Haifeng Xu

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RESEARCH INTERESTS

Artificial Intelligence, Computational Game Theory, Machine Learning, Information Economics, The Design and Analysis of Algorithms

APPOINTMENTS

Postdoctoral Fellow 08/2018 – present
Center for Research on Computation and Society (CRCS)
Harvard University, USA
Supervisors: David C. Parkes and Yiling Chen

Lecturer on Computer Science 09/2018 – present
Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS)
I teach CS 182: Artificial Intelligence

Alan Batson Assistant Professor start from 08/2019
Department of Computer Science
University of Virginia, USA

EDUCATION

Ph.D. in Computer Science 08/2013 – 07/2018
University of Southern California, USA
Advisors: Milind Tambe and Shaddin Dughmi

MMath in Computational Mathematics 08/2012 – 08/2013
University of Waterloo, Canada
Advisor: Hans De Sterck

B.Sc. (honours) in Mathematics 08/2008 – 07/2012
School of Gifted Young, University of Science & Technology of China
I was a member of the HUA Loo-Keng Elite Program in Mathematics

SELECTED HONORS & AWARDS

- **Google Ph.D. Fellowship** 2017
  One of the three recipients worldwide in the category *Algorithms, Optimizations and Markets*
- **CAMS Prize for Excellence in Research, USC Center for Applied Mathematical Sciences** 2017
  Awarded annually to two graduate students across the university
- **Best Research Assistant Award, Computer Science Department, USC** 2017
- **Best Paper Award, AAMAS Workshop on Security and Multi-agent Systems (SecMas)** 2016

Paper: Haifeng Xu, *The mysteries of security games: Equilibrium computation becomes combinatorial algorithm design*.

- **Best Student Paper Award, AAMAS** 2016
  Paper: A. Yadav, H. Chan, A. X. Jiang, H. Xu, E. Rice, M. Tambe, *Using social networks to aid homeless shelters: Dynamic influence maximization under uncertainty*.

- **Shing-Tung Yau College Student Mathematics Contests, China**[1] 2011
  - Silver Medal in Applied Mathematics (**Top 4 in the country**)
  - Bronze Team Medal (**Top 4 teams in the country**)

- **Microsoft Young Fellowship** 2011

- **Meritorious Winner in Mathematical Contest of Modeling (MCM), US** 2011

RESEARCH VISITS AND INTERNSHIPS

Research Intern, Google Research 06/2016 – 08/2016
Mentors: Ashwinkumar Badanidiyuru and Kshipra Bhawalkar
Project: Targeting and strategic signaling in ad auctions [SODA'18]

Visiting Student, Simons Institute for the Theory of Computing 10/2015 – 12/2015
Program: Economics and Computation
Project: Signaling in Bayesian Stackelberg games [AAMAS'16]

Research Intern, Yahoo! Lab 06/2015 – 08/2015
Mentor: Ruggiero Cavallo
Project: Equilibrium analysis in Ad auctions with asymmetrically informed bidders

Course Member, *Foundations of Social Computing*, University of Waterloo 01/2013 – 04/2013
Instructor: Kate Larson
Course Project: Improving the efficiency of crowdsourcing contests [AAMAS'14]

Research Intern, Microsoft Research 07/2011 – 06/2012
Mentors: Bin Gao and Tieyan Liu
Project: Predicting advertiser bidding behaviors in ad auctions [WWW'13]

PUBLICATIONS

*For papers appearing at theoretical CS venues, the author order is alphabetical (α-β) by convention.

Refereed Journal Articles & Full Conference Papers

[21]. **Haifeng Xu**, Kai Wang, Phebe Vayanos, Milind Tambe. Strategic Coordination of Human Patrollers and Mobile Sensors with Signaling for Security Games. *Proceedings of the 32th AAAI Conference on Artificial Intelligence* (**AAAI'18**).

[20]. (α-β) Ashwinkumar Badanidiyuru, Kshipra Bhawalkar, **Haifeng Xu**. Targeting and Signaling in Ad Auctions. *ACM-SIAM Symposium on Discrete Algorithms* (**SODA'18**).

[19]. **Haifeng Xu**, Shaddin Dughmi, Milind Tambe, Venil Loyd Noronha. Mitigating the Curse of Correlation in Security Games by Entropy Maximization. *Proceedings of the 17th International Conference on Autonomous Agents and Multiagent Systems* (**AAMAS'18**, short paper).

