

Cover Letter

Dear Professors,

My name is Di Zhang, and I am studying in the Robotics Lab at the University of Science and Technology of China, where I am pursuing my master's degree. My past research interests are machine learning and robot human-robot interaction.

I was fortunate to see your admissions article and I think my experience may match this position well. So I wrote to you to apply for this PhD position in 2022. During my time at USTC, I have been involved in robotics projects such as "Jiajia" humanoid robot, "Kejia" robot platform, and "Xiaochuan" giant panda "Humanoid" robot, which involve robot control, neural network, NLP, and computer vision.

In addition, I have participated in internships at Microsoft Research Asia and Ant Group (Alibaba), where I have involved in distributed machine learning platform development and algorithm implementation. In terms of engineering development, I can use Pytorch, keras and other mainstream machine learning toolboxes to build models for problems and reproduce works quickly.

Finally, I have rich experience in machine learning competitions held by Ali Cloud Platform and Kaggle and achieved good results. I have experience in open source developments, I can use Git to manage code and ML development environments. I can skillfully use crawler, Google Scholar, Zotero, LaTeX and other tools for information collection, literature searching, management and paper writing.






I can start my work at the first time after my graduation from USTC and I have already prepared Research plans for further discussion.

My CV is attached, It would be my great honor to have a opportunity to work with you!

Thanks,

Di Zhang

Zhang Di

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Personal Information

- Postgraduate student, Robotics Laboratory, USTC, b. 1998
- Past main research interests : Machine Learning, Human-Robot Interaction
- Interested in: Improving human-machine interaction through natural language processing and other machine learning algorithms. Make technology development benefit more people.

Education Experience

- Master, University of Science and Technology of China, Computer Science and Technology, 2019.9~
- B.S., Hefei University of Technology, Municipal Engineering, 2015.9~2019.7

Internship & Works

- Intern algorithm engineer, Institute of Advanced Technology, University of Science and Technology of China, 2019.9 ~ 2021.1
Participated in the development of software and hardware systems for several robotics projects
- Research internship, Microsoft Research Asia, 2021.03 ~ 2021.06
Participated in the *Talking face with upper body gestures* project of Microsoft Research Asia and Multimedia Laboratory (MMLab) of the Chinese University of Hong Kong, and was responsible for survey of past researches and earlier data collection.
- Intern Machine Learning engineer, Ant Group (Alibaba Group), 2021.06 ~ 2021.07
Internship in the Computational Intelligence department, CTO line, Ant Group. I participated in the development of Ray core, a distributed computing platform, and PyMars, a distributed scientific computing machine learning platform. I was responsible for the survey of existing distributed LightGBM projects and participated in the development of PyMars LightGBM interface, and also the Failover mechanism of Ray Core.

Project Experience

- **USTC Campus Invitational Algorithm Competition**, Champion
After extracting multi-angle features from tax data and desensitized registration information like Community Discovering on interpersonal graphs and statistical features, we use a time-series convolutional neural networks to identify their risky probabilities. This algorithm has been deployed in Wuhu smart city big data platform after that competition.
- **Logistics robot hotlink optimization**, Cooperation project with EFORT Intelligent Equipment Co., Ltd.
By planning the hotspot switching strategy for the robot's route through the factory, We can reduce the problems of robots caused by the hotspot switching, such as network delay or dropping.
- **"Jiajia" humanoid robot**, Cooperation project with National Grid
Human-robot interaction, dialogue system, customer service robot, BERT
Participated in the design for the emotion recognition module and the collection of a datasets in human-robot conversational interaction. We applying cutting-edge models such as BERT and TF-IDF to develop the emotion recognition algorithm in the dialogue system, so that business establishments can find what affecting their user's experience and service quality and make it better.
- **Alibaba Cloud Digital Intelligence Service Innovation Challenge 2020**, Top 4%
Liking task scheduling on distributed platforms, to improve the task allocation efficiency of technicians in an ideal service platform, we developed a constrained search optimization algorithm to scheduling tasks and reducing the average waiting time of customer's jobs and average workflow stress of technicians. In addition, when priority preemption occurs, the preempt service must be transferred safely.
- **Giant Panda "humanoid" Robot**, Cooperation Project with Chengdu Giant Panda Breeding Basement

Participated in the design for the front-end interaction module of the robot, allowing the robot to interact with visitors to the site more naturally and intimately, including tour guidance, proactively seek out visitors to initiate interactions, and answer displays etc.

- **Smart Farm Agricultural Robot**, Funded by Anhui Province

I participated in the development of robotic positioning and navigation over GPS, and part of integration of sensing and gripping systems.

