Qingyun Wu

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RESEARCH INTEREST Machine Learning, Reinforcement Learning and Information Retrieval

EDUCATION

University of Virginia Charlottesville, VA, U.S.A
Ph.D candidate, Department of Computer Science 08/2014 - present
Advisor: Hongning Wang
Ph.D Thesis: Interactive online learning from incomplete knowledge

Xidian University Xi'an, China
B.E, Department of Telecommunications Engineering 08/2010 - 07/2014

RESEARCH EXPERIENCE

Research Assistant at the University of Virginia 08/2014 - present
Thesis topic: Interactive Online Learning with Incomplete Knowledge

- Advisor: Hongning Wang

Research Intern at Microsoft Research 05/2019 - 08/2019
Worked on a research project on Automated Machine Learning (AutoML) in data management, exploration and mining (DMX) Lab of Microsoft Research

- Mentor: Chi Wang

Research Intern at Adobe Research 02/2019 - 05/2019
Worked on a research project on efficient exploration of prior information to conquer the cold-start problem in recommender systems.

- Mentors: Georgios Theocharous, Zheng Wen, Yasin Abbasi−Yadkori

Research Intern at Yahoo Research 05/2016 - 08/2016
Worked on a research project about long-term user engagement optimization in news recommendation.

- Mentors: Liangjie Hong, Yue Shi

PREPRINTS

[1] Chi Wang and **Qingyun Wu**. FLO: Fast and Lightweight Hyperparameter Optimization for AutoML, arXiv preprint arXiv:1911.04706, 2019

PUBLICATIONS

[1] Wenqiang Lei, Xiangnan He, Yisong Miao, **Qingyun Wu**, Richang Hong, Min-Yen Kan and Tat Seng Chua. Estimation-Action-Reflection: Towards Deep Interaction Between Conversational and Recommender Systems. WSDM 2020 (acceptance rate: 15 %; to appear)

[2] **Qingyun Wu**, Zhige Li, Huazheng Wang, Wei Chen, and Hongning Wang. Factorization Bandits for Online Influence Maximization. In Proceedings of the 25th ACM SIGKDD International Conference, pages 636-646, KDD 2019 (acceptance rate for oral presentation: 9.1%)

[3] Huazheng Wang, Sonwoo Kim, Eric McCord-Snook, **Qingyun Wu**, and Hongning Wang. Variance Reduction in Gradient Exploration for Online Learning to Rank. In Proceedings of the 42th International ACM

SIGIR conference, pages 835-844, SIGIR 2019 (acceptance rate:20%, **Best Paper Award**).

[4] **Qingyun Wu**, Huazheng Wang, Yanen Li, and Hongning Wang. Dynamic Ensemble of Contextual Bandits to Satisfy Users' Changing Interests. In Proceedings of The World Wide Web Conference, pages 2080-2090, WWW 2019 (acceptance rate for oral presentation: 8%)

[5] Yi Qi, **Qingyun Wu**, Hongning Wang, Jie Tang, and Maosong Sun. Bandit Learning with Implicit Feedback. In Proceedings of the 32nd International Conference on Neural Information Processing Systems, pages 7287-7297, NeurIPS 2018 (acceptance rate: 20%).

[6] **Qingyun Wu**, and Naveen Iyer and Hongning Wang. Learning Contextual Bandits in a Non-stationary Environment. In Proceedings of the 41th International ACM SIGIR conference, pages 495-504, SIGIR 2018 (acceptance rate: 21%).

