Zhuohao Chen
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RESEARCH INTERESTS

My research focuses on speech & language processing, behavior signal processing, multimodal approaches and transfer learning. I'm particularly interested in NLP applications of healthcare and have extensively worked on modeling and evaluating psychotherapy conversations using computational approaches such as recurrent neural networks and transformers.

EDUCATION

Doctorate in Electrical Engineering | University of Southern California – Los Angeles, CA   **expected Aug. 2023**
Advisor: Prof. Shrikanth Narayanan; GPA: 3.90/4.0
Masters in Electrical Engineering | University of Southern California – Los Angeles, CA   **Dec. 2016**
Honors: Masters Students Honors Program (top 5%); GPA: 3.90/4.0
Bachelors in Automation | Zhejiang University – Hangzhou, China   **Jun. 2014**

PROFESSIONAL EXPERIENCE

Signal Processing and Interpretation Laboratory (SAIL), University of Southern California   Jan. 2017 –Present
Graduate Research Assistant; Supervisor: Prof. Shrikanth Narayanan – Los Angeles, USA

- Technology-supported Training and Quality Assurance for Psychosocial Interventions
  - Performed classification and regression tasks by BERT and Longformer to evaluate the quality of the cognitive behavior therapy sessions with an average sequence length equal to 5,500 in terms of the F1 score and root mean squared error.
  - Adapted BERT to the psychotherapy domain via domain-adaptive and task-adaptive pre-training on Tensorflow.
  - Developed a hierarchical transformer framework to better address longer sequences and improved the F_1 score by 8.6% and the root mean squared error by 10.6% of the evaluation tasks.
  - Modeled the overall session quality as a function of local performance to achieve the local quality estimates. The hierarchical transformer benefited from the estimated local quality and further improved the F_1 score by 2.1% and the root mean squared error by 4.6%.
- Implementation of Technology-based Evaluation of Motivational Interviewing
  - Collaborated with a team of 20 researchers and contributed to the development of a speech pipeline for a web-based automated therapist feedback system for motivational interviewing fidelity.
  - Augmented the speech data with speed perturbation, noise and reverberation, trained a robust automatic speech recognition model via Kaldi and adapted to different psychotherapy domains.
  - Implemented a multimodal architecture using bidirectional LSTM layers and self-attention mechanism, leveraged prosodic features to assist the lexical information in the behavioral code prediction of the evaluation system, achieving an averaged F_1 score of 52.4% with 9 target labels.
  - Proposed a domain adversarial network framework with label shift correction to adapt the behavioral code prediction module to new domains. The average improvement in terms of F_1 score is 2.6%.
- Improving Quality and Equity of Oncology Communication
  - Implemented a speech and language processing pipeline to extract lexical features and acoustic features of the oncology conversational recordings and developed computational methods to quantify the nursing skills.
  - Developed a multimodal approach to automatically detect the empathic interactions with different combinations and fusion strategies of features.
  - Successfully recalled 90% of the empathic interactions with only 35% duration of the recording data.
- DARPA's Low Resource Languages for Emergent Incidents Program
  - Built interface to connect the machine translation module and the situation frames prediction module.
  - Performed domain adaptation training of situation type prediction from multiple source languages to the target language.

Amazon   May 2022 – Aug. 2022
Applied Scientist II; Manager: Dr. Jangwon Kim – Seattle, USA

- Topic Classification on Doctor-patient Conversations
  - Proposed a coding scheme of sub-section types for spoken utterances in doctor-patient conversation and manually labeled 48 sessions of mock customer data consisting of 6760 utterances.
  - Developed baseline algorithms via BERT with the role and contextual information to automatically predict the sub-section label for spoken utterances from medical conversations.
  - Leveraged dataset from a broad domain - AWS Transcribe data to address the data sparsity via language model pre-training, self-training, and a novel meta-learning framework with task augmentation. The prediction accuracy was improved by 9.7% compared to the best baseline model.

