Toby Jia-Jun Li

Curriculum Vitae

Department of Computer Science and Engineering
College of Engineering
University of Notre Dame
Notre Dame, IN 46556 USA

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Research Interests

Human-Computer Interaction (HCI), Human-AI Interaction, End-User Development, Programming by Demonstration, Multi-Modal Interface, Interactive Task Learning, Natural Language Programming, Instructable Agents, Developer Tools.

Professional Experience

Assistant Professor **2021–Present**
University of Notre Dame, *Notre Dame, IN*
Department of Computer Science and Engineering

Education

Ph.D. in Human-Computer Interaction **2015–2021**
Carnegie Mellon University, *Pittsburgh, PA*
Human Computer Interaction Institute, School of Computer Science
Advisor: Brad A. Myers
Committee: Tom M. Mitchell, Jeffery P. Bigham, John Zimmerman, and Philip J. Guo

B.S. with Distinction in Computer Science **2012–2015**
University of Minnesota, *Minneapolis, MN*
Department of Computer Science and Engineering
Advisor: Brent J. Hecht

Selected Honors and Awards

CHI 2021 Best Paper Honorable Mention Award [C.14]	2021
UIST 2020 Best Paper Award [C.13]	2020
Yahoo! InMind Fellowship *(Full support for 4 years*)	2016–2019
NSF Travel Award for ACM IUI 2019 *($450)*	2019
NSF Travel Award for ACM MobiSys 2018 *($1,500)*	2018
Rethinking Interaction CHI 2018 Workshop Travel Award *($1,000)*	2018
IS-EUD 2017 Best Paper Award [C.6]	2017
CHI 2017 Best Paper Honorable Mention Award [C.5]	2017
VL/HCC 2017 Doctoral Consortium Grant *($1,200*)	2017
2016 Bosch Internet of Things Hackathon – 1st place *($1,000)*	2016
University of Minnesota Gold Global Excellence Scholarship *($33,680 over 4 years)*	2012–2015

UROP Undergraduate Research Opportunity Program Award *($1,400)*	2013–2014
NSF Travel Award for ACM SIGSPATIAL 2014 *($720)*	2014
ESRI Scholarship *($2,000)*	2014
University of Minnesota Cultural Corps Award *($150)*	2014
University of Minnesota College of Science and Engineering: Dean's List	2012–2015
ACM/ICPC International Collegiate Programming Contest Word Final Qualifier	2013

Major Peer-Reviewed Conference and Journal Papers

[Google Scholar Profile]

[C.14] **Screen2Vec: Semantic Embedding of GUI Screens and GUI Components**
Toby Jia-Jun Li, Lindsay Popowski, Tom M. Mitchell and Brad A. Myers
Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2021)
Best Paper Honorable Mention Award

[C.13] **Multi-Modal Repairs of Conversational Breakdowns in Task-Oriented Dialogs**
Toby Jia-Jun Li, Jingya Chen, Haijun Xia, Tom M. Mitchell and Brad A. Myers
Proceedings of the ACM Symposium on User Interface Software and Technology (UIST 2020)
Best Paper Award

[C.12] **Geno: A Developer Tool for Authoring Multimodal Interaction on Existing Web Applications**
Ritam Sarmah, Yunpeng Ding, Di Wang, Cheuk Yin Phipson Lee, **Toby Jia-Jun Li** and Xiang 'Anthony' Chen
Proceedings of the ACM Symposium on User Interface Software and Technology (UIST 2020)

[C.11] **Interactive Task Learning from GUI-Grounded Natural Language Instructions and Demonstrations**
Toby Jia-Jun Li, Tom M. Mitchell and Brad A. Myers
Proceedings of the Annual Meeting of the Association for Computational Linguistics (ACL 2020): System Demonstrations

[C.10] **Privacy-Preserving Script Sharing in GUI-based Programming-by-Demonstration Systems**
Toby Jia-Jun Li, Jingya Chen, Brandon Canfield and Brad A. Myers
Proceedings of the ACM on Human-Computer Interaction (CSCW 2020)

[C.9] **PUMICE: A Multi-Modal Agent that Learns Concepts and Conditionals from Natural Language and Demonstrations**
Toby Jia-Jun Li, Marissa Radensky, Justin Jia, Kirielle Singarajah, Tom M. Mitchell and Brad A. Myers
Proceedings of the ACM Symposium on User Interface Software and Technology (UIST 2019)

