Personal Statement - Steven Walton

I believe that our society faces significant challenges over the next century, and am inspired to pursue a career in science because I believe science will be the key to solving these challenges. I began my education as a physicist, but have shifted to computer science since I believe that machine learning will be essential to solving these societal challenges. That said, I view my background as a strength, since my direction within computer science considers high-performance computing, computational science, and scientific visualization, and each of these are made stronger with a physics background. In this personal statement, I describe my experiences leading up to this proposal, including my qualifications and why I believe I can succeed in answering the questions outlined in this fellowship proposal. In particular, I will describe my passion for science, my desire to participate in science education, my experiences to date which include working in industry and obtaining funding, ...

Passion for science: I grew up reading Science-Fiction and watching Star Trek. This had a lasting impact on how I view the world, showing how science can change peoples' lives and the ethical decisions that need to be made. Growing up with role models such as Isaac Asimov, Carl Sagan, and Captain Kathryn Janeway, I have always been aware that while science can greatly advance peoples' lives, there are new ethical dilemmas that arise. As another role model might say: "With great power comes great responsibility." As a researcher, I want to act in a way that I believe would make these role models proud. I believe that this requires me to: be part teacher, ensuring that my work is accessible and available to others; part researcher, being creative and performing the best work that I can; and part philosopher, questioning the impacts and ethical dilemmas of my own research.

With the rise in popularity of Artificial Intelligence and Machine Learning it is becoming clear that ethical dilemmas are growing and are frequently being unanswered, or ignored. Conversely, the rise in AI research has helped push for more open science, where papers are being published to locations such as ArXiv and code is being open sourced on platforms such as GitHub. I believe that encouraging open science helps everyone, from scientists to the public.

With open science, I believe the public can be more informed with current research and help ask and answer the ethical problems that arise. When science is locked behind paywalls it causes gate-keeping that only hinders everyone involved, especially the public and those in impoverished neighborhoods and countries. Open research leads to higher reproducibility, catching more mistakes, and allows the public to be involved in the process. I also believe that when work is performed through public funding that such work should be accessible to those that funded it.

Having worked on several open sourced scientific projects as well as closed source, it is apparent to me that open sourced projects are more readily adopted by the scientific community. It also provides a direct line to the developer and the users, which leads to higher quality software and a better understanding of user needs.

I have always been passionate about learning and trying to understand any problem that interested me. This lead me to pursue an undergraduate degree in Space Physics. While I was able to buy all the books that were required for my classes I found that many times these were not enough. An advantage that I had was that the material in undergraduate physics textbooks have not change much in the last hundred years, enabling me to get old text books freely or for very cheap. I found that sometimes the way one textbook was written would be difficult for me to understand a topic, but that by going through several textbooks I could find one that enabled the information to finally

sink in. I found that the more resources available to me, the better I performed. This made me realize how important it is for experts to write on topics. Though there may already be existing material that thoroughly explains a subject, sometimes it requires a different voice for the reader to absorb the knowledge.

Like many other physicists, my colleagues and I admired Richard Feynman. When we learned about the "Feynman Technique", which says that one of the best ways to learn is by teaching, we started to arrange our study groups so that one person would lecture on a problem and the rest would ask as many questions as they could. I found this exercise both challenging and exhilarating. Studying by teaching was a great technique that helped me discover my passion for teaching.

Following through my passion for teaching, I became a Teaching Assistant for several of the advanced physics labs. I had talked to my professor about my enthusiasm for teaching and the possibility of becoming a professor after I went through graduate school. To encourage me, he gave me the opportunity to lecture several times in his place so that I could get the experience. This directly lead to me becoming a Supplementary Instructor for a class in Computational Methods, where I gave a mini lecture twice weekly. I found that this position challenged me but had great rewards. I loved seeing students succeed and helping them reach their potential.

My undergraduate university frequently had outreach days, where we would discuss with the other colleges and the public about different phenomena in physics. In my role, I had to design experiments that would both be exciting and could be discussed in a elegant and understandable manner. Being a Space Physics program, our outreach frequently revolved around astronomical events, where we would provide the public and other students the ability to observe events such as Lunar Eclipses, the Venus Transit, and several comets. I found great joy in being a science communicator and want that role to always be part of my life.

