

# Muhao Chen

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## Research Interests

*Representation learning for complex multi-relational data. Machine learning and commonsense reasoning for natural language understanding. Deep learning approaches to computational biology.*

## EDUCATION

### University of California, Los Angeles, USA

*Ph.D. in Computer Science*

2014.9-2019.6

*Dissertation: Multi-relational Representation Learning and Knowledge Acquisition Advisor: Carlo Zaniolo Collaborators: Kai-Wei Chang, Wei Wang, Yizhou Sun*

### Fudan University, Shanghai, China

*B.S. in Computer Science*

2010.9-2014.6

*Advisor: X. Sean Wang*

## PUBLICATIONS

\*Indicating equal contributions. ✉Indicating contact authors. ^Indicating advisee students.

### Refereed Journal Publications

1. **Muhao Chen**<sup>✉\*</sup>, Chelsea J. T. Ju<sup>\*</sup>, Guangyu Zhou, Tianran Zhang, Kai-Wei Chang, Carlo Zaniolo, Wei Wang. Multifaceted Protein-Protein Interaction Prediction Based on Siamese Residual RCNN. *Bioinformatics*, Oxford University Press. Proceedings of ISMB/ECCB, 2019.
2. Carlo Zaniolo<sup>✉</sup>, Shi Gao, Maurizio Atzori, **Muhao Chen**, Jiaqi Gu. User-Friendly Temporal Queries on Historical Knowledge Bases. In *Information and Computation*. Elsevier, 2018.

### Refereed Publication in Conference Proceedings

3. Changping Meng, **Muhao Chen**, Jie Mao, Bruno Ribeiro. ReadNet: A Hierarchical Transformer Framework for Readability Analysis. In *the 42<sup>nd</sup> European Conference on Information Retrieval (ECIR)*, 2020.
4. Zequn Sun, Chengming Wang, Wei Hu, **Muhao Chen**, Jian Dai, Wei Zhang, Yuzhong Qu. Knowledge Graph Alignment Network with Gated Multi-hop Neighborhood Aggregation. In *the 34<sup>th</sup> International Conference on Artificial Intelligence (AAAI)*, 2020.
5. **Muhao Chen**, Yingtao Tian, Haochen Chen, Kai-Wei Chang, Steve Skiena, Carlo Zaniolo. Learning to Represent Bilingual Dictionaries. In *Proceedings of the 23rd SIGNLL Conference on Computational Natural Language Learning (CoNLL)*, 2019
6. **Muhao Chen**, Chris Quirk. Embedding Edge-attributed Relational Hierarchies. In *Proceedings of the 42<sup>nd</sup> ACM SIGIR Conference on Research and Development in Information Retrieval (SIGIR)*, 2019.
7. Junheng Hao, **Muhao Chen**, Wenchao Yu, Yizhou Sun, Wei Wang. Universal Representation Learning of Knowledge Bases by Jointly Embedding Ontological Concepts and Instances. In *Proceedings of the 25<sup>th</sup> ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD)*, 2019. (Oral presentation)
8. Xuelu Chen, **Muhao Chen**, Weijia Shi<sup>^</sup>, Yizhou Sun, Carlo Zaniolo. Uncertain Knowledge Graphs Embeddings. In *the 33<sup>rd</sup> International Conference on Artificial Intelligence (AAAI)*, 2019.
9. Weijia Shi<sup>\*,^</sup>, **Muhao Chen**<sup>\*</sup>, Pei Zhou<sup>^</sup>, Kai-Wei Chang. Retrofitting Contextualized Word Embeddings with Paraphrases. In *Proceedings of the 24th Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 2019 (Oral presentation)
10. Pei Zhou<sup>^</sup>, Weijia Shi<sup>^</sup>, Jieyu Zhao, Kuan-Hao Huang, **Muhao Chen**, Ryan Cotterell, Kai-Wei Chang. Examining Gender Bias in Languages with Grammatical Gender. In *Proceedings of the 24th Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 2019.

