

## Seokhwan Kim

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CONTACT INFORMATION	Amazon Alexa AI 1120 Enterprise Way Sunnyvale, CA 94089, USA	<i>Mobile:</i> +1 (669) 204-2805 <i>E-mail:</i> seokhwk@amazon.com <i>WWW:</i> <a href="http://seokhwankim.com/">http://seokhwankim.com/</a>
RESEARCH INTERESTS	Natural Language Processing, Spoken Dialogue Systems, Natural Language Understanding, Text Mining	
EDUCATION	<b>Pohang University of Science and Technology (POSTECH)</b> , Pohang, Korea <i>Ph.D., Computer Science and Engineering</i> <span style="float:right"><i>February 2012</i></span> Dissertation Topic: “Cross-Lingual Weakly-Supervised Learning of Semantic Relations” Advisor: Gary Geunbae Lee Committee: Jong-hyeok Lee, Seung-jin Choi, Seung-won Hwang, Sung-Hyon Myaeng <i>B.S., Computer Science and Engineering</i> <span style="float:right"><i>August 2005</i></span>	
RESEARCH EXPERIENCE	<b>Amazon Alexa AI</b> , USA <i>Sr. Machine Learning Scientist</i> <span style="float:right"><i>June 2019 -</i></span>  <b>Adobe Research</b> , USA <i>Research Scientist</i> <span style="float:right"><i>July 2017 - May 2019</i></span>  <b>Institute for Infocomm Research (I2R)</b> , Singapore <i>Scientist</i> <span style="float:right"><i>January 2012 - July 2017</i></span>  <b>Max Planck Institute for Informatics (MPI-INF)</b> , Saarbrucken, Germany <i>Research Intern</i> <span style="float:right"><i>April 2011 - August 2011</i></span> <i>Advisor: Prof. Gerhard Weikum</i>  <b>Pohang University of Science and Technology (POSTECH)</b> , Pohang, Korea <i>Research Assistant</i> <span style="float:right"><i>September 2005 - December 2011</i></span> <i>Advisor: Prof. Gary Geunbae Lee</i>	
TEACHING EXPERIENCE	<b>Pohang University of Science and Technology (POSTECH)</b> , Pohang, Korea <i>Teaching Assistant</i> <span style="float:right"><i>Spring 2010</i></span> <b>CS101, Introduction to Computing</b> <i>Teaching Assistant</i> <span style="float:right"><i>Spring 2006</i></span> <b>CS421, Database System</b>	
PROFESSIONAL EXPERIENCE	<b>The Eighth Dialog System Technology Challenge (DSTC8)</b> <i>Challenge Chair</i> <span style="float:right"><i>2019</i></span>  <b>The Seventh Dialog System Technology Challenge (DSTC7)</b> <i>Steering Committee</i> <span style="float:right"><i>2018</i></span>	

<b>The Sixth Dialog System Technology Challenge (DSTC6)</b> <i>Organizing Committee</i>	2017
<b>The Fifth Dialog State Tracking Challenge (DSTC5)</b> <i>Organizing Committee</i>	2016
<b>The Fourth Dialog State Tracking Challenge (DSTC4)</b> <i>Organizing Committee</i>	2015
<b>The Ninth Asia Information Retrieval Societies Conference (AIRS 2013)</b> <i>Local Organizing Committee Co-chair</i>	2013
<b>ACL Special Workshop: Rediscovering 50 Years of Discoveries</b> <i>Publicity Committee Member</i>	2012
<b>ACL, ACM-SIGIR, CSL, CoNLL, EMNLP, IEEE ASRU, IEEE ICASSP, IEEE SLT, IEEE/ACM TASLP, IJCAI, IJCNLP, IWSDS, Interspeech, NAACL-HLT</b> <i>Reviewer</i>	

## TALKS

### Tutorials

*Rafael E. Banchs, Seokhwan Kim, Luis Fernando D'Haro, Andreea I. Niculescu.* **Natural Language in Human-Robot Interaction.** Tutorial @ The 4th International Conference on Human-Agent Interaction (HAI 2016), 2016-10-04.