[C.8] **A Multi-Modal Interface for Specifying Data Descriptions in Programming by Demonstration Using Verbal Instructions**
Toby Jia-Jun Li, Igor Labutov, Xiaohan Nancy Li, Xiaoyi Zhang, Wenze Shi, Wanling Ding, Tom M. Mitchell and Brad A. Myers
Proceedings of the IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC 2018)

[C.7] **KITE: Building conversational bots from mobile apps**
Toby Jia-Jun Li and Oriana Riva
Proceedings of the the ACM Conference on Mobile Systems, Applications, and Services (MobiSys 2018)

[C.6] **Programming IoT Devices by Demonstration Using Mobile Apps**
Toby Jia-Jun Li, Yuanchun Li, Fanglin Chen and Brad A. Myers
International Symposium on End User Development (IS-EUD 2017). LNCS, vol. 10303
Best Paper Award

[C.5] **SUGILITE: Creating Multimodal Smartphone Automation by Demonstration**
Toby Jia-Jun Li, Amos Azaria and Brad A. Myers
Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2017)
Best Paper Honorable Mention Award

[C.4] **PrivacyStreams: Enabling Transparency in Personal Data Processing for Mobile Apps**
Yuanchun Li, Fanglin Chen, **Toby Jia-jun Li**, Yao Guo, Gang Huang, Matthew Fredrikson, Yuvraj Agarwal and Jason I. Hong
Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (PACM IMWUT / UbiComp 2017)

[C.3] **Not at Home on the Range: Peer Production and the Urban/Rural Divide**
Isaac Johnson, Yilun Lin, **Toby Jia-Jun Li,** Andrew Hall, Aaron Halfaker, Johannes Schöning and Brent Hecht
Proceedings of the ACM Conference on Human Factors in Computing Systems (CHI 2016)

[C.2] **Leveraging Advances in Natural Language Processing to Better Understand Tobler's First Law of Geography**
Toby Jia-Jun Li, Shilad Sen and Brent Hecht
Proceedings of the ACM Conference on Advances in Geographic Information Systems (SIGSPATIAL 2014)

[C.1] **WikiBrain: Democratizing Computation on Wikipedia**
Shilad Sen, **Toby Jia-Jun Li,** WikiBrain Team and Brent Hecht
Proceedings of the International Symposium on Open Collaboration (OpenSym / WikiSym 2014)

Minor Lightly-Reviewed Posters, Extended Abstracts and Workshop Papers

[W.8] **Towards Effective Human-AI Collaboration in GUI-Based Interactive Task Learning Agents**
Toby Jia-Jun Li, Jingya Chen, Tom M. Mitchell and Brad A. Myers
CHI 2020 Workshop on Artificial Intelligence for HCI: A Modern Approach (AI4HCI)

[W.7] **Interactive Task and Concept Learning from Natural Language Instructions and GUI Demonstrations**
Toby Jia-Jun Li, Marissa Radensky, Justin Jia, Kirielle Singarajah, Tom M. Mitchell and Brad A. Myers
The AAAI-20 Workshop on Intelligent Process Automation (IPA-20)

[W.6] **A Multi-Modal Approach to Concept Learning in Task Oriented Conversational Agents**
Toby Jia-Jun Li, Marissa Radensky, Tom M. Mitchell and Brad A. Myers
CHI 2019 Workshop on Conversational Agents: Acting on the Wave of Research and Development

[W.5] **How End Users Express Conditionals in Programming by Demonstration for Mobile Apps**
Marissa Radensky, **Toby Jia-Jun Li** and Brad A. Myers
IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC 2018) Poster Track

[W.4] **Supporting Co-Adaptive Human-Agent Relationship through Programming by Demonstration using Existing GUIs**
Toby Jia-Jun Li, Igor Labutov, Xiaohan Nancy Li, Tom M. Mitchell and Brad A. Myers
CHI 2018 Workshop on Rethinking Interaction

[W.3] **End User Mobile Task Automation using Multimodal Programming by Demonstration**
Toby Jia-Jun Li
IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC 2017) Graduate Consortium

[W.2] **Designing a Conversational Interface for a Multimodal Smartphone Programming by Demonstration Agent**
Toby Jia-Jun Li, Brad A. Myers, Amos Azaria, Igor Labutov, Alexander Rudnicky and Tom M. Mitchell *CHI 2017 Workshop on Conversational UX Design*

[W.1] **Smartphone Text Entry in Cross-Application Tasks**
Toby Jia-Jun Li and Brad A. Myers
CHI 2016 Workshop on Inviscid Text Entry and Beyond

Book Sections

[B.3] **Demonstration + Natural Language: Multimodal Interfaces for GUI-based Interactive Task Learning Agents**
Toby Jia-Jun Li, Tom M. Mitchell and Brad A. Myers
Chapter of *Artificial Intelligence for Human Computer Interaction: A Modern Approach*. Springer. *To appear*.