11. Qingheng Zhang, Zequn Sun, Wei Hu, **Muhao Chen**, Lingbing Guo, Yuzhong Qu. Multi-view Knowledge Graph Embedding for Entity Alignment. In *Proceedings of the 28<sup>th</sup> International Joint Conference on Artificial Intelligence (IJCAI)*, 2019.
12. Zequn Sun, Jiacheng Huang, Wei Hu, **Muhao Chen**, Yuzhong Qu. TransEdge: Translating Relation-contextualized Embeddings for Knowledge Graphs. In *the 18<sup>th</sup> International Semantic Web Conference (ISWC)*, 2019.
13. Haochen Chen, Syed Fahad Sultan, Yingtao Tian, **Muhao Chen**, Steven Skiena. Fast and Accurate Network Embeddings via Very Sparse Random Projection. In *Proceedings of the 28<sup>th</sup> ACM International Conference on Information and Knowledge Management (CIKM)*, 2019.
14. Changjun Fan, Yuhui Ding, Li Zeng, **Muhao Chen**, Yizhou Sun and Zhong Liu. Betweenness Centrality Estimation from Scratch: A Novel Graph Neural Network Based Approach. In *Proceedings of the 28<sup>th</sup> ACM International Conference on Information and Knowledge Management (CIKM)*, 2019.
15. **Muhao Chen**, Changping Meng, Gang Huang, Carlo Zaniolo. Learning to Differentiate Between Main-articles and Sub-articles in Wikipedia. In *IEEE International Conference on Big Data (BigData)*, 2019.
16. Yingtao Tian, Haochen Chen, Bryan Perozzi, **Muhao Chen**, Xiaofei Sun, Steven Skiena. Social Relation Inference via Label Propagation. In *the 41<sup>st</sup> European Conference on Information Retrieval (ECIR)*, 2019.
17. Qi Zhao, **Muhao Chen**, Pengyuan Du, Tuan Le, Mario Gerla. Towards Efficient Cellular Traffic Offloading via Dynamic MPTCP Path Configuration with SDN. In *IEEE International Conference on Computing, Networking and Communications (ICNC)*, 2019.
18. **Muhao Chen**, Gang Huang, Changping Meng, Carlo Zaniolo. Neural Article Pair Modeling for Wikipedia Sub-article Matching. In *the 29<sup>th</sup> European Conference on Machine Learning (ECML)*, 2018 (**Plenary Presentation**, ~1.7% acceptance rate)
19. **Muhao Chen**, Yingtao Tian, Kai-Wei Chang, Steven Skiena, Carlo Zaniolo. Co-training Embeddings of Knowledge Graphs and Entity Descriptions for Cross-lingual Entity Alignment. In *the 27<sup>th</sup> International Joint Conference on Artificial Intelligence (IJCAI)*, 2018.
20. **Muhao Chen**, Yingtao Tian, Xuelu Chen, Zijun Xue, Carlo Zaniolo. On2Vec: Embedding-based Relation Prediction for Ontology Population. In *Proceedings of the 17<sup>th</sup> SIAM International Conference on Data Mining (SDM)*. SIAM, 2018
21. Haochen Chen, Xiaofei Sun, Yingtao Tian, Bryan Perozzi, **Muhao Chen** and Steven Skiena. Enhanced Network Embeddings via Exploiting Edge Labels. In *the 27<sup>th</sup> ACM Conference on Information and Knowledge Management (CIKM)*. ACM 2018.
22. Pengyuan Du, Seunghyun Yoo, Qi Zhao, **Muhao Chen**, Mario Gerla. Towards Opportunistic Resource Sharing in Mobile Social Networks - an Evolutionary Game Theoretic Approach. In *Proceedings of the 19<sup>th</sup> ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc)*, ACM 2018.
23. **Muhao Chen**, Qi Zhao, Pengyuan Du, Carlo Zaniolo, Mario Gerla. Demand-driven Cache Allocation Based on Context-aware Collaborative Filtering. In *Proceedings of the 19<sup>th</sup> ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc)*, ACM 2018.
24. **Muhao Chen**, Yingtao Tian, Mohan Yang, Carlo Zaniolo. Multilingual Knowledge Graph Embeddings for Cross-lingual Knowledge Alignment. In *Proceedings of the 26<sup>th</sup> International Joint Conference on Artificial Intelligence (IJCAI)*. 2017.
25. **Muhao Chen**, Carlo Zaniolo. Learning Multi-faceted Knowledge Graph Embeddings for Natural Language Processing. In *Proceedings of the 26<sup>th</sup> International Joint Conference on Artificial Intelligence (IJCAI)*. 2017 (Extended abstract)
26. **Muhao Chen**, Shi Gao, X. Sean Wang. Converting Spatiotemporal Data Among Heterogeneous Granularity Systems. In *Proceedings of the 25<sup>th</sup> IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*. IEEE, 2016
27. **Muhao Chen**, Shi Gao, Jingheng Zhou, X. Sean Wang. Converting Spatiotemporal Data Among Multiple Granularity Systems. In *Proceedings of the 31<sup>st</sup> ACM SIGAPP Symposium on Applied Computing (SAC)*. ACM, 2016.

