Andrew H. Fagg
Teaching Statement

Teaching Philosophy

I see my role in the classroom as one of structuring the class experience so that the students have the tools, confidence, and interest in the subject matter to perform well in my class and in their future endeavors. I approach the challenge of teaching by 1) having high expectations of students, 2) pushing students to take an active role in their own education, and 3) showing students that their classroom experience relates to what they have already learned and that it will be relevant to their future classes and careers. My approach takes a variety of forms:

1. I explicitly engage the students in discussion and problem solving during class. Inspired by the work of Dee Fink (2003), problem solving sessions are done in small groups or with the entire class. In addition to practicing the skills that we are learning in class, these structured sessions help to develop the students' collaborative problem solving skills and give me an opportunity to dynamically tailor the presentation of the material to the needs of the students.

2. I structure class assignments such that the students must interact with one-another, both inside and outside of class. Something that has been lost in the *computer in every backpack* culture is that students in the same class often do not have contact with other students outside of the classroom. As a result, the students lose out on the opportunity to learn from each another. I find that giving collaborative assignments helps this contact, but that the effects are enhanced when the assignments are designed such that students must work side-by-side outside of the classroom.

3. I design projects that require students to make choices in the path that their project work will take. This forces students to be more engaged in the process from the beginning and gives them an additional degree of ownership in their work. Providing enough structure to ensure that students can make positive progress very early in the project is key to making this approach successful. While this is easiest to accomplish with graduate and senior-level courses, with the proper structure, freshmen can be engaged in this way as well.

4. Where possible, I bring my current research activities into the classroom. My embedded systems course has focused over the last two years on designing the control hardware and software for a set of small mobile manipulation robots. My work on *Bion* has found its way into courses for middle and high school students, freshmen (Introduction to Engineering), juniors (AME Real-Time Embedded Systems), and seniors/graduate students (Embedded Systems).

Training Students in Research

In addition to classwork, I have supervised the research activities of a number of graduate and undergraduate students in a range of research projects in the areas of robotics, computational neuroscience, machine learning, interactive art, embedded systems and wearable computing. At all levels, my first goal is to teach the students some of the fundamentals of working in science: how to transform a problem into a scientific question, how to design an experiment from a question, how to analyze the results, and how to express oneself in spoken and written form. I also focus on making sure that the students develop an appropriate tool set with which to tackle the problems in their research area. With the younger students, I am typically careful about setting the direction of the research and writing processes. But as the students mature, I think it is most valuable to them (and to me) for them to take a more active role in determining the direction of their own research. In this context, research and writing become more collaborative processes. I also expect senior students to take on leadership and mentoring roles. In addition to creating more of a collaborative environment within the laboratory, this gives the students a better sense of investment in the laboratory and prepares them to direct research in their own labs.

I have served and am now serving on a variety of Masters and PhD committees (detailed in my CV). Although most of these students are from the Computer Science Department, I have served as an outside member of two committees in the University of Massachusetts (UMass) Psychology Department and one committee of the UMass Neuroscience and Behavior Program. In addition, I have served as a PhD committee member for students from the Universitat Jaume I in Spain and the University of Queensland in Australia.

The undergraduate research has been performed either in the context of a Research Experiences for Undergraduates (REU) funded program (NSF) or through supervision of honors theses. In particular, I directed the OU/UNM REU site on Embedded Machine Learning Systems from 2/5 to 2/8, and am currently directing the OU/UNM REU site on Integrated Machine Learning Systems, which is funded through 12/10.

A total of 33 students have participated in the four years of our REU program; I have directed ten of these students. As of the Summer of 2008, 18 of the 33 have completed their bachelors degrees. Of these, ten have moved on to graduate programs. Our REU students have received two honorable mentions in the 2007 CRA Outstanding Undergraduate Award Competition, one best paper nomination, two outstanding senior awards, one outstanding junior award, and one honorable mention in the NSF Graduate Fellowship Competition. A total of 14 published or accepted papers were produced with REU (or former REU) coauthors; four of these publications were authored by my REU students.

MS and PhD Student Supervision

The following table details the number of students that I have directly supervised per semester while at OU.