After graduating I obtained a job in Tennessee to work at a rocket company. I was able to work on low level research in conjunction with NASA and the University of Tennessee, Knoxville. While there, I wrote and won a Phase I NASA Small Business Technology Transfer (STTR) proposal. My employers gave me the lead position on the project, where I was in charge on planning, running the experiments, and handling the communication with our University partner (University of Tennessee, Knoxville). My success in this directly lead to Phase II funding and a continuation of this work. A large part of this work was performing computational simulations and then building and testing the resulting materials that the simulations predicted would have the best performance. This was my first time working with large and complex simulation code and I found that I really enjoyed it. I found that programming really resonates with the way I think and I found it exciting to build simulations that made real world predictions and that I was making real contributions to science.

This interest grew to a full on hobby, where I spent a lot of my time outside of work learning new things about programming and computer science. I found that there was a large amount of material on the internet that accelerated my learning. Different blogs, papers, and videos helped me grasp concepts that I had not learned through my undergraduate classes. I found many exciting topics, including Artificial Intelligence and Machine Learning, and because of the open nature of the research I was able to learn a lot about these subjects on my own.

After working for a few years, I decided that I wanted to continue down the path of the intersection of computer science and the physical sciences. There were new topics that I had been excited about and teaching myself but felt that this would be more efficient if I could get a mentor that could help guide me to the right problems and refine my abilities. I found the High Performance Computing

(HPC) visualization at the University of Oregon (UO) and applied for a PhD program, where I was accepted and have been a student for a year.

During my studies at UO, I have been able to work on scientific visualization projects and contribute to open sourced projects. I believe that my broad set of skills has added value to our research group, as I can help bridge the communication between domain scientists and the visualization experts. Through my current advisor I have had the opportunity to work at several National Labs. These internships gave me my first on-hands experience with HPC simulations and the data analysis involved. Working on these projects I saw that there was need for improvement, especially as there has been a push for larger scale computing. With my interests in machine learning, physics, mathematics, and computation I see ample opportunity to combine these topics and that my interdisciplinary skills would enable me to research this intersection of Machine Learning and computational analysis.

Intellectual Merit

With my background in physics and mathematics, coming over to the computer science field I believe that I am in a unique position for a project such as this. My strong math and physics background has already enabled me to help my research group bridge gaps in communication between domain scientists and visualization experts. It is not uncommon for miscommunication to happen between different research domains, as researchers may be using similar words but in different contexts. This has helped our group better understand what domain scientists are looking for, but may have a difficult time communicating. Having come from a background of performing simulations, it is easier to intuit what a simulation scientist is trying to accomplish.

My strong background in mathematics has enabled me to quickly catch up with modern machine learning techniques and understand the underlying statistical properties of models. Being in a computer science environment has helped reduce my so called "Swiss Cheese" knowledge in computer science and HPC and allow me to progress towards expertise.

Broader Impacts

I believe that one of the most important duties of a researcher is being able to communicate their work. Scientists such as Carl Sagan and Neil deGrasse Tyson have impacted my life and I believe their method of communication should be emulated by the scientific community. I have greatly enjoyed my experiences teaching classes and would like to become a professor in the future. I believe that becoming a professor would allow me to follow through with my passion for research and teaching.

Additionally, I am passionate about open source software and blogging. Personally, I have benefited greatly from both of these and blogging has enabled me to learn a large breadth of subjects. In an effort to contribute back to the community, which has helped me so much, I try to open source as much software as I can and write in my blog about what I am learning. I believe that a NSF fellowship puts me in a position that will encourage these passions. Not only will it free up time to enable more blogging of my research, but through a public funding I am not restricted from open sourcing my research and having the research be in the open.

I believe that by open sourcing and blogging about my research that this can more greatly enable reproducibility of results and push science to be more open. It is my belief that science is performed more efficiently when more eyes are able to see what is being done and more people are able to perform research. With funding through the NSF, I am able to perform research without constraints of visibility and can perform my research in the open.