ACCESSIBLE ROBOTICS AND INTELLIGENT SYSTEMS FOR SOCIAL SCIENCE UNDERGRADUATES*

POSTER SESSION

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In 2001, Wheaton implemented an innovative curriculum called *Connections* [5] where students enroll in pairs of linked courses that span disciplinary boundaries. We developed a course offering entitled *Intelligent Systems*, which will be linked with several Psychology courses (e.g., *Consciousness, Comparative Animal Behavior*) and a Sociology course. *Intelligent Systems* provides a rigorous introduction to robotics and surveys selected topics in artificial intelligence. Unlike the upper-level Computer Science courses in this area, this course is intended for non-major students.

We explicitly created this course to increase the enrollment of social science students in our course offerings, and to foster scholarly collaborations between faculty in those disciplines with Computer Science. The wide-reaching appeal and interdisciplinarity of robotics and artificial intelligence drove its selection as the course subjects. To further increase the viability of the course, it also satisfies one of the College's curriculum distribution requirements in quantitative analysis. To make the course accessible, no programming experience is expected and no mathematical background is required. In the initial offering of the course, students from the Psychobiology, Psychology, Music, and Economics majors enrolled along with students from Biology, Bioinformatics, and our study-abroad program.

Popular science and press coverage of robotics and artificial intelligence indicate broad appeal, and students outside of the Computer Science major seem both curious and eager to learn more about the topics. Enticing students with hands-on entry-level components is now, more that ever before, particularly affordable and accessible [1]. The popularity drives coursework inside the major with, for example, robotics as the unifying theme for the standard AI class [4]. Similarly, a significant number of intelligent systems-infused offerings are directed at students outside of Computer Science. Several

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approaches focus on specific pairings of disciplines like Computer Science and Art [10] or Computer Science and Mechanical Engineering in specialty courses [6, 7]. However, most contact with non-major students happens in a CS0-style course and often some portion of the content is devoted to AI [2]. Or, the course has content tailored for a specific other discipline [3]. Particularly at small colleges, there are few opportunities to offer courses for non-majors. *Intelligent Systems* is distinct in form and purpose from these other offerings for two reasons: 1) the course content is a rigorous technical introduction to robotics and artificial intelligence without prerequisites; 2) it serves as a Computational Thinking (CT) [9] course targeted at students in the social sciences with, we argue, a compelling set of topics with greater appeal than a traditional or targeted CS0 offering.

The course is designed in a way that it is accessible to students with no prior technical background. The first half of the course is a rigorous introduction to robotics beginning with fundamental paradigms and then adding components to build larger systems. We discuss and experiment with effectors and actuators, evaluate kinematics and methods of locomotion, and explore sensors. Students gain hands-on learning experience using iRobot's Create, an inexpensive programmable robotics platform, and examining other robotic systems. Students are tasked with some programming tasks (e.g., wall following) and are expected to program the robots using a modified version of Alice [8] and complete written assignments (e.g., designing and analyzing a robot for a specific task).

The second half of the course builds on students' knowledge of *sensing* and *acting* in autonomous robotic systems to focus on *planning*. We begin with discussions of knowledge representation and single- and multiplayer games. We spend several weeks on approaches to natural language processing and machine translation. Students use their own second language skills and commercially available software to test and evaluate Turing test contestants and machine translation systems. We cover emergent behaviors of complex systems in the context of robot swarms and artificial life. The semester is rounded out with a discussion of robotic ethics and the use of autonomous vehicles in military and humanitarian domains. Each topic is accompanied with relevant literature and significant class discussion.

During the second half of the semester, student groups propose and implement a project. Students have access to a variety of robotics platforms (e.g., LEGO NXT, iRobot Create, and Arduino kits), other computing resources outside of class, and Computer Science majors with programming experience. One group built a decision tree learning system for a game of “20 Questions” about Wheaton's campus. Another group programmed a swarm of square dancing iRobot Creates and took extended-exposure photographs of the swarm. Finally, a group built an Arduino-powered version of Braitenberg's third vehicle, *Love*.

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