Uddhav P. Gautam (CS PhD-Candidate@VT)

A Software Veteran with a decade of experience as a Mobile Engineer, Technical Lead & Software Architect
*** I build reliable, modular, scalable, and maintainable softwares using software development best-practices ***

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Personal Statement

With 15+ years of experience in Software Engineering, Mobile Development, Android Tech Lead & Architect, DevOps, and System/Network Administration, I've led as Senior/Lead Developer for multiple start-ups. Significantly, I architected and oversaw TD Ameritrade's transition_hub, facilitating seamless migration for millions to Charles Schwab's platform.

Research Interests

Systems, Extended Berkeley Packet Filter (eBPF), Virtualization, Container Technology, Process sandboxing and isolation, Lightweight computing abstractions, Confidential computing (e.g., Intel SGX, TDX, AMD SEV), System programming in Rust, Software Engineering, Programming Languages, Formal Methods, Automated Code Generation, Software Testing, Runtime Verification, Security & Privacy, Mobile Computing, Cloud Computing, Infrastructure Automation/Orchestration, Machine Learning(ML), Artificial Intelligence(AI), Distributed Architecture, P2P Architecture, Blockchain, Cybersecurity, Big Data, Elastic Stack, Cyber Physical Systems (CFS)

Skills and Core Competencies

1.	Software Architect	Design Specifications, Coding Standards, IT Strategies, Migration Techniques
2.	Leadership	Team Sync. & Code sharing meetings, Content sharing & Presentation, Technical documentation, Technical leadership, Training & Mentoring, Conflict resolution, Strategic initiatives, Technological trends, Project management, Performance monitoring, Research
3.	Virtualization & Containerization	QEMU, Docker, LXC, Kubernetes, Terraform, Unikernel, Library OS
4.	DSL/Scripting	Bash, Powershell, Regex, Groovy
5.	Programming Languages	Kotlin, Java, C/C++, Python, Dart, Java Script
6.	CI/CD & Project Management	Jenkins, Github Actions, AppCenter, Jira, Bitrise, CircleCI, Confluence, Wiki, Nexus & JFrog Artifactory, container orchestration in Kubernetes
7.	Android	App Publishing, Notification, Jetpack Compose, Navigation, MVP, Redux state management using MVI, MVVM, Repository Pattern, WebView Instrumentation, Material Design, Leak Canary, Room DB, Content Providers & Shared Preferences, Proguard, Android App Security best practices, Hilt/Koin/Dagger DI, Static SonarQube Analysis with Lint and Jacoco, Timber, CheckStyle, Docca Kotlin, PMD, Spotbugs, JUnit, Espresso, Appium, Selenium, Cucumber Gherkin BDD, Monkey Stress Testing, App Debugging and Profiling (network, memory, cpu, and app), Layout Optimization, Systrace, Firebase A/B testing, Crash reporting, Network Inspection, Android trust-anchor config.
8.	Cyber Physical Systems (CFS)	SCADA, OT protocols like DNP3, Modbus, and IEC 61850 etc., OT-IT integration, RTU, PLC, Automation Controller
9.	Other	Yaml, Swagger/Postman, Nginx proxy, Porting Groovy scripts into Kotlin, Maven, Gradle, Flutter, React native, REST Api design, AWS/GCP various technologies, Java Instrumentation (e.g., Java Agent), Runtime Verification like JavaMop, Aspect Oriented Programming (AOP) & Monitored Oriented Programming (MOP), Randoop test generator, Create and Publish Maven library, Linux Kernel, Linux Firmware, HAL, Android Open Source Project (AOS), Linux service layers, Linux/Windows/Mac. System administration, Windows Active Directory, Group Policy, SQL, Patch Management, Ansible, HPC, LLVM, TCP/IP, Multithreading, Firewall, Proxy, DNS, DHCP, MS Exchange Server, SharePoint, Embedded Linux, Splunk, Software Vulnerability Research, Reverse Engineering, Wireshark, Burp Suite, Ethical Hacking, Virtualization, GPU Passthrough, Forensics Analysis