## PUBLICATIONS

### International Journals

*Chiori Hori, Julien Perez, Ryuichi Higashinaka, Takaaki Hori, Y-Lan Boureau, Michimasa Inaba, Yuiko Tsunomori, Tetsuro Takahashi, Koichiro Yoshino, Seokhwan Kim.* **Overview of the Sixth Dialog System Technology Challenge: DSTC6.** Computer Speech and Language, 55 (1-25), May 2019.

*Seonghan Ryu, Seokhwan Kim, Junhwi Choi, Hwanjo Yu, Gary Geunbae Lee.* **Neural sentence embedding using only in-domain sentences for out-of-domain sentence detection in dialog systems.** Pattern Recognition Letters, 88 (26-32), Mar 2017.

*Seokhwan Kim, Minwoo Jeong, Jonghoon Lee, Gary Geunbae Lee.* **Cross-Lingual Annotation Projection for Weakly-Supervised Relation Extraction.** ACM Transactions on Asian Language Information Processing, 13:1 (3), Feb 2014.

*Seokhwan Kim, Minwoo Jeong, Gary Geunbae Lee.* **A Local Tree Alignment Approach to Relation Extraction of Multiple Arguments.** Information Processing and Management, 47:4 (593-605), Jul 2011.

*Cheongjae Lee, Sangkeun Jung, Seokhwan Kim, Gary Geunbae Lee.* **Example-based dialog modeling for practical multi-domain dialog system.** Speech Communications, 51:5 (466-484), May 2009.

*Sangkeun Jung, Cheongjae Lee, Seokhwan Kim, Gary Geunbae Lee.* **DialogStudio: A workbench for data-driven spoken dialog system development and management.** Speech Communications, 50:8-9 (683-697), , Aug-Sep 2008.

## International Conferences

*Amirreza Shirani, Franck Dernoncourt, Paul Asente, Nedim Lipka, Seokhwan Kim, Jose Echevarria, Tamar Solorio*. **Learning Emphasis Selection for Written Text in Visual Media from Crowd-Sourced Label Distributions**. Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics (ACL 2019), pp 1167-1172, Florence, Jul 2019.

*Logan Lebanoff, Kaiqiang Song, Franck Dernoncourt, Doo Soon Kim, Seokhwan Kim, Walter Chang, Fei Liu*. **Scoring Sentence Singletons and Pairs for Abstractive Summarization**. Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics (ACL 2019), pp 2175-2189, Florence, Jul 2019.

*Seokhwan Kim*. **Deep Recurrent Neural Networks with Layer-wise Multi-head Attention for Punctuation Restoration**. Proceedings of the 44th International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2019), pp 7280-7284, Brighton, May 2019.

*Seokhwan Kim*. **Dynamic Memory Networks for Dialogue Topic Tracking**. Proceedings of the AAAI-19 Workshop on Dialog System Technology Challenges (DSTC7), Honolulu, Jan 2019.

*Arman Cohan, Franck Dernoncourt, Doo Soon Kim, Trung Bui, Seokhwan Kim, Walter Chang, Nazli Goharian*. **A Discourse-Aware Attention Model for Abstractive Summarization of Long Documents**. Proceedings of the 16th Annual Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies (NAACL HLT 2018), pp 615-621, New Orleans, Jun 2018.

*Andrei Dulceanu, Thang Le Dinh, Walter Chang, Trung Bui, Doo Soon Kim, Manh Chien Vu, Seokhwan Kim*. **PhotoshopQuiA: A Corpus of Non-Factoid Questions and Answers for Why-Question Answering**. Proceedings of the 11th International Conference on Language Resources and Evaluation (LREC 2018), pp 2763-2770, Miyazaki, May 2018.

*Zhe Wang, Kingsley Kuan, Mathieu Ravaut, Gaurav Manek, Sibor Song, Yuan Fang, Seokhwan Kim, Nancy F. Chen, Luis Fernando D'Haro, Anh Tuan Luu, Hongyuan Zhu, Zeng Zeng, Ngai Man Cheung, Georgios Piliouras, Jie Lin, Vijay Chandrasekhar*. **Truly Multi-modal YouTube-8M Video Classification with Video, Audio, and Text (Team DL2.0, ranked at 22/650)**. Proceedings of the CVPR 2017 Workshop on YouTube-8M Large-Scale Video Understanding (YouTube-8M), Honolulu, Jul 2017.

