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As a part of generation Z, I grew up surrounded by technology. Both of my parents are software engineers; born in India, they understood the value of technology and always sought to provide my sister and me with the best opportunities possible. I used to wake up to the sound of the keyboard. Discussions about production issues and merge conflicts infiltrated dinner table conversation - computer science jargon was commonplace in my household. I couldn't seem to make it one day without hearing something about programming. It drove me crazy, to the point where I vowed to never code in my life.

Ironically, that decision barely lasted a year. Even in rural Lancaster, Pennsylvania, computer time in the library was a crucial part of Mrs. Adsitt's 3rd grade. On Wednesdays, our class had reserved time to use the library desktops. While our class was learning how to use a search engine, I spent hours intrigued by technical nuances. Inspecting page elements, I gradually learned how to change the page color with HTML and write my name on home pages; by that point, everyone thought my desktop was broken!

Soon enough, I couldn't stop. I took to learning platforms like Khan Academy and W3Schools. After learning the basics of JavaScript, I felt so accomplished to start the Advanced JS courses. In time, I built rudimentary graphing calculators and video games, but what captivated me the most were natural simulations. Following tutorials, I learned about Brownian motion, object-oriented programming, and basic mechanics. I loved the fact that I could use a computer in the real world to simulate real-world phenomena; suddenly, 'simple' things like collisions seemed like a mystery.

From a young age, I had participated in mathematics competitions, but computer simulation was a whole new way of looking at math and physics for me. In failing efforts to simulate, I learned about the founding principles of our universe and my thoughts of the equations on Wikipedia went from frustration to awe. Modeling physical phenomena was the perfect fusion of computer science and mathematics. The keyboard of my family computer gave me the power to create, discover, and innovate all on my own without the need of fancy equipment or a large working area. From there, curiosity drove me on, and now my parents wake up to me typing on my keyboard

Recently, I have been learning about differential equations, the capstone of mathematical modeling. With the help of great mentors, I started exploring the world of numerical recipes: numerical integration, finite difference methods, domain decomposition, etc. It wasn't long before I discovered fluid mechanics and the Navier Stokes millennium problem. I was awestruck by the beauty of the Navier Stokes Equations, results of the elementary laws of conservation that govern the complex modern world of fluid flow. Every time I see them, I am reminded of the elegance of mathematics. Yet despite their beautiful simplicity, modern solutions tend to be hairily computational.

Without the recent technological progressions in the last two decades, such numerical techniques would not be possible; we sure have come a long way from VHS tapes! With great strides in computing, data scientists and mathematicians have begun dusting off old techniques that once seemed practically impossible. Consider backpropagation, a rediscovered algorithm used in deep learning that only became possible given the growing compute power of a modern processor. With supercomputers and parallel computing, computational fluid dynamics (CFD) is a growing field with a plethora of industrial applications.

Naturally, fluid dynamics is a top priority of the Navy and Marine Corps, NASA, and likely many other organizations. Since fluid dynamics not only applies to liquids but gasses as well, CFD is an essential component in the design process of all types of vehicles from rockets to airplanes, submarines, and even cars. Though this may seem a bit absurd to the untrained eye, CFD is useful because it allows us to evaluate and in some cases improve the aerodynamic/hydrodynamic efficiency of a vehicle without building the complete design for the sake of testing.

All design problems come with a set of constraints: size, speed, weight, etc. Submarines, for example, must be able to sustain large oceanic pressures while maintaining maneuverability and speed. Hydrodynamically-inefficient submarine designs can cause excess hydrodynamic drag which not only limits the maximum speed of the submarine but requires more fuel to achieve a desired speed. Increasing fuel capacity to accommodate pushes on design constraints such as weight, limiting technical innovation. Furthermore, according to Dr. Karen Flack, biological growth on the surface of submarines can increase drag caused by the surface texture (biofouling). By modeling biological growth coupled with CFD techniques, naval researchers can evaluate chassis designs and anti-fouling mechanisms leading to more efficient submarines that can better protect Americans.

However, this does not mean that physical testing is obsolete. Currently, computationalists use data from physical experiments to predict fluid flow. CFD techniques can simulate fluid flow which has recently been shown to match experimental results. As classical processors continue to grow in compute power and with further research in quantum computing techniques for potential speed-ups, near real-time CFD could enable the navy to optimize vehicle development pipelines. With faster CFD simulations, possible designs could be quickly simulated to determine viability before further iteration.

However, without human ingenuity and out-of-the-box solutions, testing pipelines are effectively useless. An inspiring example of creativity is the story of Dr. Richard Ordoñez, a researcher at a naval graphene microfluidics lab. After trying to make a biodegradable transistor from water and sugars, Dr. Ordoñez, in frustration, used a drop of honey. Almost miraculously, the same honey that he was taking for his cold brought to life a functioning transistor! When thinking about Newton and 'his apple', it is easy to believe that science is all luck. But, at a closer glance, Dr. Ordoñez's story proves otherwise. Many researchers would preemptively dismiss outlandish ideas like using honey. This is not a story of luck but one of audacity and creativity. Innovation takes creativity and an acceptance of the risk of being wrong.

The perseverance and creativity shown in Dr. Ordoñez's work inspire me. The story of his Nature publication demonstrates that research requires risk and persistence; as Thomas Edison puts it, "genius is 1% inspiration and 99% perspiration". The passion that researchers like Dr. Ordoñez have to work tirelessly on their own ideas without guaranteed results is quite inspirational. Someone once told me that "the best way to find your career is to figure out where you find people similar to you". Frequently, I find myself working on personal projects, like a real-time flight simulator, for days on end simply to satisfy my intrinsic curiosity. The self-motivation of Dr. Ordoñez resonates with me.

As for my future, my affinity for computer science and mathematics suggests a career in applied mathematics. I find joy in developing my own ideas and products, and I know that in my ideal career, I want to have my mind blown at least once a week. That craving for discovery seems to only be satisfied in some type of R&D work. I want my work to have real-world impact and revolutionize the lives of future if not current generations. Whether that happens in academia, government, or industry I have no idea!

However, I do know that the future of the Navy and Marine Corps depends on the innovative ideas of young people like me. Over the next 15-20 yrs, the Navy and industry will have to rapidly shift towards automation and rapid iteration. Though some say Moore's Law is 'dead', as computing power increases, albeit 'slowly', full-scale simulation will become possible. From machine learning and additive manufacturing, emergent technologies like generative design coupled with rapid simulation and testing pipelines could quickly generate and evaluate preliminary designs. In fact, generative design features are already present in Autodesk software.

As self-driving technology rapidly develops, I believe that unmanned vehicles will gain prevalence, increasing the design space for many naval projects. I can already imagine a network of ROVs monitoring our oceans, streaming data to distributed machine learning systems that can be used to inform climate change policy decisions. Architecting such large-scale automated systems using microservices and containerization will be a high priority for future software developers. With these systems and innovations in artificial reality technology, our daily lives will be encapsulated in data, enhancing our decision-making and virtual sense of community.

As new technology like quantum computing gains traction, the Navy and Marine Corps will be forced to revise encryption practices and redesign R&D procedures to use new technology. In 2040, I envision a Navy that does not lag behind academia but is able to conduct cutting-edge research at a similar if not faster rate. I envision a Navy that prioritizes rapid iteration over one-shot perfection. But most of all, I envision a Navy that utilizes autonomy to maintain the freedom of the American people.