Experiences

1. eBPF and Linux Kernel Researcher, Virginia Tech, USA   Sept/2023 -

- Explored eBPF-based tracing and profiling use cases.
- Instrumented the kernel for micro and macro benchmarking.
- Published a paper on eliminating eBPF tracing overhead on untraced processes.
- Used terraform to provision and configure KVM VMs for developer environments.
- Developed modules for various use cases, including propagating user-space code into kernel-space and triggering kernel functions.
- Developed a custom Kfunc to extend eBPF Protocol Buffers (protobuf) serialization/deserialization.
- Implemented an in-kernel firewall that uses protobuf data for enhanced network security and filtering.
- Integrated the user-space pbtools into the kernel to streamline Protocol Buffers processing directly within the kernel environment.

Keywords: eBPF, libOS, Virtualization, Containerization, Terraform, Process Abstraction, Process Instrumentation, Software Instrumentation & Monitoring, Clsact Qdisc, Kfunc.

2. Android Technical Lead, Perficient Inc, USA   Jun/2021 - May/2023

As a Perficient contractor, I served as a Tech Lead for TD Ameritrade, overseeing four projects: TD Ameritrade Main App, TD Ameritrade Authenticator, CMS Repo., and TD Ameritrade Core C++ shared between iOS and Android. I managed bug-fixing for the Charles Schwab Android App. In TDA projects, I transformed designs into code while adhering to guidelines and strategic roadmaps provided by Product owners and Engineering managers. I mentored developers/testers through bi-weekly code-sharing sessions, conducting demos and presentations on upcoming features. I helped them settle down by providing documentation/personal notes to configure their systems. I helped new hires by leading peer-programming sessions highlighting the company's standard SDLC practices like planning, design, feature/product scaffolding, development, testing, deployment, maintenance, app quality and security, CI/CD workflow, and team sync-up meetings. I took care of all bitbucket repositories, did PR code reviews, worked on the issues, and ensured everything worked. I also helped the Sr. Software Manager in decision-making and time estimation of the problems. I provided technical help to Product managers by improving Jira tickets and writing Confluence documentation. I ensured apps get upgraded to support the new Android SDK. I took care of Jenkins Pipelines to produce three different app flavors (retail, debug, EQA) for our two-fold testing (Internal and EQA) and deployed them in MS Appcenter.

- Ported existing Groovy build scripts into Kotlin.
- Used static analysis checks using Checkstyle, PMD, Spotbugs, and Lint.
- Conducted interviews to help the organization hire android developers.
- Configured and used Promon App shielding for application's runtime self-protection.
- Rendered web & embedded content in WebView and ensured the correct UI for both dark and light modes.
- Designed, led, and developed transition_hub to migrate millions of TDA users to Charles Schwab.
- Wrote djinni Interface Definition Language (IDL) files to generate parallel C++, Java, and Objective-C type definitions from a single IDL file, and consumed them from the native side (i.e., Android).

3. US Army (now reserve)   Apr/2019 - Apr/2023

- Achieved 96 percentile in Armed Forces Classification Test (AFCT), served 4-years in US Military, mastering commands, disciplines, methods, and enhancing interpersonal and leadership skills.

4. Sr. Android Application Developer, Viper Design LLC   Mar/2020 - Feb/2021

In Viper Design LLC, we built Shark Robot IOT Vacuum firmware and their Android/iOS apps.

- Configured and used Proguard for apk shrinking, obfuscation, and optimization.
- Used Timber as a feature-rich logging framework, and integrated it with Crashlytics.
- Implemented Koin for Dependency Injection (DI) to facilitate seamless injection of dependencies.
- Integrated Firebase and Localytics for comprehensive crash reporting and real-time app analytics.
- Applied clean architecture principles for refining shark-core libraries and introducing new features.
- Used Coroutines, suspend functions, and Retrofit/Volley for non-blocking, and one-shot network calls.
- Switched GSON to Moshi/KotlinX shift for Protobuf/JSON serialization, prioritizing type-safety, performance, and embracing Kotlin-first approach.
- Developed the Do Not Disturb (DND) feature with the standard Repository pattern, accurately managed app state changes, and conducted comprehensive unit testing to ensure its proper functionality.
- Used Navigation, ConstraintLayouts, BottomSheet, fleeting dialogues, and several custom-built widgets like SwipeRefreshLayout to enable refresh the Stock chart, custom Slider, and date picker dialog etc.