*Seokhwan Kim, Luis Fernando D'Haro, Rafael E. Banchs, Jason D. Williams, Matthew Henderson, Koichiro Yoshino*. **The Fifth Dialog State Tracking Challenge**. Proceedings of the 2016 IEEE Spoken Language Technology Workshop (SLT 2016), pp 511-517, San Diego, Dec 2016.

*Seokhwan Kim, Rafael E. Banchs, Haizhou Li*. **Exploring Convolutional and Recurrent Neural Networks in Sequential Labelling for Dialogue Topic Tracking**. Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics (ACL 2016), pp 963-973, Berlin, Aug 2016. (28.0% acceptance)

*Seokhwan Kim, Luis Fernando D'Haro, Rafael E. Banchs, Jason D. Williams, Matthew Henderson*. **The Fourth Dialog State Tracking Challenge**. Proceedings of the 7th International Workshop on Spoken Dialogue Systems (IWSDS 2016), Saarisekka, Jan 2016.

*Ridong Jiang, Rafael Banchs, Seokhwan Kim, Luis Fernando D'Haro, Andreea Niculescu, Kheng Hui Yeo*. **Configuration of Dialogue Agent with Multiple Knowledge Sources**. Proceedings of the Asia-Pacific Signal and Information Processing Association Annual Summit and Conference 2015 (APSIPA ASC 2015), Hong Kong, Dec 2015.

*Luis Fernando D'Haro, Seokhwan Kim, Rafael E. Banchs.* **A Robust Spoken Q&A System with Scarce In-Domain Resources.** Proceedings of the Asia-Pacific Signal and Information Processing Association Annual Summit and Conference 2015 (APSIPA ASC 2015), Hong Kong, Dec 2015.

*Ridong Jiang, Seokhwan Kim, Rafael E. Banchs, Haizhou Li.* **Towards Improving the Performance of Vector Space Model for Chinese Frequently Asked Question.** Proceedings of the 19th International Conference on Asian Language Processing (IALP 2015), Suzhou, Oct 2015.

*Seokhwan Kim, Rafael E. Banchs, Haizhou Li.* **Wikification of Concept Mentions within Spoken Dialogues Using Domain Constraints from Wikipedia.** Proceedings of the 2015 Conference on Empirical Methods in Natural Language Processing (EMNLP 2015), pp 2225-2229, Lisbon, Sep 2015. (24.0% acceptance)

*Seokhwan Kim, Rafael E. Banchs, Haizhou Li.* **Towards Improving Dialogue Topic Tracking Performances with Wikification of Concept Mentions.** Proceedings of the 16th Annual SIGdial Meeting on Discourse and Dialogue (SIGDIAL 2015), pp 124-128, Prague, Sep 2015.

*Luis Fernando D'Haro, Seokhwan Kim, Rafael E. Banchs.* **Conversational Agent and Management Tools for Conference and Tourism Domain.** Proceedings of the 16th Annual Conference of the International Speech Communication Association (Interspeech 2015), Dresden, Sep 2015. (Show and Tell)

*Luis Fernando D'Haro, Seokhwan Kim, Kheng Hui Yeo, Ridong Jiang, Andreea I. Niculescu, Rafael E. Banchs, Haizhou Li.* **CLARA: a multifunctional virtual agent for conference support and touristic information.** Proceedings of the 6th International Workshop on Spoken Dialog System (IWSDS 2015), Busan, Jan 2015. (Demo)

*Kyusong Lee, Seonghan Ryu, Paul Hongsuck Seo, Seokhwan Kim, Gary Geunbae Lee.* **Grammatical Error Correction Based on Learner Comprehension Model in Oral Conversation.** Proceedings of the 2014 IEEE Spoken Language Technology Workshop (SLT 2014), South Lake Tahoe, Dec 2014.

*Seokhwan Kim, Rafael E. Banchs.* **R-cube: a dialogue agent for Restaurant Recommendation and Reservation.** Proceedings of the Asia-Pacific Signal and Information Processing Association Annual Summit and Conference 2014 (APSIPA ASC 2014), Siem Reap, Dec 2014.

