Ling Luo（罗 凌)

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Dalian University of Technology (DUT), Dalian, China

Education

- **Dalian University of Technology** **Dalian, China**
  Ph.D., College of Computer Science and Technology *09/2014-11/2019*
  Research Interests: Natural Language Processing, Biomedical Text Mining, Deep Learning
- **Xiamen University** **Xiamen, China**
  M.S., School of Information Science and Engineering *09/2011-06/2014*
  Research Interests: Natural Language Processing, Machine Translation
- **Xiamen University** **Xiamen, China**
  B.S., School of Information Science and Engineering *09/2007-06/2011*

Experience

- **Dalian University of Technology (DUT)** **Dalian, China**
  Associate Professor, School of Computer Science and Technology *02/2023-present*
- **National Institutes of Health (NIH)** **Bethesda, USA**
  Postdoc Fellow, National Center for Biotechnology Information (NCBI) *01/2020-01/2023*

Personal Statement

- My research interests include Natural Language Processing, Biomedical Text Mining, and Machine Learning. My current research works focus on biomedical text mining by developing novel deep learning methods to unstructured text data in the biomedical literature, especially for the tasks of document classification, named entity recognition and relation extraction. My long-term research goal is to develop computational methods to better understand the natural language in biomedical text in order to accelerate knowledge discovery and improve health. I have multiple published papers in leading journals and conferences in biomedical informatics such as *Briefings in Bioinformatics*, *Bioinformatics*, *JAMIA*, *Nucleic Acids Research*, and *BIBM*. Since 2017, I have co-authored over 40 peer-reviewed journal and conference proceedings articles with 1,600+ citations (Google Scholar). I won the first place in multiple tasks at the famous international biomedical text mining challenge BioCreative.

Selected Publications (* denotes equal contribution)

1. **Ling Luo*,** Jinzhong Ning, Yingwen Zhao, et al**.** Taiyi: a bilingual fine-tuned large language model for diverse biomedical tasks [J]. Journal of the American Medical Informatics Association, 2024, ocae037. (**IF: 4.7, JCR Q1**)
2. **Ling Luo*,** Chih-Hsuan Wei*, Po-Ting Lai, Robert Leaman, Qingyu Chen, Zhiyong Lu**.** *AIONER: all-in-one scheme-based biomedical named entity recognition using deep learning* [J]. Bioinformatics, Volume 39, Issue 5, May 2023, btad310. (**IF: 6.931, JCR Q1**)
3. **Ling Luo*,** Po-Ting Lai*, Chih-Hsuan Wei*, Cecilia N Arighi, Zhiyong Lu**.** *BioRED: a rich biomedical relation extraction dataset* [J]. Briefings in Bioinformatics, 2022, bbac282. (**IF: 13.994, JCR Q1**)
4. **Ling Luo,** Po-Ting Lai, Chih-Hsuan Wei, Zhiyong Lu**.** *A sequence labeling framework for extracting drug–protein relations from biomedical literature* [J]. Database-The Journal of Biological Databases and Curation, 2022, 2022: baac058. (**IF: 4.462, JCR Q1**)
5. **Ling Luo,** Shankai Yan, Po-Ting Lai, Daniel Veltri, Andrew Oler, Sandhya Xirasagar, Rajarshi Ghosh, Morgan Similuk, Peter N. Robinson, Zhiyong Lu. *PhenoTagger: A Hybrid Method for Phenotype Concept Recognition using Human Phenotype Ontology* [J]**.** Bioinformatics, 2021, 37(13):1884-1890. (**IF: 6.931, JCR Q1**)
6. **Ling Luo,** Zhihao Yang, Mingyu Cao, Lei Wang, Yin Zhang, Hongfei Lin. *A neural network-based joint learning approach for biomedical entity and relation extraction from biomedical literature* [J]*.* Journal of Biomedical Informatics, 2020, 103: 103384. (**IF: 8.000, JCR Q1**)
7. **罗凌**, 杨志豪, 宋雅文, 李楠, 林鸿飞. *基于笔画ELMo 和多任务学习的中文电子病历命名实体识别研究* [J]. 计算机学报, 2020, 43(10): 1943-1957. (**CCF 推荐中文 A 类**)
8. **Ling Luo**, Zhihao Yang, Pei Yang, Yin Zhang, Lei Wang, Hongfei Lin and Jian Wang. *An attention-based BiLSTM-CRF approach to document-level chemical named entity recognition* [J]. Bioinformatics, 2018, 34(8): 1381-1388. (**IF: 6.931, JCR Q1**)
9. **Ling Luo**, Zhihao Yang, Lei Wang, Yin Zhang, Hongfei Lin, Jian Wang, Liang Yang, Kan Xu and Yijia Zhang. *Protein-Protein Interaction Article Classification: A Knowledge-enriched Self-Attention Convolutional Neural Network Approach* [C]. Procceding of 2018 IEEE International Conference on Bioinformatics and Biomedicine (BIBM), 2018. (**CCF 推荐 B 类会议**)
10. **Ling Luo**, Zhihao Yang, Pei Yang, Yin Zhang, Lei Wang, Jian Wang and Hongfei Lin. *A neural network approach to chemical and gene/protein entity recognition in patents* [J]. Journal of Cheminformatics, 2018, 10: 65. (**IF: 8.489, JCR Q1**)

