Zhekai Jiang

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GitHub Homepage: https://github.com/zhekai-jiang

Education

McGill University

Sep 2019 – May 2023 (Expected)

Bachelor of Software Engineering

Montréal, Québec, Canada

- **Cumulative Grade Point Average:** 4.00 / 4.00
- **Course Highlights:**

  Software Engineering and Computer Science: Model-Based Programming (Top Performer), Software Requirements Engineering, Database Systems, Programming Languages and Paradigms, Theory of Computation, Operating Systems (100%, Top 3 Best Projects Winner), Applied Machine Learning (Graduate), Signals and Networks

  Mathematics: Discrete Structures (100%), Probability and Statistics for Engineers

  Languages and Communication: Communication in Engineering, Beginners' French 2

  Other Personal Interdisciplinary Interests: Physics of Music, Introduction to Psychology (Advanced Placement)

The University of Hong Kong (HKU)

Jul 2018 – Aug 2018

Visiting

Hong Kong, China

- **Course:** Mathematical Laboratory and Modeling, **Grade:** A+, 4.30 / 4.30

Honours and Awards

McGill **Dean's Honour List** (3 times) for ranking in the top 10% of the Faculty of Engineering in an academic year

McGill **Hatch Scholarship in Engineering** (CAD 4,700) for my academic merit

McGill **Schull–Yang International Experience Award / Summer Undergraduate Research Award in Engineering (SURE International Award)** (CAD 2,500) for my research internship at EPFL (Swiss Federal Institute of Technology in Lausanne)

EPFL **Scholarship of Excellence** (CHF 4,800) for participating in the Excellence Research Internship Program (ERIP)

McGill **Tomlinson Engagement Award for Mentoring (TEAM)** (4 times, CAD 300 each) for my efforts mentoring in courses

McGill **Engineering Class of 1983 Scholarship** (CAD 3,000) for my academic standing and overall contribution to university life

McGill **John V. Galley Scholarship** (CAD 1,000) for my distinguished academic standing

McGill **Rio Tinto – Richard Evans International Exchange Award** (CAD 2,000) for my academic achievements, as well as leadership values of personal responsibility, integrity, accountability, and mutual respect

HKU **Award of Excellence** (HKD 1,200) for achieving distinction in the undergraduate-level course during my visit

Research Experiences

Excellence Research Intern

May 2022 – Aug 2022

Data Analysis Theory and Applications (DATA) Laboratory, EPFL (Swiss Federal Institute of Technology in Lausanne)

Lausanne, Vaud, Switzerland

Supervisor: Prof. Christoph Koch

Supported by EPFL Excellence Research Internship Program (ERIP) and McGill Summer Undergraduate Research in Engineering (SURE) International Program

Funded by EPFL Scholarship of Excellence and McGill Schull–Yang International Experience Award

Sudokube: an online analytical processing (OLAP) database system for data scientists based on partially materialized pre-computed high-dimensional data cubes

- Researching on algorithms based on probabilistic graphical models for marginal problems with maximum-entropy constraint optimization, to be integrated into the core query engine to efficiently approximate results of analytic queries with aggregation operations using partially materialized pre-computed data cubes
- Implemented existing variants of the iterative proportional fitting algorithm in Scala; proposing and implementing new heuristic variants of the algorithm in Scala as optimizations
- Implemented experimenters in Scala, executed experiments on remote Linux servers, plotted diagrams using Python scripts, and analyzed performance in terms of accuracy and efficiency of approximation among all variants and existing solvers

Root cause analysis in realistic semi-quantitative simulations

- Researching on metaphysics- and logic-based principles to define, represent, and reason about causality

- Formalizing applications to the root cause analysis for events in semi-quantitative simulations of realistic scenarios

Research Assistant
May 2020 – Present

Critical Software-Intensive Systems Group, McGill University Montréal, Québec, Canada

Supervisor: Prof. Dániel Varró

Refinery: an efficient graph solver to generate consistent, well-formed models based on partial models

- Based on a novel specification language Problem, developing the online service to visualize partial models and the process of model generation in real time, using React, D3, and Xtext web editor supports, in TypeScript and Java
- Applicable to automated synthesis of test data and feature modelling for critical and cyber-physical systems

Applying force-directed graph layout to solve and visualize models with constraints

- Implemented a force-directed layout algorithm in Python to solve models with constraints and generate models of test cases involving objects in the surrounding environment in the context of autonomous driving
- Potentially applicable to automatic generation of test cases for systems involving similar realistic graphical environments