[7] Huazheng Wang, **Qingyun Wu** and Hongning Wang, Online Interactive Recommendation via Factorization Bandits. In Proceedings of the 31st AAAI Conference, pages 2695-2702, AAAI 2017 (acceptance rate: 24.6%)

[8] **Qingyun Wu**, Hongning Wang, Liangjie Hong and Yue Shi. Returning is believing: Optimizing long-term user engagement in recommender systems. In Proceedings of the 26th ACM International Conference on Information and Knowledge Management, pages 1927-1936, CIKM 2017 (acceptance rate: 21%)

[9] Huazheng Wang, **Qingyun Wu** and Hongning Wang, Learning Hidden Features for Contextual Bandits. In Proceedings of the 25th ACM International Conference on Information and Knowledge Management, pages 1633-1642, CIKM 2016 (acceptance rate: 17.6%)

[10] **Qingyun Wu**, Huazheng Wang, Quanquan Gu, and Hongning Wang. Contextual bandits in a collaborative environment. In Proceedings of the 39th International ACM SIGIR conference, pages 529-538, SIGIR 2016 (acceptance rate: 18%; Awarded as the **Best Research Short** at the 2017 ACM Capital Region Celebration of Women in Computing Conference)

AWARDS

- **SIGIR 2019 Best Paper Award** 2019
- **Rising stars in EECS 2019** 2019
- **Virginia Engineering Foundation Graduate Fellowship** 2018-2019
- **Graduate Student Award for Outstanding Research** 2018
  From the Department of Computer Science, University of Virginia.
- **Best Research Short Finallist** 2018
  From the 14th annual University of Virginia Engineering Research Symposium (UVERS) for exceptional graduate research.

- **CAPWIC Best Research Short** 2017
  From the 2017 ACM Capital Region Celebration of Women in Computing Conference.
- **Graduate Student Award for Outstanding Research** 2017
  From the Department of Computer Science, University of Virginia.
- Student Travel Awards
  -Travel award from Women in Machine Learning 2019
  -NSF student travel awards to NeurIPS 2019, SIGKDD 2019, WWW 2019, NeurIPS 2018, SIGIR 2018 and CIKM 2017
  -ACM SIGIR student travel award to SIGIR 2016
  -ACM SIGKDD student travel award to KDD 2016
- Excellent Undergraduate Thesis Award at Xidian Univ.($< 1\%$) 2014
- National Encouragement Scholarship of China ($< 3\%$) 2013
- Honorable Mention, Mathematics Contest in Modeling/Interdisciplinary Context in Modeling 2013
- Provincial First Price, China Undergraduate Mathematics Contest in Modeling 2012
- Yulong CoolPad Scholarship for Excellent Students ($< 1\%$) 2012
- Outstanding Student Scholarship of Xidian Univ.($< 5\%$) 2011-2014

INVITED TALKS AND ACTIVITIES

- Invited talk at AI Rising Stars Symposium at USC, hosted by USC 12/2019
- Invited talk at University of Illinois at Urbana-Champaign, Database and Information System (DAIS) Lab 10/2019
  Talk title: *Interactive Online Learning for Intelligent Systems*
- Rising Stars in EECS workshop 2019, hosted by UIUC 10/2019
- Women in Research Lean In, Facebook 09/2019
- AI Breakthroughs Workshop, Microsoft Research AI 09/2019
- Invited talk at Microsoft Research AI, Reinforcement Learning Group 08/2019
  Talk title: *Variance Reduction in Gradient Exploration for Online Learning to Rank*

TEACHING EXPERIENCE

- Teaching assistant of CS 6501 Text Mining 2017 Spring, UVa
- Teaching assistant of CS 4501 Information Retrieval 2016 Spring, UVa
- Teaching assistant of CS 6161 Algorithm 2015 Spring, UVa
- Teaching assistant of CS 2150 Program and Data Representation 2014 Fall, UVa

SERVICES

- Reviewer of ICML 2019, AAAI 2019, WSDM 2017, WSDM 2018, ACL 2018, CIKM 2016, TKDE, Information Retrieval Journal, Neurocomputing, Transactions on Data Science,
- Computer Science Graduate Student Group (CSGSG) Officer in the University of Virginia
- **Diversity committee member** in the University of Virginia