Challenges

- BioCreative VIII Challenge: Phenotype normalization (genetic conditions in pediatric patients) Track, **The Second Place** in 5 Teams *10/2023*

- BioCreative VII Challenge: Text mining drug and chemical-protein interactions (DrugProt) Track, **The Second Place** in 30 Teams *11/2021*
- The 2019 China Conference on Knowledge Graph and Semantic Computing (CCKS 2019) Challenge: Chinese Clinical Named Entity Recognition Task, **The Third Place** in 44 Teams *07/2019*
- The 2018 China Conference on Knowledge Graph and Semantic Computing (CCKS 2018) Challenge: Chinese Clinical Named Entity Recognition Task, **The Third Place** in 69 Teams *07/2018*
- BioCrative VI Precision Medicine Track: Document Triage Task, **The Second Place** in 10 Teams *10/2017*
- BioCreative V.5 Challenge: The CEMP (Chemical Entity Mention in Patents) Task, **The First Place** in 14 Teams *02/2017*
- BioCreative V.5 Challenge: The GPRO (Gene and Protein Related Object) Task, **The First Place** in 7 Teams *02/2017*

Awards & Honors

- IEEE BIBM 2018 Student Travel Award *12/2018*
- Best Student Paper Award, 22rd China Conference on Information Retrieval (CCIR 2016) *11/2016*

Academic Service

- Conference Reviewer: ACL(2021-), EACL(2021), EMNLP(2020-), AACL(2020-), ICHI (2020-), ISMB(2020-), BIBM(2020-)
- Journal Reviewer: npj Digital Medicine, Bioinformatics, JAMIA, Knowledge-Based Systems, IEEE JBHI, Journal of Biomedical Informatics, IEEE TETCI, IEEE TASLP, IPM, Information Sciences, JMIR, Database, Artificial Intelligence In Medicine, BMC Bioinformatics, Bioinformatics Advances, Artificial Intelligence Review, PLOS ONE, IEEE Access, TALLIP, IJDMB

Publications ([+] denotes equal contribution, * denotes Corresponding author)

1. **Ling Luo*,** Jinzhong Ning, Yingwen Zhao, et al. *Taiyi: a bilingual fine-tuned large language model for diverse biomedical tasks* [J]. Journal of the American Medical Informatics Association, February 2024, btad310.
2. **Ling Luo[+],** Chih-Hsuan Wei[+], Po-Ting Lai, Robert Leaman, Qingyu Chen, Zhiyong Lu**.** *AIONER: all-*

in-one scheme-based biomedical named entity recognition using deep learning [J]. Bioinformatics, Volume 39, Issue 5, May 2023, btad310.

3. Chih-Hsuan Wei+, **Ling Luo+**, Rezarta Islamaj, Po-Ting Lai, Zhiyong Lu. *GNorm2: an improved gene name recognition and normalization system* [J]. Bioinformatics, Volume 39, Issue 10, October 2023, btad599.

4. **Ling Luo+,** Po-Ting Lai+, Chih-Hsuan Wei+, Cecilia N Arighi, Zhiyong Lu**.** *BioRED: a rich biomedical relation extraction dataset* [J]. Briefings in Bioinformatics, 2022, bbac282.