*Rafael E. Banchs, Seokhwan Kim.* **An empirical evaluation of an IR-based strategy for chat-oriented dialogue systems.** Proceedings of the Asia-Pacific Signal and Information Processing Association Annual Summit and Conference 2014 (APSIPA ASC 2014), Siem Reap, Dec 2014.

*Andreea Niculescu, Kheng Hui Yeo, Luis Fernando D'haro, Seokhwan Kim, Ridong Jiang, Rafael Banchs.* **Design and Evaluation of a Conversational Agent for the Touristic Domain.** Proceedings of the Asia-Pacific Signal and Information Processing Association Annual Summit and Conference 2014 (APSIPA ASC 2014), Siem Reap, Dec 2014.

*Rafael E. Banchs, Seokhwan Kim.* **Spoken Dialogue System for Restaurant Recommendation and Reservation.** Proceedings of the 15th Annual Conference of the International Speech Communication Association (Interspeech 2014), pp 1488-1489, Singapore, Sep 2014. (Show and Tell)

*Andreea Niculescu, Seokhwan Kim, Kheng Hui Yeo, Arthur Niswar, Ridong Jiang, Rafael E.*

*Banchs.* **SARA - Singapore's Automated Responsive Assistant for the Touristic Domain.** Proceedings of the 15th Annual Conference of the International Speech Communication Association (Interspeech 2014), pp 2138-2139, Singapore, Sep 2014. (Show and Tell)

*Andreea Niculescu, Rafael E. Banchs, Seokhwan Kim, Kheng Hui Yeo, Arthur Niswar, Ridong Jiang.* **SARA - Singapore's Automated Responsive Assistant - A Multimodal Dialogue System for Touristic Information.** Proceedings of the 11th International Conference on Mobile Web Information Systems (MobiWIS 2014), pp 153-164, Barcelona, Aug 2014.

*Seokhwan Kim, Rafael E. Banchs, Haizhou Li.* **A Composite Kernel Approach for Dialog Topic Tracking with Structured Domain Knowledge from Wikipedia.** Proceedings of the 52nd Annual Meeting of the Association for Computational Linguistics (ACL 2014), Vol. 2, pp 19-23, Baltimore, Jun 2014. (25.0% acceptance)

*Seokhwan Kim, Rafael E. Banchs.* **Sequential Labeling for Tracking Dynamic Dialog States.** Proceedings of the 15th Annual SIGdial Meeting on Discourse and Dialogue (SIGDIAL 2014), pp 332-336, Philadelphia, Jun 2014.

*Arthur Niswar, Rafael E. Banchs, Ridong Jiang, Seokhwan Kim.* **AIDA: An Avatar-Supported Multimodal Dialogue System.** Proceedings of the 27th International Conference on Computer Animation and Social Agents (CASA 2014), Houston, May 2014.

*Seokhwan Kim, Rafael E. Banchs, Haizhou Li.* **Wikipedia-based Kernels for Dialogue Topic Tracking.** Proceedings of the 39th International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2014), pp 131-135, Florence, May 2014.

*Ridong Jiang, Rafael E. Banchs, Seokhwan Kim, Kheng Hui Yeo, Arthur Niswar, Haizhou Li.* **Web-based Multimodal Multi-domain Spoken Dialogue System.** Proceedings of the 5th International Workshop on Spoken Dialog Systems (IWSDS 2014), Napa, Jan 2014.

*Rafael E. Banchs, Ridong Jiang, Seokhwan Kim, Arthur Niswar, Kheng Hui Yeo.* **AIDA: Artificial Intelligent Dialogue Agent.** Proceedings of the 14th Annual Meeting of the Special Interest Group on Discourse and Dialogue (SIGDIAL 2013), pp 145-147, Metz, Aug 2013. (Demo)

*Seokhwan Kim.* **A Graph-based Cross-lingual Projection Approach for Spoken Language Understanding Portability to a New Language.** Proceedings of the 38th International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2013), pp 8332-8336, Vancouver, May 2013.

*Injae Lee, Seokhwan Kim, Kyungduk Kim, Donghyeon Lee, Junhwi Choi, Seonghan Ryu, Geunbae Lee.* **A Two-Step Approach for Efficient Domain Selection in Multi-Domain Dialog Systems.** Proceedings of the 4th International Workshop on Spoken Dialog System (IWSDS 2012), pp 105-111, Ermenonville, Nov 2012.

