I want to make complicated ideas simple. It seems like most--at least 90%--of research done today isn't very important. Many papers seem relevant to only sub-sub-communities, and impenetrable to everyone else. Why? As far as I can tell, the majority of work is complicated or boring--usually both. It's hard to make complicated work fun, interesting, or intriguing, and it's difficult to vet a complicated idea, system or explanation. It seems like the only way to stay relevant is to stay simple. As the mathematician John Baez put it,

> "I used to try to prove 'tricky' or 'difficult' things, and it never worked — I kept finding mistakes in my proofs. Eventually I gave up and decided to only prove stuff that was completely obvious to me. The challenge then became making lots of things completely obvious!"

In order to make complicated ideas simple, I think it will be crucial to develop a broad base of knowledge and do multi-disciplinary work that actually spans boundaries, rather than just working between them. During my time at the University of Texas, I worked towards this goal in my speaking, research, and community organization.

One of the biggest challenges is to simplify technical information for non-specialists. Often "non-specialist" means another researcher--just in a different field. A month ago, I prepared and presented a two lecture mini-course on the application of classical geometry and exterior algebra in computer graphics. Although my labmates had certainly heard of concepts like projective and affine spaces, they appreciated the talk for unifying and deepening their understanding through less familiar approaches. (eg. transformation groups) In a similar vein, I presented Maurice Herlihy and Nir Shavit's work on "The Topological Structure of Asynchronous Computability" to the systems research group. At the time, I was taking both distributed computing and algebraic topology, putting me in a unique position to explain the topological content which had eluded them for so long. Both talks challenged me to compress semesters of material into digestible and entertaining forms. The only viable solution was to talk about simple topics, or topics I could make simple.

Taking a very different angle on this idea, I started researching 3d sculpting and geometric Booleans because I felt 3d modeling was unnecessarily complicated for artists. I thought the solution was to create a minimally complicated modeler. It would support only two operations: add (clay) and subtract (chisel). Starting with human computer interaction, working through Boolean algorithms (ie. boundary evaluation) down to details of floating point computations, and up to algebraic theories, I worked across existing boundaries, letting the problem guide me. I found that making Booleans fast and 100% robust (to numerical and geometric degeneracies) is really complicated. So I did everything I could to simplify them. Over the course of the last 3 years I developed the fastest 100% robust algorithm, implemented it from scratch, and demonstrated that it runs as fast as non-robust commercial systems developed by teams of programmers over many years. I received department funding for 3 summers in a row, best math poster at the Natural Sciences Undergraduate Research Forum, and honorable mention from the CRA's outstanding undergraduate award. (If you are interested, feel free to peruse a draft copy of my honors thesis on this topic at www.cs.utexas.edu/users/gilbo/thesis.pdf)

In addition to the Booleans project, I have also been working in the math department (with Dr. Cameron Gordon and another student) on a topic at the intersection of knot theory and graph theory: intrinsically knotted graphs. Since beginning work on the problem last spring, we have identified a new minor-minimal intrinsically knotted graph. I demonstrated that certain techniques to prove this fact would not work by using a computer program to solve a laborious counting problem. This saved a tremendous amount of time where my collaborators had been trying—unsuccessfully—to count by hand. Expanding on this idea, I devised a new proof strategy which allows for rapid exploration of hypotheses using this counting program. My computer science background not only made the programming trivial, but more importantly led me to think of the approach in the first place. Additionally, my growing familiarity with knot theory will better prepare me to recognize potential applications in computing. Although the topic seems rather removed from computation at first blush, knots have already been linked to quantum mechanics, quantum computing and a variety of combinatorics problems, most notably in complexity theory.

Regardless of how much work I personally do, speaking and researching, I'm still only a single person, with limited time and resources. In order to encourage a broader movement to make things simple, it's necessary to build community momentum. Although there are many undergraduates in computer science working on research, the department is generally unaware of their work. Looking to correct this issue, I devised, planned and acquired funding for a one day computer science undergraduate mini-conference last Spring. Ten students gave short, 15-25 minute presentations on their work to an assembled audience of undergraduates and professors. By encouraging undergraduates to attend and imposing relatively short time limits, the speakers were forced to summarize their research clearly, succinctly and simply, so that everyone present could understand. I am currently planning for another conference this coming Spring, and looking for younger students with which to co-organize. This way the conference will continue on after I leave the University of Texas.

Graduate school will afford me the once in a lifetime opportunity to learn in depth about many different areas and topics in computer science. Although I plan to focus on computer graphics in my own research, I believe that this breadth of knowledge is crucial in order to be a truly effective academic. The University of Washington's graphics group really impresses me with their breadth, particularly in comparison to other programs, many of which are heavily specialized in particular subfields. Plus, the mathematics department's large combinatorics and discrete geometry group seems like a fertile ground for collaboration. Last, but certainly not least, I am particularly interested in the University of Washington, having already spent (and enjoyed) a Summer internship in Seattle. I would be thrilled to return for graduate school. Please feel free to peruse my website at www.cs.utexas.edu/users/gilbo/ for additional information on my activities and pursuits.