Zhifei "Soso" Song

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HIGHLIGHTS

- A passionate Canadian software engineer and University of Toronto graduate
- 3.91 average GPA in the last 2 years (3rd & 4th year), including 18 CS courses (3 graduate-level courses)
- Led 4+ tech teams with a collective total of 22+ unique members from NUS, UofT, and OCAD University
- Collaborated closely with 3 professors across 3 different University of Toronto campuses
- 16 months as a backend developer at IBM, earning 2 commendations, 2 appreciation letters, and a return offer
- North America 2021 IBM Intern Challenge (Hackathon) 2nd Place
- Presenter/Speaker at the 2023 CMS Research Symposium, Applied Research in Action 2023, and Level UP 2023

EDUCATION

University of Toronto   November 2023
Honours Bachelor of Science (H.B.Sc.) in Computer Science, with Distinction   *Toronto, ON*
Specialist (Co-operative) Program, Software Engineering Stream

PROJECTS

Zero Knowledge Proof of Location | *LaTeX, Circom, Solidity, JavaScript, TypeScript*   May 2023 - March 2024
- Collaborated with Dr. Thierry Sans to analyze 50+ scholarly papers, refining our understanding of Zero Knowledge Proofs, Proof of Location, and Decentralization concepts.
- Designed a novel proof-of-location scheme utilizing ZK-SNARKs, ensuring practicality, tamper resistance, and privacy preservation. This work has led to a targeted cryptography conference submission, grant applications, and demonstrates potential for industry transformation.
- Received the 2023 UTSC CMS Research Symposium Certificate for a commendable research presentation.

UTAP | *JS, TypeScript, Python, SQL, Docker, React, Node, Express, Cypress, Mocha&Chai, Axios*   August 2023
- Collaborated with Dr. Bogdan Simion on the UTM TA Application System (UTAP), improving user experience, workflow efficiency, and system performance for the TA hiring, midterm (duties) review, and hours allocation processes. This work benefited applicants, faculty, and coordinators.
- Revamped TA scheduling system using CSP and COP solvers, resolving long-standing, intermittent inefficiencies to boost accuracy for the Fall 2023 admissions cycle.
- Executed full-stack development tasks (API integration, bug fixing, feature enhancements) and enhanced testing capabilities by expanding automated mock data generation, implementing midterm review dataset generation, and deploying Cypress for E2E validation.

Pintos | *C, Perl, x86 Assembly, Docker, Pintos, GCC, GDB/GNU, Bochs/QEMU*   August 2023
- Led a 3-member team in a comprehensive enhancement of a multi-threaded OS, significantly improving threading, user program, virtual memory, and file system functionalities. Achieved a 97% score on the project's design and implementation.
- Implemented priority-based scheduling with priority donation to address priority inversion and prevent busy waiting. Enhanced the scheduler with a multilevel feedback queue (MLFQ) algorithm for dynamic priority adjustment and efficient CPU allocation.
- Developed a comprehensive set of system calls (with argument passing) for process control, synchronization, and file operations, enabling user-level application execution. Enhanced security with access controls to protect kernel memory and refined process termination to prevent resource leaks.
- Integrated a shared and dynamic memory allocation and swap management system, enabling page swapping between physical memory and disk. Implemented comprehensive virtual memory features, including demand paging, page fault handling, a page replacement algorithm, and support for memory-mapped files, allowing processes to access file contents directly through memory operations.
- Optimized the file system with extensible files/directories, buffer caching, and synchronization mechanisms. Implemented write-behind and read-ahead techniques, along with an inode-based structure, to improve access times and storage utilization.

illucid | *C#, HLSL, Unity3D, Gravity Sketch, Blender*   April 2023
- Led a team of 9 to develop a 3D puzzle game featuring unique illusion mechanics crafted from components such as camera perspective shifts, mesh deformation, and object slicing. Established a modular codebase, seamlessly integrating UI components, feedback collection instrumentation, 3 player abilities, and 9 distinct levels.

- Led game design and development as a core developer, employing a milestone-driven approach. Collaborated closely with other developers and artists (music, environment, character, VFX) to gather internal feedback and ensure the project stayed aligned with key objectives.
- Conducted playtests with experts from Gameloft, Ubisoft, Snowman Games, and Uken Games.
- Presented the project at prestigious showcases including Level Up Showcase 2023 (Westin Harbour Castle, Toronto) and Applied Research in Action 2023 (Metro Toronto Convention Centre), gaining valuable exposure.
- Conducted independent research to generate internal textures for sliced 3D objects. Developed an asset pipeline that applies 3D texture patches to tetrahedral mesh assets based on user-defined volumetric tensor fields. Employed 3D math, geometry processing, Unity HLSL, and created a method to simulate marching tetrahedra using Unity 3D textures and custom shaders.
- Proven Competition & Team Excellence
  * Earned selection for a multidisciplinary capstone project involving 5 courses across UofT and OCAD University through competitive balloting, following my theoretical knowledge from graphic courses, practical experience with 5 apps published on the Apple App Store since 2017, and proficiency in 3D modeling and VFX.
  * Elevated to lead a 9-member interdisciplinary team from Computer Science, Art, and Music, due to exceptional achievements in two game jams and a top-tier project proposal among over 400 submissions.
  * Selected as one of two leaders to publicly present our top project, showcasing departmental achievements.

