Chuyi (Sky) Hou

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Summary

Applied Machine Learning Engineer with a passion for utilizing cutting-edge models to develop innovative solutions. I specialize in leveraging advancements in machine learning, including large language models (LLMs), to create impactful systems that improve user experience and system functionality. With a forward-thinking approach, I focus on maximizing the potential of rapidly evolving models to address real-world challenges. My expertise spans from developing and fine-tuning machine learning algorithms to deploying practical, efficient solutions across diverse applications, ensuring my work remains at the forefront of the field.

Education

Master of Engineering in Mechanical and Industrial Engineering Toronto 2022-Present

- **University of Toronto**

  MEng Project - Supervisor: Prof. Eldan Cohen

  Improving Patient Safety Event Report Classification with Parameter Efficient Fine-tuned Language Model

  - Focused on enhancing NLP model performance for patient safety applications, significantly improving classification accuracy and reducing computational complexity.
  - My coursework includes deep dives into blockchain technologies, AI-driven finance, and data science, equipping me with the skills to develop scalable, data-driven solutions across multiple industries.

Bachelor of Applied Science (BASc) in Engineering Science Toronto 2017-2022

- **University of Toronto**

  Honour List: 2017, 2019, and 2020
- **Major: Robotics**
- **Minor: Artificial Intelligence Engineering and Engineering Business**

Undergraduate thesis supervisor: Margaret P. Chapman

Supervisor Position as of 2022: Assistant Professor

Thesis title: "Towards a Scalable Approach for Risk-Averse Safety Analysis"

- Developed a computationally efficient risk-averse safety analysis method using Monte Carlo Tree Search to improve existing algorithms with theoretical guarantees.
- Demonstrated cost improvement properties and proposed potential future research directions for scalable applications.

Working Experience

R&D Full-time Signal Processing and ML Engineer Toronto 2022 - Present

Unmodal Research Inc.

- **Firmware Development & Hardware Assembly:** Spearheaded the development of robust firmware for microcontrollers to enable multichannel audio output, optimizing system performance and reliability. Demonstrated strong expertise in firmware creation and hardware integration, resulting in streamlined signal processing for complex audio applications.
- **Signal Processing & Machine Learning Applications:** Applied advanced signal processing techniques and machine learning algorithms to bridge the gap between theoretical research and practical implementation. Delivered innovative solutions that contributed to the company' s product development, enhancing real-time data processing capabilities.
- **Multidisciplinary Skillset:** Leveraged expertise in Python programming, human-computer interaction, machine learning, and UI/UX design to lead projects across various domains. Notable projects include developing intuitive user interfaces and contributing to full-stack development for internal tools and prototypes, showcasing versatility in both hardware and software engineering.

Academic Part-time Online Tutor Remote 2018 - 2022

UASK Education

- **Personalized Tutoring:** Delivered over 300 hours of one-on-one and group tutoring sessions for high school and university students, specializing in mathematics, engineering, and programming. Tailored lesson plans to meet individual student needs, resulting in improved academic performance and strong student satisfaction.
- **Communication & Pedagogy:** Developed exceptional communication skills by explaining complex engineering and programming concepts in a clear and accessible manner. Created engaging learning environments, encouraging active participation and critical thinking during sessions.

Research Experience

Improving Patient Safety Event Report Classification with Parameter Efficient Fine-tuned Language Models 2024-present

The Optimization and Machine Learning (OptiMaL) Lab of the University of Toronto Canada

Supervisor: **Prof. Eldan Cohen**

Engaged in a project aimed at improving the classification of patient safety event reports using fine-tuned language models. Developed a parameter-efficient model that significantly improved the accuracy of report classifications while reducing computational overhead. Leveraged state-of-the-art natural language processing (NLP) techniques, particularly focusing on parameter-efficient fine-tuning to optimize performance. Applied insights gained from AI in healthcare, with the goal of enhancing automated systems for patient safety and error prevention.

Research Associate 2021 - 2022

Dynamic Graphics Project Lab of the University of Toronto Canada

Supervisor: **Prof. Daniel Wigdor** PI: **Dr. Varun Perumal C**

Conducted cutting-edge research into human-computer interaction through the development of machine learning models for real-time hand and finger tracking in mixed reality. Designed and tested pipelines for hardware prototypes, ensuring efficient data transfer to computing units. My primary contribution was in validating various machine learning models, comparing their trade-offs, and documenting findings. Developed pressAR, a novel method leveraging depth and infrared sensors within head-mounted displays (HMDs) to detect subtle anatomical changes in the user' s fingers during surface interactions. This research achieved 82% accuracy in detecting freehand gestures, contributing to advancements in controller-free interaction for mixed reality environments.

pressAR : Vision-based freehand touch and force sensing 2021 - 2022

Dynamic Graphics Project Lab of the University of Toronto Canada

Supervisor: **Prof. Daniel Wigdor** PI: **Dr. Varun Perumal C**

Developed a novel technique for freehand touch and force sensing in mixed reality environments, focusing on improving human-computer interaction through precise gesture detection. This method employed the depth and infrared sensors in HMDs to identify subtle variations in finger positioning and pressure. Achieved a high accuracy rate in detecting contact and force events, enhancing the control and interactivity of mixed reality systems. The project involved advanced machine learning algorithms, hardware integration, and user interface design, resulting in a significant leap toward fully immersive, controller-free interactions.