[B.2] **Teaching Agents When They Fail: End User Development in Goal-Oriented Conversational Agents**
Toby Jia-Jun Li, Igor Labutov, Brad A. Myers, Amos Azaria, Alexander Rudnicky and Tom M. Mitchell
Chapter of *Studies in Conversational UX Design*. Springer. 2018.

[B.1] **Making End User Development More Natural**
Brad A. Myers, Amy Ko, Chris Scaffidi, Stephen Oney, YoungSeok Yoon, Kerry Chang, Mary Beth Kery and **Toby Jia-Jun Li**
Chapter of *New Perspectives in End-User Development*. Springer. 2017.

Patents

[P.1] **Automatically generating conversational services from a computing application**
Oriana Riva, Jason Kace, Doug Burger, and **Toby Jia-Jun Li**
U.S. Patent 10,705,892. Granted July 7, 2020; Filed June 7, 2018.

Relevant Research Grants

J.P. Morgan Research Award: Machine Learning from Human Instruction: Every Person a Programmer
PI: Tom M. Mitchell, Co-PI: Brad A. Myers
$149,207 (2019-2020)

- This grant was directly based on my research in [C.9] on combining natural language task instructions with GUI-grounded demonstrations. I helped write the proposal, prepared the progress reports, and gave invited talks at J.P. Morgan.

Google Cloud Research Credit Grant: Screen2Vec: A New Method for Embedding GUI Screens in Vector Spaces
PI: Toby Jia-Jun Li
$1,000 in credits (2020)

- This grant funded the computational resources used the development of a new method for creating distributed representations of GUI screens and GUI components.

Google Cloud Research Credit Grant: SUGILITE: A Multi-Modal Agent that Learns Tasks from Natural Language and Demonstrations
PI: Toby Jia-Jun Li
$2,000 in credits (2019-2020)

- This grant funded the infrastructure and computational resources used for the development and the field deployment of our SUGILITE system.

NSF IIS-1814472: CHS: Small: Multimodal Conversational Assistant that Learns from Demonstrations
PI: Brad A. Myers and Tom M. Mitchell
$499,019 (2018-2021)

- This grant was directly based on my research in [C.5-11] on enabling conversational assistants to learn from demonstrations. I helped write the proposal and prepared the progress reports.

Yahoo InMind Award: Automating Repetitive and Cross-App Tasks
PI: Brad A. Myers, Co-I: Toby Jia-Jun Li
$400,000 (2016-2019)

- This grant was directly based on my research in [C.5-6] on automating repetitive and cross-app tasks through programming by demonstration. I helped write the proposal, prepared progress reports, and gave invited talks at Yahoo!.

Relevant Research Experience

Engineering Implementation Consultant **Aug. 2017–Dec. 2017**
Research Intern **May. 2017–Aug. 2017**
Microsoft Research, Redmond, WA
Mentor: Dr. Oriana Riva

- Designed, developed, and studied a new conversational bot development tool using deep neural network, user task modeling, and mobile app analysis. My work was published [C.7] and patented [P.1].

Research Assistant **Jan. 2013–Aug. 2015**
GroupLens Research, University of Minnesota

- Led the development and field deployment of ATLASIFY – a novel interactive spatial visualization and exploratory search system used by over 10,000 unique users [T.2] [T.3].
- Developed major parts of WIKIBRAIN – a popular open-source software framework for knowledge extraction and computation on Wikipedia [C.1] [T.1].
- Designed and conducted spatial and natural language analysis on Wikipedia data for evaluating Tobler's First Law of Geography and measuring the urban/rural bias in Wikipedia [C.2] [C.3].