Amazon   May 2021 – Aug. 2021
Applied Scientist II; Manager: Dr. Ram Bhakta – Seattle, USA

- Automated Clinical Section Classification with Limited Data
  - Implemented Baseline models such as BERT and multi-task learning to predict subsection types of the clinical note sentences.
  - Applied meta-learning for clinical section classification at sentence level in low-resource scenarios utilizing out-of-domain datasets, which achieves the relative improvement among 0.9% to 3.2% for different tasks.
  - Proposed a new task transferability metric for selecting the source tasks relevant to the target tasks by category selection and section selection, which improves meta-learning performance among 0.8% to 4.2% for different tasks.
  - Wrote a paper on intern work, which was accepted by ACL 2022.

Signal and Image Processing Institute, University of Southern California   **May 2016 – Dec. 2016**
Graduate Research Assistant; Supervisor: Prof. Alexander Sawchuk – Los Angeles, USA

- Instrument Tracking on Cataract Surgery Videos
  - Developed adaptive thresholding and connectivity-based clustering algorithms and identified surgical instruments in over 97.5% of video data.
  - Applied principal component analysis method to determine the direction of the surgical instruments.
  - Achieved accurate instrument movement with error less than 3.5 pixels on average.

Gzrobot Company (a leading industrial robot company)   **Aug. 2014 – Nov. 2014**
Software Engineer Intern – Hangzhou, China

- Industrial application of an automated guided vehicle (AGV)
  - Applied Dijkstra algorithm to find the route minimizing the cost of the AGV.
  - Implemented a proportional–integral–derivative algorithm to control the direction of the AGV that carried production materials. Test the performance in the guest company.

Wireless Sensor Networks Lab, Zhejiang University   **May 2013 – Jun. 2014**
Undergraduate Research Assistant – Hangzhou, China

- Adjustable Wireless Sensor Network based Target Monitoring
  - Implemented a random compressed sampling algorithm for accurate sampling interval control scheme on FPGA, which reduced the wireless data exchange volume to 20% with little degradation.
  - Proposed a novel multi-source direct position approach via joint sparse representation of array covariance matrices and increased the localization accuracy by 30%.

TEACHING EXPERIENCE

Teaching Assistant, University of Southern California   **Spring, Fall 2022**
EE519 Speech Recognition and Processing for Multimedia
EE503 Probability for Electrical and Computer Engineers

ACDEMIC SERVICE

Reviewer, ACL Rolling Review

GRADUATE COURSES

EE450 Introduction to Computer Networks (A-)	EE483 Introduction to Digital Signal (A)
CSCI570 Analysis of Algorithms (A-)	CSCI455 Introduction to Programming Systems Design (A)
CSCI561 Foundations of Artificial Intelligence (A)	EE441 Applied Linear Algebra for Engineering (A)
EE519 Speech Recognition and Processing for Multimedia (A)	EE569 Introduction for Digital Image Processing (A)
EE559 Mathematical Pattern Recognition (A)	CSCI567 Machine Learning (PhD Session) (A-)
EE517 Statistics for Engineers (A-)	EE562 Random Processes in Engineering (A)
EE503 Probability for Electrical and Computer Engineers (A)	CSCI644 Natural Language Dialogue Systems (A-)
MATH449 Mathematics of Machine Learning (A)	EE 546 Mathematics of High-Dimensional Data (A)

PUBLICATIONS

Journals

Benjamin van der Woerd, **Zhuohao Chen**, Nikolaos Flemotomos, Maria Oljaca, Lauren Timmons Sund, Shrikanth Narayanan, Michael M. Johns. "Evaluating dysphonia severity of recorded audio samples using machine learning." Submitted to *The laryngoscope*

Zhuohao Chen, Nikolaos Flemotomos, Karan Singla, Torrey Creed, Zac Imel, David Atkins, Shrikanth Narayanan. "An Automated Quality Evaluation Framework of Psychotherapy Conversations with Local Quality Estimates." *Computer Speech & Language 2022*

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Nikolaos Flemotomos, Victor Martinez, **Zhuohao Chen**, et al. "Automated Quality Assessment of Cognitive Behavioral Therapy Sessions Through Highly Contextualized Language Representations." *PlOS ONE, October 2021*