REFERENCES

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Liangjie Hong

- Director of Engineering, Data Science and Machine Learning at Etsy
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Wei Chen

- Principal Researcher at Microsoft Research Asia
- Adjunct Professor in the Institute of Interdisciplinary Information Sciences, Tsinghua University
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Chi Wang

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Research Statement

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Department of Computer Science, University of Virginia

The past decades have witnessed a prominent trend of adopting intelligent systems, such as recommendation systems and smart homes, into ordinary people's daily life. One key characteristic of such systems is the need of *online sequential decision making*: decisions have to be made when the learning agent only has incomplete knowledge about the environment (e.g., users of the systems). The consequences of such decisions will, in turn, contribute to the data the agent can collect, forming an interactive feedback loop. This makes conventional offline training based machine learning methods incompetent, i.e., the so-called explore-exploit dilemma. It urges us to move from the passive learning paradigm to a more interactive and proactive one. My research vision is to develop efficient interactive online learning solutions that can continuously learn from and interact with sophisticated real-world environments, where humans are involved. My current research has built solid foundation for me to realize my vision. In the long term, my research can impact a broad spectrum of applications that were impossible or immature before, including conversational recommendation systems, interactive online education systems, human-in-the-loop cyber-physical systems, and many more.

1 Research Achievements

As an important part of my long-term research vision, my current research builds upon the insight that interactive online learning agents are often situated in a dynamically changing and potentially collaborative or structured environment. Based on these insights, themes of my research to date include 1) Sample-efficient interactive online learning, specifically multi-armed bandit learning, in collaborative and structured environments; 2) Dynamic online decision making in non-stationary environments. My research has generated impactful contributions in various application scenarios, including personalized online recommendation [5, 6, 9–11], online education [2], online learning to rank [4], and online influence maximization [8].

1.1 Efficient online learning in collaborative and structured environments

Real-world environments can be highly structured. For example, users targeted by a recommendation system can be connected in social networks, which reveal potential affinities or similarity among users; low-rank structure can thus be exploited due to the similarity between users or network assortativity. Such information can be effectively leveraged to reduce the sample complexity of online learning algorithms.

Efficient online learning in explicitly collaborative environments. I proposed collaborative contextual bandit learning solutions [5, 10], which successfully leverage the structural information for online decision making through collaborative learning. The key insight of my solutions is to capitalize on the information propagation among learning agents to reduce uncertainty and thus expedite the convergence of the online learning process. These works provide a theoretical understanding of the relationship between the available structural information and the sample efficiency of an online learning agent. Under this proposed framework, an up to $O(\sqrt{T}\log N)$ regret reduction can be achieved, where T is the total rounds of interactions and N is the number of users served in the system. This sheds light on the need and benefits of leveraging structure information in online decision making.

Efficient online learning in implicitly structured environments. In many cases, the structural information may not be explicitly available to the learners, indicating an implicitly structured environment. To address this problem, I proposed solutions [2, 5, 6, 8] that can infer the structure from interactions with the environment and then leverage it to improve online decision making. My main insight is that, domain knowledge, such as human behavior modeling and network assortativity, in different application scenarios should be leveraged to help regulate the collaborative effect or structural information in the learning environment. This insight enable us to use interactive feedback from the environment to maintain an online estimate of the structural information. Unique properties of different environments can thus be leveraged to reduce sample complexity.

1.2 Dynamic online decision making in non-stationary environments

In many real-world systems, the only constant is the forever changing user intent and preferences. Adaption in decision making must be made in accordance with the changes in the environment; otherwise, sub-optimal decisions will result constantly.

Dynamic bandit learning in non-stationary environments. I proposed a suite of non-stationary contextual bandit learning solutions [7, 11], where instead of maintaining only one learning agent for the environment, a higher level learner is introduced to maintain a dynamic set of base learning agents. Insights from statistical hypothesis tests are used to adaptively create and remove a learner, and form learner ensembles to fit the changing environment. With these solutions, a near-optimal regret bound is achieved when learning in environments with abrupt changes.

