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Songning Lai

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Education

Shandong University 2020.9 — 2024.6 (expected)
Bachelor in Communication Engineering

- *Overall GPA: 83.53/100.00*

Research Interests

My research interests focus on practical problems in artificial intelligence and the potential applications of Deep Learning in various fields. I believe that advanced technologies like DL can have a positive impact on society. My research includes bioinformatics, multimodal sentiment analysis, domain generalization, and the interpretability of multimodal models. I am committed to contributing to meaningful causes that bring benefits to society through the development of practical DL solutions.

Publications

1. **Predicting Lysine Phosphoglycerylation Sites using Bidirectional Encoder Representations with Transformers & Protein Feature Extraction and Selection**
   Songning Lai, Xifeng Hu, Jing Han, Chun Wang, Subhas Mukhopadhyay, Zhi Liu and Lan Ye
   *Oral and **Best Paper Award**– IEEE Conference on International Congress on Image and Signal Processing, BioMedical Engineering and Informatics (CISP-BMEI 2023)—IEEE Xplore, EI Compendex*

2. **Classifying Crime Types using Judgment Documents from Social Media**
   Haoxuan Xu, Zeyu He, Mengfan Shen, **Songning Lai**, Ziqiang Han and Yifan Peng
   IEEE Conference on International Seminar on Artificial Intelligence, Networking and Information Technology (AINIT 2023)—IEEE Xplore, EI Compendex

3. **BERT_PLPS: A BERT-based Model for Predicting Lysine Phosphoglycerylation Sites**
   Songning Lai, Yankun Cao, Pengwei Wang, Lan Ye and Zhi Liu
   *Under review in the journal BMC Bioinformatics **(JCR Q2 IF:3.307, CCF C)***

4. **Shared and Private Information Learning in Multimodal Sentiment Analysis with Deep Modal Alignment and Self-supervised Multi-Task Learning**
   Songning Lai, Xifeng Hu, Yulong Li, Zhaoxia Ren, Zhi Liu and Danmin Miao
   *Under review in the journal IEEE Transactions on Affective Computing **(JCR Q1 IF:13.99, CCF B)***

5. **Multimodal Sentiment Analysis: A Survey**
   Songning Lai, Haoxuan Xu, Xifeng Hu, Zhaoxia Ren and Zhi Liu
   Under review in the journal Visual Intelligence

6. **Cross-Domain Car Detection Model with Integrated Convolutional Block Attention Mechanism**
   Haoxuan Xu, **Songning Lai(co-first author)** and Yang Yang
   *Under review in the journal Image and Vision Computing **(JCR Q1 IF:3.86)***

Selected Awards

National awards–9 awards in total

- First Prize in Contemporary Undergraduate Mathematical Contest in Modeling National **(Top 0.6%)**
- First Prize in MathorCup University Mathematical Modeling Challenge National **(Top 3%)**
- Broze Medal in China Collegiate Algorithm Design & Programming Challenge Contest

Provincial awards

- Second Prize in National Undergraduate Electronic Design Contest (Shandong Province)
- Second Prize in National Crypto-math Challenge Second (East China Competition)

School awards

- More than **35** university-level awards, including academic competition, social practice, innovation and entrepreneurship, sports, aesthetic education, volunteer, scholarship and other aspects, are not displayed here

Others

- IEEE/EI (CISP-BMEI 2022) **Best Paper Award**
- The invention patent is under examination: The invention relates to a method and system for recognizing lysine phosphate glycerylation site
- Computer software copyright first copyright owner
- Computer software copyright third copyright owner

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Laboratory Research Projects

- Research on key scientific issues of accurate diagnosis and intelligent risk assessment of coronary heart disease based on multimodality radiomics———**NO. ZR2019ZD05 Natural Science Foundation of Shandong Province**
- Research on Physiological Data Aggregation and Mining techniques———**2018YFC0831006-3 Key R&D plan**
- Development of AI image recognition and monitoring system for early gastric cancer———**2021CXGC010506 Key R&D plan of Shandong Province**
- Intelligent wearable medical ultrasound equipment———**CXGC010504 Major Innovation Project of Shandong Province**

Selected Projects

All project descriptions, including published articles, are available **here**.

BERT_PLPS: A BERT-based Model for Predicting Lysine Phosphoglycerylation Sites

- We propose a novel and efficient computational method, BERT_PLPS, to predict lysine phosphoglycerylation sites.
- The dynamic masking strategy is used to replace the original static masking strategy, which effectively improves the anti-noise ability of the model.
- Several groups of experiments are designed to compare and explore the adaptability of various data dimensionality reduction algorithms for amino acid sequence task learning.
- Experiments on the public benchmark data sets verify the feasibility of the model. Moreover, our current approach outperforms the current state-of-the-art methods.

Shared and Private Information Learning in Multimodal Sentiment Analysis with Deep Modal Alignment and Self-supervised Multi-Task Learning

- A function based on the covariance matrix is proposed as a second-order statistic to measure the distribution of features between aligned and drawn-out modes.
- To train the network to learn shared information between modalities, a differentiable loss function is designed.
- A self-supervised learning strategy generation module is utilized to guide the multimodal task to focus on modality-specific private information.
- Comprehensive experiments are conducted on three benchmark datasets for multimodal sentiment analysis to validate the feasibility of this designed module, which outperforms the current state-of-the-art methods.

Cross-Domain Car Detection Model with Integrated Convolutional Block Attention Mechanism

- A comprehensive framework for cross-domain target detection is developed. By fine-tuning the target detector using the image generator in the target domain based on source domain training, high-accuracy cross-domain target detection is achieved in the absence of the target domain, improving mAP by 18.55% over original target detection results.
- An improved CycleGAN-based image generator that learns the primary features of blackout vehicles through a target domain image generation module with an integrated convolutional attention mechanism is created.
- The overall detection performance of the Faster R-CNN model is enhanced by using generalized cross union as the loss function of the target detection framework, combined with the Convolutional Block Attention Module.
- An effective data augmentation method is employed to expand the dataset effectively, even with a limited training set.

Course Project MIT Intelligent Car (Electrical Engineering And Computer Science I)

- Implemented system simulation based on models and algorithms.
- Utilized signals and systems for system control, so that intelligent vehicles could drive stably and avoid collisions.
- Built a posteriori probability through the probability model, judged the labyrinth elements, and selected the path.
- Used amplifier to build circuit, combined with photosensitive resistor to move the vehicle towards light source.

Course Project YOLOV5, LPRNet neural network and SE5 realize license plate detection

- Implemented LPRNet neural network for license plate recognition model based on pytorch.
- Improved classification accuracy by modifying network parameters and network structure.
- Completed the model transformation and run it on SE5 computing platform.

Skills

- Tools and Languages
  - Python, C, MATLAB, R, Git, LaTeX, MarkDown, design software(such as PS, AI and SAI, and have won the **first prize** of the city and the **second prize** of the province in computer painting competition.)
- Deep Learning Research
  - Pytorch, MATLAB, matplotlib, OpenCV, Numpy, Streamlit