TEACHING STATEMENT

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I am a firm believer in the principle of teaching someone how to learn a concept rather than explaining the concept word-for-word, as that is the way to prepare our best young talent to face the challenges of an ever-changing field such as computer science. I also believe that teaching is a process of collective improvement for both the student and the teacher and should be regarded as a two-way learning process. I also care deeply about incorporating new topics into the courses I teach to keep them fresh.

Past Teaching

I have had the opportunity to teach several courses as lead- or co-instructor in computer science and related subjects from high school level to graduate level. In most of these courses, I was responsible for designing the course material and delivering it to diverse student groups.

AI in Fact and Fiction: I have been the co-instructor (with Prof. Jim Hendler) of the AI in Fact and Fiction course (CSCI 4945, COGS 4962) in Summer 2020 and 2021 at RPI. The course explored current AI topics through reading, writing, programming, and exploring some of the classic fiction on machine intelligence. The course was designed to give computer science and cognitive science students who have not yet taken any formal AI courses an appreciation of how to separate fiction from fact and critically evaluate the impact current, and upcoming AI topics will have on society. As the instructor leading the AI programming section, I gave the students an overview of various AI techniques on topics such as the history of AI, basics of deep learning, introduction to computer vision, natural language processing, reinforcement learning, and emerging topics such as federated learning. Each of these topics had an associated lab that I developed as a Jupyter notebook providing a lot of theoretical and practical information, yet leaving plenty of room for the students to experiment independently. I always encouraged the students to start the lab sessions during class time as soon as the lecture ended and guided those who were having difficulty getting started on the lab. The labs I designed were an essential piece of the learning experience in the course, as they encouraged the students to explore the topics on their own in a hands-on manner to solidify the concepts learned in the class. More importantly, the labs helped the students successfully apply AI techniques to an open-ended AI project that solved a small problem of their interest with the instructors' guidance.

MIT Accelerating Information Technology Innovation: I conducted summer programs on mobile application development as part of the MIT Accelerating Information Technology Innovation (AITI), now known as the MIT Global Startup Labs (GSL)[1]. The programs were held at Swathmore University, Nairobi, Kenya, in 2011 and the University of the Philippines Diliman, Manila, in 2012. As the lead instructor, I was responsible for developing the course material, delivering the technical lectures for a diverse student group of different levels and backgrounds, and coordinating guest lectures sourced locally and internationally. It was very satisfying to see how the students from different countries learn mobile application development and apply the learned concepts in developing applications, some of which have been deployed in the mobile app marketplaces and are being actively used.

MIT Women's Technology Program: During the 2010 summer, I taught Introduction to Computer Science to a highly talented group of female high school seniors who were yet unsure about Science Technology Engineering and Math (STEM) as their chosen field of study, as part of the MIT Women's Technology Program[2]. I was part of the committee for selecting the students for this program, where I reviewed their applications and interviewed them. In addition, I also selected and on-boarded teaching assistants for the course from a talented pool of MIT CS senior undergraduate students. Since the high school students had very little or no background in computer science, I made sure the subject material was very approachable, with plenty of fun exercises. Overall, teaching this course was very enjoyable and rewarding for me as well. I later learned that many of the high school students I taught majored in computer science in college, and some of them even went to get PhDs from major universities in the US. The experience from this program was such a positive experience for me that I decided to write about it in a book chapter titled "Making computer science attractive to high school girls with computational thinking approaches: A case study" [1] in a book on emerging research, practice, and policy on computational thinking.

Teaching Assistantships: I had the privilege of working as a teaching assistant (TA) in a couple of MIT courses during my graduate studies. I was a TA for Mathematics for Computer Science (6.042) taught by

[1] `https://gsl.mit.edu/mit-global-startup-labs`
[2] `http://wtp.mit.edu/eecs/index.html`

Prof. Albert Meyer in 2011 Spring. This course introduced the mathematical foundations behind various CS concepts and was one of the most exciting courses I have enjoyed participating in. As a TA, I was tasked with holding recitation sessions to answer any questions the students could not ask the professor during class time and walk the students through several problems. During one such recitation session on bipartite graph matching, I did a fun exercise to pair students based on their friendships, which was very well received by the students.

I was also a TA for Linked Data Ventures that was taught by my thesis advisor, Sir. Tim Berners-Lee. This course was piloted in 2010 Jan during the independent activity period and later offered as a regular course in 2011 Fall and 2013 Spring. For this course, I had the opportunity to deliver several lectures on linked data and semantic web concepts. More importantly, being part of this course gave me the first preview of and the experience on how to organize and deliver a special topics course.

Mentoring: During many research activities at MIT as a graduate student and at RPI as a member of the research staff, I mentored many students, a process I enjoy very much. At RPI, I have helped advise several master's students, two of whom have continued to the PhD program. I am also actively mentoring several PhD students funded by the IBM Research AI Horizon Network funded Health Empowerment through Analytics Learning and Semantics (HEALS) project[3]. Since the start of the project in 2017, I have mentored close to 30 undergraduate research students. Furthermore, as part of the IBM AI Research Collaboration funded Smart Contracts Augmented with Learning and Semantics (SCALES) project[4], I mentored a PhD student and ten undergraduate students. In all of these projects, I am incredibly proud of several undergraduate students whom I mentored, securing first author publications in international computer science conferences and workshops (examples include [2, 3, 4, 5, 6, 7, 8]). One such student that I mentored won the best student paper award at a workshop co-located with the International Data Engineering Conference for her paper on Semantic Modeling for Food Recommendation Explanations [9]. Another student won the best resource paper award at the International Semantic Web Conference for her paper on Explanation Ontology [10].
Additionally, I am currently (during Fall 2021) offering mentorship to over 15 students on their class projects in the RPI Data Analytics Research Lab led by Prof. Kristin Bennett. The students are investigating a Decentralized Finance dataset on lending and borrowing to discover opportune and anomalous patterns. I am guiding them on gathering the data, providing an overview of the underlying technologies, and helping them interpret the results.