B2ST | *React, MongoDB, Docker, Node.js, Express.js, Twilio, scikit-learn, Stripe*   December 2022
| *Jest, Sentry, Sumo Logic, GitHub Actions, Heroku*
- Initiated a B2B SMS marketing automation startup, leveraging machine learning for strategic planning and MVP development, focusing on campaign oversight and sales data analysis.
- Co-led a 6-member, cross-functional international graduate project team within the Department of Computer Science Innovation Lab (DCSIL), collaborating with students from the National University of Singapore and the University of Toronto.
- Developed a dynamic frontend using React, integrating Twilio and Stripe APIs for seamless SMS functionality and payment processing.
- Orchestrated a scalable microservices backend using Docker, Node.js, and Express.js, facilitating seamless communication between services, including a Scikit-Learn-powered sales prediction model and MongoDB. Implemented DevOps practices with GitHub Actions and Sentry for streamlined integration and monitoring.
- Proactively pitched to industry leaders at Shopify, Stripe, and TD Bank, gathering valuable insights that drove strategic project refinements and enhanced overall progression.

Geodesic Paths | *C++, Eigen, libigl*   December 2022
- Successfully implemented the "FlipOut" algorithm (scholarly reference) for a graduate-level geometry processing project, significantly improving geodesic path computation and mesh quality on complex surfaces. Utilized Eigen and libigl's built-in solvers for efficient implementation.
- Designed and implemented a mesh improvement algorithm utilizing edge flips and shell transformations. Achieved measurable enhancements in mesh quality, including improved triangle aspect ratios and dihedral angles, resulting in a more accurate and efficient mesh representation.

NaiveOracle | *Solidity, React, Ethers.js, Netlify, Hardhat, Mocha&Chai, Waffle, OpenZeppelin*   November 2022
- Led a 3-person team in researching and applying insights from Chainlink's white papers to build a decentralized oracle network, advancing understanding of blockchain oracles.
- Architected and deployed on-chain contracts, including a Service Level Agreement with reputation management, order-matching, and aggregation components, ensuring data security, accuracy, and cost-effectiveness.
- Developed NaiveTokens, an ERC20 token model, to facilitate transactions within the network. Created a user-friendly frontend interface and local nodes to monitor, receive, and execute orders from user contracts, demonstrating practical skills in decentralized network operations.

Kickstarter | *Solidity, Hardhat, React, Ethers.js, Metamask, OpenZeppelin/ERC20, Chai, Netlify*   November 2022
- Designed, implemented, and deployed a decentralized fund management application (dApp) on Ethereum using Solidity smart contracts, incorporating ERC20 token issuance and token-based stakeholder voting to enable DAO-based governance.
- Implemented core dApp features (ETH deposits, spending proposal creation/voting, execution of approved spending requests), utilizing Hardhat and Goerli testnet for robust contract functionality, security, and thorough testing.
- Developed a responsive React frontend with Material UI styling, integrated Ethers.js for seamless blockchain interaction, and enabled MetaMask for secure user authentication, emphasizing an intuitive user experience.

- Implemented rigorous security measures and comprehensive testing strategies utilizing OpenZeppelin contracts for secure smart contract development, and Mocha, Chai, and Waffle for extensive unit and integration tests, mitigating potential vulnerabilities and enhancing contract security.

Sosocoin | *Python, JS, Docker, React, Flask*   November 2022
- Engineered a fully functional ledger-based blockchain, incorporating essential Bitcoin concepts such as proof of work, race conditions, validation, transaction pools, and a non-deterministic wallet.
- Architected and deployed an intuitive development environment, featuring a React frontend and APIs, to facilitate monitoring and interaction with blockchain nodes within isolated Docker containers, enabling seamless internal and external communications that efficiently simulate blockchain components.
- Developed comprehensive blockchain testing protocols covering node addition, minting, block creation, synchronization, and adaptive difficulty, ensuring system robustness under various conditions.