5. **Ling Luo,** Chih-Hsuan Wei, Po-Ting Lai, Qingyu Chen, Rezarta Islamaj, Zhiyong Lu**.** *Assigning species information to corresponding genes by a sequence labeling framework* [J]. Database-The Journal of Biological Databases and Curation, 2022, 2022: baac058.

6. **Ling Luo,** Po-Ting Lai, Chih-Hsuan Wei, Zhiyong Lu**.** *A sequence labeling framework for extracting drug–protein relations from biomedical literature* [J]. Database-The Journal of Biological Databases and Curation, 2022, 2022: baac090.

7. **Ling Luo**, Po-Ting Lai, Chih-Hsuan Wei, Zhiyong Lu. *Extracting Drug-Protein Interaction using an Ensemble of Biomedical Pre-trained Language Models through Sequence Labeling and Text Classification Techniques* [C]. Proceedings of the BioCreative VII Challenge Evaluation Workshop, 2021: 26-30.

8. **Ling Luo,** Shankai Yan, Po-Ting Lai, Daniel Veltri, Andrew Oler, Sandhya Xirasagar, Rajarshi Ghosh, Morgan Similuk, Peter N. Robinson, Zhiyong Lu. *PhenoTagger: A Hybrid Method for Phenotype Concept Recognition using Human Phenotype Ontology* [J]**.** Bioinformatics, 2021, 37(13):1884-1890.

9. **Ling Luo,** Zhihao Yang, Mingyu Cao, Lei Wang, Yin Zhang, Hongfei Lin. *A neural network-based joint learning approach for biomedical entity and relation extraction from biomedical literature* [J]*.* Journal of Biomedical Informatics, 2020, 103: 103384.

10. **Ling Luo,** Zhihao Yang, Lei Wang, Yin Zhang, Hongfei Lin and Jian Wang**.** *KeSACNN: a protein-protein interaction article classification approach based on deep neural network* [J]*.* International Journal of Data Mining and Bioinformatics, 2019, 22(2): 131-148.

11. **Ling Luo**, Zhihao Yang, Pei Yang, Yin Zhang, Lei Wang, Hongfei Lin and Jian Wang. *An attention-based BiLSTM-CRF approach to document-level chemical named entity recognition* [J]. Bioinformatics, 2018, 34(8): 1381-1388.

12. **Ling Luo**, Zhihao Yang, Pei Yang, Yin Zhang, Lei Wang, Jian Wang and Hongfei Lin. *A neural network approach to chemical and gene/protein entity recognition in patents* [J]*.* Journal of Cheminformatics, 2018, 10: 65.

13. **Ling Luo**, Zhihao Yang, Hongfei Lin and Jian Wang. *Document triage for identifying protein–protein interactions affected by mutations: a neural network ensemble approach* [J]*.* Database-The Journal of Biological Databases and Curation, 2018, 2018(1): bay097. (IF: 2.593)

14. **罗凌**, 杨志豪, 宋雅文, 李楠, 林鸿飞. *基于笔画 ELMo 和多任务学习的中文电子病历命名实体识别研究* [J]. 计算机学报, 2020, 43(10): 1943-1957.

15. **罗凌**, 陈毅东, 史晓东, 苏劲松. *基于复述技术的汉语成语翻译方法研究* [J]. 中文信息学报, 2015, 29(04): 166-174.

16. **Ling Luo**, Shankai Yan, Po-Ting Lai, Daniel Veltri, Andrew Oler, Sandhya Xirasagar, Rajarshi Ghosh, Morgan Similuk, Peter N. Robinson, Zhiyong Lu. *A Hybrid Method for Phenotype Concept Recognition using the Human Phenotype Ontology* [C]. Proceeding of 28th Conference on Intelligent Systems for Molecular Biology (ISMB 2020), Abstracts (oral and poster), July 2020, online.

17. **Ling Luo**, Zhihao Yang, Lei Wang, Yin Zhang, Hongfei Lin, Jian Wang, Liang Yang, Kan Xu and Yijia Zhang. *Protein-Protein Interaction Article Classification: A Knowledge-enriched Self-Attention Convolutional Neural Network Approach* [C]. Procceding of 2018 IEEE International Conference on Bioinformatics and Biomedicine (BIBM), 2018, Regular Paper.