## Tutorial

28. **Muhao Chen**, Kai-Wei Chang, Dan Roth. Recent Advances in Transferable Representation Learning. **AAAI**, 2020 (accepted)

## Refereed Workshop and System Demonstration Papers

29. Weijia Shi<sup>^</sup>, **Muhao Chen**, Yingtao Tian, Kai-Wei Chang. Learning Bilingual Word Embeddings Using Lexical Definitions. In *Proceedings of ACL Workshop on Representation Learning for NLP (RepL4NLP)*, 2019.
30. Pei Zhou<sup>^</sup>, Weijia Shi<sup>^</sup>, Jieyu Zhao, Kuan-Hao Huang, **Muhao Chen**, Kai-Wei Chang. Examining Gender Bias in Languages with Grammatical Gender. In *ICML AI for Social Good Workshop (AISG)*, 2019.

31. Zhubo Deng<sup>^</sup>, Pei Zhou<sup>^</sup>, Weijia Shi<sup>^</sup>, **Muhao Chen**, Kai-Wei Chang. Computational Analysis of French-origin Reborrowing Process for English Loanwords. In *ICDM Workshop on Multilingual Cognitive Services (ICDMW)*, 2019
32. Changjun Fan, Yizhou Sun, Li Zeng, Yang-Yu Liu, **Muhao Chen**, Zhong Liu. Dismantle Large Networks through Deep Reinforcement Learning. In *ICLR Workshops*, 2019.
33. Yingtao Tian, Haochen Chen, Bryan Perozzi, **Muhao Chen**, Xiaofei Sun, Steven Skiena. Social Relation Inference via Label Propagation. In *the 14th KDD Workshop on Mining and Learning with Graphs (MLG)*, 2018.
34. Pei Zhou<sup>^</sup>, **Muhao Chen**, Kai-Wei Chang, Carlo Zaniolo. Quantification and Analysis of Scientific Language Variation by Research Fields. In *Proceedings of the ICDM Workshops (ICDMW)*, 2018.
35. **Muhao Chen**, Tao Zhou, Pei Zhou<sup>^</sup>, Carlo Zaniolo. Multi-graph Affinity Embeddings for Multilingual Knowledge Graphs. **Contributed talk** in the *6th Workshop on Automated Knowledge Base Construction at NIPS (AKBC)*. 2017.
36. Tao Zhou, **Muhao Chen**, Demetri Terzopoulos, Jie Yu. Attention-based Natural Language Person Retrieval. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*. IEEE, 2017.
37. Shi Gao, **Muhao Chen**, Maurizio Atzori, Carlo Zaniolo. SPARQL<sup>T</sup> and its User-Friendly Interface for Managing and Querying the History of Knowledge Bases. In *the 14<sup>th</sup> International Semantic Web Conference (ISWC)*, 2015 (demo).