- **A novel robot action planning algorithm based on sequence prediction and reinforcement learning**

Through processing of robot action history sequences by an attention-based neural network and combined with traditional deep reinforcement learning methods, We implemented a new robot action planning algorithm. I was responsible for the part of research on attention-based action sequence segmentation and prediction models.

- **AI-Earth 2021 El Nino-Southern Oscillation Indicator Prediction Contest**, Top 10%

This competition gives global weather data for the past years and asks for predicting the ENSO index in the coming year. After constructing higher-order interaction features, we extract the representation vectors of the weather maps through an attention-based convolutional neural network, finally the future ENSO index is predicted by a time-series Seq2Seq approach.

Summer school & MOOCs

- MLSS 2021 TAIPEI (Machine Learning Summer Schools)
- RLChina Reinforcement Learning Summer School, 2021.8
- GreedyAI.com - Advanced Machine learning Camp
- Stanford CS231N - Convolutional Neural Networks for Visual Recognition
- Stanford CS224W - Machine Learning with graphs

Open-Source practices

- In the field of robotic controlment, We have developed reliable and practical toolkits based on ROS and popular real-time communication systems and has deployed our robots in real industrial environments
- Actively participate in technical community activities and help Microsoft Chinese VSCODE community to organize several seminars for beginners
- Active in the open-source community, maintaining several active open source repositories in Github and actively participating in other projects' discussions on PR
- Actively helping peers to solve problems in technical Q&A communities such as Zhihu and StackOverFlow, and writes blogs to share development and algorithm researching experience

Technical Skills

- A good theoretical foundation in deep learning and reinforcement learning, rich experience in algorithm development and machine learning environment management
- Proficiency in Python/C/Golang and other mainstream programming languages
- Proficiency in Pytorch, Tensorflow/Keras, Flask and other mainstream technical frameworks
- Skilled in collecting information, literature management through Zotero or Endnote, and tracking the industry's cutting-edge development by mainstream scholarship toolchains
- Ability to quickly reproduce and master new technologies and algorithms such as Transformer and graph neural networks in the industry

Publications & Patents

- Submitted
 - CHENGUANG L, DI Z, BO Z, et al. Curriculum learning strategies based on service-oriented places such as electric power supply offices[J]. Computer Applications and Software, 2021.
 - CHENGUANG L, DI Z, BO Z, et al. Text empathy prediction based on transfer learning[J]. Journal of Chinese Computer Systems, 2021.
 - CHENGUANG L, DI Z, XIAOPIN C et al. Sentiment analysis dataset for dialogue systems in power business[J]. Journal of Computer Applications, 2021.
 - DI Z. A system of target selection model and actively interaction method for human-robot interaction[P]. 2021
- Preprint
 - DI Z. Juvenile state hypothesis: What we can learn from lottery ticket hypothesis researches?[arXiv]. 2021

Research statement

Dear Professors,

It is my pleasure to introduce my research and work experience to you.

I am currently pursuing my master's degree at the University of Science and Technology of China, and my current main research interests are machine learning and robot human-robot interaction.

In my past studies, I have participated in the lab's Kejia robot project, Jiajia humanoid robot project and giant panda robot project, which involve topics such as robot control, computer vision and natural language processing.

Below I will describe my role in these projects and the specific tasks I was responsible for.

Jiajia humanoid robot is a robot with human appearance, facial expressions and movements, and natural language dialogue capabilities developed in our lab. In 2018, the State Grid Group of China and our lab started a collaborative project for the development of robotic customer service, in which there was a requirement that after a customer interacts with a robot, the robot should be able to make an analysis of the customer's feedback and determine the emotional polarity and the source of emotion generated by the customer's feedback. After being assigned this task, my colleagues and I first conducted data collection in real sites, collecting a large amount of data in the form of audio recordings, comment books, and web message boards, and then obtained a preliminary dataset after data cleaning, labeling, and augmentation. Firstly, we tested statistical learning models such as SVM, XGBOOST, LightGBM and tree models using TF-IDF as the feature extraction function. We then measured the attention-based pre-trained language models, BERT and DistilBERT, etc. The output layer is responsible for outputting the category probabilities for both classification tasks. The final best accuracy of 93.7% was obtained with the BERT model on the dataset, and eventually this model was actually deployed on the robot platform.

The giant panda simulation robot is a derivative project of Kejia Robotics, which was conducted by the lab in collaboration with the Chengdu Giant Panda breeding Base in Sichuan. The robot has realistic giant panda fur, movable arms, a face that can perform expressive movements, and an autonomously movable chassis system from the Kejia project. In this project, I was assigned to work on the development of the robot's active interaction and autonomous movement functions.