Teaching Experience

Guest Lecturer, *05-830: Advanced User Interface Software* **Fall 2020**
Human-Computer Interaction Institute, Carnegie Mellon University

Teaching Assistant, *05-391 / 05-891: Designing Human-Centered Software* **Spring 2019**
Human-Computer Interaction Institute, Carnegie Mellon University

Teaching Assistant, *05-410 / 05-610: User-Centered Research & Evaluation* **Fall 2018**
Human-Computer Interaction Institute, Carnegie Mellon University

Teaching Staff, *CSCI 5715: From GPS and Google Maps to Spatial Computing* **Fall 2014**
Coursera MOOC & Dept. of Computer Science and Engineering, Univ. of Minnesota

Teaching Assistant, *CSCI 2011: Discrete Structures of Computer Science* **Fall 2013, Spring 2014**
Department of Computer Science and Engineering, University of Minnesota

Students Mentored

Tiffany Cai (CMU, now at Google X) **Spring 2017**
- *Worked on a new mobile keyboard for recording text entries in demonstration.*

Jeremy Wei (CMU, now at Flatiron Health) **Spring 2017**
- *Worked on identifying crucial actions in demonstrated scripts.*

Xiaohan Nancy Li (CMU, now at Microsoft) **Fall 2017**
- *Worked on representing and querying snapshots of mobile GUIs.* [C.8][W.4]

Wenze Shi (CMU, now at Facebook) **Spring 2018**
- *Worked on extracting semantic entities from mobile GUIs.* [C.8]

Wanling Ding (CMU, now at Shopee) **Spring 2018**
- *Worked on generating user friendly representations for demonstrated scripts.* [C.8]

Marissa Radensky (Amherst College, REU at CMU, now Ph.D. student at UW) **Summer 2018**
- *Worked on supporting conditionals in programming by demonstration.* [W.5][W.6][C.9]

Justin Jia (CMU) **Spring 2019**
- *Worked on semantic parsing for concept instructions.* [C.9]

Kirielle Singarajah (CMU) **Spring 2019**
- *Worked on semantic parsing for concept instructions.* [C.9]

Brandon Canfield (Yale University, REU at CMU) **Summer 2019**
- *Worked on enabling privacy-preserving sharing of end user developed scripts.* [C.10]

William Timkey (Cornell University, REU at CMU, now at Univ. of Cambridge) **Summer 2019**
- *Worked crowd-sourced data collection for semantic parsers.*

Jingya Chen (CMU, first position at MIT, now at Microsoft Research) **Summer 2019–2020**
- *Worked on multi-modal error handling for speech interfaces.* [W.8][C.10][C.13]

Lindsay Popowski (Harvey Mudd, REU at CMU, now Ph.D. student at Stanford) **Summer 2020**
- *Worked on the semantic embedding of GUI screens and components.* [C.14]

🏆 **CRA 2021 Outstanding Undergraduate Researcher Award**

Vanessa Hu (Harvard University, REU intern at CMU) **Summer 2020**
- *Worked on the fuzzy lexicon matching and time expression parsing in semantic parsers.*

Professional Service

Academic Service

Organizing Committee

ACM UIST 2021 Web and Design Chair

Program Committee

EMNLP 2021
ACM UIST 2021
ACL 2021 Workshop on NLP for Programming (NLP4Prog)
ACM CHI 2020 Late Breaking Work Track
AAAI 2020 Workshop on Intelligent Process Automation (IPA 20)
ACM CHI 2019 Late Breaking Work Track

Session Chair

ACM CHI 2019 Session on Conversational Interactions

Conference Reviewer

ACM CHI (2017-2021), **ACM UIST** (2017-2020), **ACM CSCW** (2018-2021), **ACL** (2021), **ACM DIS** (2018-2021), **ACM MobileHCI** (2018-2020), **ACM TEI** (2018), **ACM SIGCSE** (2018), **ACM CHI PLAY** (2019)

Received "special recognitions" for outstanding reviews for ACM UIST 2017, ACM CHI 2018, ACM DIS 2020, and ACM CHI 2021 (twice).

Journal Reviewer

ACM IMWUT (2017-2020), **IEEE TMC** (2018), **IEEE TSC** (2020), **IEEE Pervasive** (2018-2019), **IJGIS** (2017), **IEEE Access** (2019-2020)

Departmental and Community Service

Member, CMU HCII Anti-Racism Work Group (2020-2021)
Coordinator, CMU HCII Open House Faculty Research Talks (2020-2021)
Committee Member, CMU HCII Faculty Lunch Organization Committee (2019-2020)
Committee Member, CMU HCII Ph.D. Student Lounge Committee (2019-2020)
Committee Member, CMU HCII Ph.D. Admissions Committee (2018-2019)
Student Volunteer, ACM IUI 2019, ACM SIGSPATIAL 2014

