

# Bing Liu

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## Research Interests

- Deep learning and its applications in natural language processing and understanding
- Spoken language understanding and dialog management

## Education

- Carnegie Mellon University** 2013.08 - 2018.05 (Expected)
- Ph.D., Electrical and Computer Engineering
  - *Machine Learning, Deep Learning, Natural Language Understanding, Spoken Dialog Systems*
- Nanyang Technological University, Singapore** 2011.07
- B.Eng., Electrical and Electronic Engineering
  - First Class Honors, GPA 4.87/5.0 (Top 2%)
- KTH Royal Institute of Technology, Sweden** 2010.01 - 2010.05
- Exchange student in school of Information and Communication Technology

## Work Experience

- Google Research** Software Engineer Intern 2017.05 - Present
- Research on natural language understanding and dialog systems with deep reinforcement learning.
- Capio.ai** Software Engineer Intern 2015.05 - 2015.08
- Developed and integrated natural language understanding modules (intent identification & semantic tagging) with Capio's Automatic Speech Recognition (ASR) core engine
  - Designed contextual RNN language model in Capio's core engine for enhanced ASR performance
- Capio.ai** Software Engineer Intern 2014.05 - 2014.08
- Designed and developed the initial version of Capio's cloud infrastructure and APIs for ASR
  - Developed and improved language model for Capio's ASR core engine
- Oracle** Technical Consultant / Data Engineer 2011.07 - 2013.07
- Designed and delivered Big Data solution to top tier telecommunication companies in Oracle APAC
  - Took full accountability for Big Data project delivery: gathering functional requirements, designing and developing applications, testing and trouble shooting, engaging and advising clients
- Agency for Science, Technology and Research (A\*STAR), Singapore** Research Intern 2009.07 - 2009.12
- Conducted research on designing high performance polarization rotators and splitters

## Selected Publications

- **Bing Liu**, and Ian Lane, "*An End-to-End Trainable Neural Network Model with Belief Tracking for Task-Oriented Dialog*", accepted for INTERSPEECH, 2017
- **Bing Liu**, and Ian Lane, "*Dialogue Context Language Modeling with Recurrent Neural Networks*", in ICASSP, 2017
- **Bing Liu**, and Ian Lane, "*Joint Online Spoken Language Understanding and Language Modeling With Recurrent Neural Networks*", in SIGDIAL, 2016
- **Bing Liu**, and Ian Lane, "*Attention-Based Recurrent Neural Network Models for Joint Intent Detection and Slot Filling*", in INTERSPEECH, 2016
- **Bing Liu**, and Ian Lane, "*Recurrent Neural Network Structured Output Prediction for Spoken Language Understanding*", in NIPS Workshop, 2015
- **Bing Liu**, Ping Shum, Jing Zhang, and Guo-Qiang Lo, "*Fabrication Tolerance Study on Mode-coupling-based Polarization Rotators*" In IEEE ICCS, 2010.
- **Bing Liu**, and Chinlon Lin, "*A Novel Side-Pumping Coupler for High-Power Fiber Laser*", in Proceedings of URECA (NTU), 2009.

## Honors and Awards

- Outstanding Entry Award - CMU Silicon Valley Annual Tech Showcase 2014.08
- Carnegie Institute of Technology Dean's Fellowship 2013.08
- Oracle Consulting Services ASEAN - Consultant of the Month 2012.05
- NTU Industrial Attachment Book Prize (Best Overall Performance) 2010.12
- NTU EEE Dean's List and President Research Scholar 2008/09/10/11

## Teaching Experience

- Project Sponsor. 11-751/18-781 Speech Recognition and Understanding, CMU. Fall 2016
- Teaching Assistant. 11-755/18-797 Machine Learning for Signal Processing, CMU. Fall 2015
- Teaching Assistant. 18-645 How to Write Fast Code, CMU. Spring 2015

## Skills and Languages

- TensorFlow, Theano, Hadoop, Python, Java, Shell scripts, etc.
- Github: <https://github.com/hadoopit>
- Language: English, Mandarin Chinese

## Research Experience

**Carnegie Mellon University** Advisor: Ian Lane  
**Spoken Language Understanding and Dialog Management** 2015.08 - Present

- Designed neural network based models for joint intent detection and semantic slot filling in spoken language understanding that show robust performance with both text and noisy speech input.
- Designed incremental neural network based SLU models that can be used in online settings for real time language understanding.
- Achieved consistent performance gain on both SLU tasks over the independent training models on ATIS benchmarking data set.

**Carnegie Mellon University** Advisor: Ian Lane  
**Context-aware Language Modeling** 2014.08 - Present

- Designed topic conditioned and speaker intent conditioned RNN language models that enable next word prediction in automatic speech recognition (ASR) to be context dependent.
- Proposed dialog context language models that have special design in modeling dialog interactions and implicitly capture the context state in dialog.

## Short-Term Projects

**Neural Network Methods for Sentence Modeling** Spring 2015

- Designed convolutional neural network (CNN) and recurrent neural network for short and long text modeling. Achieved near state-of-the-art classification accuracy (94.0%) on TREC QA task using ensemble of RNN generative model and CNN.

**Action Prediction for Driver Assistance Systems Using Deep Learning Methods** Spring 2014

- Designed algorithms for driver's action prediction with data of multiple modalities. Achieved 73.2% accuracy on driver action prediction with unsupervised feature learning using deep neural networks.

## Talks and Posters

- *Joint Online Spoken Language Understanding and Language Modeling With Recurrent Neural Networks*
  - BayLearn Symposium, Sunnyvale, USA, Oct 06, 2016.
  - Young Researchers' Roundtable on Spoken Dialog Systems, Los Angeles, USA, Sep 16-18, 2016
  - Oral presentation at SIGDIAL, Los Angeles, USA, Sep 13-15, 2016.
- *Attention-Based Recurrent Neural Network Models for Joint Intent Detection and Slot Filling*
  - INTERSPEECH, San Francisco, USA, Sep 08-12, 2016
- *Recurrent Neural Network Structured Output Prediction for Spoken Language Understanding*
  - NIPS Workshop on Machine Learning for SLU, Montreal, Canada, Dec 07-12, 2015
- *Learning Drivers' Behaviour with Deep Neural Networks*
  - CMU Silicon Valley Annual Tech Showcase, Moffett Field, USA, Aug 09, 2014