

I am writing this letter to give my highest recommendation to Victor Churchill. He is a gifted student at the top of a highly competitive Master's degree program at one of the top math departments in the world. I would like to particularly stress his initiative, independence, and curiosity.

I have known Victor since he entered my course, Advanced Topics in Applied Math: Fast Analysis-Based Algorithms. This is an advanced course intended for Ph.D. students. The course is an introduction to several numerical methods including fast multipole methods, butterfly algorithms, hierarchical matrix compression and fast direct solvers. These algorithms can be used to solve many of the partial differential equations governing classical mathematical physics, namely electromagnetics, acoustics, heat diffusion, and fluid dynamics. I should emphasize that this branch of applied mathematics and scientific computing has attracted exceptional research attention over the past two decades, and one has to possess broad mathematical scholarship to work here. Victor has been able to effectively apply his foundational math knowledge in this research area. This is certainly the sign of a successful graduate student.

Victor has always been an attentive and proactive student. He came to me at the beginning of the semester to discuss potential research topics for the course project, and for his Master's degree thesis. We met and I agreed to advise his thesis. I outlined several projects in the field of fast algorithms, and suggested a few papers for him to review. Victor immediately jumped in to the project. He went to the library and explored online, independently finding and carefully reading relevant papers and notes. He came back often with specific well-formed questions about the next steps for the project that showed me he thoroughly understood the material and was eager to learn more. It was immediately clear to me that Victor has zeal to learn beyond the scope of the syllabus. This is the level of curiosity, motivation, and effort I would expect of a strong Ph.D. student.

At the end of the course, Victor distinguished himself by submitting an ambitious and exceptionally well-researched project. I viewed his course project as a progress report for his thesis. In his report, Victor provided background and context to the problem he hoped to solve, and also laid out an effective plan to

achieve further results. He clearly demonstrated his ability to come to a detailed understanding of a challenging new concept. In his presentation for our class, he proved that he was able to effectively communicate his ideas to his peers. In addition, he was able to quickly acquire the programming skills necessary to provide excellent numerical estimates that confirmed the theoretical results he had predicted. I have no doubt that Victor will continue to impress me as I advise him further on his Master's thesis, which should prove to be a top thesis in the department.

From our discussions concerning Victor's future plans I can conclude that he is serious about a career in math research. He is taking an accelerated course load to finish his Masters degree in 3 semesters rather than the typical 4, and also has teaching experience as a recitation leader. The program and the environment at Courant are intensive, and Victor has proven himself very successful in it.

For these reasons, I strongly recommend Victor Churchill for graduate studies toward the Ph.D. degree at your University. I am sure that he will become an excellent scholar and will produce serious quality work.