scikit-learn Contributions | *Python, Cython, scikit-learn, NumPy, SciPy, pytest, GitHub*   May 2021
- Led a team of 6 members in the scikit-learn community, contributing 2 new features and providing in-depth analysis of 3 potential bugs to guide future development. Utilized Agile methodologies (Jira, Scrum) to enhance algorithm optimization and data handling.
- Played a pivotal role in enhancing scikit-learn's data preprocessing and validation capabilities by implementing an Imputation transformer for matrix completion, enabling handling of NaN values in OrdinalEncoder, and addressing issues with default kwargs in scipy.linalg functions.
- Developed a GroupTimeSeriesSplit class for scikit-learn, enhancing model training and validation with group-aware, time-based cross-validation capabilities.
- Proposed the integration of Fibonacci heaps into scikit-learn's Ball Tree algorithm, potentially leading to significant improvements in nearest neighbor search efficiency.

JScene | *JavaScript, C++, libigl*   August 2020
- Developed a robust, self-contained 3D rendering library, incorporating components such as Camera, Lighting, Materials, Objects, and Triangle Meshes.
- Integrated advanced 3D capabilities within the library, including graphics canvas, optics, illumination, reflectance, radiometry, curves, and ray tracing, without relying on external dependencies.
- Optimized library performance by implementing multi-threaded rendering using Web Workers, mitigating JavaScript's single-threaded limitations.
- Implemented an STL parser to convert 3D objects into the custom triangle soup format, enhancing compatibility.
- Extended functionality by implementing a C++ version using libigl, adding features such as bounding volume hierarchy, mesh handling, shader pipeline, kinematics, and mass-spring systems.

LOQAL | *JS, Node.js, Express.js, MongoDB, Mongoose, bcryptjs, Heroku, Cloudinary, MVC Architecture* August 2020
- Spearheaded the development of LOQAL, a localized Q&A web application built on Node.js, Express, MongoDB, and Cloudinary to facilitate efficient community knowledge sharing. Led a team of 4, employing agile methodologies to deliver continuous improvement based on user feedback and analytics.
- Secured LOQAL with robust data modeling (Mongoose ORM), password hashing (bcryptjs), session management (express-session), and comprehensive user authentication featuring input validation.
- Designed an intuitive, responsive UI/UX, ensuring accessibility across devices. Integrated Cloudinary for seamless image management and connect-multiparty for efficient file handling to enhance user interaction.
- Pioneered key features including question/answer posting, comprehensive content moderation with dedicated user and admin interfaces, personalized feeds, keyword search, and user/tag following. Optimized performance with efficient database indexing for scalability.
- Prepared LOQAL for smooth deployment with detailed documentation, ensuring easy cloud-hosting integration and long-term maintainability.

SportsCred | *Golang, Gin, Neo4j, Docker, Cron, Google Cloud, JWT, React, Agile SCRUM*   August 2020
- Collaborated in the design and development of a sports-focused social media platform (Golang, React, Neo4j) with features including user profiles, interactive posts, trivia games, leaderboards, and predictions. Optimized platform performance and scalability (Google Cloud Compute Engine) through strategic database indexing and query optimization, utilizing Agile SCRUM methodology within a 7-member team.
- Built a robust user management system (profile customization, JWT authentication, Google Cloud Storage integration) with a security focus: endpoint protection, advanced data encryption (rest/transit), MFA, and RBAC to ensure comprehensive data protection.

- Enhanced user engagement with interactive features (likes, comments, hashtags), a dynamic trivia system (Neo4j integration, single/multiplayer modes), and a prediction system featuring an Analytical Credibility Score. Integrated a notification system to drive engagement through alerts about game invites, debate outcomes, and prediction results.

16-bit MIPS CPU | *Assembly, Python, Verilog, Quartus Prime, FPGA, MIPS Architecture, VGA*   April 2019
- Designed and developed a 16-bit MIPS CPU on FPGA, utilizing RISC architecture principles to achieve optimized instruction efficiency. Created a custom Python assembler to streamline assembly-to-binary code conversion.
- Engineered an instruction set (33 operations) covering arithmetic, logic, memory access, and control flow operations, enabling the execution of complex computational tasks, including recursive algorithms such as Bubble Sort and the Fibonacci sequence. Implemented a VGA controller, empowering the CPU with real-time graphical output capabilities.
- Developed debugging tools and a user interface with manual clock control, reset, and real-time monitoring to improve developer workflow.
- Authored comprehensive documentation on CPU architecture, instruction set, and assembler usage. Outlined future enhancements (pipelining, game/text editor development) to guide project evolution.