*Seokhwan Kim, Gary Geunbae Lee.* **A Graph-based Cross-lingual Projection Approach for Weakly Supervised Relation Extraction.** Proceedings of the 50th Annual Meeting of the Association for Computational Linguistics (ACL 2012), Vol. 2, pp 48-53, Jeju, Jul 2012. (20.0% acceptance)

*Hongsuck Seo, Jonghoon Lee, Seokhwan Kim, Kyusong Lee, Sechun Kang and Gary Geunbae Lee.* **A Meta Learning Approach to Grammatical Error Correction.** Proceedings of the 50th Annual Meeting of the Association for Computational Linguistics (ACL 2012), Vol. 2, pp 328-332, Jeju, Jul 2012. (20.0% acceptance)

*Junhwi Choi, Kyungduk Kim, Sungjin Lee, Seokhwan Kim, Donghyeon Lee, Injae Lee, Gary Geunbae Lee.* **Seamless error correction interface for voice word processor.** Proceedings of the 37th International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2012), pp 4973-4976, Kyoto, Mar 2012.

*Junhwi Choi, Kyungduk Kim, Seokhwan Kim, Donghyeon Lee, Injae Lee, Gary Geunbae Lee.* **Multi-domain spoken dialog system for information access in mobile environment.** Proceedings of the IEEE Automatic Speech Recognition and Understanding Workshop (IEEE ASRU 2011), Hawaii, Dec 2011. (Demo)

*Seokhwan Kim, Minwoo Jeong, Jonghoon Lee, Gary Geunbae Lee.* **A Cross-lingual Annotation Projection-based Self-supervision Approach for Open Information Extraction.** Proceedings of the 5th international joint conference on natural language processing (IJCNLP 2011), pp 741-748, Chiang Mai, Nov 2011. (27.0% acceptance)

*Donghyeon Lee, Cheongjae Lee, Minwoo Jeong, Kyungduk Kim, Seokhwan Kim, Junhwi Choi, Gary Geunbae Lee.* **Web-search enhanced contents retrieval for information access dialog system.** Proceedings of the 12th Annual Conference of the International Speech Communication Association (Interspeech 2011), pp 1297-1300, Florence, Aug 2011.

*Seokhwan Kim, Minwoo Jeong, Jonghoon Lee, Gary Geunbae Lee.* **A Cross-lingual Annotation Projection Approach for Relation Detection.** Proceedings of the 23rd International Conference on Computational Linguistics (COLING 2010), pp 564-571, Beijing, Aug 2010. (19.0% acceptance)

*Seokhwan Kim, Minwoo Jeong, Gary Geunbae Lee.* **A Local Tree Alignment-based Soft Pattern Matching Approach for Information Extraction.** Proceedings of the North American Chapter of the Association for Computational Linguistics/Human Language Technology (NAACL HLT 2009), pp 169-172, Colorado, May 2009.

*Seokhwan Kim, Minwoo Jeong, Gary Geunbae Lee.* **An Alignment-based Pattern Representation Model for Information Extraction.** Proceedings of the 31st Annual International ACM SIGIR Conference (SIGIR '08), pp 875-876, Singapore, Jul 2008.

*Seokhwan Kim, Minwoo Jeong, Gary Geunbae Lee, Kwangil Ko, Zino Lee.* **An alignment-based approach to semi-supervised relation extraction including multiple arguments.** Proceedings of the fourth Asian Information Retrieval Symposium (AIRS 2008), Harbin, Jan 2008.

*Cheongjae Lee, Seokhwan Kim, Minwoo Jeong, Sangkeun Jung, Donghyeon Lee, Gary Geunbae Lee.* **Example-based spoken dialog processing for guidance robots.** Proceedings of the 4th international conference on ubiquitous robots and ambient intelligence (URAI 2007), Pohang, Nov 2007.

*Seokhwan Kim, Minwoo Jeong, Gary Geunbae Lee.* **A semi-supervised method for efficient construction of statistical spoken language understanding resources.** Proceedings of the 8th Annual Conference of the International Speech Communication Association (Interspeech 2007), pp 2797-2800, Antwerp, Aug 2007.

