

# Muhao Chen

Email: [muhaochen@ucla.edu](mailto:muhaochen@ucla.edu) Homepage: <https://muhaochen.github.io/>

Tel: (424)-324-0494 Address: 415 Washington Blvd, Apt 606, Marina Del Rey, CA 90292

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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 Publication

- Guangyu Zhou\*, **Muhao Chen**✉\*, Chelsea J. T. Ju\*, Zheng Wang, Jyun-Yu Jiang, Wei Wang✉. Mutation effect estimation on protein-protein interactions using deep contextualized representation learning. *NAR Genom. Bioinform*, vol. 2 (2). Oxford University Press. 2020.
- Zequn Sun, Qingheng Zhang, Wei Hu✉, Chengming Wang, **Muhao Chen**, Chengkai Li, Yuzhong Qu. A Benchmarking Study of Embedding-based Entity Alignment for Knowledge Graphs. *Proceedings of the VLDB Endowment (PVLDB)*, vol. 13. ACM. 2020
- Muhao Chen**✉\*, Chelsea J. T. Ju\*, Guangyu Zhou, Tianran Zhang, Kai-Wei Chang, Carlo Zaniolo, Wei Wang. Multifaceted Protein-Protein Interaction Prediction Based on Siamese Residual RCNN. *Bioinformatics*, vol. 35 (14) Oxford University Press. Proceedings of **ISMB/ECCB**, 2019.
- Carlo Zaniolo✉, Shi Gao, Maurizio Atzori, **Muhao Chen**, Jiaqi Gu. User-Friendly Temporal Queries on Historical Knowledge Bases. *Information and Computation*, Vol. 259 (3). Elsevier, 2018.

### Refereed Publication in Conference Proceedings

- Muhao Chen**, Hongming Zhang, Haoyu Wang🎓, Dan Roth. “What Are You Trying to Do?” Semantic Typing of Event Processes. In *Proceedings of the 24<sup>th</sup> SIGNLL Conference on Computational Natural Language Learning (CoNLL)*, 2020.
- Zequn Sun, **Muhao Chen**, Wei Hu, Chengming Wang. Knowledge Association with Hyperbolic Representation Learning of Knowledge Graphs. In *Proceedings of the 25<sup>th</sup> Conference on Empirical Methods in Natural Language Processing (EMNLP)* 2020.
- Haoyu Wang🎓, **Muhao Chen**, Hongming Zhang, Dan Roth. Joint Constrained Learning for Event-Event Relation Extraction. In *Proceedings of the 25<sup>th</sup> Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 2020.
- Hongming Zhang, **Muhao Chen**, Haoyu Wang🎓, Y. Song, Dan Roth. Analogous Process Structure Induction for Sub-event Sequence Prediction. In *Proceedings of the 25<sup>th</sup> Conference on Empirical Methods in Natural Language Processing (EMNLP)*, 2020.
- Xuelu Chen🎓, **Muhao Chen**, Changjun Fan, Ankith Uppunda🎓, Yizhou Sun, Carlo Zaniolo. Multilingual Knowledge Graph Completion via Ensemble Knowledge Transfer. In *Findings of EMNLP*, 2020.
- 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> AAAI Conference on Artificial Intelligence (AAAI)*, 2020.
- Changping Meng, **Muhao Chen**, Jie Mao, Jennifer Neville. ReadNet: A Hierarchical Transformer Framework for Readability Analysis. In *the 42<sup>nd</sup> European Conference on Information Retrieval (ECIR)*, 2020.