An unified approach through statistical hypothesis tests. The application of our proposed solutions are not limited to handle non-stationarity in the time horizon, and they can be generalized to multi-agent/environment cases, where the non-stationarity can be formulated as the heterogeneity across different environments. I developed more general solutions based on online hypothesis tests to unify the online change detection in non-stationary environments and online clustering of learners. Through this unified approach with online hypothesis tests, much more flexible methodologies can be developed to efficiently handle environments where both non-stationarity and collaborative structure co-exist.

1.3 Research impact

My research has generated impacts on both improved theoretical guarantees and pioneering practical deployments. As proof of the former, my theoretical analysis on the relationship between the structural information and sample efficiency in online learning [5, 10] sheds light on the need of collaborative online learning and has inspired many follow-up studies. As proof of the latter, my research [7, 8] have turned into modules for handling users' changing preferences in various real-world commercial recommendation systems, such as news recommendation in Yahoo, and lens recommendation in Snapchat. And one of our solutions [2] was successfully deployed on the largest MOOC platform in China, XuetangX, to recommend pop-up quiz questions for improving student engagement, where positive learning outcome measured by reduced student dropout rate and increased online time was achieved. It is worth mentioning that in [4] we were able to significantly improve the dueling bandit gradient descent based online learning to rank methods' convergence by carefully designed variance reduction techniques during online exploration. For its unique contribution to the Information Retrieval community, our work [4] has received the **SIGIR'2019 Best Paper Award**.

2 Future Research Plan

My current research has prepared me with deep working experience in efficient online learning for building intelligent systems, and promises exciting potential impact on the next generation of artificial intelligence. Looking forward, I plan to conduct fundamental research to build intelligent systems that can benefit humans and society.

2.1 Long-term goals

Human-in-the-loop interactive machine learning. One long term goal of my research is to develop interactive online learning systems where humans are an integral part. The involvement of humans in such interactive systems brings in both challenges and opportunities. First, **ethical issues**, such as privacy protection, fairness constraints, become a critical consideration when designing online learning agents. Second, as acquiring feedback from humans can be expensive, learning efficiency need to be improved to reduce the number of interactions needed. Third, richer forms of information acquisition from humans can be adopted to improve the interaction efficiency. As an example of such attempts, recently through my collaboration with researchers from National University of Singapore, we augmented traditional recommendation systems with a conversational component via a reinforcement learning [1]. Despite such promising attempts and growing interest in the community, there is far more to be done especially in terms of **interaction efficiency, systematic bias** and **robustness**. I will continue my effort in such endeavors to develop interactive learning systems that can better serve human needs.

Human-out-of-the-loop trial and error. Design choices are pervasive in both scientific and industrial endeavors: for example, engineers and scientists design machines or programs to execute tasks more efficiently, and pharmaceutical researchers design new drugs to cure disease. Such design choices inevitably involve extensive human experts' trial and error to find the right combinations. Any significant advances in automating such processes can result in immediate productivity improvement and innovation in a wide area of domains. Another direction of my long-term research goals is to use interactive online learning techniques to move humans out of those tedious trial and error processes. Such a long-term goal is not an unachievable tale, and promising progress has been made in areas such as automated machine learning (AutoML), and autonomous systems using machine learning and reinforcement learning techniques. However, such innovations are not mature enough to be widely adopted in real-world scenarios. A lot of challenges are yet to be addressed. For example, achieving this goal requires the online learning agent to be **efficient, robust, and accountable**. As an important attempt toward this long-term goal, I have collaborated with researchers from Microsoft Research to develop a fast and lightweight hyperparameter optimization method for AutoML [3], which showed superior empirical performance over state-of-the-art hyperparameter optimization baselines and AutoML libraries. I will continue my exploration in this direction, which can help improve human productivity.