[1] A prestigious national contest organized by the famous mathematician Shing-Tung Yau (a winner of Fields Medal and Wolf Prize).

[18]. Aaron Schlenker, Omkar Thakoor, **Haifeng Xu**, Fei Fang, Milind Tambe, Long Tran-Thanh, Phebe Vayanos, Yevgeniy Vorobeychik. Deceiving Cyber Adversaries: A Game Theoretic Approach. *Proceedings of the 17th International Conference on Autonomous Agents and Multiagent Systems* (**AAMAS'18**).

[17]. (α-β) Shaddin Dughmi, **Haifeng Xu.** Algorithmic Bayesian Persuasion. *SIAM Journal on Computing*. [Supersedes the STOC'16 paper below.]

[16]. (α-β) Shaddin Dughmi, **Haifeng Xu**. Algorithmic Persuasion with No Externalities. *Proceedings of the 18th ACM Conference on Economics and Computation* (**EC'17**).

[15]. **Haifeng Xu***, Benjamin Ford*, Fei Fang, Bistra Dilkina, Andrew Plumptre, Milind Tambe, Margaret Driciru, Fred Wanyama, Aggrey Rwetsiba, Mustapha Nsubaga and Joshua Mabonga. Optimal Patrol Planning for Green Security Games with Black-Box Attackers. *Proceedings of the 8th Conference on Decision and Game Theory for Security* (**GameSec'17**). (*Equal Contributions)

[14]. Aaron Schlenker, **Haifeng Xu**, Mina Guirguis, Christopher Kiekintveld, Arunesh Sinha, Milind Tambe, Solomon Sonya, Darryl Balderas, Noah Dunstatter. Don't Bury your Head in Warnings: A Game-Theoretic Approach for Intelligent Allocation of Cyber-security Alerts. *Proceedings of the 26th International Joint Conference on Artificial Intelligence* (**IJCAI'17**). **Highlighted in the press release opening the IJCAI'17 conference.**

[13]. (α-β) Shaddin Dughmi, **Haifeng Xu.** Algorithmic Bayesian Persuasion. *Proceedings of the 48th ACM Symposium on Theory of Computing* (**STOC'16**).

[12]. **Haifeng Xu.** The Mysteries of Security Games: Equilibrium Computation Becomes Combinatorial Algorithm Design. *Proceedings of the 17th ACM Conference on Economics and Computation* (**EC'16**).

[11]. **Haifeng Xu**, Rupert Freeman, Vincent Conitzer, Shaddin Dughmi, Milind Tambe. Signaling in Bayesian Stackelberg Games. *Proceedings of the 15th International Conference on Autonomous Agents and Multiagent Systems* (**AAMAS'16**).

[10]. **Haifeng Xu***, Long Tran Thanh*, Nick Jennings. Playing Repeated Security Games with No Prior Knowledge. *Proceedings of the 15th International Conference on Autonomous Agents and Multiagent Systems* (**AAMAS'16**). (*Equal Contributions)

[9]. Amulya Yadav, Hau Chan, Albert Jiang, **Haifeng Xu**, Eric Rice, Milind Tambe. Using Social Networks to Aid Homeless Shelters: Dynamic Influence Maximization Under Uncertainty. *Proceedings of the 15th International Conference on Autonomous Agents and Multiagent Systems* (**AAMAS'16**). **Best student paper award.**

[8]. **Haifeng Xu**, Albert X. Jiang, Arunesh, Sinha, Zinovi Rabinovich, Shaddin Dughmi, Milind Tambe. Security Games with Information Leakage: Modeling and Computation. *Proceedings of the 24th International Joint Conference on Artificial Intelligence* (**IJCAI'15**).

[7]. Yue Yin, **Haifeng Xu**, Jiarui Gan, Bo An, Albert X. Jiang. Computing Optimal Mixed Strategies for Security Games With Dynamic Payoffs. *Proceedings of the 24th International Joint Conference on Artificial Intelligence* (**IJCAI'15**).

[6]. Zinovi Rabinovich, Albert X. Jiang, Manish Jain, **Haifeng Xu**. Information Disclosure as a Means of Security. *Proceedings of the 14th International Conference on Autonomous Agents and Multiagent Systems* (**AAMAS'15**).

[5]. **Haifeng Xu**, Zinovi Rabinovich, Shaddin Dughmi, Milind Tambe. Exploring Information Asymmetry in Two-Stage Security Games. *Proceedings of the 29th AAAI Conference on Artificial Intelligence* (**AAAI'15**).