NSERC Summer Research Assistant 2019

Intelligent Transportation System Lab of the University of Toronto Canada

Supervisor: **Prof. Baher Abdulhai** PI: **Dr. Hasan Bayanouni**

Explored the use of ontology and inferencing techniques within smart city projects, with a focus on transportation systems. Conducted a comprehensive literature review on ontology-based mapping for smart city infrastructures, identifying key opportunities for optimization. Integrated the loop detector ontology with OpenTripPlanner using AllegroGraph, enabling more effective data-driven transportation planning. Developed a GTFS auto-updater tool in Python, streamlining the integration of real-time data for urban transportation systems. This project advanced my expertise in data management, ontology mapping, and Python-based automation, contributing to smart city transportation research.

Projects

Steam Game Review Analysis 2024

Role: **Lead Data Analyst** Supervisor: **Prof. Mariano P. Consens** University of Toronto

Conducted an extensive analysis of over 3 million Steam game reviews to identify key factors influencing review helpfulness and engagement. Cleaned and preprocessed the dataset to ensure accuracy, which significantly improved the model' s predictive power. Utilized exploratory data analysis (EDA) to uncover patterns and correlations between review content and user metrics such as helpfulness and the number of comments. Developed and trained a linear regression model, classifying and predicting review quality based on these key metrics. This project demonstrated advanced proficiency in data analysis, machine learning, and natural language processing (NLP) techniques, providing actionable insights that informed industry strategies for improving review engagement.

Animyth - A tool for assisting creation of 2D animation for game development 2023

Role: **Developer** Supervisor: **Prof. Jonathan Rose** University of Toronto

Spearheaded the development of Animyth, a cutting-edge tool designed to streamline 2D animation for game development. Collaborated with a partner to integrate emerging technologies, including GPT-4, prompt engineering, and Python' s OpenCV, for automated keyframe processing. Defined the project scope, managed datasets, and implemented both qualitative and quantitative metrics to evaluate results. The project showcased proficiency in Python, computer vision, and machine learning techniques, contributing to the development of an open-source tool that aids in automating time-consuming processes for game developers.

Social Media Sentiment Analysis 2023

Role: **Lead Data Analyst** Supervisor: **Prof. Oleksandr Romanko** University of Toronto

Led a comprehensive sentiment analysis on Twitter data related to a real-world event, extracting public opinions and reactions. Employed machine learning classifiers (Random Forest, Logistic Regression, Support Vector Machines) to train and test models on the data, accurately predicting sentiment trends. Created compelling visualizations, including word clouds and data charts, that highlighted key findings. Presented the project results to an audience, demonstrating advanced skills in data analysis, sentiment analysis, and machine learning, while offering insights into public opinion dynamics during significant events.

Producing 360-Degree Panoramas Using the CPET Dataset 2020

Role: **Developer** Supervisor: **Prof. Jonathon Kelly** University of Toronto

Led the design and development of two panorama-stitching algorithms using Python and image processing libraries (OpenCV, SciPy, NumPy). The project utilized data from the Clearpath Husky rover to produce high-quality 360-degree panoramas with reduced vignetting effects. Presented a comprehensive project report that detailed the methods, implementation, and outcomes. This project highlighted my ability to apply advanced image processing techniques and demonstrated proficiency in designing scalable solutions for robotic applications.

YouTube Trending Video Database Analysis 2020

Role: **Developer** Supervisor: **Prof. Diane Horton** University of Toronto

Designed and implemented a schema to analyze YouTube's trending video dataset. Cleaned the dataset using Python and structured it using SQL to investigate patterns and answer key investigative questions. Wrote and optimized queries that extracted valuable insights, helping to uncover trends and performance metrics across YouTube videos. The project showcased proficiency in database management, SQL, and Python, and provided critical insights into factors influencing video popularity on social media platforms.

