My journey as a research mathematician. My journey from an undergraduate at the University of Illinois to now, where I am a Ph.D. student studying mathematics at Georgia Tech, has been long and at times difficult for me. One constant that has always been with me over this time period has been my enthusiasm and drive to work on mathematics. I received the Barry M. Goldwater scholarship in 2010. The scholarship is awarded to current undergraduate students who demonstrate strong research potential and who are committed to a Ph.D. degree in fields of mathematics, Engineering, and other scientific disciplines. In the five years since I earned my two undergraduate degrees in mathematics and computer science in 2012, I have published a total of seven original research articles, in addition to my master's thesis in 2014, in peer-reviewed journals with a total 16 articles on the *ArXiv* so far. I have also worked on significant open-source software projects outside of the classroom including two focused on STEM education. The support of the GRFP will allow me to focus more fully on my research, publications, and graduate studies continuing along this path that I have set for myself. Moreover, I feel that as a student at Georgia Tech, I have the best resources to continue developing new and innovative research and educational software projects. Since Georgia Tech has a 1:4 faculty ratio of women to men, which is one of the highest among leading U.S. universities, I feel that I will also be able to more broadly contribute to initiatives in mathematics and other STEM fields. This work will include my involvement in the *Association of Women in Mathematics* (AWM) and other professional associations bringing together women in STEM fields at Georgia Tech. The support of this fellowship award will allow me the freedom and flexibility to get involved in more research and related mentoring projects in an accelerated timeline during my Ph.D. program at Georgia Tech.

My particular areas of interest combine mathematics and computer science with emphasis on number theory, enumerative combinatorics, and software development. I intend to conduct research and publish in my fields of study, both working on my personal research and as a professional in industry. I will continue to publish significant findings in professional journals and other peer-reviewed scholarly outlets. I will continue to pursue challenging research problems with cross-disciplinary applications in mathematics and computer science. I intend to publish the results of my research on these topics in peer-reviewed journals, present the results through talks at professional conferences, and make the research broadly available for educational, teaching, and other purposes in venues such as the web. As a female in my fields of study, I will continue to promote new learning and research mentorship opportunities to encourage diversity and to bridge the gender gap for the under-represented minority of talented women in these fields.

I have always been drawn to the forms and properties of recurrence relations and integer sequences in mathematics. In the summer before my first semester at the University of Illinois as an undergraduate, I became interested in finding exact formulas related to prime numbers. Inspired by the unusual result of Binet's formula for the Fibonacci numbers I learned about in my first course in elementary number theory which inspired me and made me excited to work on math starting in my pre-college years, I started challenging myself to find such a non-intuitive result for the sequence of primes of the form $4k+1$. The explorations of this topic first sparked my interest and led me to develop original research of my own. Since I was first drawn to number theory and mathematics, I have battled medical hardships which prevented me from enrolling full time in school for years at a time. Despite these

circumstances I have always found working on my mathematics research to be a rewarding focus of my activities.

Detours along the way. In my time away from the University of Illinois at Urbana-Champaign as an undergraduate I had medical issues that prevented me from continuing in formal academic studies for an extended period of time. I knew that my interests would eventually lead me to graduate studies and I pursued research opportunities from professors to work on their projects during my recovery. These projects primarily involved development of software programs combining computer science with my love of mathematics. An extension of one of these software projects I worked on over this time eventually became the topic for my MS thesis completed in 2014. During this first real time away from a campus environment, I had the freedom to devote my studies to my own software projects and personal interests in mathematics research. This independent research effort led to the combinatorial mathematics which I eventually first published as an undergraduate in 2010. I have seen that I can look forward to giving the same full-time intensity to my studies required by a rigorous Ph.D. program in mathematics.

I graduated from my undergraduate studies at the University of Illinois in 2012 with bachelor's degrees in both mathematics and computer science with institutional honors of *Highest Honors*, *Cum Laude* and departmental honors of *Highest Distinction MATH*. After I graduated with my thesis-based MS in computer science in 2014 related to recognition of special mathematical sequences by software, I decided to enroll in a mathematics Ph.D. program at the University of Washington in Seattle. My time at that institution was similarly plagued by medical issues that I had no control over and which forced me to take a medical leave of absence and hardship withdrawals after only two quarters of graduate coursework. I soon returned home to live with family after taking the medical leave and have lived with close family for approximately two and a half years where I was again free to devote most of my time and energy to working on my own more developed mathematics research over this time period.