After being given this task, my classmates and I researched and analyzed the project. The robot activity site is located in the hall of a museum, the maximum hourly flow of people is about 2,000 people, when the crowd is dense, the robot's activities should be fully considered pedestrian factors. The first is to ensure the safety of the robot when cruising. Through the fusion of LIDAR and ultrasonic radar sensing data and SLAM navigation, we obtained the preliminary map and positioning information. We use the depth camera and YOLOv5 model to detect pedestrian targets and obtain the spatial coordinates of pedestrians in the field, for which we can avoid pedestrians or actively approach specific pedestrians during the movement.

Second, the active interaction function is also a key point, when there are fewer people in the venue or the robot is snubbed, it has to rely on the sensor judgment to actively approach the target and initiate interactions. First, we use the HydraPlus vision model to obtain the age, gender, and other attributes of the pedestrians, and the robot uses these attributes to filter the people most likely to respond to the interaction request and actively approach them to initiate the interaction. The active interaction is initiated by a combination of voice prompts and the GUI front-end interface, which guides the user to interact with the

robot through the featured content.

Finally, the robot operates in a complex environment, so it needs safety and robustness assurance. We use the sensor system to design a QR code based positioning recovery function, a tipping detection and a climbing detection system, which can alert the staff in case of danger and allow them to resume robot back to its normal operation.

Out of lab projects I have participated in internships at several companies regarding machine learning and algorithms. In March 2021, I worked as an intern on the "talking face with upper body" project at Microsoft Research Asia and the Chinese University of Hong Kong, which is dedicated to synthesizing smooth facial videos with upper body movements from text or speech. During this work, I did a comprehensive survey of past works on mainstream talking face models, and conducted preliminary data collection and collation using crawlers on YouTube and other video websites.

In June 2021, I participated in Ant Group as an intern machine learning engineer. During this work, I was involved in the development of Ray, a distributed framework, and pyMars, a distributed machine learning platform, where I was responsible for the research of existing distributed LightGBM models and the development of LightGBM for distributed training on the pyMars platform. and the development of the failover mechanism in Ray.

In addition to these tasks, I have participated in many machine learning and data science competitions on AliCloud platform or kaggle platform. One of the more impressive ones is tax data risk identification, where we use the community discovery algorithm of graph to identify community information on the interpersonal graph. Then we can discover fraudulent groups and their connections in tax registration information. Through multi-angle feature extraction and convolutional neural network in the temporal dimension, we can finally determine whether there is tax fraud in a corporate's tax data. This work has been actually deployed in Wuhu City's smart city platform.

In addition is the El Niño indicator prediction competition of AliCloud, where the organizer provides global meteorological data for the past two years and asks us to predict the El Niño indicator data in the coming year. We first extracted features from the weather maps at each time point through a residual convolutional neural network, and then predicted El Niño indicators for the next twelve months through an attention-based RNN or Transformer by a Seq2Seq method.

The above is my research and work experience. During the past few years of research, I have been involved in several areas of machine learning, so I have the interest and confidence to shift my research direction and participate in this PhD project, and I think my advantages are.

1. I have a good theoretical foundation in machine learning and rich experience in engineering development, I have participated in many research and engineering projects involving machine learning, I can analyze problems and model design and construction quickly, and manage hardware clusters and software architectures
2. I have a rich research and engineering development experience in computer vision and NLP, and I have been involved in dialogue system and object detection during my internship and research works.
3. I am proficient in using Pytorch, I trained myself in many machine learning competitions, and I am also proficient in using TensorFlow and Keras.

Here are two things that I think make me a better match for this position,

4. I have a good skill in information collection, I can use tools like crawlers, Google scholar, Zotero and overleaf LaTeX to do literature survey, management and paper writing

5. I have experience in open source developments and I can use Git, Docker to manage versions of project code and development environments.

These are my personal statements, and I hope to have the opportunity to work with you in the future to make artificial intelligence benefit society and more individuals!



中国科学技术大学
University of Science and Technology of China

研究生在读证明

兹有张迪，男，出生日期1998年11月25日，学号SA19011175，于2019年9月1日入学，系我校计算机科学与技术学院计算机技术专业全日制硕士研究生。

This is to certify that Zhang Di (Male, Date of birth 11/25/1998, Student NO. SA19011175) is studying at the School of Computer Science and Technology in University of Science and Technology of China with the major in Computer Technology as full-time Master's student since 09/01/2019.

中国科学技术大学研究生院

Graduate School of University of Science and Technology of China

2021.03.31



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