EXPERIENCE

IBM   May 2021 – August 2022
Software Engineer Intern (Java)   *Toronto, ON*
- Secured second place in the 2021 North America IBM Intern Challenge (Hackathon), developing a Zero Hunger Challenge solution utilizing IBM Cloudant and Watson AI, demonstrating innovative problem-solving skills.
- Enhanced the DevOps Z Systems (IBM Z Development and Test Environment) by designing and implementing automated E2E and API tests with qTest, boosting test coverage by 60% and efficiency through strategic test redesign.
- Contributed to the CI/CD pipeline as a member of the development team for the IBM Wazi Sandbox component within the IBM Z and Cloud Modernization Stack in OpenShift.
- Re-engineered the License Generator's frontend and backend to align with updated licensing requirements, incorporating expanded user options.
- Received two commendations and appreciation letters, leading to a full-time job offer, by demonstrating exceptional adaptability and expertise.

TheClass   Nov 2018 – Jun 2019
Teaching Assistant   *Toronto, ON*
- Led instruction for multiple courses with over 60 UTSC students, maintaining a full course load while employing interactive teaching methods to increase student engagement and comprehension.

HOBBIES

From Concept to App Store | *Python, C#, Swift, Xcode, Unity3D, Unity Ads*   January 2018
- TruthTable2: Developed a paid robust boolean equation parser in Swift, streamlining complex logic evaluations for efficiency.
- MeowDozer: Built a free 'coin-dozer' game in Unity3D (C#), integrated Unity Ads, and achieved 2.9k downloads, demonstrating both development and monetization skills.

3d Modeling, Animation and VFX | *Blender, Gravity Sketch, Procreate*   2017
- Engaged in diverse 3D art disciplines including portrait modeling, pixel-style animation, motion and camera tracking, physics simulation, 3D modeling (Unity & Gravity Sketch in VR), and 3D printing.
- Utilized Blender for advanced techniques including backface culling, custom toon shaders, and rotational constraints.

Othello Agent AI | *Python*   May 2020
- Developed Python-based Othello (Reversi) AI agents using Minimax, Node Ordering Heuristics, Alpha-Beta Pruning, Depth Limiting, and State Caching; achieved near-perfect solutions within a reasonable timeframe and 10x runtime efficiency improvement on a 6x6 board.

RELEVANT COURSEWORK (4.0/4.0 GPA)

- All Calculus Courses
- Database and Web Applications
- Programming on the Web
- Engineering Large Software Systems
- Artificial Intelligence
- Computer Graphics
- Research on P2P
- Computer Organization
- Blockchains and DApps
- Theory of Computation
- Algo Design & Analysis
- Computability and Complexity
- Video Game Design
- UofT UTAP Project
- Innovation Lab
- Business Software
- Geometry Processing
- Computability and Logic

TECHNICAL SKILLS

Languages: C, C++, C#, Cython, Go, Haskell, Java, JavaScript, TypeScript, PHP, Python, R, Ruby, Perl, Rust, Swift, SQL, Solidity, Circom, HLSL, Verilog, Assembly, HTML/CSS, LaTeX, Markdown, Sh, Bash, Zsh

Developer Tools: GitHub, GitLab, GitHub Actions, Jenkins, Ansible, Maven, Ant, Visual Studio, Eclipse, Xcode, VS Code, Android Studio, Selenium, GDB/GNU Debugger, JUnit, qTest, Jira, Docker, Docker Compose, Bochs/QEMU, pgAdmin, Quartus Prime, Postman, Operator SDK, OpenZeppelin, Angular, IBM ZD&T, Figma, Blender, Gravity Sketch, Procreate, Unity3D, Unity Ads.

Tech Stacks: ReactJS, MUI(Material UI), Node.js, Express.js, Flask, Gin, Java Spring Boot, PostgreSQL, MySQL, MongoDB, Mongoose, Neo4j, DB2, IBM Cloudant, Cypress, Chai, Mocha, Jest, pytest, Hardhat, Waffle, Ethers.js, Metamask, scikit-learn, NumPy, SciPy, Watson AI, Google Cloud, AWS, IBM Cloud, Heroku, Netlify, Cloudflare, DigitalOcean, Linode, Kubernetes, OpenShift, Dagger2, Axios, JWT, Sentry, Sumo Logic, Twilio, Stripe, libigl, Eigen, OpenGL, Vulkan, Wazi, Cloud Modernization Stack, Unix, Linux, macOS, Windows, z/OS, Pintos, IBM HTTP Server, Cloudinary, Nginx, LAMP, WordPress.

Development Practices and Standards: Agile, SCRUM, Extreme Programming (XP), Lean Software Development , Feature-Driven Development (FDD), Test-Driven Development (TDD), SAFe, Waterfall model, DevOps, CI/CD, MVC Architecture, Microservices Architecture, PEP 8, ERC Standards (ERC-20, ERC-721).