Teaching Goals Statement

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Good teaching and good research can reinforce each other in attractive ways, and I want to do both. The richest, most productive research environments are most often found in university faculty positions, precisely because some teaching is required. Teaching and research compete fiercely for a faculty member's time, but each can provide disciplines and skills useful for the other.

A researcher who teaches is never isolated. Teaching encourages regular contact and collaboration with a steady stream of new students and other faculty members. I learned from the rapid progress of the Georgia Tech Graphics, Visualization, and Usability Center how well collaboration enriches research, and how teaching pulls people together. Classroom work, curriculum planning, guiding students and broad-ranging discussions can aerate research and prevent stagnation. Classroom teaching also helps a researcher to stay well-practiced at explaining new ideas briskly and clearly, and such practice aids in writing journal articles, in speaking at conferences, and in assembling funding proposals.

Teaching broadens a researcher's view. Researchers who teach must continually revisit the underpinnings of the entire field, not just their chosen research area. Genuine advances in science often come from pondering its limits, by finding a missing part or hidden connection in a tested body of knowledge. Grappling for a vivid way to explain an old familiar idea is a very good way to find and understand more of its subtleties.

Conversely, research helps teachers keep their enthusiasm for computer science by staying current on its latest advances. Research reminds teachers that often the field's most powerful and widely used tools are first presented in the introductory coursework. For example, very few computer science research areas can safely ignore graphs and tree structures or linear algebra. A teacher with research experience knows the importance of these tools firsthand, and is less likely to teach them as a tedious series of symbol games to be learned by rote. These teachers know the excitement of new ideas, and know how basic material, when elegantly presented, leads quickly to the outer edges of what we know.

A teacher with research experience can show how complex, abstract ideas grow from accessible and mundane beginnings. For example, instead of relying solely on textbooks for fundamental material, Greg Turk at Georgia Tech taught me to read the original research papers as well. These papers show that the first path to an important idea often isn't the one presented in most textbooks, and the original author's own words may reveal surprisingly different goals and unusual reasoning. Textbooks are more efficient, but may mislead students into thinking that the scientific progress is beyond their reach, made by huge unified leaps every few years, and not by a boiling soup of smaller ideas where larger patterns eventually emerge.

Good teaching is a combination of classroom work, easy availability to students to answer questions and to offer guidance in coursework and reading, and an amiable willingness to shoulder some necessary clerical duties. I look forward to informal one-on-one discussions, advising, and collaboration with students. For example, at Cornell I helped students Dan Kartch and Hector Yee polish drafts of their theses, and in that process I revisited topics in Fourier optics and holography. Memorable informal collaborations both at Georgia Tech and at Cornell have led to useful insights and some published papers, including work on perception of human motion with James O'Brien and Jessica Hodgins at Georgia Tech (*IEEE Trans. on Visualization and Computer Graphics*, Oct. 1998), discussions on temporal adaptation with Sumant Pattanaik (*SIGGRAPH 2000* paper), and debates on particle-based graphics ideas with Philip Dutré at Cornell (preparing a paper on it now).

I do not have as much classroom teaching experience as I would like, but what I have done has been invigorating to me and well-received by students. At Georgia Tech I was the teaching assistant, grader and a guest lecturer in Dr. Irfan Essa's computer vision course (CS 7321 Winter '97). I presented guest lectures and wrote corresponding homework sets for two courses at Cornell (Arch 476.6 Fall '99, CS 517 Winter'00, both taught by Dr. Philip Dutré). I also lectured in the NSF/STC Televideo Seminar Series that links five universities (Brown, Cornell, Utah, CalTech, and UNC-Chapel Hill) by interactive video for collaborative teaching and research discussions, and received several strong compliments on the presentation.

In addition, I proposed and led a popular weekly series of 'Brown Bag' Seminars at Cornell to encourage careful reading and discussion of recent research papers in computer graphics. Each week a volunteer discussion leader presents a concise summary of the paper, and then group members work together to clarify difficult or confusing passages. We list the key contributions and new ideas in the paper, and debate how the paper could be improved and extended. Readings often become valuable 'brainstorming' sessions about new research ideas.

I look forward to teaching a few core courses, such as Computer Architecture & Organization, Data Structures, Algorithms, Automata Theory, and Introductory Programming. I also would like to develop and teach new interdisciplinary courses, including:

- Introductory Computer Graphics – Fundamental tools and methods for all areas. Topics include viewing transformations and homogeneous coordinates, polygons and scan conversion, clipping, hidden surface removal, surface color and basic light transport, texture mapping and warping, an introduction to antialiasing, scene graph structures, software libraries and basic interactivity/animation.
- Advanced Computer Graphics – Surveys more specialized topic areas in computer graphics, including local shading methods, global illumination methods, L-system modeling, subdivision surfaces, rigorous anti-aliasing, particle systems, spring-mass systems, motion capture, image-based modeling and rendering, lumigraph/light-field rendering, and non-photorealistic rendering.
- Curves, Surfaces and Solids – An advanced course to address problems of shape representation in computers. The course begins with a review of polyhedral mesh representations, presents a thorough introduction to parametric curves and surfaces, introduces subdivision surfaces and implicit surface representations, and explores the practical advantages and limitations of each.
- Human Visual Processing – A broad, two-part, graduate-level survey of what we know and do not know about visual signal processing in the human visual system. Course will give special emphasis to computational properties and problems in computer graphics and computer vision. The course will explore the physiology of the eye, retina, and visual cortex, receptive field organization and computational models, and difficulties with nonlinearity. It will review psychophysical measurement results, temporal and spatial response, tri-stimulus models of color perception, lightness/brightness theories, eye movements, and collections of instructive illusions.
- Image-Based Graphics – An advanced course devoted entirely to graphics made without spatial connectivity. The course reviews recent work in modeling and rendering using pixels or point samples as first-class primitives. Topics include reprojection and plenoptic modeling, lumigraph/lightfield capture and rendering, epipolar geometry and correspondence, voxel carving methods, and point-cloud rendering. Explores the growing overlap between computer graphics and computer vision topic areas.

The first two courses familiarize junior or senior level undergraduate students with the entire field of computer graphics and its connections with physics, geometry, and vision. Further courses encourage graduate students and interested undergraduates towards more specific applied work and research.