2.2 Short-term plans

To achieve my long-term goals, a series of research questions needs to be answered, on which I will base my plans for future research in the incoming 3-6 years.

From sample-efficient to interaction-efficient interactive online learning. Deep reinforcement learning has achieved great success in recent years, notably in playing video games and strategic board games. However, training those agents, especially model-free ones, usually requires a huge amount of samples. This directly limits its application in many important real-world problems, especially the ones where humans are involved. One of my future research plans is to

improve the sample efficiency of online learning agents from the perspective of meta-learning and experiences sharing. Another important research plan is to extend the concept of sample efficiency to **interaction efficiency**. Interaction efficiency can be a fundamentally more suitable optimization target in many application scenarios, where richer forms of interactions between the learning agent and the environment are feasible. For example, different forms of interactions can be considered as actions with different information acquisition resolutions. Fewer number of interactions can be achieved when enabling such multiresolution interactions.

Detection of model misspecifications during online learning. Model-based approaches are generally more sample-efficient than model-free ones, but they are prone to model misspecifications. Model misspecification directly leads to serious systematic bias, such as representational bias and learning bias. Unfortunately, model misspecification is largely ignored in model-based approaches, which greatly hinders the application of such solutions to real-world scenarios. I plan to develop principled solutions to address this limitation and make model-based online learning approaches more robust. My insight is that accumulated errors from the deployed models are strong signal of model misspecification [7] and this can be measured via statistical tests. My expertise in online hypothesis tests for non-stationarity will help me develop principled solutions to address this important challenge.

Robust, accountable, private and fair interactive online learning. **Robustness.** In many real-world scenarios, the environment with which the learning agent is interacting is not always benign. Various attacks, such as data poisoning attack and extract attack, exist in many real-world situations. Thus it is necessary to consider the online learning process in an adversarial setting. In my future research, I plan to harden the interactive online learning solutions for adversarial robustness and study the theoretical effects of such solutions. **Accountability.** The performance of an interactive online learning algorithm, such as multi-armed bandit and reinforcement learning, can vary drastically during online learning. Conventional online learning algorithms provide little information about the quality of their current policies before deployment, which directly limits their usage in high-stake applications like healthcare. To conquer this severe limitation, I plan to develop accountable online learning frameworks whose performance can be quantified and guaranteed during online learning. Furthermore, I plan to extend theoretical understandings about online learning algorithms to a more holistic view: variance and stability of an online learning algorithm need to be studied in addition to sample-complexity. **Privacy.** Privacy concerns have been raised on online learning algorithms. Real-world privacy breaches have been reported in Amazon's and Facebook's recommendation systems, where an adversary extracts private information about a user solely based on the system's recommendation sequence. In my future research, I plan to harden the interactive online learning solutions with privacy protection under different threat models. **Fairness.** Fairness is another important ethical constraint for online learning algorithms, especially when humans are in the loop, and the online decisions have important consequences on people's lives, such as hiring, policing, and even criminal sentencing. In my future work, I would like to study fairness in online decision making from the following perspectives: First, because of the online learning agents' uncertainty about the environment, the definition of 'fairness' needs to be carefully studied, and it needs to be defined in a problem-dependent manner in the online learning setting. Second, due to the sequential nature of many online learning solutions, such as reinforcement learning, the impact of decisions may be delayed, which requires us to study their delayed impact on fairness. Third, it is necessary to study the trade-off and reconciliation between fairness and utility maximization during online decision making.

3 Summary

I believe the research I am planning to conduct will greatly contribute to both algorithmic deployment and theoretical understanding of interactive online learning in both human-in-the-loop and human-out-of-the-loop scenarios. It not only can contribute to the next generation of artificial intelligence, but also can bring in broader impacts on education and the next generation of the industrial revolution. The resolution of these important issues necessarily requires fundamental academic research and interdisciplinary collaborations, to which I would be excited to contribute. I believe my extensive experience in both theoretical and applied research has prepared me well for this mission.