12. Junheng Hao , Chelsea J. T. Ju, **Muhao Chen**, Yizhou Sun, Carlo Zaniolo, Wei Wang. Bio-JOIE: Joint Representation Learning of Biological Knowledge Bases. In *the 11<sup>th</sup> ACM Conference on Bioinform., Comput. Bio. and Biomed. (ACM BCB)*, 2020
13. Tianran Zhang , **Muhao Chen**, Alex Bui. Diagnostic Prediction with Sequence-of-sets Representation Learning for Clinical Events. In *Proceedings of the 18<sup>th</sup> International Conference on Artificial Intelligence in Medicine (AIME)*, 2020
14. **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
15. 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)**
16. Xuelu Chen , **Muhao Chen**, Weijia Shi , Yizhou Sun, Carlo Zaniolo. Uncertain Knowledge Graphs Embeddings. In *the 33<sup>rd</sup> International Conference on Artificial Intelligence (AAAI)*, 2019.
17. Weijia Shi , **Muhao Chen**\*, Pei Zhou , 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)**
18. Pei Zhou , Weijia Shi , 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.
19. **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.
20. 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. Also in **ISWC 2020** Invited Sister Conference Track.
21. 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.
22. 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.
23. Changjun Fan, Yuhui Ding, Li Zeng, **Muhao Chen**, Yizhou Sun and Zhong Liu. Learning to Identify High Betweenness Centrality Nodes from Scratch: A Novel Graph Neural Network Approach. In *Proceedings of the 28<sup>th</sup> ACM International Conference on Information and Knowledge Management (CIKM)*, 2019.
24. **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.
25. 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.
26. 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.
27. **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)**
28. **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.
29. **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
30. Haochen Chen, Xiaofei Sun, Yingtao Tian, Bryan Perozzi, **Muhao Chen** and Steven Skiena. Enhanced Network Embeddings via Exploiting Edge Labels. In *the 27th ACM Conference on Information and Knowledge Management (CIKM)*. ACM 2018.
31. 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 19th ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc)*, ACM 2018.







Chen, Muhao – CV (Sept. 19, 2020)

32. **Muhao Chen**, Qi Zhao, Pengyuan Du, Carlo Zaniolo, Mario Gerla. Demand-driven Cache Allocation Based on Context-aware Collaborative Filtering. In *Proceedings of the 19th ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc)*, ACM 2018.
33. **Muhao Chen**, Yingtao Tian, Mohan Yang, Carlo Zaniolo. Multilingual Knowledge Graph Embeddings for Cross-lingual Knowledge Alignment. In *Proceedings of the 26th International Joint Conference on Artificial Intelligence (IJCAI)*. 2017.
34. **Muhao Chen**, Carlo Zaniolo. Learning Multi-faceted Knowledge Graph Embeddings for Natural Language Processing. In *Proceedings of the 26th International Joint Conference on Artificial Intelligence (IJCAI)*. 2017 (Extended abstract)
35. **Muhao Chen**, Shi Gao, X. Sean Wang. Converting Spatiotemporal Data Among Heterogeneous Granularity Systems. In *Proceedings of the 25th IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*. IEEE, 2016. Shorter version in *Proceedings of the 31st ACM SIGAPP Symposium on Applied Computing (SAC)*. ACM, 2016.



## Tutorials

36. **Muhao Chen**, Kai-Wei Chang, Dan Roth. Recent Advances in Transferable Representation Learning. In **AAAI**, 2020.
37. **Muhao Chen**, Hongming Zhang, Qiang Ning, Manling Li, Heng Ji, Dan Roth. Event-centric Natural Language Understanding. In review for **AAAI** Tutorials 2021. In review for **AAAI** Tutorials, 2021.
38. **Muhao Chen**, Hongming Zhang, Qiang Ning, Manling Li, Heng Ji, Kathleen McKeown, Dan Roth. Event-centric Natural Language Understanding II. In review for **ACL** Tutorials, 2021.

