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The Computer Science Professional's Hatchery

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Board 71: The Computer Science Professionals Hatchery

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Amit Jain is the Chair of the Computer Science Department at Boise State University. He was the lead for the IDoCode project that helped to embed high quality computer science in Idaho high schools. The IDoCode project was funded by a $1 million grant from the National Science Foundation. He serves on the statewide Governor's working group that has developed Computer Science standards for Idaho K-12 schools. He is also the lead on the CS Professionals Hatchery project, a $2 million dollar project funded by the National Science Foundation to serve as an exemplar on how to revolutionize the undergraduate CS experience. He has received over $6 million in grants and awards over the last five years from various state-level and national-level organizations as well as from industry. Previously, he has also served as the Chief Scientist for Balihoo, a local startup in Boise, Idaho. He holds a PhD in Computer Science from the University of Central Florida and a B.Tech. in Computer Science and Engineering from the Indian Institute of Technology, New Delhi.

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Noah Salzman is an Assistant Professor at Boise State University, where he is a member of the Electrical and Computer Engineering Department and IDoTeach, a pre-service STEM teacher preparation program. His work focuses on the transition from pre-college to university engineering programs, how exposure to engineering prior to matriculation affects the experiences of engineering students, and engineering in the K-12 classroom. He has worked as a high school science, mathematics, and engineering and technology teacher, as well as several years of electrical and mechanical engineering design experience as a practicing engineer. He received his Bachelor of Science degree in Engineering from Swarthmore College, his Master's of Education degree from the University of Massachusetts, and a Master's of Science in Mechanical Engineering and Doctorate in Engineering Education from Purdue University.

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The Computer Science Professional's Hatchery

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Boise State University

As a recipient of a National Science Foundation Revolutionizing Engineering and Computer Science Departments (RED) grant, the Computer Science Department at the Boise State University is building a *Computer Science (CS) Professionals Hatchery*. This paper is a summary to accompany the poster to be presented.

The *CS Professionals Hatchery* integrates ethics and social justice in 5 week or 7 week agile 1-credit 'Hatchery Unit courses' (the course prefix for these courses is CS-HU) to blend social and technical essentials that promote a more inclusive culture, prepare students to work effectively on software development teams, and encourage students to be advocates for cultural and institutional change in their future careers. The five-year project is currently in its third year of implementation.

A core focus of this involves accounting for and approaching an understanding of the experiences of members of underrepresented groups in computer science and those affected by the use of computer science products in society. Once this is accomplished, it then becomes possible to guide students in identifying sustainable processes for addressing the lack of inclusion and social justice.

A common approach to incorporating ethics in the Computer Science (CS) curriculum is to relegate it to a single course. Often these courses focus on professional and legal responsibility, licenses and copyright, etc but do not consider social justice and inclusivity. Other approaches span courses [2], but require substantial and unsustainable investment and lack a consistent structured process for students to investigate and address issues. Other approaches exist, such as [1], but stay close to pre-conceived approaches to ethics. Our approach goes beyond basic knowledge and comprehension of issues to a systematic application of tools designed following theory and research ([3], [4], [5]) that can lead students across the curriculum in analyzing real case examples, synthesizing what they have learned and applying that knowledge to address problems and develop skills for improving CS.

The Hatchery Unit curriculum was designed through several iterative meetings with industry. The industry advisors identified the Knowledge, Skills, and Abilities (KSAs) that would help the most with the transition from student to professional. These KSAs led directly to the design of the Hatchery Unit (HU) courses. Forty professionals from twelve companies have participated in the design and delivery of HU courses. The academic-industry collaboration has been critical in getting acceptance from faculty and students.

To date, we have offered 57 CS-HU sections with 1591 students (non-unique) enrolled in these courses. The five required CS-HU courses are *Foundational Value*s (14 sections, 473 students), *Navigating Computer System*s (12 sections, 354 students), *Intro to Version Contro*l (7 sections, 184 students), *Agile Development* (9 sections, 235 students), and *Intro to Database System*

Usage (6 sections, 214 students). In addition, several elective CS-HU courses have also been implemented. See the Hatchery website [6] for more details on the courses. See Figure 1 for the how the CS-HU courses integrate with the more traditional introductory CS curriculum.