References

[1] Wenqiang Lei, Xiangnan He, Yisong Miao, Qingyun Wu, Richang Hong, Min-Yen Kan, and Tat-Seng Chua. Estimation–action–reflection: Towards deep interaction between conversational and recommender systems. In *13th ACM International WSDM Conference, WSDM '20.*

[2] Yi Qi, Qingyun Wu, Hongning Wang, Jie Tang, and Maosong Sun. Bandit learning with implicit feedback. In *Advances in Neural Information Processing Systems*, pages 7276–7286, 2018.

[3] Chi Wang and Qingyun Wu. Flo: Fast and lightweight hyperparameter optimization for automl. *arXiv 1911.04706*, arXiv 2019.

[4] Huazheng Wang, Sonwoo Kim, Eric McCord-Snook, Qingyun Wu, and Hongning Wang. Variance reduction in gradient exploration for online learning to rank. In *42nd ACM SIGIR Conference on Research and Development in Information Retrieval*, SIGIR'19, pages 835–844. ACM, 2019.

[5] Huazheng Wang, Qingyun Wu, and Hongning Wang. Factorization bandits for interactive recommendation. In *The 31th AAAI Conference on Artificial Intelligence, AAAI '17*.

[6] Huazheng Wang, Qingyun Wu, and Hongning Wang. Hidden feature leaning for contextual bandit. In *The 25th ACM International Conference on Information and Knowledge Management, CIKM '16.*

[7] Qingyun Wu, Naveen Iyer, and Hongning Wang. Learning contextual bandits in a non-stationary environment. In *The 41st International ACM SIGIR Conference on Research Development in Information Retrieval*, SIGIR '18, pages 495–504, New York, NY, USA, 2018. ACM.

[8] Qingyun Wu, Zhige Li, Huazheng Wang, Wei Chen, and Hongning Wang. Factorization bandits for online influence maximization. In *Proceedings of the 25th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining*, KDD '19, pages 636–646, New York, NY, USA, 2019. ACM.

[9] Qingyun Wu, Hongning Wang, Liangjie Hong, and Yue Shi. Returning is believing: Optimizing long-term user engagement in recommender systems. In *Proceedings of the 2017 ACM on Conference on Information and Knowledge Management*, CIKM '17, pages 1927–1936, New York, NY, USA, 2017. ACM.

[10] Qingyun Wu, Huazheng Wang, Quanquan Gu, and Hongning Wang. Contextual bandits in a collaborative environment. In *Proceedings of the 39th International ACM SIGIR conference on Research and Development in Information Retrieval*, pages 529–538. ACM, 2016.

[11] Qingyun Wu, Huazheng Wang, Yanen Li, and Hongning Wang. Dynamic ensemble of contextual bandits to satisfy users' changing interests. In *The World Wide Web Conference*, WWW '19, pages 2080–2090, New York, NY, USA, 2019. ACM.

Teaching Statement

Qingyun Wu (qw2ky@virginia.edu)
Department of Computer Science, University of Virginia

I consider educating and mentoring as the most important activities and noble duties of an academic career. As the first-generation of college student in my family and the only one who goes to graduate school, I deeply believe in the power of education and how it can change one's life. The experiences I had have shaped my determination to devote myself to such a noble mission. As a growing and ever-changing field, I believe teaching in computer science is not only about transmitting knowledge to students but also about inspiring the students to ***inquire proactively***, to ***think critically***, and to ***learn independently***. It is a process of collective improvement for both the students and the teacher. One of the reasons I want to become a professor is that I am enthusiastic about engaging in this exciting process with the best young talents of our next generation.