## Refereed Workshop and System Demonstration Papers

39. Weijia Shi , **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.
40. Zubo Deng , Pei Zhou , Weijia Shi , **Muhao Chen**, Kai-Wei Chang. Computational Analysis of French-origin Reborrowing Process for English Loanwords. In *ICDM Workshop on Multilingual Cognitive Services (ICDMW)*, 2019
41. Changjun Fan, Yizhou Sun, Li Zeng, Yang-Yu Liu, **Muhao Chen**, Zhong Liu. Dismantle Large Networks through Deep Reinforcement Learning. In *ICLR Workshops*, 2019.
42. Pei Zhou , **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.
43. **Muhao Chen**, Tao Zhou, Pei Zhou , 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.
44. 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.
45. 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 14th International Semantic Web Conference (ISWC)*, 2015 (demo).

## In Submission

46. **Muhao Chen**, Weijia Shi, Ben Zhou, Dan Roth. Cross-lingual Entity Alignment for Knowledge Graphs with Incidental Supervision from Free Text. Todo: **EACL**, 2021.
47. Fangyu Liu, **Muhao Chen**, Dan Roth, Nigel Collier. Visual Pivoting for (Unsupervised) Entity Alignment. In review in **AAAI**, 2021.
48. Cunchao Zhu, **Muhao Chen**, Changjun Fan, Yan Zhang. Learn from The History: Modeling Temporal Knowledge Graphs with Sequential Copy-Generator Network. In review in **AAAI** 2021.
49. Dat Duong, Ankith Uppunda , Chelsea Ju, James Zhang, **Muhao Chen**, Eleazar Eskin, Jingyi Jessica Li, Kai-Wei Chang. Evaluating Representations for Gene Ontology Terms.
50. Jyun-yu Jiang, Chelsea J. T. Ju, Junheng Hao , **Muhao Chen**, Wei Wang. Circular RNA Prediction based on Junction Encoders and Deep Interaction among Splice Sites.

## PRESENTATIONS

1. Event Schema Instantiation as Knowledge Graph Alignment. *PI meeting (KAIIROS)*, DARPA. June 2020.

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2. Recent Advances in Transferable Representation Learning. *Half-day tutorial at AAAI*. NYC, NY, Feb 2020.
3. Multi-relational Knowledge Acquisition with Transferable Representation Learning. *AI Seminar, USC ISI*. Los Angeles, Jan 2020.
4. Multi-relational Knowledge Acquisition with Transferable Representation Learning. *IBM Research Almaden*. San Jose, Jan 2020.
5. Multi-relational Knowledge Acquisition with Transferable Representation Learning. *Invited talk at FDSiF, Fudan Univ., Shanghai, China*. Dec 2019.
6. Retrofitting contextualized word embeddings with paraphrases. *Conference talk at EMNLP, Hong Kong, China*. Nov 2019
7. Cross-lingual Dependency Parsing with Unlabeled Auxiliary Languages. *Conference talk at CoNLL, Hong Kong, China*. Nov 2019
8. Multi-relational representation learning and knowledge acquisition. *Invited talk at Stanford SNAP Seminar*. Jan 2019
9. Multi-relational representation learning and knowledge acquisition. *UCLA Machine Learning and Big Data Seminar*. Jan 2019
10. Neural Article Pair Modeling for Wikipedia Sub-article Matching. *Plenary talk at ECML, Dublin, Ireland*. Sept 2018
11. Co-training Embeddings of Knowledge Graphs and Entity Descriptions for Cross-lingual Entity Alignment. *Conference talk at IJCAI, Stockholm, Sweden*. July 2018
12. On2Vec: Embedding-based Relation Prediction for Ontology Population. *Conference talk at SDM, San Diego, CA, USA*. May 2018
13. Multilingual Knowledge Graph Embeddings for Cross-lingual Knowledge Alignment. *Contributed talk at AKBC, Longbeach, CA, USA*. Dec 2017
14. Neural Article Pair Modeling for Wikipedia Sub-article Matching. *Google Search Intelligence Seminar Talk*. Sept 2017
15. Multilingual Knowledge Graph Embeddings for Cross-lingual Knowledge Alignment. *Conference talk at IJCAI, Melbourne, Australia*. Aug 2017
16. Converting Spatiotemporal Data Among Heterogeneous Granularity Systems. *Conference talk at FUZZ-IEEE, Vancouver, Canada*. Aug 2016
17. Reasoning Across Multiple Spatiotemporal Granularity Systems. *Invited talk at Teradata Labs, El Segundo, CA, USA*. Mar 2015