In my second time away from formal studies at the University of Washington, I kept in contact with Professor Jayadev Athreya, whom I had met at the University of Illinois when I was enrolled there taking advanced mathematics and computer science courses as a Master's student. He provided me with computational research projects and undergraduate research mentoring opportunities. He was able to provide me with funding to work on an open-source tilings-related statistics project where I developed software implementations of more than forty substitution tilings and famous pentagonal tilings of the plane (`https://sites.math.washington.edu/wxml/tilings/`). During the Spring quarter of 2017, supervised by Professor Athreya, I taught a remote, self-created WXML topics course focusing on this tilings software. The instruction focused on programming in *Sage* with *Python* and mentoring the undergraduates enrolled in my special course offering. Through this mentoring experience, I was able to pass on my knowledge of software practices and methodologies such as the waterfall model, which we practiced in addition to new MARS roles for participants every week, to mathematically motivated undergraduate students. My aim through this mentorship opportunity was to give them new experience using software-driven experimental mathematics techniques which they will use, as I do regularly now, as their research becomes more mature in graduate school (see `github.com/maxieds/WXMLTilingsHOWTO/wiki`).

I have personally benefited from undergraduate research experiences such as the *Honors*

Intro to Math Research course taught by Professor Bruce Reznick and mentoring experiences with Professor Bruce Berndt who has greatly influenced me in developing my mathematical writing style. I have found being taken seriously as an undergraduate pursuing original research of my own particularly encouraging through these experiences. I plan to pass on this encouragement and the wisdom I have learned by talking with experienced career mathematicians to other motivated researchers as my professional career progresses. This especially applies to offering advice and influencing talented women in mathematics with opportunities to develop their work beginning as undergraduates as I have been fortunate enough to benefit from early in my career with my mentors. While I was completing my MS, I was involved with several projects in the *Illinois Geometry Lab* (IGL) facility in the mathematics department at the University of Illinois. I assisted with programming tasks for various projects in the lab supervised again by Jayadev Athreya. The projects in the IGL focused on mathematical visualization and community engagement. Within the lab, undergraduate students work closely with graduate students and postdocs on visualization projects set forth by University of Illinois faculty members, as well as to bring mathematics to the community through school visits and other activities.

Intellectual merit and broader impacts. The first article I published in the *Journal of Integer Sequences* (JIS) in 2010 was based on a significant subset of my independent mathematics research from my first time away from formal academic studies. A review of the 54–page *JIS* publication appeared on *MathSciNet* in 2011. states that the research presented in the article is "*excellent*" and "*will be useful for a further study in enumerative combinatorics*". I presented a report based on a subset of the research from my *JIS* article at the *Young Mathematicians Conference* in the Summer of 2012. Since then I have published several other articles in ranked peer-reviewed journals including two in the *Journal of Integer Sequences*, *Acta Arithmetica*, the *Journal of Number Theory*, and the *Journal of Inequalities and Special Functions* with more to come within the next year (see `https://arxiv.org/a/schmidt_m_2.html`). I have begun to coauthor several new articles with mathematicians from across the globe, including one manuscript to appear in 2018 in the highly selective *American Mathematical Monthly* (AMM).

There are a number of other mentorship and broader outreach activities I am engaged in outside of the classroom. For example, I have independently developed at least four separate open-source-software projects. The program source code is freely available on the project webpages for various purposes including educational study. My portfolio of software projects encompasses both research and educational tools intended for distribution as open-source software for broader uses within STEM fields. These open-source software projects include an add-on package rewritten and extended in *Python* for special combinatorial sequence recognition based on my MS thesis program originally coded in *Mathematica*. I submitted this add-on *Python* package to be included in the stock list of packages distributed with *Sage* which has a broad reach as high-quality open-source software to both mathematicians and educators in STEM fields worldwide. I have also authored a notebook on the *Wolfram Demonstrations* website, which supports STEM learning, on generalized Ulam sets in the plane which extends my work on the tilings project over 2016–2017. I have so far given two talks to the Georgia Tech graduate AWM and to an undergraduate seminar intended to expose students to upper-level math research based on my 2018 AMM article. ⊡