Public transit hub connection planning by design space exploration

- Identified problem and designed meta model of the problem domain using Ecore in the Eclipse Modeling Framework (EMF)
- Specified constraints, objectives, and transformations as graph model patterns using the VIATRA Query Language (VQL)
- Generated code from models, implemented setup process, specified search strategies, and executed design space exploration in Java with the VIATRA Design Space Exploration (VIATRA-DSE) Framework

Teaching Experiences

Tomlinson Engagement Awardee for Mentoring (TEAM Mentor)
Sep 2020 – Apr 2022

Tomlinson Project in University-Level Science Education (T-Pulse), McGill University Montréal, Québec, Canada

- **Winter 2022 – Programming Languages and Paradigms** (357 students): Hosted weekly virtual mentoring hours via Zoom
- **Fall 2021 – Linear Algebra and Geometry** (895 students): Wrote optional reading materials on applications of linear algebra in other areas of mathematics and computer science (available on my personal website); monitored course discussion board
- **Winter 2021 – Introduction to Software Engineering** (76 students): Monitored the course discussion board and advised students on the semester-long full-stack group project (an application for an imaginary auto repair shop, including a backend, a website, and an Android application) and general course materials
- **Fall 2020 – Linear Algebra and Geometry** (1081 students): Hosted weekly office hours at the virtual $\overrightarrow{F}\,\mathrm{Re}(z)\,\mathrm{Ca}$ (First Year Residence Cafeteria tutorial program) via Microsoft Teams

Teaching Assistant – Grader
Oct 2021

Department of Electrical and Computer Engineering, McGill University Montréal, Québec, Canada

- **Fall 2021 – Introduction to Software Engineering** (126 students): Graded design problems on user and system requirements analysis and specification, use case and activity modelling, domain modelling, relational database design, and object-relational mapping, in an online midterm exam; resulted in zero complaints or regrading requests

Selected Additional Project Experiences

Wall-Pi: a prototype of an automatic box retrieval system for shoe stores using RaspberryPi, BrickPi, and LEGO MINDSTORMS EV3 (Design project, Design Principles and Methods) Feb 2022 – Apr 2022

Collaborators: Michael Grieco, Weiheng Xiao, Venkata Satyanarayana Chivatam, Noshin Chowdhury, Karen Fu

- As the project manager, coordinated tasks, tracked progress using Gantt charts, led meetings, and managed documentations
- Served as a primary designer of the system model
- Fine-tuned part of the software algorithms for navigation, colour detection, and alerts in Python
- Conducted unit and integration testing for software and the integration of hardware and software
- Designed part of the poster and conducted part of the poster presentation and live demonstrations

À l'heure: a decision-tree-based artificial intelligence to predict flight delays (Best AI for Commerce (Stonks), MAIS Hacks 2021, McGill Artificial Intelligence Society) Oct 2021

Links: Web Application | Devpost Presentation | GitHub Repository

Collaborators: Junjian Chen, Xichong Ling, Shichang Zhang

- Developed a frontend in HTML and CSS and a backend with Flask to store the model and process HTTP requests
- Deployed the Flask backend on Heroku and HTML frontend to my personal website
- Conducted the oral presentation and live demonstration

Be My Chef: a solution for La Tablée des Chefs aimed at encouraging teenagers to create and share food recipes, learn about healthy eating, and encourage food sustainability (Morgan Stanley 2021 Code to Give MTL Hackathon) Sep 2021

Link: GitHub Repository

Collaborators: Anthony Zhao, Eric Zhang, Jessica Yang, Frédéric Polletier, Jia Ming Wei

- Elicited requirements and identified features through interviews with stakeholders at La Tablée des Chefs
- Developed recipe display and search-by-available-ingredients features in JavaScript using React
- Compiled texts and graphics for documentations on GitHub and BeMyApp, the Hackathon's platform
- Proposed recommendations for implementation and future work

Exploring Solutions for Spam Filtering (Research paper assignment, Communication in Engineering) Jan 2021 – Apr 2021

- Through a literature survey, analyzed and compared Bloom filter, support vector machine, and convolutional neural network for spam filtering, in terms of complexity, accuracy, and adaptability
- Proposed a solution using convolutional neural network, complemented with a Bloom filter as the initial step

Pocket McGill: a proposal of a one-stop mobile application for McGill students to conveniently access essential services for their academic lives (Business proposal assignment, Communication in Engineering) Mar 2021 – Apr 2021

Collaborators: Justin Legrand, Mohamed Amine El Felsoufi, Ping Gu, Ramin Akhavan-Sarraf, Sébastien Cantin