	Phd	MS	ugrad	
Fall 2004	1(UMass)			
Spring 2005	1(UMass)	1		
Summer	1(UMass)	2	3	
Fall	1(UMass)	3	3	
Spring 2006	1(UMass)	3	3	Graduated Rob Platt (PhD, UMass)
Summer		3	4	
Fall		3	4	Graduated Charles de Granville (ugrad to MS)
Spring 2007		4	3	
Summer		4	4	
Fall	1	4	4	Graduated Di Wang (MS to PhD) and David Goldberg (MS)
Spring 2008	2	2	4	
Summer	2	2	4	Graduated Charles de Granville (MS)
Fall	3	2	4	

Courses Taught

In my time at the University of Oklahoma I have taught several core and seminar-style classes:

- Spring 2007-2008: Embedded Systems (CS 4163/5163), 18 students. **New preparation in 2007 (with some material from my AME class and my 2003 Embedded Systems class)**

  This combined graduate and senior undergraduate course focuses on designing, implementing and debugging computational systems that are tightly integrated with sensing and actuation. In their semester-long project, students developed a control system for a 14 degree-of-freedom mobile manipulation robot equipped with two arms, force sensors, camera, compass and a range sensor. The final project required the students to coordinate the activities of 6-7 microcontrollers to perform the set of searching, grasping, transportation, and stacking actions. The mobile manipulator platform was developed by me and my research students.

  This course has been selected as an **OU Presidential Dream Course** in 2009 in conjunction with Adam Brown's "How to Build Robots for Artists" course ($20,000 has been pledged to support external speakers).

- Spring 2007-2008: Introduction to Engineering (ENGR 1420), Interactive Art Laboratory section, 26 and 50 students, respectively. **New preparation in 2007 with a substantial redesign for 2008**

  The Interactive Art Laboratory develops a range of problem solving and collaboration skills in the context of designing and programming interactive behavior for small groups of computing units from our Bion art installation. Students learn the fundamentals of expressing temporal and reactive behavior using the Finite State Machine (FSM) model of computing. An interface designed by the instructor enables students to graphically express a FSM, to simulate the interactive behavior that results from the FSM, and then to automatically compile and download the FSM code to the physical bion. The interface hides many of the details of programming from the students, enabling them to produce interesting behavior within a short period of time.

  We have used the same teaching modules and GUI to successfully teach the basics of FSMs and programming to middle and high school students (Global Conference on Educational Robotics), as well as to middle school teachers (K20 Research Experience for Science Teachers Institute).

- Spring 2005-2008: Real-Time Embedded Systems (AME 3623), average 22 students. **New preparation for 2005 (with some basis in the 2004 offering of the class); New lab design for 2007**

  Real-Time Embedded Systems is a required junior-level course for aerospace engineering students. Similar in its goals to the CS counterpart, we also focus on the fundamentals of computing, and program design, implementation and debugging. Over the course of the semester, students develop a control system for a 4-rotor helicopter. The helicopter platform (commercially available) was adapted for use in the classroom by me.

- Spring 2006: Smart Art Spaces (CS 5973 and Art 6010; co-taught with Adam Brown), 10 students. **New preparation for 2006**

  This course brings together art, computer science, and engineering students to learn a common set of tools and language for developing interactive art pieces. Students learn the fundamentals of art and embedded systems design and practice. This course resulted in a student-driven art piece, *PulsePool* that was shown at the Boston Museum of Science for the 2007 Boston Cyber-Arts Festival.

- Fall 2006: Empirical Methods for Computer Science (CS 5973; co-taught with Dr. Dean Hougen), 7 students. **New preparation for 2006**

  Empirical Methods aims to bring standard scientific techniques to the practice of computer science and related disciplines. We focus on the formulation of experimental questions, the design of empirical methods to get at these questions, and the evaluation of the empirical results.

- Fall 2005: Neuro-cognitive Robotics (CS 5973), 6 students. **New preparation for 2005**

  In this graduate-level seminar, we examine a range of computational theories of representation, learning, and control from the neuro- and cognitive science domains and explore 1) the application of these theories in the design of robot control systems, and 2) the use of robotic implementations in testing these theories.

Prior to arriving at the University of Oklahoma, I taught a number of classes at the University of Massachusetts:

- Fall 2003: Graduate/Undergraduate Embedded Systems (CS 503/591c), 15 students. **New preparation for 2003 (some material used from the 2002 version of the course)**

  This course provides an introduction to integrated hardware/software solutions in computational systems with sensing and actuation. Topics include digital and analog electronics, PIC microcontroller architecture and programming, scheduling, interrupt handling, timing, sensor interfaces and processing, actuator control, and inter-processor communication. In addition to the lecture, the class requires a significant amount of laboratory work. In this semester's class, we focused on the design and construction of components for an interactive room. I developed a majority of the course material.

