AI and Developing Socially-engaged Computational Thinkers

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Abstract

This position paper reflects on why we want greater participation in the computing sciences, what 'greater participation' means and should mean, and on the particular characteristics of AI that recommend it as an enticement and way into computing. Primary tenets are that the need for and training of socially-engaged '*computational thinkers*' (Wing, 2006) is the most important motivation for increasing the *diversity* (and numbers) of students in the computing sciences and that 'AI for the social good' may bring students into computing for whom AI *per se* would not.

Computational Thinkers

In this time of rapid technological and societal change, when policy and practice involving technology have enormous consequences (e.g., global climate change), often looming beyond some myopically-construed horizon, we need what Jeannette Wing (2006) calls *"computational thinkers"*, which I take as *critical* thinkers who are conversant with computational principles, tools, practices, and broader impacts. Wing's desiderata for human thinkers certainly includes deterministic skills of comparison, tracing, and simulation, but her vision is dominated by a desire that human problem solvers exhibit a sophisticated heuristic and systematized approach to non-deterministic reasoning, aspects of thinking that AI seeks to codify. Socially-engaged computational thinkers are motivated to and capable of modeling and tracing through the societal and environmental consequences of technical and social designs and actions.

Dismantling Compartmentalization

The goal of training socially-engaged, computational thinkers is paramount. Professional societies and accrediting boards, most notably IEEE and ABET, are insisting on "an ability to analyze the local and global impact of computing on individuals, organizations, and society." (ABET criteria, p. 19) and like characteristics among computing graduates. These institutions recognize that segregating technical training from technology's broader impacts do not serve society well.

Diversity, not numbers *per se*

It is fortuitous that dismantling the compartmentalization between computing and larger societal purposes is synergistic with broadening the diversity of recruits to computing. Studies show that many women, for example, are drawn into computing when they see its fit into larger societal purposes [Margolis & Fisher, 2002]. In this case, greater diversity reinforces a greater community vision for computing's utility, and vice versa. The diversity goes beyond gender, race, and culture. Under the assumption that computational competence is a necessity, diversity of values (or of value weighting) is vital.

Layers of an onion

None of this discussion derides the technology-centered motivations that bring many into computing, but the drawing power of that interest is insufficient to many in the face of societal and environmental concerns. If we view computing, its environs and contexts, as layered – from core computing technology, principles, and practices, to larger societal purposes – we might expect that each layer can add diversity and numbers to computing. In database, for example, the layers might extend from query programming and database design, to database management issues such as data security, to practices and policies to ensure data privacy, to legal and humanitarian concerns with identity theft and patient rights. Seeing the connections between these layers expressed by professors and textbooks may attract students.

Consider too Bryn Mawr's (2006) program of drawing students to computing through robotics. Importantly, this occurs in a larger curricular context: "*We see computer science as a way of asking and attempting to answer some of the big questions that are really at the heart of a liberal-arts degree, be it in French, physics or philosophy. Big* *questions such as: Who are we? Where have we come from? What is consciousness?*" (Douglas Blank, Bryn Mawr, 2006). Robotics *may* have an additive attraction over "core computing", but larger context and purpose (e.g., the many forms of human-assistive robotics) may have further attraction.

Guarding against bait and switch

Playing a computer game is a different activity than creating and building one. We should understand in some deep sense what it is about gaming, for example, that draws the interest of *prospective*, *competent* computer scientists. We should assess any recruiting strategy at varying intervals and design advanced coursework in ways that are informed by initial recruiting strategies; maintenance is at least as important as initial recruiting. A concern with focusing primarily on 'fun' in designing gateways into computing is the significant possibility of bait-and-switch. Analogous possibilities presumably exist with socially-embedded introductions into computing, though once instilled in students, such enticements may translate to more persistent motivations that are resistant to students' feelings of bait-and-switch.

Why AI?

My interest in AI as a gateway into computing is not about numbers of students *per se*, but of developing socially-engaged computational thinkers. Many if not all areas of computing (e.g., database, software engineering, algorithm theory) can be productive bridges. Moreover, areas mentioned in the Symposium's call such as robotics, need not involve any substantive AI at all, yet still be a draw (e.g., they exercise particular forms of creativity and/or appeals to naïve anthropomorphism). Other referenced areas that might involve AI, such as computational biology and computational economics, are contextualized by social utilities, which confounds crediting AI with the drawing power – social utility is a draw.

What is special about AI is that it codifies complex and nondeterministic aspects of thought and *its study* addresses two important facets of computational thinking. First, it requires study and practice of computational principles, tools, etc. Second, AI can be used to illustrate, convey, and exercise the *critical* thinking skills that we want in humans. Existing programs of study in critical thinking are concerned with the processes targeted by AI: "*Many of our students will find themselves in careers that will require them to be decision makers and they will need to reason their way through various dilemmas in an uncertain and complex world. A number of thinking skills, including the abilities to consider options, predict consequences, determine the reliability of information, and think about causality, are crucial to reasoning one's way to a good decision*" (Tufts University, Critical Thinking Program). As such, these programs may be good sources of ideas for using AI as a medium for developing computational thinkers, including the importance of computational thinking in societal contexts (e.g., University of Massachusetts, Boston, Critical and Creative Thinking Program).

Conclusion

This position paper presumes that an interest in numbers is secondary to an interest in developing computational thinkers. Beyond some of the details, the paper asks that the Symposium organizers and participants consider questions: Why do we want "greater participation" in computer science? What does "greater participation" mean? What might confound an evaluation of AI as a bridge to computing?

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