

# Toby Jia-Jun Li

## *Curriculum Vitae*

Human-Computer Interaction Institute  
School of Computer Science  
Carnegie Mellon University  
5000 Forbes Avenue  
Pittsburgh, PA 15213 USA

Email: [tobyli@cs.cmu.edu](mailto:tobyli@cs.cmu.edu)  
Office: Newell-Simon Hall 2620C  
Website: <http://toby.li/>  
Tel: (612) 756-8886  
Twitter: [@TobyJLi](https://twitter.com/TobyJLi)

---

## 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.

## Education

### **Ph.D. in Human-Computer Interaction**

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

**2015–Present**

(Expected May 2021)

### **B.S. with Distinction in Computer Science**

University of Minnesota, *Minneapolis, MN*

Department of Computer Science and Engineering

*Advisor:* Brent J. Hecht

**2012–2015**

## 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)*

### [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.

## Invited Talks and Presentations

- [T.12] **Interactive Systems for Configuring, Extending, and Developing AI Applications**  
Invited Talk at Google People + AI Research (PAIR)  
Virtual Visit. Oct. 13, 2020
- [T.11] **Interactive Systems for Configuring, Extending, and Developing AI Applications**  
Invited Talk at IBM Research Cambridge  
Virtual Visit. Aug. 12, 2020
- [T.10] **SUGILITE: A Multi-Modal Agent that Learns Tasks from Natural Language and Demonstrations**  
Demo Presentation at *the ACL 2020 Workshop on Natural Language Interfaces*  
Seattle, WA. July 10, 2020
- [T.9] **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.8] **SUGILITE: A Multi-Modal Agent that Learns Tasks from Natural Language and Demonstrations**  
Demo at *the International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS 2019)*  
Pittsburgh, PA. Oct. 28, 2019
- [T.7] **SUGILITE: A Multi-Modal Agent that Learns Tasks from Natural Language and Demonstrations**  
Invited Lightning Talk at CMU HCII 25<sup>th</sup> Anniversary  
Pittsburgh, PA. Oct. 25, 2019
- [T.6] **Machine Learning from Human Instruction: Every Person a Programmer**  
Invited Talk at J.P. Morgan (*with Forough Arabshahi*)  
New York, NY. May 24, 2019
- [T.5] **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.4] **SUGILITE: Enabling InMind Agent to Learn New Tasks from User Demonstration**  
Invited Talk at Oath (formerly Yahoo!)  
Sunnyvale, CA. May 30, 2018
- [T.3] **Atlasify – The Geography of Everything**  
Invited Demo at *3M Science and Engineering Symposium*  
St Paul, MN. Jun. 25, 2015
- [T.2] **Atlasify – The Geography of Everything**  
Invited Demo at *the Social Media and Business Analytics Collaborative (SOBACO) Spring 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) Spring Research Symposium*  
Minneapolis, MN. May 6, 2014.

## Relevant Research Grants

### **JP 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 JP 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!.

## Selected Honors and Awards

UIST 2020 Best Paper Award [C.13]	2020
Yahoo! InMind Fellowship ( <i>Full support for 4 years</i> )	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

## 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]

<b>Wenze Shi</b> (CMU, now at Facebook) - <i>Worked on extracting semantic entities from mobile GUIs.</i> [C.8]	<b>Spring 2018</b>
<b>Wanling Ding</b> (CMU, now at Shopee) - <i>Worked on generating user friendly representations for demonstrated scripts.</i> [C.8]	<b>Spring 2018</b>
<b>Marissa Radensky</b> (Amherst College, REU intern at CMU, now Ph.D. student at UW) - <i>Worked on supporting conditionals in programming by demonstration.</i> [W.5][W.6][C.9]	<b>Summer 2018</b>
<b>Justin Jia</b> (CMU) - <i>Worked on semantic parsing for concept instructions.</i> [C.9]	<b>Spring 2019</b>
<b>Kirielle Singarajah</b> (CMU) - <i>Worked on semantic parsing for concept instructions.</i> [C.9]	<b>Spring 2019</b>
<b>Brandon Canfield</b> (Yale University, REU intern at CMU) - <i>Worked on enabling privacy-preserving sharing of end user developed scripts.</i> [C.10]	<b>Summer 2019</b>
<b>William Timkey</b> (Cornell University, REU intern at CMU, now at Univ. of Cambridge) - <i>Worked crowd-sourced data collection for semantic parsers.</i>	<b>Summer 2019</b>
<b>Jingya Chen</b> (CMU, now at MIT) - <i>Worked on multi-modal error handling for speech interfaces.</i> [W.8][C.10][C.13]	<b>Summer 2019–2020</b>
<b>Lindsay Popowski</b> (Harvey Mudd College, REU intern at CMU) - <i>Worked on the semantic embedding of GUI screens and components.</i> [C.14]	<b>Summer 2020</b>
<b>Vanessa Hu</b> (Harvard University, REU intern at CMU) - <i>Worked on the fuzzy lexicon matching and time expression parsing in semantic parsers.</i>	<b>Summer 2020</b>

## Professional Service

### Academic Service

**Web and Design Chair**, ACM UIST 2021

**Associate Chair**, ACM CHI 2020 Late Breaking Work Track

**Program Committee Member**, AAAI-20 Workshop on Intelligent Process Automation (IPA 20)

**Associate Chair**, ACM CHI 2019 Late Breaking Work Track

**Session Chair**, ACM CHI 2019 Session on *Conversational Interactions*

### Paper Reviewing

**Conferences:** ACM CHI (2017-2021), ACM UIST (2017-2020), ACM CSCW (2018-2021), ACM DIS (2018-2020), 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).

**Journals:** 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 SCS Anti-Racism Work Group (2020)

**Coordinator**, CMU HCII Open House Faculty Research Talks (2020)

**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

## 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

## References

**Brad A. Myers** (*doctoral advisor*)

Professor

Human-Computer Interaction Institute, Carnegie Mellon University

<http://www.cs.cmu.edu/~bam/>

[bam@cs.cmu.edu](mailto:bam@cs.cmu.edu)

**Tom M. Mitchell**

E. Fredkin University Professor

Machine Learning Department, Carnegie Mellon University

<http://www.cs.cmu.edu/~tom/>

[tom.mitchell@cs.cmu.edu](mailto:tom.mitchell@cs.cmu.edu)

**Oriana Riva**

Principal Research Manager

Microsoft Research

<https://www.microsoft.com/en-us/research/people/oriana/>

[oriana@microsoft.com](mailto:oriana@microsoft.com)