Lei LYU

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Education

University of Southern California — Aug. 2023 –

Doctor of Philosophy

- Electrical Engineering (Major)
- Language of Instruction: English

Columbia Engineering, Columbia University — Sep. 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 — Sep. 2016 – Aug. 2020

Bachelor of Science

- Electrical and Computer Engineering (Major) + Data Science (Minor)
- Language of Instruction: English
- GPA: 3.76/4.00
- Awarded status of Shanghai Jiao Tong University "Merit Graduate" for year 2020
- 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 via Sparse Model — *Jan. 2022 – May 2022*

Individual

- Learned the topic on sparse and low dimensional models for high dimensional data and read papers on sparse model methods applied on image related task.
- Discussed with Professor John Wright about the methodology on the image denoising task and implemented K-SVD algorithm to solve the problem.
- Conducted mathematical analysis to know about the correctness and convergence of the K-SVD algorithm and experimented to show the influence of hyperparameters, dictionary sizes and noise types on the denoising performance.

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

Team member

- Discovered no overfitting concerns on using complex neural network models and knew about the traditionary overfitting theory and modern double descent phenomenon in machine learning area.
- Experimented on Convolutional Neural Network (CNN) with Fashion MNIST dataset to observe the double descent phenomenon and explored the effects of training epochs, CNN sizes, bias between training and testing data, etc.
- Analyzed on the results from the experiments and inferred the potential reasons behind double descent phenomenon as different overfitting patterns for different sizes of CNN.

ELEN E4810- Project: Image Super Resolution — *Sep. 2021 – Dec. 2021*

Team leader

- Researched on the related work of the image super resolution task and decided to use the FSRCNN structure and image cropping schemes.
- Implemented FSRCNN model in Python and experimented to adjust the hyperparameters with training data.
- Tested the performance on testing dataset and switched patch combination strategy to gain better visual and statistical quality on up-scaled images.

ELEN E6885- Project: Gomoku AI Based on AlphaZero — *Sep. 2021 – Dec. 2021*

Team member

- Reviewed the literature of the topic on deep learning combining reinforcement learning and explored deeper into 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 on the decision schemes used in MCTS, the structure of the neural networks, etc. and concluded how these factors influence the strength of AI.

ELEN E6690- Project: Statistical Learning *Sep. 2021 – Dec. 2021*

Team leader

- Collected and processed Quantitative Structure−Activity Relationship (QSAR) dataset.
- Read papers that have conducted research on classifying the QSAR dataset and replicated, in R language, the terminology in the papers, including support vector machine (SVM), k-nearest neighbor classifier, partial least squares discriminant analysis (PLSDA).
- Implemented other machine learning models to classify the data, including 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 – Sep. 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, delivered group presentations on the findings weekly and completed a project on lung cancer diagnose using CNN based on knowledge and skills grasped during the program.
- Explored deeper into the topic of the 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 and indexed in EI and SCOPUS.

Emerging Computing Technology Laboratory *Apr. 2021 – Sep. 2021*

Research assistant

- Worked in the lab at SJTU-UM Joint Institute with Professor Weikang Qian and 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/C++ language.
- 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 *Sep. 2019 – Dec. 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 the EM algorithm and positioned trees in each cluster.
- Consulted a professor to figure out weakness of model and proposed using the GMM algorithm to improve the model.

VE413-Monolithic Amplifier Circuits: Project *Sep. 2019 – Dec. 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 parameters, like the resistance, printed the final circuit on PCB and assembled it with motors to build the solar tracking system.
- Showed our work at a school exhibition and introduced our projects to visitors.

VV214-Linear Algebra: Project *Mar. 2019 – Apr. 2019*

Team member

- Researched and studied materials on the topic of Leontief Inverse Matrix in the field of economics.
- Discussed with team members on the mathematical property of the Leontief Inverse Matrix and how it is used in economics.
- Created an accompanying poster to introduce the research and presented the findings of our research at a school exhibition to students and staff.

VE401-Probabilistic Methods in Eng.: Projects1&2 *Mar. 2019 – Apr. 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 statistical analysis on the data and compiled a final report about the findings.

VE312-Digital Integrated Circuits: Lab & Project *Nov. 2018 – Dec. 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 *Sep. 2018 – Dec. 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 – Aug. 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 *Oct. 2017 – Nov. 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 *Jan. 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 clarify 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 *Dec. 2018 – Jan. 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 third prize.

Skills

- Computer programming: Proficient in Python and C/C++, 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 Python, C/C++ and R 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.