*Seokhwan Kim, Cheongjae Lee, Sangkeun Jung, Gary Geunbae Lee.* **A spoken dialog system for electronic program guide information access.** Proceedings of The 16th IEEE International Symposium on Robot and Human Interactive Communication (IEEE RO-MAN 2007), pp 178-181, Jeju, Aug 2007.

*Seokhwan Kim, Yu Song, Kyungduk Kim, Jeong-Won Cha, Gary Geunbae Lee.* **MMR-based**

**active machine learning for Bio named entity recognition.** Proceedings of the Human Language Technology/North American Chapter of the Association for Computational Linguistics (HLT-NAACL 2006), pp 69-72, New York, Jun 2006.

## Patents

*Cheongjae Lee, Seokhwan Kim, Gary Geunbae Lee.* **Dialog management apparatus and method for chatting agent.** Registration #10-0818979, South Korea, 2008. 3. 27

*Seokhwan Kim, Yu Song, Kyungduk Kim, Gary Geunbae Lee.* **Method and system for recognizing biological named entity based on workbench.** Registration #10-0825687, South Korea, 2008. 4. 22

*Seokhwan Kim, Hyungjong Noh, Gary Geunbae Lee.* **Method and apparatus for automatically constructing ontology from non-structure web documents.** Registration #10-0917176, South Korea, 2009. 9. 7  
Registration #, South Korea,

*Seokhwan Kim, Donghyeon Lee, Hyungjong Noh, Gary Geunbae Lee.* **Method of automatically detecting dangerous situation using natural language extraction and apparatus thereof.** Registration #10-1023031, South Korea, 2011. 3. 10

*Donghyeon Lee, Hyungjong Noh, Seokhwan Kim, Gary Geunbae Lee.* **Method and apparatus for searching voice data from audio and video data under the circumstances including unregistered words.** Registration #10-1069534, South Korea, 2011. 9. 26

*Hyungjong Noh, Seokhwan Kim, Donghyeon Lee, Gary Geunbae Lee.* **User profile automatic creation apparatus through voice dialog meaning process, and contents recommendation apparatus using the same.** Registration #10-1072176, South Korea, 2011. 10. 4

*Gary Geunbae Lee, Seokhwan Kim, Kyungduk Kim, Donghyeon Lee, Junhwi Choi.* **Method for searching for information using the web and method for voice conversation using same.** PCT/KR2012/004405, 2012. 8. 28

*Gary Geunbae Lee, Seokhwan Kim, Kyungduk Kim, Donghyeon Lee, Junhwi Choi.* **Korean Open Type Information Extracting Method and Program Readable Recording Medium Capable of Increasing Korean Open Type Information Extracting Performances.** Registration #10-1180589, South Korea, 2012. 8. 31

*Gary Geunbae Lee, Junhwi Choi, Seokhwan Kim, Kyungduk Kim, Donghyeon Lee.* **Speech Processing Device Capable of Effective Input Modification and a Method Thereof.** Registration #10-1197010, South Korea, 2012. 10. 26

*Donghyeon Lee, Kyungduk Kim, Junhwi Choi, Seokhwan Kim, Gary Geunbae Lee.* **Information Search Method by Using the Web Capable of Using a Vector Space Database and a Voice Conversaion Method Using the Method.** Registration #10-1252397, South Korea, 2013. 4. 2

*Donghyeon Lee, Kyungduk Kim, Junhwi Choi, Seokhwan Kim, Gary Geunbae Lee.* **Conversation Classification Method Capable of Classifying Conversation Intention by Using a Hidden Markov Model.** Registration #10-1255468, South Korea, 2013. 4. 10

*Gary Geunbae Lee, Seokhwan Kim, Kyungduk Kim, Donghyeon Lee, Junhwi Choi.* **Entity Name Tagging Method Capable of Applying an Unsupervised Learning Method Including**

**a Restriction Condition and a Device Thereof.** Registration #10-1255957, South Korea,  
2013. 4. 11

SKILLS

**Programming Languages:** Python, C++, Java

**Machine Learning Toolkits:** PyTorch, TensorFlow, scikit-learn, SVM-Light, CRFsuite

**NLP and IR Toolkits:** NLTK, spaCy, Stanford CoreNLP, Lucene

**Databases:** MySQL, SQLite, MongoDB, Neo4j

REFERENCES

Available upon request