18. **Ling Luo**, Nan Li, Shuaichi Li, Zhihao Yang and Hongfei Lin. *DUTIR at the CCKS-2018 Task1: A Neural Network Ensemble Approach for Chinese Clinical Named Entity Recognition* [C]. Proceedings of the Evaluation Tasks at the China Conference on Knowledge Graph and Semantic Computing (CCKS-Tasks 2018), 2018.

19. **Ling Luo**, Zhihao Yang, Hongfei Lin and Jian Wang. *DUTIR at the BioCreative VI Precision Medicine Track: document triage for identifying PPIs affected by genetic mutations* [C]. Proceedings of the BioCreative VI Workshop, 2017: 120-123.

20. **Ling Luo**, Pei Yang, Zhihao Yang, Hongfei Lin and Jian Wang. *DUTIR at the BioCreative V.5.BeCalm Tasks: A BLSTM-CRF Approach for Biomedical Entity Recognition in Patents* [C]. Proceedings of the BioCreative V.5 Challenge Evaluation Workshop, 2017: 28-39.

21. **罗凌**, 杨志豪, 赵哲焕, 林鸿飞, 王健. *融合领域知识的深度神经网络生物医学文本分类* [C]. 第二十二届全国信息检索学术会议(CCIR 2016), 2016.

22. Zeyuan Ding, Zhihao Yang, **Ling Luo**, Yuanyuan Sun, Hongfei Lin. *From Retrieval to Generation: A Simple and Unified Generative Model for End-to-End Task-Oriented Dialogue* [C]. Proceedings of the AAAI Conference on Artificial Intelligence, 38(16), 2024, 17907-17914.

23. Rezarta Islamaj, Chih-Hsuan Wei, Po-Ting Lai, **Ling Luo**, Cathleen Coss, Preeti Gokal Kochar, Nicholas Miliaras et al. *The biomedical relationship corpus of the BioRED track at the BioCreative VIII challenge and workshop* [J]. Database, 2024 (2024): baae071.

24. Rezarta Islamaj, Po-Ting Lai, Chih-Hsuan Wei, **Ling Luo**, Tiago Almeida, Richard AA Jonker, Sofia IR Conceição et al. *The overview of the BioRED (Biomedical Relation Extraction Dataset) track at BioCreative VIII* [J]. Database, 2024 (2024): baae069.

25. Chih-Hsuan Wei, Alexis Allot, Po-Ting Lai, Robert Leaman, Shubo Tian, **Ling Luo**, Qiao Jin, Zhizheng Wang, Qingyu Chen, Zhiyong Lu. *PubTator 3.0: an AI-powered literature resource for unlocking biomedical knowledge* [J]. Nucleic Acids Research, April 2024, gkae235.

26. Tudor Groza, Honghan Wu, Marcel E Dinger, Daniel Danis, Coleman Hilton, Anita Bagley, Jon R Davids, **Ling Luo**, Zhiyong Lu, Peter N Robinson. *Term-BLAST-like alignment tool for concept recognition in noisy clinical texts* [J]. Bioinformatics, Volume 39, Issue 12, December 2023,

btad716.

27. Travis C Hyams, **Ling Luo**, Brionna Hair, Kyubum Lee, Zhiyong Lu, Daniela Seminara. *Machine Learning Approach to Facilitate Knowledge Synthesis at the Intersection of Liver Cancer, Epidemiology, and Health Disparities Research* [J]. JCO Clinical Cancer Informatics, 2022:6.

28. Shankai Yan, **Ling Luo**, Po-Ting Lai, Daniel Veltri, Andrew J Oler, Sandhya Xirasagar, Rajarshi Ghosh, Morgan Similuk, Peter N Robinson, Zhiyong Lu. *PhenoRerank: A re-ranking model for phenotypic concept recognition pre-trained on human phenotype ontology* [J]. Journal of Biomedical Informatics, 2022, Volume 129, 104059.