1 Teaching and mentoring experiences

During my graduate study, I contributed to four courses as a teaching assistant (TA). I was the teaching assistant for two undergraduate courses (CS 2150 Program and Data Representation, and CS 4501 Information Retrieval) and two graduate courses (CS 6161 Algorithm, and CS 6501 Text Mining) in the Computer Science department at the University of Virginia. My responsibilities included grading assignments, holding office/lab hours, reviewing students' progress on course projects. Also, I was the TA lecturer for the biweekly problem-solving sessions of CS 6161 Algorithm class. During these processes I learned the importance of inspiration and patience. For example, when I was lecturing the problem-solving sessions in the Algorithm class, instead of directly telling the students how to solve the problems, I ask the students to tell me their attempts in solving the problems. Based on their attempts, I ask questions or give them hints to help them identify the bottlenecks. I found that since the students have a diverse educational background, they have difficulties in solving problems for different reasons. It may be because of a lack of understanding of the course material, or lack of prerequisite knowledge on related concepts. I need to explain the same problem in different ways and with different levels of detail. It requires a lot of patience and effort, but it is also rewarding to guide students out of the woods. This experience also gave me the chance to work with different professors and learn the course development for various subjects.

My teaching and mentoring experience are not restricted to the classroom. As a senior Ph.D. student, I was privileged to have the opportunity to mentor four undergraduate students and three junior year graduate students on research projects, together with my advisor Dr. Hongning Wang. Through this experience, I learned many important things about mentoring students, including how to encourage critical thinking, how to capitalize on each students' strengths, and how to encourage independent research. I also volunteered during UVA open houses to give introductory and interactive lectures about my research to high school students. Through interactions with high school students, I learned how to catch students' interests and curiosity on unfamiliar topics.

2 Professional development

When serving as a TA, I was constantly reflecting on my role as a teacher and tried to seek honest feedback from both students and the course instructors. To better prepare myself for the

teaching responsibilities as a professor, I have participated in the Tomorrow's Professor Today (TPT) program at the University of Virginia since fall 2018. The program is designed to facilitate the transition from a student to an academic professional. In this program, I participated in a series of teaching seminars and workshops, teaching observations followed by feedback sessions, and course design materials preparation. Through this professional training, I learned several important things about effective teaching: 1) from content-oriented teaching to goal-oriented teaching; and 2) effective interactive teaching. From this program, I also learned many small tricks from experienced teachers that will be useful for my future teaching, including how to project my voice in a large classroom, and how to effectively encourage classroom participation.

3 Teaching and mentoring philosophy

My teaching philosophy has been shaped by my experiences as a student, as a teaching assistant, and the professional training I received. By reflecting on the many classes I attended, I know how inspiring a good teacher can be and how a boring class can ruin a student's interest. As I mentioned in the introduction, I believe the goal of teaching in computer science is to inspire the students to inquire proactively, to think critically, and to learn independently. With such a goal in mind, my teaching philosophy up to date has the following four essential components:

1. Intrigue students' ***interest and curiosity*** on the concerned subject or concept, such that students can be self-motivated to learn.
2. Motivate and guide students to recognize and fully understand the ***fundamental concepts*** and unify the seemingly disparate concepts to an integrated understanding.
3. Encourage and help students to develop ***critical thinking*** on the concepts.
4. Inspire and encourage students to ***learn and explore independently*** to solve the cutting-edge and fundamental challenges.

To achieve all these components, a deep understanding of the course subject, carefully designed course material, and tremendous patience are needed. I believe my research experience and expertise, my teaching and mentoring experiences, and the professional training I received have prepared me well for realizing such philosophies.

4 Teaching plan

As a future faculty, I am looking forward to opportunities for teaching introductory courses on **machine learning**, **reinforcement learning** and **information retrieval** at both undergraduate and graduate levels. I am also interested in developing interdisciplinary graduate courses that combine the areas of machine learning with some other important research areas such as data science, and cyber-physical systems. I look forward to sharing my knowledge with students and also learning from them. I am excited to be an integral part of the department and share the teaching responsibilities with my colleagues.