Selected Talks, Seminars, and Invited Demos

[T.9] **Human-Centered Interactive Systems for Configuring, Extending, and Developing AI Applications**
Seminar Talk at Department of Computer and Information Science, University of Pennsylvania
Seminar Talk at Department of Computer Science, Purdue University
Seminar Talk at Department of Electrical Engineering and Computer Science, MIT
Seminar Talk at School of Computing and Information, University of Pittsburgh
Seminar Talk at Department of Computer Science, Aarhus University
Seminar Talk at Department of Computer Science and Engineering, Ohio State University
Seminar Talk at Department of Computer Science and Engineering, Texas A&M University
Seminar Talk at Department of Computer Science and Engineering, University of Notre Dame
Seminar Talk at School of Computer Science, University of Sydney
Seminar Talk at Department of Electrical Engineering and Computer Science, Vanderbilt University
Seminar Talk at School of Information Sciences, University of Illinois Urbana-Champaign
Seminar Talk at Department of Computer Science, Virginia Tech
Seminar Talk at Department of Computer Science, George Mason University
Seminar Talk at Institute for Artificial Intelligence, Peking University
Virtual Visit, Spring 2021

[T.8] **Screen2Vec: Semantic Embedding of GUI Screens and What They are Useful for**
Invited Talk at HCI Group, Stanford University
Host: Michael Bernstein
Virtual Visit, Feb. 22, 2021

[T.7] **Interactive Systems for Configuring, Extending, and Developing AI Applications**
Invited Talk at Apple Research
Host: Jeff Nichols
Virtual Visit, Mar. 8, 2021

Invited Talk at HCI Lab, Hasso Plattner Institut
Host: Patrick Baudisch
Virtual Visit, Mar. 4, 2021

Invited Talk at Sigma Research Seminar Series
Host: Çağatay Demiralp
Virtual Visit, Feb. 24, 2021

Invited Talk at Microsoft Research Montréal
Host: Adam Trischler
Virtual Visit, Jan. 11, 2021

Invited Talk at Google People + AI Research (PAIR) Seminar
Host: Carrie Cai
Virtual Visit, Oct. 13, 2020

Invited Talk at IBM Research Cambridge
Host: Casey Dugan
Virtual Visit, Aug. 12, 2020

[T.6] **Interactive Task Learning from GUI-Grounded Natural Language Instructions and Demonstrations**
Invited Talk at *the AAAI-20 Workshop on Intelligent Process Automation (IPA-20)*
New York, NY. Feb. 7, 2020

[T.5] **Machine Learning from Human Instruction: Every Person a Programmer**
Invited Talk at J.P. Morgan (*with Forough Arabshahi*)
Host: Sumitra Ganesh and Denis Kochedykov
New York, NY. May 24, 2019

[T.4] **Teaching Intelligent Agents New Tricks: Natural Language Instructions plus Programming-by-Demonstration for Teaching Tasks**
Invited Talk at *Human Computer Interaction Consortium (HCIC '18)* (*with Brad Myers*)
Watsonville, CA. Jun. 25, 2018

[T.3] **SUGILITE: A Multi-Modal Agent that Learns Tasks from Natural Language and Demonstrations**
Invited Demo at *the ACL 2020 Workshop on Natural Language Interfaces*
Seattle, WA. July 10, 2020

Invited Demo at *the ACM SIGACCESS Conference on Computers and Accessibility (ASSETS 2019)*
Pittsburgh, PA. Oct. 28, 2019

Invited Lightning Talk at CMU HCII 25th Anniversary
Pittsburgh, PA. Oct. 25, 2019

Invited Talk at Oath (formerly Yahoo!)
Sunnyvale, CA. May 30, 2018

[T.2] **Atlasify – The Geography of Everything**
Invited Demo at *the 3M Science and Engineering Symposium*
St Paul, MN. Jun. 25, 2015

Invited Demo at *the Social Media and Business Analytics Collaborative (SOBACO) Research Symposium*
Minneapolis, MN. May 14, 2015

[T.1] **WikiBrain: Making Computer Programs Smarter with Knowledge from Wikipedia**
Invited Demo at *the Social Media and Business Analytics Collaborative (SOBACO) Research Symposium*
Minneapolis, MN. May 6, 2014.

Languages

English – Native or bilingual proficiency, **Chinese (Mandarin)** – Native or bilingual proficiency

Technical Skills

Programming Languages: C/C++, Java, Python, Android, JavaScript, SQL, HTML and others
UX Skills: Qualitative Research, Quantitative Research, Experiment Design, Data Analysis, UX Design
Keywords: Machine Learning, Deep Learning, Natural Language Processing, Dialog Systems, Conversational UX