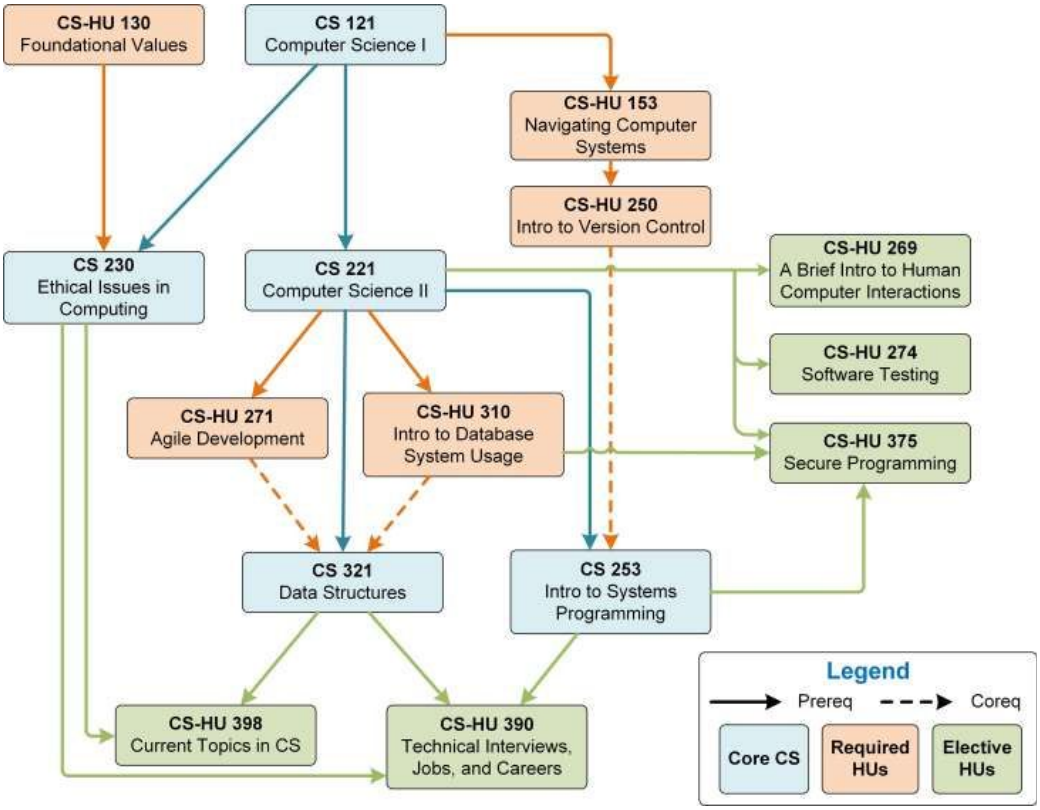

Figure 1. HU Curriculum Layout

The *Foundational Values* (CS-HU 130) course focuses on using a framework to examine issues of inclusion, diversity, and justice as they occur in the practice: teamwork, design and development of products and societal impacts. Students take this course in the first semester in the program at the same time or before the first technical computer science course. Students use a custom-designed rubric, which guides the analysis of issues of professional morality and ethics in a manner that fits into a general engineering process. They apply the framework to multiple cases, mostly drawn from current industry, such as [8], and [9].

These cases include situations in which bias is reflected in the context of actual computer-science related work (such as [9], [10]), and in the design and application of computer-science products that reinforce that bias (such as [8], [11]). The students work in teams to apply a problem-solving rubric based on Rawls' Theory of Justice ([4]) and draft proposed solutions that can be enacted to improve the situation in question.

At the end of CS-HU 130, students were surveyed on two questions: (1) Are matters of professional morality and ethics relevant for computer scientists? (2) Can professional morality

and ethics contribute to becoming a better computer scientist? A total of 388 students responded with 90-100% agreement. Students **do** see this as relevant to their success as computer scientists.