Diversity Statement

Qingyun Wu (qw2ky@virginia.edu)
Department of Computer Science, University of Virginia

I have long understood the value of working with and interacting with diverse groups of people, and I am determined to play a leading role in fostering an environment of diversity and inclusion in my future career. My perspectives on diversity and inclusion are largely shaped by my own background: I was born and raised in a small town of Henan province in China, where, for historical reasons, women are largely undervalued. In the environment where I was raised, female students are not encouraged to study science, technology, engineering, and mathematics (STEM) majors and sometimes are even discouraged from seeking higher education. Many of my female friends from childhood stopped seeking education after finishing high school because of the lack of family support and continuous discouragement from peers and family members. Growing up in such an environment, I deeply understand how such stereotypes can easily devastate a young woman or man's confidence and dreams, and how external support can positively affect a person's life. After finishing college, I started my graduate studies in the United States. Similar to many international students, I experienced an intimidating and difficult process of adjusting to new cultures, and it took a long time to dispel the feeling of being an outsider. These experiences all motivated me to strive to recognize and remove implicit biases and to foster an inclusive environment.

Since my graduate study, I have been actively participating in diversity supportive activities, including conferences and workshops. During my junior years as a graduate student, I was fortunate to be selected to participate in the Grace Hopper Celebration of women in computing conference, CRA-W, and ACM Capital Regional women in computing celebration conference. During the meetings and workshops, I received a lot of help and support. More importantly, I did not just position myself as a mentee. Instead, I started to learn and think about how to support and mentor others who need help.

From Nov 2017, I started to serve as a student representative in the diversity committee of our department at the University of Virginia. The diversity committee members meet regularly to discuss potential issues, solutions, and activities to support underrepresented students and students with disabilities. One of my responsibility is to help solicit students' voices on their concerns or difficulties on diversity-related matters. There is one time, we received an email from a junior student. He told us that as the only African American student in one of his classes, nobody teamed up with him on course projects, and he is too shy to reach out to other students. We also received emails from several female graduate students. From the emails, we learned that many female graduate students feel isolated in their labs, where male students usually take the majority. It is hard for them to join the discussions, especially on topics that are not familiar to them, such as some sports activities that they are not a part of. Those emails made the committee members realize that although many people do know the importance of building inclusive environments, some of their unconscious behaviors can lead to an exclusive atmosphere. To resolve such implicit bias and unconscious exclusive behaviors, I helped organize department-wide training sessions for faculty and students. Those training helped improve awareness of obstacles faced by underrepresented students. Many faculty members started to act by encouraging underrepresented students' classroom/lab participation or public speaking. I also helped in applying for funding from external sponsors to support the underrepresented students to attend conferences or workshops.

Apart from serving on the diversity committee, I am also a group member of Women in Computing Sciences (WiCS) group at the University of Virginia. The aim of WiCS is to raise awareness of issues faced by women in technology, in addition to inspiring women to explore educational and professional opportunities in the field through mentorship and service. As a senior group member, I regularly attend the mentor-mentee meetings to answer questions from undergraduate group members and host high school visitors during open houses at UVa.

Recently, I was invited to participate in the Women in Research Lean In Workshop at Facebook, where I met the 40 excellent female researchers from different backgrounds and talked to Sheryl Sandberg about how to enhance the leadership and development of under-representative minorities in the research community. I am also privileged to be selected to participate in the EECS Rising Stars workshop this year. Through these outreach activities and career development activities, I learned the importance of building an affirming and inclusive environment in the broader research community.

In my future career, I will continue to seriously pursue diversity and outreach initiatives at every opportunity, including serving on the diversity committee, initiating or serving on mentorship programs, and participating in diversity outreach activities. I believe that to be effective, diversity initiatives must be tailored to the unique needs and barriers to entry faced by different underrepresented groups and different stages of their careers. I believe that my long-lasting efforts and services prepared me well to make my leading contribution in building a diverse and inclusive environment in any university.