TEACHING STATEMENT

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December 2021

Three principles guide my teaching methodology. First, I am a firm believer in the principle of teaching someone how to learn a concept rather than explaining the concept word-for-word. Second, I 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. Third, I care deeply about incorporating new topics into courses to keep them fresh and evolving, as that is the best way to prepare our young talent to face the challenges of an ever-changing field such as computer science (for example, 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). Guided by these three principles, I am very excited to take on the challenge of designing new courses, and continuing old courses to incorporate new content and novel teaching methodologies in the classroom. I plan to utilize a teaching strategy where the students "learn how to learn" and nurture computational thinking mechanisms to solve problems. In terms of lecture delivery, I always strive to be as interactive as possible in the lectures where I encourage students to ask questions. I also make it a point to put ice-breaker questions to ease the students into the topic and keep them engaged. During office hours, unless a student has a fundamental misunderstanding of the concepts taught during class, I usually urge the students to show me their work/code to resolve the issue, as I believe in the mantra "talk is cheap, show me the code." By doing that, I have demonstrated to the students how I approach solving the problem, which I believe to be a valuable learning outcome in computer science.

Furthermore, I am very well aware of the need to cater to unexpected situations, both in my research and teaching. Many educators encountered extra challenges as they shifted to primarily online communication mediums instead of in-person classrooms due to the Covid-19 pandemic. Through student interactions in the courses I taught and research projects conducted during the pandemic, I found online meeting solutions effective for some, while others needed physical meetings for effective learning. Gauging such diverse needs and being agile is a significant challenge. Being receptive to student needs requires establishing an effective communication pattern in the classroom and student mentoring activities. When it comes to student mentoring, having regular weekly meetings might be effective for some students but unproductive for others, whereas asynchronous communication, such as slack messages and email, may be more effective for the other students. Regardless of the communication mechanism, I aim to make the students the owners of solving the task at hand, as the goal is to nurture the students' ability to productively and independently learn the subject matter or do research on their own.

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 to graduate level. In most of these courses, I was responsible for designing the course material from scratch and teaching it to a diverse group of students.

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 separating fiction from fact and critically evaluating 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[1]. I always encouraged the students to start the lab sessions during class time as soon as the lecture ended and guided those having difficulty getting started. The labs I designed were an essential piece of the learning experience in the course, as the labs enabled 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. The students were not expected to be limited to the concepts learned in the lectures and labs for their final class projects. However, we required periodic updates on their project progress assessed during dedicated class times and our extensive office hours. I also encouraged the students to frequently check their code in a GitHub repository and make the final product open-source, which trained them to work on a collaborative project effectively and in a community-driven way.

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). The programs were held at Swathmore University, Nairobi, Kenya, in 2011 and the University of the Philippines Diliman, Manila, the Philippines, 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

[1] All the lab notebooks are available at `https://github.com/AIFictionFact/Summer2021`.

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: I taught Introduction to Computer Science to a highly talented group of female high school seniors selected from all over the US, 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 in summer 2010. 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. 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 or were hired at top technology companies. 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 Springer book titled "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 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 participated 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 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. I had the opportunity to deliver several lectures on linked data and semantic web concepts for this course. 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.

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 guest lectures have helped me formulate several ideas for special topics classes and the core fundamental computer science courses that I am excited to teach.

Student Mentoring

At RPI, I am currently actively mentoring several PhD students funded by the IBM Research AI Horizon Network funded Health Empowerment through Analytics Learning and Semantics (HEALS) project[2]. I have helped advise several master's students, two of whom have continued to the CS PhD program. I have mentored close to 30 undergraduate research students since the start of the project in 2017. These students contributed to various facets of the HEALS project, including building a demo application that utilizes knowledge base question answering, a risk prediction dashboard, the development of a food knowledge graph, ontologies for various explanation types, study cohorts, and guideline provenance under my guidance. Furthermore, as part of the IBM AI Research Collaboration funded Smart Contracts Augmented with Learning and Semantics (SCALES) project[3] , I mentored a PhD student and ten undergraduate students. In all of these projects, I am incredibly proud of the achievements of the students that I mentored. Some of them secured first author publications at international computer science conferences and workshops (examples include [2, 3, 4, 5, 6, 7, 8]). One student 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], and 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 investigate 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.

Planned Teaching

My past teaching and research experience has covered a wide range of topics in computer science, including artificial intelligence/machine learning, software engineering, data structures, security, privacy, algorithms, blockchain technologies, and the semantic web. Given the need, I am qualified and ready to teach courses in these subjects effectively. I am eager to teach undergraduate and graduate-level courses directly related to my research projects. In particular,

[2] https://idea.rpi.edu/research/projects/heals

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

I am very much interested in conducting courses focusing on practical applications and those that involve hands-on coding tasks. Several courses I would be delighted to teach 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 scientists that need to be well-versed in AI technologies. 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 and upcoming (potentially bleeding-edge) 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. The primary goal of this course would be to teach the students an appreciation for how to pick the right tool for the right problem, which I believe to be a very must-have skill for any computer science student.

Data-Centric AI: Data-Centric AI is the recent transition from improving the AI model to improving 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. It would introduce the topics related to decentralized systems that are not traditionally covered in core computer science classes and provide a practical introduction to developing decentralized applications that are transforming many areas. As I mentor undergraduate students for research projects requiring linked data, semantic web, and fundamentals of blockchain technologies, I have already developed a set of teaching materials and lectures to ease them into the complex topics of decentralization to get them started on the research. These preliminary teaching materials could be easily integrated into this proposed course. It would also 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.

In conclusion, 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. As evidenced by the above-suggested courses, I believe theory and application go hand in hand for the best possible computer science education. As a professor, I will constantly strive to hone my teaching skills and update my courseware to keep abreast with the latest topics. When mentoring students, I believe that every student can excel at the task at hand if they are provided with the right motivation and guidance. The greatest asset that I can equip my students with is a learning mentality, the belief that they can learn anything with determination, hard work, and the right approach. These skills start with passion but grow with classroom experience, and I eagerly look forward to this growth both in myself and my students.

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