[4]. **Haifeng Xu**, Fei Fang, Albert X. Jiang, Vincent Conitzer, Shaddin Dughmi, Milind Tambe. Solving Zero-Sum Security Games in Discretized Spatio-Temporal Domains. *Proceedings of the 28th AAAI Conference on Artificial Intelligence* (**AAAI'14**).

[3]. Leandro Marcolino, **Haifeng Xu**, Albert X. Jiang, Milind Tambe, Emma Bowring. Give a Hard Problem to a Diverse Team: Exploring Large Action Spaces. *Proceedings of the 28th AAAI Conference on Artificial Intelligence* (**AAAI'14**).

[2]. **Haifeng Xu**, Kate Larson. Improving the Efficiency of Crowdsourcing Contests. *Proceedings of the 13th International Conference on Autonomous Agents and Multiagent Systems* (**AAMAS'14**).

[1]. **Haifeng Xu**, Bin Gao, Diyi Yang, Tieyan Liu. Predicting Advertiser Bidding Behaviors in Sponsored Search by Rationality Modeling. *Proceedings of the 22nd International Conference on World Wide Web* (**WWW'13**).

Book Chapters & Magazine Articles

[3]. Amulya Yadav, Hau Chan, Albert Jiang, **Haifeng Xu**, Eric Rice, Milind Tambe. Using Social Networks to Raise HIV Awareness Among Homeless Youth. *IBM Journal of Research and Development, 2017*.

[2]. Leandro S. Marcolino, **Haifeng Xu**, David Gerber, Boian Kolev, Samori Price, Evangelos Pantazis, and Milind Tambe. Multi-agent Team Formation for Design Problems. *Coordination, Organizations, Institutions and Norms in Agent Systems XI. Springer-Verlag Lecture Notes in AI, 2016.*

[1]. Leandro S. Marcolino, **Haifeng Xu**, Albert X. Jiang, Milind Tambe, and Emma Bowring. The Power of Teams that Disagree: Team Formation in Large Action Spaces. *Coordination, Organizations, Institutions and Norms in Agent Systems X. Springer-Verlag Lecture Notes in AI, 2015.*

Symposium & Workshop Papers

[8]. A. Schlenker, **H. Xu**, C. Kiekintveld, A. Sinha, M. Tambe, M. Guirguis, S. Sonya, D. Balderas, N. Dunstatter. Don't Bury your Head in Warnings: A Game-Theoretic Approach for Intelligent Allocation of Cyber-security Alerts. The *Algorithmic Game Theory Workshop (AGT) with IJCAI-1017*.

[7]. **Haifeng Xu.** The Mysteries of Security Games: Equilibrium Computation Becomes Combinatorial Algorithm Design. The *Workshop on Security and Multi-agent Systems (SecMAS) with AAMAS 2016*. **Best Paper Award**.

[6]. **Haifeng Xu**, Albert X. Jiang, Arunesh, Sinha, Zinovi Rabinovich, Shaddin Dughmi, Milind Tambe. Security Games with Information Leakage: Modeling and Computation. The *Algorithmic Game Theory Workshop with IJCAI-1015*.

[5]. **Haifeng Xu**, Zinovi Rabinovich, Shaddin Dughmi, Milind Tambe. Exploring Information Asymmetry in Two-Stage Security Games. The *AAAI Spring Symposium 2015 on Applied Computational Game Theory*.

[4]. Leandro S. Marcolino, **Haifeng Xu**, David Gerber, Boian Kolev, Samori Price, Evangelos Pantazis, and Milind Tambe. Agent Teams for Design Problems. The *19th International Workshop on Coordination, Organisations, Institutions and Norms (COIN 2015), May 2015.*

[3]. **Haifeng Xu**, Hans De Sterck, Geoff Sanders. Fast Multilevel Co-Clustering: Unraveling the Multilevel Overlapping Cluster Structure of Social Network Data. The *Workshop of Scalable Data Analytics: Theory & Application, with the ACM International Conference on Web Search and Data Mining (WSDM), 2015.*

[2]. **Haifeng Xu**, Fei Fang, Albert X. Jiang, Vincent Conitzer, Shaddin Dughmi, Milind Tambe. Computing Minimax Strategy for Discretized Spatio-Temporal Security Games. The *Workshop on Optimization in Multi-Agent Systems and Distributed Constraint Reasoning (OPTMAS-DCR) at AAMAS 2014.*

