Lei LYU

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Education

Columbia Engineering, Columbia University — Sept. 2020 – May 2022

Master of Science

- Electrical Engineering (Major)
- Language of Instruction: English
- GPA: 4.20/4.33

UM-SJTU Joint Institute, Shanghai Jiao Tong University — Sept. 2016 – Aug. 2020

Bachelor of Science

- Electrical and Computer Engineering (Major) + Data Science (Minor)
- Language of Instruction: English
- GPA: 3.76/4.00
- Won Undergraduate Merit-based Scholarship (B-level) for the academic year 2018-2019 and John Wu & Jane Sun Sunshine Scholarship
- Awarded status of Shanghai Jiao Tong University "Merit Student" for the academic year 2017-2018 and Undergraduate Merit-based Scholarship (B-level) for the academic years 2016-2017 & 2017-2018

Research & Projects

ELEN E6876- Project: Image Denoising vis Sparse Model — *January 2022 – May 2022*

Individual

- Learned the sparse and low dimensional models used on high dimensional data and conducted literature review on sparse models applied on image denoising task.
- Researched on dictionary learning method and implemented K-SVD algorithm, which alternatively updates dictionary and sparse coding, to solve the image denoising task.
- Conducted mathematical analysis to know about the intrinsic logics behind K-SVD algorithm and experimented on the influence of hyperparameters, dictionary sizes and noise types on the denoising performance.

ELEN E6699- Project: Double Descent in Deep Learning — *January 2022 – May 2022*

Team member

- Conducted literature review to learn about the traditionary overfitting theory and modern double descent phenomenon in machine learning area
- Experimented on Fashion MNIST dataset to observe the double descent phenomenon in Convolutional Neural Network (CNN) and explored on the effects of training epochs, CNN sizes, bias between training and testing data, etc.
- Analyzed on the results from the experiments to conclude the intrinsic reasons behind double descent phenomenon as different overfitting patterns for different sizes of CNN.

ELEN E4810- Project: Image Super Resolution — *September 2021 – December 2021*

Team leader

- Researched on the related work of image super resolution task and selected FSRCNN structure and image cropping schemes to solve the problem.
- Implemented FSRCNN model in Python and experimented to find the best hyperparameters on training and validation dataset.
- Tested the performance with testing dataset and adjusted patch combination strategy to gain better visual and statistical quality of super resolution image.

ELEN E6885- Project: Gomoku AI Based on AlphaZero — *September 2021 – December 2021*

Team member

- Reviewed the literature on deep learning combining reinforcement learning and explored deeper in the topic of AlphaGo and AlphaZero algorithms.
- Implemented Monte-Carlo Decision Tree (MCTS), which is the key structure in AlphaZero algorithm and trained neural networks, which works as AI in the Gomoku game.

- Discussed with other teammates to explore more aspects like the decision schemes used in MCTS, the structure of the neural networks, etc. that will influence the strength of AI and concluded the findings in the whole process into a report.

ELEN E6690- Project: Statistical Learning *September 2021 – December 2021*

Team leader

- Collected and processed Quantitative Structure−Activity Relationship (QSAR) dataset.
- Read related papers that have conducted research on QSAR dataset and replicated, using R, the terminology used by the paper, including support vector machine (SVM), k-nearest neighbor classifier, partial least squares discriminant analysis (PLSDA).
- Implemented other machine learning methods to classify the data, like Random Forests, Bagging, AdaBoost and neural networks and applied model ensemble techniques to further improve the classification accuracy beyond the best individual method.

MIT Path Academics Online Research Seminar *May 2021 – September 2021*

Team leader

- Participated in the program – Introduction to Deep Learning: Theory and Application Online Seminar, to have discussions on thinking in the area of neural networks and deep learning with Professor Mark Vogelsberger and other students.
- Led a group of four to discuss on specific deep learning topics, do experiments on different types of neural networks, deliver group presentations on the findings weekly and completed a final project on lung cancer diagnose using CNN based on knowledge and skills grasped during the program.
- Explored deeper into the topic of the final project individually, improved the model performance significantly and summarized the results in a paper *Lung Cancer Diagnosis Based on Convolutional Neural Networks Ensemble Model*, which has been accepted by AINIT 2021 Conference.

Emerging Computing Technology Laboratory *April 2021 – September 2021*

Research assistant

- Worked in the lab at SJTU-UM Joint Institute with other lab researchers to do the research on the topic of accelerating circuit rewriting algorithm using CUDA.
- Analyzed digital circuit rewriting algorithm in ABC Library and experimented on AIG-format benchmarks in C.
- Reviewed papers on state-of-art research of digital circuit representation and rewriting methods and proposed ideas to design parallel-computing rewriting algorithm in CUDA.

VE414-Bayesian Analysis: Project *September 2019 – December 2019*

Team member

- Analyzed the project given a dataset of fruits detection on various routes through the yard and conducted Bayesian analysis to establish posterior distributions of fruits and implemented reject sampling to estimate fruits' locations in the yard with Julia.
- Devised procedures to group fruits using EM algorithm and positioned trees in each cluster.
- Consulted a professor to figure out weakness of model and suggested GMM algorithm to improve the model to teammates.