The foundational values course helps students develop a framework for understanding issues of ethics and social justice in computer science, and students have multiple opportunities to utilize this framework in other technically focused hatchery units, such as Navigating Computer Systems, and traditional courses, such as Senior Design, that are part of the required curriculum.

For example, the *Navigating Computer Systems* (where they learn to build and manage servers in the cloud) course has a module where the students have to apply foundational concepts to challenging social and ethical issues related to systems. They are provided with two scenarios involving ethical dilemmas concerning systems that were drawn from actual industry events. The first scenario involved internet intrusion and violation of privacy while the second scenario involved a security shakedown with conflicting business implications. Their assignment is to identify the stakeholders, their interests, concerns and risks, and then apply a subset of five ethical theories (Utility, Rights, Justice, Common Good, and Virtue. See [7] for more information on these theories) to analyze the situation. This is one out of the six total modules in a technical course but it ties technical concepts with the social and ethical dilemmas that they can lead to.

Preliminary results suggest that many students orient to current societal norms, and have difficulty independently identifying loss of inclusivity and social justice. However, interventions we have developed provide students with tools and skills to identify and address these biases in the classroom and in near-transfer settings. We are using multiple methods of documenting and exploring the effects of these changes, including surveys, interviews with students and faculty, and social network analysis. Next steps on the project will involve exploring and implementing ways to build and sustain inclusive community through increasing collaboration among students in different years in the curriculum, and incorporating strategies from CS-HU 130 across the curriculum to provide repeated and distributed practice in identifying and proposing systemic changes to address ethical and moral dilemmas.

Overall, this project illustrates the benefits of developing a curriculum that is both able to quickly respond to industry needs and current issues of bias and ethics in computer science, for preparing students who are better prepared for industry, ethical practice, and capable of becoming agents of change.

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References

1. Ghorbani, M., Maciejewski, A., Siller, T... Atadero, R. (2018). Incorporating Ethics in Electrical & Computer Engineering. ASEE Conference. Salt Lake City: ASEE. https://peer.asee.org/30645

2. Grosz, B., Grant, D., Vredenburgh, K... Waldo, J. (forthcoming). Embedded EthiCS: Integrating Ethics Broadly Across CS Education. *Communications of the ACM*. Retrieved from https://dash.harvard.edu/handle/1/37622301

3. Dubey, A., & Rozovsky, J. (2016). What makes an effective team at Google? [Google Rework Project]. Retrieved June 29, 2018, from https://www.youtube.com/watch?v=KZlSq_Hf08M

4. Rawls, J. (1999). A Theory of Justice (Revised edition). Cambridge, MA: Belknap Press of Harvard University.

5. Winiecki, D., & Salzman, N. (2019). Teaching Professional Morality & Ethics to Undergrad CS Students through Cognitive Apprenticeships & Case Studies. ACM SIGCSE/Research on Equity & Sustained Participation in Computing, Engineering & Technology (RESPECT), Minneapolis, MN.

6. CS Hatchery Unit website (2018). Retrieved from (*omitted for review*)

7. Vallor, S. (2016). Technology and the Virtues: A Philosophical Guide to a Future Worth Wanting. Cambridge: Oxford University Press.

8. Angwin, J., Larson, J., Mattu, S., & Kirchner, L. (2016, May 23). Machine Bias: There's software used across the country to predict future criminals. And it's biased against blacks. [ProPublica]. Retrieved May 24, 2016, from https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

9. Fowler, S. (2017, February 19). Reflecting on one very, very strange year at Uber. Retrieved February from https://www.susanjfowler.com/blog/2017/2/19/reflecting-on-one-very-strange-year-at-uber

10. Mims, C. (2017, August 13). What the Google Controversy Misses: The Business Case for Diversity. Wall Street Journal.

11. Buolamwini, J. (2017). Gender Shades: Intersectional Phenotypic and Demographic Evaluation of Face Datasets and Gender Classifiers (Master of Science). Massachusetts Institute of Technology, Cambridge, MA. Retrieved from https://www.media.mit.edu/publications/full-gender-shades-thesis-17/