[1]. Leandro Marcolino, **Haifeng Xu**, Albert X. Jiang, Milind Tambe, Emma Bowring. Diverse Teams in Large Action Spaces. *The 17th International Workshop on Coordination, Organisations, Institutions and Norms (COIN 2014) with AAMAS 2014.*

CONTRIBUTIONS TO DEPLOYED SOFTWARE SYSTEMS

- **Software Assistant for the US Federal Air Marshal Service (FAMS)**

  To mitigate the harm due to potential insider threat or real-time surveillance, I developed a new algorithm that enhances unpredictability in FAMS scheduling. This algorithm has been integrated into the software that is delivered to FAMS by Avata Intelligence, and is currently under evaluation for deployment.

- **PAWS (Protection Assistant for Wildlife Security)**

  I have developed a novel algorithm that provides optimal randomized patrol plans against poachers whose behavior is captured via complex machine learning models. My algorithm is being integrated into PAWS, an anti-poaching software system that has been tested in Uganda and Malaysia by multiple conservation agencies, including Wildlife Conservation Society (WCS) and Panthera.

PATENTS

- Algorithmic Bayesian Persuasion (with Shaddin Dughmi), 2015
  US Provisional Application No. 62/137,613

PROFESSIONAL SERVICE

Tutorials

- Tutorial on Information, Persuasion and Decision Making at EC 2018.

(Co-)Chair

- Workshop on AI for Imperfect Information Games with AAAI 2018.
- Workshop on Adversarial Reasoning in Multi-Agent Systems with AAMAS 2017.

Conference Program Committee

- AAAI (2018, 2019)
- IJCAI (2015, 2016, 2017)
- GameSec (2017, 2018)

Journal Reviewing Activities

- JAIR (2017)
- JAAMAS (2017, 2018)
- Theoretical Computer Science (2018)
- Transactions on Cloud Computing (2018)

Conference Reviewing Activities

STOC (2017), FOCS (2016), SODA (2019, 2018, 2015), AAAI (2015), AAMAS (2016), ICALP (2017), ITCS (2018).

MENTORING

- **Kai Wang**, USC: *Strategic Coordination of Human Patrollers and Mobile Sensors*, Fall 2017.
- **Sarah Cooney**, USC: *Adversary Behavior Modeling in Security Games with Deception*, Fall 2017.
- **Venil Loyd Noronha**, USC: *Mitigating Harms of Information Leakage in Security Games*, Spring 2017.

TEACHING

Lecturer

- Harvard University CS 182: Artificial Intelligence Fall'18

Guest Lecturer

- USC ISE 599: Security and Game Theory Spring'16
  - Lecture 1: *Security Games and Combinatorial Algorithm Design*
  - Lecture 2: *Information Leakage in Security Games*
- USC CSCI 270: Introduction to Algorithms and the Theory of Computing Spring'16
  - Lecture 1: *Reductions among NP-Complete Problems*

I was a TA for the following courses at USC: CSCI 675, Convex and Combinatorial Optimization; CSCI 270, Introduction to Algorithms and the Theory of Computing (I served as the **head TA**).

INVITED TALKS

- *Information as A Double-Edged Sword in Strategic Interactions*
  The Institute for Interdisciplinary Information Sciences (IIIS), Tsinghua University, June 2018.
- *Strategic Coordination of Human Patrollers and UAVs with Signaling for Security Games*
  Computational Sustainability Open Graduate Online Seminar, May 2018.
- *The Mysteries of Security Games: Equilibrium Computation Becomes Combinatorial Algorithm Design*
  Southern California Symposium on Network Economics and Game Theory (NEGT), Caltech, Jan 2018.
- *Strategic Coordination of Human Patrollers and Mobile Sensors with Signaling for Security Games*
  CMU CyLab, October 2017.
- *Persuasion Through the Computational Lens*
  China Theory Week, Shanghai, China, July 2017.
- *Algorithmic Persuasion: Theory and Applications*
  Multiagent Systems Professional Group (MSPG) Online Seminar Series, May 2017.
- *Algorithmic Bayesian Persuasion*
  "Young" Workshop on Economics and Computation (YoungEC) , Tel Aviv, Israel, January 2017,
- *Persuasion Through the Computational Lens*
  Caltech Social and Information Sciences Laboratory (SISL) Seminar Series, October 2016.
- *Algorithmic Bayesian Persuasion*
  Google Research Seminar Series, Mountain View, July 2016.