### In Submission

38. Guangyu Zhou<sup>\*</sup>, **Muhao Chen**<sup>\*✉</sup>, Chelsea J. T. Ju<sup>\*</sup>, Zheng Wang, Jyun-Yu Jiang, Wei Wang. Mutation effect estimation on protein-protein interactions using deep contextualized representation learning. In revision in *Nucleic Acids Res: Genom. Bioinform.* Oxford University Press.
39. **Muhao Chen**, Weijia Shi, Ben Zhou, Dan Roth. Cross-lingual Entity Alignment for Knowledge Graphs with Incidental Supervision from Free Text. In submission to **ACL**, 2020.
40. Zequn Sun, **Muhao Chen**, Wei Hu, Chengming Wang, Jian Dai, Wei Zhang. Knowledge Association with Hyperbolic Representation Learning of Knowledge Graphs. In submission to **ACL**, 2020.
41. Zequn Sun, Qingheng Zhang, Wei Hu, Chengming Wang, Lingbing Guo, **Muhao Chen**, Chengkai Li, Yuzhong Qu. A Benchmarking Study. In submission to **VLDB**, 2020
42. Xuelu Chen, **Muhao Chen**, Changjun Fan, Ankith Uppunda<sup>^</sup>, Yizhou Sun, Carlo Zaniolo. Cross-lingual Knowledge Graph Completion via Ensemble Knowledge Projection.
43. Dat Duong, Ankith Uppunda<sup>^</sup>, Chelsea Ju, James Zhang, **Muhao Chen**, Eleazar Eskin, Jingyi Jessica Li, Kai-Wei Chang. Evaluating Representations for Gene Ontology Terms.

## PRESENTATIONS

1. Transferable Representation Learning for Multi-relational Data. *Invited talk at FBDC, 2019. Fudan Univ., Shanghai, China. Dec 2019.*
2. Retrofitting contextualized word embeddings with paraphrases. *Conference talk at EMNLP 2019. Hong Kong, China. Nov 2019*
3. Cross-lingual Dependency Parsing with Unlabeled Auxiliary Languages. *Conference talk at CoNLL 2019. Hong Kong, China. Nov 2019*
4. Multi-relational representation learning and knowledge acquisition. *Invited talk at Stanford SNAP Seminar. Jan 2019*
5. Multi-relational representation learning and knowledge acquisition. *UCLA Machine Learning and Big Data Seminar. Jan 2019*
6. Neural Article Pair Modeling for Wikipedia Sub-article Matching. *Plenary talk at ECML 2018. Dublin, Ireland. Sept 2018*
7. Co-training Embeddings of Knowledge Graphs and Entity Descriptions for Cross-lingual Entity Alignment. *Conference talk at IJCAI 2018. Stockholm, Sweden. July 2018*
8. On2Vec: Embedding-based Relation Prediction for Ontology Population. *Conference talk at SDM 2018. San Diego, CA, USA. May 2018*
9. Multilingual Knowledge Graph Embeddings for Cross-lingual Knowledge Alignment. *Contributed talk at AKBC 2017. Longbeach, CA, USA. Dec 2017*
10. Neural Article Pair Modeling for Wikipedia Sub-article Matching. *Google Search Intelligence Seminar Talk. Sept 2017*

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11. Multilingual Knowledge Graph Embeddings for Cross-lingual Knowledge Alignment. *Conference talk at IJCAI 2017. Melbourne, Australia.* Aug 2017
12. Converting Spatiotemporal Data Among Heterogeneous Granularity Systems. *Conference talk at FUZZ-IEEE 2016. Vancouver, Canada.* Aug 2016
13. Reasoning Across Multiple Spatiotemporal Granularity Systems. *Invited talk at Teradata Labs. El Segundo, CA, USA.* Mar 2015

## ACADEMIC SERVICES

### PC Member:

2020: AAAI, IJCAI, WSDM.