Guest Lectures: Given my interest and expertise in decentralized systems research, which includes the world wide web and blockchain, I have been invited to give guest lectures in many RPI courses such as the Data Analytics Research Lab (2021 Fall), Advanced Financial Technologies (2021 Spring), Predictive Modeling (2020 Spring), Data Analytics (2019 Spring, 2019 Fall, 2020 Spring, 2020 Fall, 2021 Spring, 2021 Fall), XInformatics (2019 Spring, 2020 Spring, 2021 Spring), Introduction to Artificial Intelligence (2019 Spring), Ontology Engineering (2018 Fall), Data Science (2018 Fall), Web Systems (2018 Fall) and Cognitive Computing (2018 and 2019 Spring). These interactions have helped me formulate several ideas for special topics classes, in addition to the core fundamental computer science courses that I would teach.

Planned Teaching

I sincerely believe that the central goal of teaching a subject is to nurture the ability of students to inquire and learn the subject by themselves. Achieving this goal is especially important in computer science because it is one of the most rapidly changing fields. Many programming languages and software techniques that we are using today did not exist ten, if not twenty years ago, and will most likely be obsolete in several years. As I favor teaching more hands-on courses, in the courses that I would teach, I plan to utilize a teaching strategy where the students would be able to learn how to learn and nurture computational thinking mechanisms to solve any problem thrown at them.

Furthermore, I am very well aware of the need to cater to any unexpected situations. Many educators encountered extra challenges as they shifted to primarily online communication mediums instead of in-person classrooms due to the Covid-19 pandemic. I found online meeting solutions such as WebEx or Zoom to be effective for some others, while another set of students need physical meetings for effective learning. Gauging such diverse needs and being agile is a significant challenge. Furthermore, being receptive to student needs might require establishing an effective communication pattern. For example, having regular weekly meetings might be effective for some students but unproductive for others. Asynchronous communication, such as slack messages and email, may be more effective for the second group of students. In all cases, I will aim

[3]`https://idea.rpi.edu/research/projects/heals`
[4]`https://idea.rpi.edu/research/projects/scales`

to make the students the owners of solving the task at hand. The goal is to nurture the students' ability to productively and independently learn or do research on their own.

My past teaching and research experience has covered a wide range of topics in computer science, including software engineering, data structures, security, privacy, algorithms, machine learning, blockchain technologies, and the semantic web. Given the need, I am qualified and ready to effectively teach courses in any of these subjects, but I am particularly eager to teach undergraduate and graduate-level courses directly related to my research projects. I am also very much interested in conducting courses with a focus on practical applications and those that involve hands-on coding tasks. Several courses I would be delighted to lead are as follows.

AI Programming: This course is inspired by the AI in Fact and Fiction course that I co-taught with Prof. Jim Hendler during the past couple of summers. Handling the lab section and the associated lectures made me realize that being able to tease apart the right AI technique for the right problem is an essential skill for the next generation of computer science students. As the AI field grows with new models, tools, and techniques, this course would provide the necessary skill set to know how best to program using existing AI models. This course would also cover broader AI topics, including classical AI topics such as expert systems, planning, etc., to give the students an appreciation for yesteryear's tried and tested methods.

Data-Centric AI: Data-Centric AI is the recent transition from improving the AI model to the underlying data used to train and evaluate models. While building and using large datasets has been critical to the recent success of AI, this endeavor is often painstaking and expensive. There are many lessons from the multi-decade-long efforts from the semantic web community, especially in establishing efficient and preferably low-cost methods and tools for findable, accessible, interoperable, reusable (FAIR) datasets. Using existing standards-based vocabularies and ontologies, quantifying and accelerating the time to source and prepare high-quality data in machine learning pipelines can be achieved. Having standards makes the data interoperability between AI models more manageable, ensuring that the data is labeled consistently using the concepts available from the community-defined and maintained vocabularies and ontologies to achieve "label consensus." Since the domain models and the associated data available in knowledge graphs have been developed with human input, the data quality is typically much higher than the sometimes noisy datasets. Therefore, there is a need to train the next generation of computer scientists to be productive and efficient in open data engineering tools to make building, maintaining, and evaluating datasets easier, cheaper, and reproducible. This proposed course could fill this critical gap, bringing innovations from the knowledge representation and semantic web communities to the classroom.

Decentralized Systems: This course is very much aligned with my inter-disciplinary research interests. As I mentor undergraduate students for research projects requiring linked data, semantic web, and fundamentals of blockchain technologies, I have developed a set of teaching materials to ease them into the complex topics of decentralization to get them started on the research. The teaching material I have developed could include various emerging topics such as federated learning for privacy-enhanced AI model training and smart contract development, which is at the center of decentralized applications, transforming many fundamental application areas.

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