Nikolaos Flemotomos, Victor Martinez, **Zhuohao Chen**, Karan Singla, Victor Ardulov, R. Peri, James Gibson, Michael Tanana, Panayiotis Georgiou, Jake Van Epps, Sarah Lord, Tad Hirsch, Zac Imel, David Atkins and Shrikanth Narayanan. " 'Am I a Good Therapist?' Automated Evaluation of Psychotherapy Skills Using Speech and Language Technologies. " *Behavior Research Methods, August 2021*

Conferences
Zhuohao Chen, Jangwon Kim, Yang Liu. "Topic Classification on Doctor-patient Conversations in Low-resourced Settings". *Manuscript in Preparation*

Zhuohao Chen, Nikolaos Flemotomos, Zac Imel, David Atkins, Shrikanth Narayanan. "Leveraging Open Data and Task Augmentation to Automated Behavioral Coding of Psychotherapy Conversations in Low-Resource Scenarios". Findings *of the Association for Computational Linguistics: EMNLP 2022*

Zhuohao Chen, Jangwon Kim, Ram Bhakta, Mustafa Sir. "Leveraging Task Transferability to Meta-learning for Clinical Section Classification with Limited Data" In *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers). 2022.*

Zhuohao Chen, Nikolaos Flemotomos, Victor Ardulav, Torrey Creed, David Atkins, and Shrikanth Narayanan. " Feature fusion strategies for end-to-end evaluation of cognitive behavior therapy sessions." In *Proceedings of IEEE Engineering in Medicine and Biology Society, November 2021*

Zhuohao Chen, James Gibson, Ming-Chang Chiu, Qiaohong Hu, Tara Knight, Daniella Meeker, James A. Tulsky, Kathryn Pollak, and Shrikanth Narayanan. Automated Empathy Detection for Oncology Encounters. In *Proceedings of International Conference on Healthcare Informatics (ICHI 2020), December 2020*

Karan Singla, **Zhuohao Chen**, David Atkins, and Shrikanth Narayanan. Towards End-2-End Learning for Predicting Behavior Codes from Spoken Utterances in Psychotherapy Conversations. In *Proceedings of the 58th Annual Meeting of the Association for Computational Linguistics, pp. 3797–3803, Association for Computational Linguistics, Online, July 2020.*

Zhuohao Chen, Karan Singla, James Gibson, Dogan Can, Zac Imel, David Atkins, Panayiotis Georgiou, and Shrikanth Narayanan. Prediction of Therapist Behaviors in Addiction Counseling by Exploiting Class Confusions. In *Proceedings of ICASSP, May 2019.*

Nikolaos Flemotomos, **Zhuohao Chen**, David Atkins, and Shrikanth Narayanan. Role Annotated Speech Recognition for Conversational Interactions. In *Proceedings of IEEE Workshop on Spoken Language Technology, December 2018.*

Karan Singla, **Zhuohao Chen**, Nikolaos Flemotomos, James Gibson, Dogan Can, David Atkins, and Shrikanth S. Narayanan. Using Prosodic and Lexical Information for Learning Utterance-level Behaviors in Psychotherapy. In *Proceedings of InterSpeech, Hyderabad, India, September 2018.*

Zhuohao Chen, Kai Yu, Ji-An Luo, and Zhi Wang. "An Improved Joint Sparse Representation of Array Covariance Matrices Approach in Multi-Source Direct Position." In *2014 IEEE 11th International Conference on Mobile Ad Hoc and Sensor Systems, pp. 696-701. IEEE, 2014.*

Preprint
Zhuohao Chen, Karan Singla, Zac Imel, David Atkins, and Shrikanth Narayanan. A Label Proportions Estimation Technique for Adversarial Domain Adaptation in Text Classification. *arXiv preprint arXiv:2003.07444 (2020).*

SKILLS SUMMARY
Programming: Python, Unix shell scripting, MATLAB, C, C++, JAVA
Tools & Libraries: Keras, Tensorflow, Pytorch, Kaldi, SRILM, OpenSmile, SPSS, LATEX