The Galbraith Memorial Mail Robot 2019

Role: **Developer** Supervisor: **Prof. G.M.T.D'Eleuterio** University of Toronto

Developed and programmed a fully autonomous TurtleBot3 Waffle Pi for the Galbraith Memorial Mail Robot competition. Implemented PID control for line-following and applied Kalman Filter and Bayesian Localization techniques to enhance the robot's navigation and accuracy. Collaborated closely with team members to integrate mechanical components and ensure smooth operation. The project demonstrated my expertise in robotics, real-time control algorithms, and autonomous systems.

Deep Learning Food Recognition Model 2019

Role: **Developer** Supervisor: **Prof. Lisa Zhang** University of Toronto

Led the design and implementation of a deep learning food recognition model, utilizing PyTorch to develop convolutional neural networks (CNN) and object detection models. Trained, tuned, and tested a Faster R-CNN, achieving high accuracy in food item classification. Developed a graphical user interface (GUI) using Python' s tkinter library for demonstration purposes. This project enhanced my proficiency in deep learning, model optimization, and user interface design, showcasing my ability to apply AI in practical settings.

Fully Autonomous Ball Dispensing Mobile Machine 2019

Role: **Developer** Supervisor: **Prof. M.R.Emami** University of Toronto

Designed and developed a fully autonomous ball dispensing machine using PID control for enhanced accuracy and performance. Integrated sensor subsystems and established communication between the PIC board and Arduino via I^2C. The project was recognized for its innovation and efficiency, winning 2nd place out of over 20 teams in a public demonstration showcase. This experience strengthened my skills in electromechanical design, firmware programming, and real-time system integration. "Almost professional", said by the supervisor. Won place out of over 20 teams for performance efficiency and overall features in a public demonstration showcase.

School Experience

Technical Design Team Lead – University of Toronto Scarborough Robotics Club 2021-2022

Designed robotics hackathon challenges and organized various workshops.

Event Director – University of Toronto Association of Chinese Engineers (UTACE) 2018-2022

Led teams to organize and conduct various student cultural/academic events.

Peer Mentor for Linear Control Theory (ECE557) – University of Toronto 2021

Strengthened students skills in deriving mathematical proofs.

Circuit Team Member University of Toronto Robotics Association (UTRA) 2019-2020

Designed and soldered circuits.

Engineering Ambassador UofT Faculty of Applied Science & Engineering 2019-2020

Student volunteers that partner with the Faculty recruitment and alumni events.

Awards

Dean's Honour List Fall 2020

Dean's Honour List Winter 2020

NSERC Undergraduate Student Research Award 2019

Dean's Honour List Fall 2019

Dean's Honour List Fall 2017

Professional Skill

Python (Proficient)

Demonstrated through various projects such as Steam Game Review Analysis, where I performed extensive data cleaning, preprocessing, and developed a linear regression model to predict review quality. Additionally, applied in Animyth, leveraging Python's OpenCV for keyframe processing in game development.

Machine Learning (Proficient)

Applied advanced machine learning techniques during the Social Media Sentiment Analysis project, where I developed classifiers (Random Forest, Logistic Regression, SVM) to analyze sentiment trends. Also integrated machine learning models in PressAR to identify subtle hand movements for HMD interfaces.

SQL (Proficient)

Used to design and implement schemas and write queries in YouTube Trending Video Database Analysis, where I analyzed trending patterns and extracted valuable insights from YouTube data using SQL alongside Python.

C Programming (Proficient)

Gained hands-on experience in firmware development and testing for microcontrollers during my role at Unmodal Research Inc., where I programmed firmware for multi-channel audio output and optimized hardware performance.

Large Language Models (Proficient)

Fine-tuned and deployed language models during my MEng Project on improving patient safety report classification, demonstrating my ability to work with state-of-the-art language models and optimize their performance.

UI/UX Design and SwiftUI (Proficient)

Developed user-friendly iOS apps using SwiftUI in Unmodal Research Inc., focusing on creating intuitive interfaces that enhance human-computer interaction. Applied similar design principles to ensure seamless integration between UI and system functionality.

Unity Engine (Experienced)

Utilized Unity for game design projects such as Animyth, where I developed 2D animation tools for game development. Also experienced in implementing interactive and immersive game environments.

Firmware Programming and Microcontroller Testing (Proficient)

Applied during my work at Unmodal Research Inc., where I was responsible for loading firmware onto microcontrollers and conducting comprehensive tests to ensure system reliability.

Personal Information

Languages

Chinese/Mandarin (native), English (fluent)

Hobbies

Video game design, board game

Sport

Tennis, table tennis, ski

Canadian permanent resident

Publications

[1] P. V. Chadalavada, C. Hou, H. Satgunarajah, N. Pol, Y. Liu, and D. Wigdor, "Pressar : Vision-based freehand touch and force sensing," ACM Conference on Human Factors in Computing Systems (CHI), 2024 in submission.