- At an imaginary startup software engineering company, compiled a business proposal to McGill University in both a written document and a live presentation
- As a senior software engineer of the imaginary company, designed the system architecture and specified management plans

Artizon: a full-stack software system for an imaginary art gallery transforming business online amid the COVID-19 pandemic (Course project, Introduction to Software Engineering) Sep 2020 – Nov 2020

Links: Frontend Website | GitHub Repository

Collaborators: Wen (Amelia) Cui, Linpei (Angelina) Duan, Zheyan Tu, Tianyu Zhao

- Analyzed and specified user and system requirements in structured text and designed part of the requirement models in UML
- Served as a primary designer of the domain model and system architecture model in UML
- Developed part of the backend services and REST APIs in Java, using Gradle and Spring Boot, with a PostgreSQL database
- Developed part of the frontend website using Vue.js and the Android application in Java in Android Studio
- Developed part of the automated unit and integration testing using JUnit
- Deployed backend and web frontend and configured PostgreSQL database on Heroku
- Configured Travis CI for continuous integration
- Collaborated and managed backlog and documentation using Git and GitHub
- Followed the agile project management methodology
- Conducted part of the presentation

Kingdomino: a software with graphical user interface for the game Kingdomino, following model-based, object-oriented, and behaviour-driven development (Course project, Model-Based Programming) Jan 2020 – Apr 2020

Collaborators: Ricky Liu, Matthew Caccavelli, Gregory Walfish, Ezra Gomolin

- Served as a primary designer of the domain model and state machine model in UML
- Developed part of the backend functionalities and the graphical user interface in Java

The Best Hospital: a mathematical model to measure the quality of hospitals, with a memo for people without much mathematical expertise or computing ability to refer to (Finalist of Greater China, International Mathematical Modeling Challenge (IMMC 2018) International Contest) Mar 2018 – Apr 2018

Publication: in journal *Maths, Physics, and Chemistry for Middle School Students* (in Chinese only)

Collaborators: Ruijia Chen, Weijia Huang, Chuxiang Lin, Ziqian Li (Teacher Advisor)

- Contributed to the overall design of the mathematical model
- Developed all computer programs in MATLAB and C++
- Edited part of the solution paper for the contest and subsequent publication
- Invited for a live presentation and oral defence at the regional final of Greater China

Education and Growth: an econometric model to predict China's economic growth in the next 20 years, indicating role of education and suggestions on government policies (Meritorious Winner, International Mathematical Modeling Challenge (IMMC 2018) Regional Contest of Greater China) Feb 2018

Publication: in journal *Mathematics Study and Research* (in Chinese only)

Collaborators: Ruijia Chen, Weijia Huang, Chuxiang Lin, Ziqian Li (Teacher Advisor)

- Contributed to the overall design of the mathematical model
- Developed all the computer programs in MATLAB and C++
- Edited part of the solution paper for the contest and subsequent publication

Organization Affiliations

Student Member, **Association for Computing Machinery (ACM)**

Student Member, **Institute of Electrical and Electronics Engineers (IEEE)**

Lifetime Member, **Golden Key International Honour Society**

Skills

Languages: English (Proficient – C1/C2), French (Basic – A1/A2), Mandarin Chinese (Native), German (Beginner)

Programming, Scripting, and Query Languages: Java, C, Scala, Python, JavaScript, TypeScript, OCaml, C++, Bash, SQL, Cypher Query Language, Pig Latin, ARMv7-Assembly

Professional Software, Tools, and Frameworks:

Integrated Development Environments and Editors: Eclipse, IntelliJ IDEA, Android Studio, Visual Studio Code, Vim

Version Control, Collaboration, and Continuous Integration: Git, GitHub, GitLab, Travis CI

Frameworks: Gradle, Spring Boot, Vue.js, React, Node.js, Express.js, Flask

Database Systems: PostgreSQL, IBM DB2, Neo4j, MongoDB

Numeric Computing: MATLAB, Scilab

Software, Systems, Requirements, Domain, and Behaviour Modelling: Umple, jUCMNav, UML Lab, Yakindu, VIATRA, Eclipse Modelling Framework, Cucumber

Big Data and Cloud Computing: Heroku, Apache Pig, Google Cloud Platform

Miscellaneous: JUnit, Data-Driven Documents (D3), Docker

Operating Systems: macOS, Windows, Linux, Unix

Software Engineering Practice: Object-oriented development, Model-based engineering, Behaviour-driven development, Test-driven development, Agile project management