the striped pattern. A fix was implemented by decreasing the queue time at CB2 as well as purging oxygen from the wafer containers by injecting nitrogen instead. This example serves to emphasize some of the experience I’ve gained from my responsibilities.

I was able to dissect a potential problem, recognize important data trails to follow, consult with experts, puzzle together the evidence to form a coherent explanation, and communicate my conclusions to achieve an improved fabrication process and much healthier SRAM chip yield.

On the job, I’ve learned many analytical techniques and developed good intuition regarding how to visualize and present data. However, most of the data is readily available through an IBM GUI. This means, besides manipulating the data through *JMP* and coding in *Excel VBA*, there aren’t many other opportunities for technical skill development like *SQL* and *Python*. In response, I took initiative to learn *SQL* from Khan Academy and *Python* from Big Data University which are great sources for free learning but are not without their limitations. I found that without utilizing what I learned, the information was hard to retain. In contrast, Berkeley’s MIDS program would offer me hands on experience through homework and projects while also offering active feedback and tutoring from professors and classmates. Additionally, the capstone project would offer a form of knowledge acquired through practice and experimentation that is extremely valuable. I endeavor to transition my career towards data science because I believe it is an organic progression. To clarify, my passion is in the technology industry but I do not wish to limit my career trajectory to the field of semiconductors. The interest and skills I’ve developed in tech-based data analytics, encourages me to pursue this path because many facets of the technology industry rely upon data. This will be amplified with the imminent implementation of 5G connectivity networks and the influx of sensors that comes with the scaling of IoT. I believe that with the technical skillset Berkeley offers, I can open up my career to a range of diverse opportunities.

Though I am attracted to all disciplines in the realm of data science, machine learning is the subject I endeavor to focus on. I am enthralled by the ground-breaking advancements in this field such as Google’s DeepMind AI teaching itself how to walk and navigate obstacles, to many examples of neural networks being able to recognize and emulate human speech patterns. My favorite recent breakthrough is OpenAI’s bot which taught itself an extremely complicated video game called “Dota” through reinforcement machine learning. This bot played a lifetime’s worth of Dota against itself in a matter of weeks and developed skills that enabled it to defeat the best professional players in the world. This was extremely impressive because the game has many intricacies regarding positioning of the character as well as correctly utilizing items and skills. What attracts me about Berkeley’s machine learning course is the focus on practical usage of supervised and unsupervised machine learning rather than being too engrossed with deeper mathematical theories. I focused on control systems and theories for my master’s degree at Georgia Tech so I am familiar with some machine learning concepts. By coupling the practical skills from Berkeley with my existing theoretical knowledge, I hope to be able to achieve deeper understanding of the topic through work experience. Besides control theories, my educational background includes engineering statistics and probability, linear algebra, and a minor in computer science. I have experience with many different scripting languages as indicated in my resume because I dabbled in various genres such as *C#* and *Unity 3D* for video game design, *Processing* for graphic design, and an extensive amount of *Matlab* and *Arduino* for various class projects. However, I haven’t had the opportunity to focus on one genre and master the required languages. Through the MIDS program, I am hoping to develop an expertise in data-driven programming that I can proudly build upon.

In summary, what I want to get out of the Berkeley MIDS program are technical skills, especially a practical knowledge of the required programming languages and algorithms to dissect complex datasets. I also hope to begin development towards my interest in machine learning and gain valuable practical experience. While in the process of obtaining my degree, I aim to apply as much of what I learn into my day to day work at IBM. For example, I can visualize setting up fail signature triggers based on pattern recognition data that would inform me if certain types of defects reemerge. In the near future, I aspire to move away from semiconductor development and reapply myself into a data science/machine learning role such as Amazon’s Alexa team who are looking for data driven improvements to language fluency. My long-term goal is to eventually move back to Thailand and utilize data to improve the developing nation I call home. For example, certain parts of Thailand suffer an excess amount of air pollution and littering. If I can analyze and report the environmental impact and its effect on the economy and quality of life, I can possibly encourage stricter preservation policies.