29. Qingyu Chen, Robert Leaman, Alexis Allot, **Ling Luo**, Chih-Hsuan Wei, Shankai Yan, Zhiyong Lu. *Artificial Intelligence in Action: Addressing the COVID-19 Pandemic with Natural Language Processing* [J]. Annual Review of Biomedical Data Science, 2021, Vol. 4.

30. Alexis Allot, Kyubum Lee, Qingyu Chen, **Ling Luo,** Zhiyong Lu. *LitSuggest: A Web-based System for Literature Recommendation and Curation using Machine Learning* [J]. Nucleic Acids Research, 2021, 49(W1): W352–W358.

31. Zhiheng Li, Zhihao Yang, Yang Xiang, **Ling Luo**, Yuanyuan Sun, and Hongfei Lin. *Exploiting sequence labeling framework to extract document-level relations from biomedical texts* [J]. BMC bioinformatics, 2020, 21: 125.

32. Nan Li**,** Zhihao Yang**, Ling Luo**, Lei Wang, Yin Zhang, Hongfei Lin and Jian Wang. *KGHC: a knowledge graph for hepatocellular carcinoma* [J]. BMC Medical Informatics and Decision Making, 2020, 20:135.

33. Zhiheng Li**,** Zhihao Yang**, Ling Luo**, Yang Xiang and Hongfei Lin. *Exploiting Adversarial Transfer Learning for Adverse Drug Reaction Detection from Texts* [J]. Journal of Biomedical Informatics, 2020, 106:103431.

34. Nan Li**, Ling Luo**, Zeyuan Ding, Yawen Song, Zhihao Yang and Hongfei Lin. *DUTIR at the CCKS-2019 Task1: Improving Chinese Clinical Named Entity Recognition using Stroke ELMo and Transfer Learning* [C]. Proceedings of the Evaluation Tasks at the China Conference on Knowledge Graph and Semantic Computing (CCKS-Tasks 2019), 2019.

35. Qingqing Li, Zhihao Yang, Zhehuan Zhao, **Ling Luo**, Zhiheng Li, Lei Wang, Yin Zhang, Hongfei Lin, Jian Wang, and Yijia Zhang. *HMNPPID—human malignant neoplasm protein–protein interaction database* [J]. Human genomics, 2019, 13: 44.

36. Wei Zheng, Hongfei Lin, **Ling Luo**, Zhehuan Zhao, Zhengguang Li, Yijia Zhang, Zhihao Yang and Jian Wang. *An attention-based effective neural model for drug-drug interactions extraction* [J]. BMC Bioinformatic, 2017, 18:445.

37. Zhehuan Zhao, Zhihao Yang, **Ling Luo**, Lei Wang, Yin Zhang, Hongfei Lin and Jian Wang. *Disease named entity recognition from biomedical literature using a novel convolutional neural network* [J]. BMC Medical Genomics, 2017, 10(5):73.

38. Zhehuan Zhao, Zhihao Yang, **Ling Luo**, Hongfei Lin and Jian Wang. *Drug drug interaction extraction from biomedical literature using syntax convolutional neural network* [J].

Bioinformatics, 2016, 32(22): 3444–3453.

39. Qingqing Li, Zhihao Yang, **Ling Luo**, Lei Wang, Yin Zhang, Hongfei Lin, Jian Wang, Liang Yang, Kan Xu and Yijia Zhang. *A multi-task learning based approach to biomedical entity relation extraction* [C]. Procceding of 2018 IEEE International Conference on Bioinformatics and Biomedicine (BIBM), 2018: 680-682.

40. Zhehuan Zhao, Zhihao Yang, **Ling Luo**, Hongfei Lin, Jian Wang and Song Gao. *Deep neural network based protein-protein interaction extraction from biomedical literature* [C]. Procceding of 2015 IEEE International Conference on Bioinformatics and Biomedicine (BIBM), 2015: 1156-1156.

41. 宋雅文, 杨志豪, **罗凌**, 王磊, 张音, 林鸿飞, 王健. *基于字符卷积神经网络的生物医学变异实体识别方法* [J]. 中文信息学报, 2021, 35(5): 63-69.

42. 丁泽源, 杨志豪, **罗凌**, 王磊, 张音, 林鸿飞, 王健. *基于深度学习的中文生物医学实体关系抽取系统* [J]. 中文信息学报, 2021, 35(5): 70-76.