Using Robotic Competitions in Undergraduate Philosophy Courses: Studying the Mind through Simple Robotics

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Abstract

Robotic competitions can add a great deal to undergraduate philosophy courses. I have successfully used Lego MindStorms kits in this manner to teach; logic, philosophy of AI, philosophy of cognitive robotics, and issues in the philosophy of technology. The following will describe some of my hard won experience in finding the best ways to cheaply and efficiently introduce robotic competition activities into the classroom, which will be of interest to any educators regardless of their disciplines.

Why use Robotic Competitions in the Philosophy Classroom?

There are certain significant tradeoffs to using robotic competitions in the undergraduate philosophy classroom. First, they take time away from typical classroom activities such as engaging with primary texts. Second, students come into the classroom with varying technical abilities, and in a humanities class they often have little or no programming experience. Third, this activity requires certain startup and maintenance costs. And finally, competition, in and of itself, can have a negative pedagogical impact and can also result in a harmful social split in the class along gender lines.

There are ways to mitigate these difficulties and I will share some of my ideas on this in the next section. The positive results of using robotic competitions in the classroom are significant though and worth the extra effort. While philosophers have a great deal to add to the theoretical discussions of topics such as AI and cognitive science, students can come to some serious misunderstandings of these positions due to simple unfamiliarity with the technologies being critiqued. These difficulties are quickly dissolved by allowing the students to interact with simple robotic kits.

In my philosophy classes I have used these kits to add considerable insight into the following topics:

- Introduction to AI
- Computationalism
- Cognitive Robotics
- Embodied Mind and Emergent Behavior
- Robotics and Society/ Sociable Robotics
- Robotics and the Philosophy of Technology
- Philosophical issues in the Design of Robots

Actually spending time working with real examples of AI and robotics gives the students many opportunities to see the topic from standpoints that are difficult or impossible to convey in a standard lecture. For example, they can learn through direct experience what the difference is between a logicist[1] approach to robotics as opposed to one that runs on subsumption architecture. And in fact they can put these two approaches in to direct competition with each other by one team building and programming a robot from the logicist paradigm and the other using subsumtion architecture and see for themselves which is faster at solving an actual maze.

Dealing with Difficulties

I keep expecting to encounter the 'wired' generation in my classroom—students who find understanding technology to be second nature. I do not think this generation actually exists. Certainly they are skilled in the use of information technology, but they are just as in the dark about why it works and how to program it as any other generation. This means that in order to get good results one must make sure the technology is easy for the instructor to teach.

I use the Lego® MindStorms™ technology and have had great results since it is not intimidating and there are brilliant after market programming platforms available that work for any skill level of programmer. Another subtle factor that helps in the humanities class is that this class attracts students from science and engineering as well, who

[1] 'Logicist' meaning designing the program to closely resemble first order logical reasoning from the point of view of the robot.

help their peers learn the technology, thus greatly reducing the workload of the instructor.

Cost is probably the Achilles' heel of any project that attempts to bring robotics into the classroom. In my experience, humanities Deans are not opposed to the idea of using technology in the classroom, but they are also not always forthcoming with funding opportunities either. The kits I use are not very expensive and they are specifically designed for educational use, but they do greatly exceed the budgets of most philosophy departments. Each robotic kit costs around $300.00 and you need one kit per three to five students. I have had some luck with grants from industry and other sources, but I must admit the cost of batteries and replacement parts come out of pocket. The worst upkeep expense has been the abuse of the kits by students. To counter this I have to have a strict policy where their grades are adversely affected by lost or damaged equipment.

But more importantly, it is competition itself that is the trickiest problem to overcome. Competition is a great motivator for certain students and the energy and excitement level in the class grows exponentially over that found during event the best lectures. Competition is enough to get students to work overtime on their projects and they invest real interest and ownership in the results.

In my first forays into this pedagogical style, I noticed the class moved far away from the rational discourse we tend to favor in philosophy and towards something akin to a cockfight. This was very intimidating for some of my students and in one instance even resulted in a very emotional conflict between two of them. To mitigate this I have implemented a few policies.

I shy away from sumo style competitions. While they are fun and simple to organize, they have a tendency to attract aggressive behavior best left out of the classroom. They also can be costly on an economic level. My students have burned out expensive electric engines by improperly designing their robots. I prefer to have the students compete against a challenge of some sort, most commonly a maze or other task. This way they are in a contest against the task and not directly against each other. There is still the motivation to be the fastest through the maze, for instance, but since there is no physical violence directed at their machine, they take it far less personally when they lose.

The most successful strategy I have used to date is to have the students compete to come up with the best project. In this way it is more of a meta-competition and has more of a 'science fair' feel. I have found that on occasion the students can dream up ideas that I would have never conceived.

Another factor that is vital to break down is the standard gender and socioeconomic divisions found in this kind of activity. While Lego has been altering its image in the past decade, it is still largely considered a toy for 'boys' by the generation of students coming through academia at this time. To mitigate this, I make sure the groups are equal in gender and try to be conscious of the personalities of each member to prevent serious mismatches. I also have to intercede in groups where aggressive students are quashing the efforts of others in the group. A good tool for this is to have the students document and critique the role each of them played in the building and design of the machine in a final report or white paper due at the end of each lab.

Legos are also toys that are relatively expensive and only students of a certain economic means will have had any significant experience using them. So one must spend some time going over the basics of how to use these tools and form the workgroups so that in each one there is at least one person that can use the technology and teach it to the others.

It is very much worth the extra effort to correctly compose your workgroups and come up with a proper challenge for them. I have had wonderful results where nontraditional students have informed me that they never thought they were the type of person that could do robotics, but because of their experience in my class, they felt it was a career path they now wanted to explore. Due to lack of space I can not go into detail on the projects I have done in class but I will have some examples of these at my poster presentation, such as how we explore the implications of Braitenberg's *Vehicles* on the philosophy of AI and Cognitve Robotics, teaching what Turing Machines are, and the role of simulated emotion in human robot interactions.

Conclusions

Robotic competitions are a powerful and unexpected tool to add to the typical philosophy of mind class. They allow the student to see this topic in a more concrete way, which makes them less susceptible to some of the spurious claims made by some critics of computationalism. It also clarifies what it means to believe that a machine can have a mind and helps make one humble at the prospect of building one, regardless of ones position on the ontological status of intelligent machines.

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