The University *of* Vermont

The Honors College at UVM

Prof. Joshua Bongard

The ability to think outside the box enabled Computer Science Assistant Professor Josh Bongard to excel in the field of robotics. His research, Bongard says, uses many different disciplines (including computer science, biology, philosophy, neuroscience and engineering). The opportunity to extend this interdisciplinarity to his teaching, he says, is what drew him to the Honors College. Recently we caught up with Bongard to talk about human and robotic intelligence, as well as the intelligence that is being developed by Honors College students in his sophomore seminar, "Embodied Cognition."

HCOL: To begin, would you say a little bit about your academic background and research interests?

Josh Bongard: As a student, I didn't follow the traditional path through higher education. I received my undergraduate degree in computer science from McMaster University in Canada, then a Masters of Science degree from Sussex University in the United Kingdom, and finally my PhD from the University of Zurich in Switzerland. The reason that I did my graduate degrees in Europe was that at the time (10 years ago), there were no graduate programs for what I was interested in in North America: My research interests involved both robotics and biology, which is not a traditional pairing of these two subjects.

HCOL: What appealed to you about the prospect of teaching a sophomore seminar in the Honors College?

JB: Much of my research does not sit squarely in the 'traditional' disciplines one finds housed in departments and colleges at a university. I spend my days pursuing a two-part question: "What is intelligence, and how could we re-create it in machines?" This question leads my lab and I through robotics, artificial intelligence, biology, psychology, philosophy, neuroscience and engineering. This seminar gave me the opportunity to take a group of undergraduates on the same journey. I'm passionate about what I do, and it's a lot of fun to share that passion with a group of willing and able students.

HCOL: What kind of student are you looking for? What are the characteristics of your ideal student?

JB: I'm looking for students who are willing to ask the big questions, but who also have the self-discipline and work ethic to explore them rigorously and deeply. Investigating interdisciplinary research questions can be very exciting, but also requires a lot of work: the investigator must absorb material from more than one field to make a contribution.

HCOL: What educational paths do you see your seminar students taking after they complete your course? What impact might your course have on their trajectories?

JB: I hope that this seminar has demonstrated that in the 21st century, many of the most exciting areas in science are now interdisciplinary: ideas and challenges in one field are being tackled in new ways using tools and approaches from other fields. This is particularly important for current students in that all of the global challenges we now face---nuclear proliferation, climate change, energy issues and terrorism---cannot be met with only social or only technical solutions. For example, transitioning to sustainable and carbon-neutral energy sources will require cultural, legal and political change, as well as development and deployment of new technologies. This seminar has hopefully prepared the students for recognizing, learning about and ultimately creating interdisciplinary solutions to some of our society's most intransigent large-scale challenges.

HCOL: Your seminar may seem quite abstract to some. What are the implications of what you discuss in the seminar for real world issues of concern to many people? What are the most pressing issues?

JB: In our seminar we have discussed all aspects of human intelligence. What it means to be self-aware and able to act intelligently in a complex world is obviously something we all have personal experience with. Amazingly however, relatively little is known about the inner workings that make this possible. In this course we have explored what neuroscience is able to tell us about the link between the brain and the mind (for example, how neural processes give rise to memory); how seemingly abstract, 'high-level' constructs like language are very much intertwined with the `low-level' details of the human body (as can be seen in metaphors like 'bending over backwards' for someone or 'looking forward' to a future event); what biology can tell us about the evolution of intelligence (such as what caused the transition from organisms without brains to those with brains); and finally how all of these lessons from nature can help us to build more intelligent machines. Building intelligent machines is necessary in order to realize machines that can work alongside us in the real world where (unlike in a factory) the environment is always changing, requiring organisms (and thus also machines) to continuously adapt to this change.

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