- Spring 2002 and 2003: Undergraduate Operating Systems (CS 377), 60 and 70 students, respectively. **New project preparation for 2002**

  The undergraduate operating systems course is required for computer science undergraduates at UMass. This class covers a wide range of topics, including: process control and scheduling, multi-threading, process synchronization, memory and disk management, inter-process communication, and I/O handling.

- Spring 2003: Co-instructor (1 of 10) of the Graduate Computational Psychology Seminar (Psych 891E), 10 Students.

  This course covers a range of topics in the area of computational modeling methods as applied to the psychology domain. My component of the course focused on the experimental and computational issues surrounding the encoding of movement in motor cortex and on the question of formulating and testing computational hypotheses in general.

- Spring 2001 and 2002: Wearable Computing Seminar (CS 691w), 12 and 8 students, respectively. **New preparation for 2001**

  The wearable computing seminar examines many topics in this new area of research, including multi-modal user interfaces, sensing, representation of user context, machine learning, and application design and testing. The students were required to perform a significant semester project.

- Fall 1999 and 2001: Computational Neuroscience Seminar (CS and Neuroscience and Behavior Programs: 691c), 12 students for both semesters. Co-taught with Dr. Andrew G. Barto in 1999. **New preparation for 1999 and substantial changes for 2001**

  This seminar introduces students to the language and computational issues of the neuroscience and motor control domains. Topics include the formulation and testing of computational hypotheses, basic anatomy and physiology, experimental techniques, movement and sensory encoding, neural plasticity, and motor learning.

OU Course Evaluations

Through the Spring of 2007, instructor evaluation in the School of Computer Science was based on the average score of a set of six questions:

Q1 "Instructor clearly stated the main objectives of the course, and the written communication of requirements (syllabus)."

Q2 "Instructor was available and helpful outside of class or during posted office hours."

Q3 "Instructor gave a clear presentation of the material."

Q4 "Instructor was well organized and made adequate preparation for class."

Q5 "Instructor was enthusiastic about teaching this class and invited question[s] and comments from students."

Q7 "Instructor was more effective compared to other engineering faculty members."

Each question was scored in a range of 1 to 5. 1 was the highest score through the Spring of 2006; 5 was the highest score thereafter.

In the Fall of 2007, instructor evaluation was changed to focus on a single question: "In general, the instructor taught this course effectively." The intent was that this question aggregates the original six questions. Again, scores of 1 to 5 were possible, with 5 being the highest score.

Figure 1a summarizes my aggregate scores over my time at OU for each course. Scores are reported relative to the mean score in the school in which the course was taught (Computer Science, Aerospace and Mechanical Engineering or Engineering). Positive values indicate scores above the school mean (scores prior to and including Spring of 2006 were corrected in sign).

Mean department scores do not change substantially as a function time (even across the different evaluation methods), and exhibit a standard deviation on the order of 1. The mean of the mean department scores since Fall of 2006 is 4.18 out of a possible of 5, leaving a maximum possible relative score on the order of 0.82. Changes in my relative score over repeated offerings of a course are due in large part to changes in my own evaluations. For these three courses (one of which has both graduate and undergraduate sections), my relative scores show an overall increase over time. In addition, the most recent offering of 5 of my 7 course sections received a score above the department mean. This includes my Real-Time Embedded Systems course, which is required for aerospace engineers (a department in which I have no other formal affiliation).

Both of my offerings of the Introduction to Engineering course scored below the "Engineering" mean. This course is a required course for freshmen, and included students from all engineering backgrounds. These factors are known to contribute to reduced teaching evaluation scores (Wachtel, 1998).

Figures 1b–d summarize the evaluation scores for Q3, Q4 and Q5 relative to the department mean. The mean of the department means for classes taught since Fall of 2006 are 4.11, 4.27 and 4.42, respectively.

Planned Courses

Over the next several years, I wish to develop the following courses:

- Computational Neuroscience
- Computational Motor Control
- Mobile Manipulation
- Computer Vision

References

Fink, L. D. (2003). *Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses*. Jossey Bass Higher and Adult Education. John Wiley & Sons, Inc., San Francisco, CA.