VE413-Monolithic Amplifier Circuits: Project *September 2019 – December 2019*

Team member

- Designed the circuit in a solar tracking system that can rotate to face into the direction of light.
- Experimented on the bread board to adjust the proper parameters, like the resistance, printed the final circuit on PCB and assembled it into the solar tracking system.
- Showed our work at a school exhibition and introduced our projects to visitors.

VV214-Linear Algebra: Project *April 2019*

Team member

- Researched and studied materials on the topic of Linear algebra in the field of economics.
- Presented the findings of our research at a school exhibition to students and staff.
- Created an accompanying poster to introduce the research.

VE401-Probabilistic Methods in Eng.: Projects1&2 *March 2019 – April 2019*

Team member

- Calculated probability statistics on varying data types using a number of different methods including confidence interval & hypothesis testing and using the OC curve to aid analysis.

- Conducted an analysis of the data and compiled a final report.

VE312-Digital Integrated Circuits: Lab & Project *November 2018 – December 2018*

Team member

- Used the Linux Cadence ICFB environment to design the schematic of an 8-bit multiplier whilst paying attention to the Energy Delay Product.
- Project completed without guidance and project methodology self-designed.
- Awarded full marks by professor for this project.

VE370-Intro to Computer Organization: Projects1-3 *September 2018 – December 2018*

Team member

- 3 related projects on MPIS assembly programs
- Developed an MIPS assembly program, conducted modelling in Verilog and finally completed a literature review on *The development of telecommunication technology: from 1G Network to 5G Network.*

VE280-Programming & Elem. Data Structures: Projects 1-5 *May 2018 – August 2018*

Team member

- Responsible for coding several projects and then conducting online testing.
- Project content included designing a model of the game Hangman using basic C++, constructing a simple world by adapting knowledge of arrays, pointers and different I/O streams, designing a model of the game Blackjack using abstract data types and abstract base.

VE215-Intro to Circuits: Electrical Circuit Experiments 1-5 *October 2017 – November 2017*

Team member

- Conducted an experiment investigating the use of an UT60A multimeter, learned to build circuits on a solderless prototype board and verified basic laws of electrical circuits.
- Built a series RC circuit, observed its responses to input signals of varied frequency and explained them using relevant theories.
- Built RLC circuits and simple second-order circuits.

Miscellaneous Projects *2016-2020*

- VG101 Programming Lab: Programming tasks with various different requirements.
- VE406 Applied Regression Analysis using R: Use linear regression model and LSTM neural network structure to make prediction on Tesla stock price during a given period.
- VC211 Chemical Experiments: Conducted Chemical experiments and compiled a final report.
- VG100 Mechanical Engineering Projects 1&2: Studied the structures of paper bridges, constructed a model and completed a final report.
- VP141 Physics Experiments 1-5: Conducted experiments and compiled final reports.
- VV285 Mathematical Project: Conducted a study on *A Perfect Pendulum* and compiled final report.
- VE215 Electrical Circuit Experiment: Conduct an experiment into the direct circuit condition including building circuits on a solderless board. Compiled summary report.
- VE270 Logical Design Labs1-7: Use Vivado to write Verilog code according to various requirements, uploaded to FPGA to simulate the operation of a computer's internal structure.

Extracurricular Activities

CSOR 4231 Analysis of Algorithms, Columbia University *January 2022 – May 2022*

Teaching assistant

- Assisted Professor Eleni Drinea in course Analysis of Algorithms on grading assignments and exams, releasing scores, responding to students' regrading requests and managing coursework
- Helped students by clarifying their homework problems and course material puzzles during office hours
- Collaborated with other teaching assistants to find out innovate solutions to assignments and give accurate answers to students' questions

Ecological Challenge Camp, Yunnan Province, China *December 2018 – January 2019*

Team member

- Conducted ecological research on the town of Dali, Yunnan. Following the completion of the

research made recommendations for local ecological development which were presented in both oral and written forms.
- Following our work, the group was awarded 3rd prize.

Skills

- Computer programming: Proficient in C++ and Python, having studied extensively during undergraduate and graduate program. Experienced programming for various different requirements during several undergraduate and graduate projects and research (above). Experienced using Vivado software for coding.
- Leadership: developed through participation in countless group projects. Able to analyze the group workload and distribute fairly and optimally according to the abilities of all group members.
- Team-work & collaboration: an experienced team player, able to remain selfless and take on extra responsibilities in the interest of the team.
- Adaptability: able to adapt to new situations and can take on and apply new knowledge quickly.
- Problem-solving: able to use new knowledge for solving problems in various situations.
- Presentation & communication: experienced creating and delivering presentations in front of the audience, particularly communicating the findings, conclusions of various kinds of projects including research projects.
- Written skills: good written skills (English and Chinese) developed through the compilation of a number of research and experiment reports and 5 years study through the medium of English.
- Proficient computer user, including Office Word, Excel and PowerPoint to present project results and Latex to arrange the text in a clear format. Familiar with and proficient in the C++ and Python programming language.

Languages

- Native Chinese Speaker.
- Proficient English speaker with 6 years' experience of education through the medium of English. Able to communicate well both orally and through writing.