2019: AAAI, AKBC, NAACL, ACL, EMNLP-IJCNLP, IEEE BigData, NLPCC, WISE, ICSC.

2018: AAAI, EMNLP, IEEE BigData, IEEE WETICE, NLPCC, SoCal NLP, IEEE AIKE.

**Organization Committee:** 2019: IEEE AIKE (Doctoral Consortium Co-chair)

**Journal Reviewer:** TKDD, BMC Genomics, BMC Medical Genomics, Frontiers of Computer Science.

## WORK EXPERIENCES

**Postdoctoral Fellow**, University of Pennsylvania, Philadelphia, PA (CogCompGroup) 2019.8-Present

**Research Intern**, Microsoft Research, Redmond, WA (NLP Group) 2018.6-2018.9

- *Embedding Edge-attributed Relational Hierarchies.* [6]

**Research Intern**, Google, Mountain View, CA (Google Knowledge Graph) 2017.6~2017.9

- *Neural Article Pair Modeling for Large-scale Sub-article Relation Extraction from Wikipedia.* [18,15]

**System SDE Intern**, Google, Mountain View, CA (Procella Real-time Data Infrastructure) 2016.6~2016.9

- *Dynamic Shard-partitioning for Large-scale Windowed Event Streams.*

**R&D Intern**, Teradata Labs, Los Angeles, CA (Optimizer Group) 2015.6~2015.9

- *Multi-task Learning for Cost-based Database Optimizers.*

## SELECTED AWARDS

*UCLA Dissertation Fellowship.* 2018-2019

*Google Research & Travel Support Archimedes Program.* 2018

*NSF Travel Grants.* 2016, 2017, 2018, 2019

*Research Grant of the National University Student Innovation Program.* Ministry of Education of China. 2014

*Tung OOCL Scholarships.* Tung's Foundation of Hong Kong & The Oriental Overseas Container Line. 2012, 2013

*Wang-Dao Fellowship.* President of Fudan University. 2013

*EMC Scholarship.* EMC Inc. 2013

*Chun-Tsung Fellowship.* Hui-Chun Chin and Tsung-Dao Lee Chinese Undergraduate Research Endowment. 2012

## TEACHING AND MENTORING EXPERIENCES

### Mentoring:

Pei Zhou (2017.6-2019.6, UCLA undergraduate student). Worked on semantic variation projects. Published in EMNLP'19\*2, ICDMW'18 '19, AKBC'17. Now Ph.D. student in USC.

## Chen, Muhao - CV

Weijia Shi (2018.6-present, UCLA undergraduate student). Work on lexical semantics and knowledge graph projects. Published in EMNLP'19\*2, AAAI'19, Repl4NLP'19, ICDMW'19.

Ankith Uppunda (2019.3-2019.6, UCLA undergraduate student). Worked on knowledge graph and machine learning for proteins projects.

Zhubo Deng (2019.1-present, UCLA undergraduate student). Worked on bilingual loanwords detection projects. Published in ICDMW'19.

Xiaoshuang Wei (2016.10-2017.3, UCLA master student). Capstone project on machine learning for cost-based query optimizer. Now software engineer at Google.

### Teaching:

Teaching assistant (2015.9-2016.6), associate (2016.9-2017.6), fellow (2017.9-2018.6) at UCLA (Data Structures; Introduction to Computer Science).

## ACADEMIC SOCIETY MEMBERSHIP BY NOMINATION

Sigma Xi (2019.9)

## REFERENCES

1. Carlo Zaniolo  
N.E. Friedmann Chair Professor, UCLA  
[zaniolo@cs.ucla.edu](mailto:zaniolo@cs.ucla.edu)  
<http://web.cs.ucla.edu/~zaniolo/>
2. Kai-Wei Chang  
Assistant Professor, UCLA  
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<http://web.cs.ucla.edu/~kwchang/>
3. Wei Wang  
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<http://web.cs.ucla.edu/~weiwang/>
4. Yizhou Sun  
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