Wachtel, H. K. (1998). Student evaluation of college teaching effectiveness: A brief review. *Assessment & Evaluation in Higher Education*, 23(2):191–121.

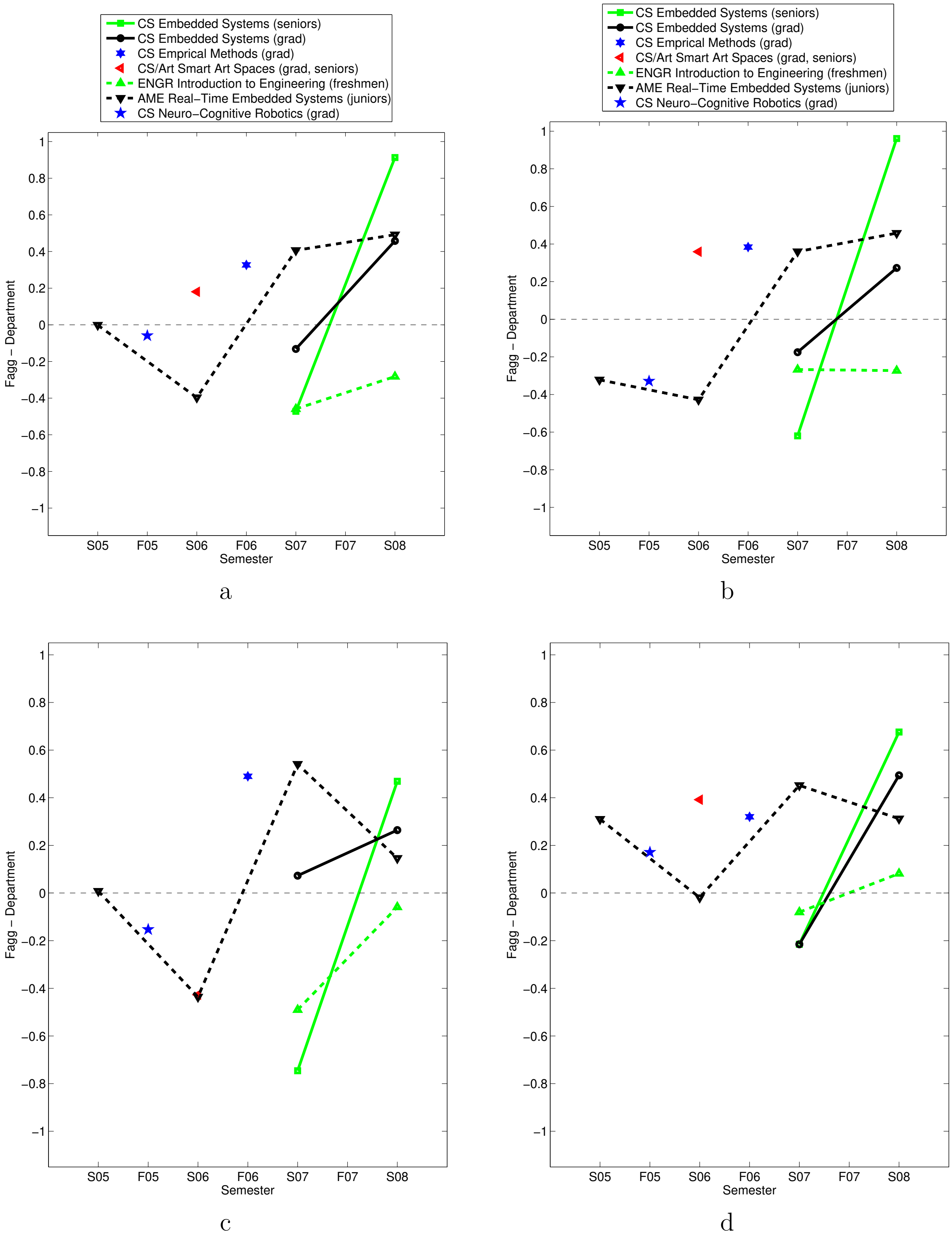

Figure 1: Teaching scores relative to department mean: (a) Aggregate, (b) Q3 ("clear presentation"), (c) Q4 ("well organized"), and (d) Q5 ("enthusiastic").