## PROFESSIONAL EXPERIENCE

<b>Computer Scientist</b> , University of Southern California, Information Science Institute	2020.8-date
<b>Postdoctoral Fellow</b> , University of Pennsylvania, Philadelphia, PA (CogCompGroup) <i>Host: Dan Roth</i>	2019.8-2020.7
<b>Research Intern</b> , Microsoft Research, Redmond, WA (NLP Group)	2018.6-2018.9
<ul style="list-style-type: none"><li>• <i>Embedding Edge-attributed Relational Hierarchies</i>. [19]</li></ul>	
<b>Research Intern</b> , Google, Mountain View, CA (Google Knowledge Graph)	2017.6~2017.9
<ul style="list-style-type: none"><li>• <i>Neural Article Pair Modeling for Large-scale Sub-article Relation Extraction from Wikipedia</i>. [27,24,10]</li></ul>	
<b>System SDE Intern</b> , Google, Mountain View, CA (Procella Real-time Data Infrastructure)	2016.6~2016.9
<ul style="list-style-type: none"><li>• <i>Dynamic Shard-partitioning for Large-scale Windowed Event Streams</i>.</li></ul>	
<b>R&amp;D Intern</b> , Teradata Labs, Los Angeles, CA (Optimizer Group)	2015.6~2015.9
<ul style="list-style-type: none"><li>• <i>Multi-task Learning for Cost-based Database Optimizers</i>.</li></ul>	

## 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

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*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 EXPERIENCE

**Mentoring** (Publications by undergraduate mentees are highlighted)

Haoyu Wang, UPenn MS Student in Computer and Information Science. **Research mentor** (EMNLP'20 in submission) 2019.9-2020.7

Xuelu (Shirley) Chen, UCLA PhD student in Computer Science. **Research mentor** 2017.10-date

Junheng Hao, UCLA PhD student in Computer Science. **Research mentor** 2017.10-date

Tianran Zhang, UCLA PhD student in Bioengineering. **Research mentor** 2019.6-2020.6

Pei Zhou, UCLA undergraduate student (Now PhD student at USC CS). **Research mentor** (First-author publications in EMNLP'19 and ICDMW'18. Coauthored paper in AKBC'18) 2019.12-2019.6

Weijia Shi, UCLA undergraduate student (Now PhD student at UW CSE). **Research mentor** (First-author publications in EMNLP'19 and RepL4NLP'19. Coauthored paper in AAAI'19) 2018.6-2019.12

Ankith Uppunda. UCLA undergraduate student. **Research mentor**. 2019.3-2019.6.

Zhubo Deng, UCLA undergraduate student. **Research mentor** (First-author publication in ICDMW'19). 2019.1-2019.6

Xiaoshuang Wei, UCLA MS student in Computer Science (Now software engineer at Google). **Thesis mentor** 2016.10-2017.3

### Teaching

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

## ACADEMIC SERVICES

### Organization Committee:

2021: AAAI (Senior PC)

2019: IEEE AIKE (Doctoral Consortium Co-chair)

### PC Member:

2021: WSDM.

2020: AAAI, AACL-IJCNLP, AKBC, COLING, EMNLP, IJCAI, ISWC, KDD, SIGIR, WSDM, \*SEM.

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

2018: AAAI, EMNLP, BigData, NLPCC, SoCal NLP.

**Journal Reviewer:** W3J, TKDD, TNNLS, TKDE, TII, Clinical and Translational Medicine, Comput. & Struct. Biotechnol., BMC Genomics, BMC Medical Genomics, Evolutionary Intelligence, Frontiers of Computer Science, Information Sciences (Elsevier).