5. GA/RA, UA Little Rock, Little Rock, AR, USA   Aug/2015 - May/2017

During my MS, I fulfilled the role of a TA for Operating Systems and Computer Architecture, simultaneously designing a sophisticated SQL query for the HandShake Single-Sign-On system at UA Little Rock during a summer internship, which the university continues to employ.

6. Android Developer, Pontos Solution, Kathmandu, Nepal   Jun/2012 - Jun/2015

- Completed code of POJO modeling for GeoJSON.

- Used Glide for image/video processing/loading.
- Completed the part of Settings using SharedPreferences.
- Designed very complex, dynamic layouts for the needs of the in-house app.
- Used JUnit, JUnitRunner, Hamcrest, and Espresso in the testing extensively.
- Extensively used Theme Editor, Layout Inspector, DPI Checker, and Proguards.
- Used Android Instant Apps and App Link Assistant to launch specific activities.
- Used Retrofit OkHttp for HTTP requests/responses, and GSON for serialization/deserialization of JSON.
- Used GIT for the version control system, Jira for issues/bugs tracking, and Jenkins for every automation.
- Employed Otto Event Bus to streamline inter-thread communication and foster modularity in software applications.
- Used RecyclerView, ListViews, Adapters, Handler, Looper, and Material Design for the overall development of the app.
- Used Constraint Layout, Coordinated Layout, FrameLayout, ViewPager, Toolbar, and GridLayout for various layouts.

7. Discrete Structure Lecturer, St. Lawrence College, Kathmandu, Nepal   Aug/2014 - Jan/2015
8. System/Network Administrator, iDream Pvt. Ltd   Feb/2008 - Jun/2012

Education
- PhD Computer Science (*GPA: 4.0/4.0*), Virginia Tech, VA, USA   Jan/2024 -
- PhD Computer Science (*GPA: 4.0/4.0*), UA Little Rock, AR, USA (*incomplete*)   Jan/2018 - Dec/2020
- MS Computer Science (*GPA: 3.58/4.0*), UA Little Rock, AR, USA   Aug/2015 - May/2017
- BS Computer Science (*GPA: 3.91/4.0*), Tribhuvan University, Nepal   Jan/2009 - Mar/2013

Awards
- 1st place Complete Societal Award, UA Little Rock
- 1st place Societal Impact Award, UA Little Rock
- 2nd place Personal Achievement Award, UA Little Rock
- 1st place Best Graduate Project Award, UA Little Rock
- 2nd place TechLaunch Entrepreneurial Team Projects Competition Award, UA Little Rock
- Top-5 final year project award from Nepal Telecom Authority (NTA), Tribhuvan University

Projects
1. HELOT - Hunting for Evil Life in Operational Technology

- A project I led at UA Little Rock, which represents a software architecture and prototype dedicated to enabling the continuous capture of Operational Technology (OT) events within the Information Technology (IT) domain. HELOT core is the Google Rapid Response (GRR), which can create a variety of platform-agnostic client binaries, each customized for collecting and streaming IT forensics data and events in real-time to the GRR server infrastructure. Our initial task was to extend the GRR client codebase so that clients could establish SSH connections with Schweitzer Engineering Laboratories Real-Time Automation Controller (SEL RTAC) and retrieve the required OT data. Through the Filebeat, we streamlined the OT data into the Logstash -- an input pipeline for Elasticsearch renowned for its dynamic data transformation capabilities. Elasticsearch handled the backend data processing, while Kibana generated comprehensive visualizations and informative reports, which we used in our paper. Furthermore, we developed an Android GRR client since the GRR, by default, did not include one for Android, providing site reliability engineers with the capability to receive OT notifications and perform a hard system shutdown in case intrusion occurs. The project evolved into a cyber-physical security research platform, enabling real-time IT-side OT data analysis akin to SCADA, with the potential for extensive research applications.

2. Realtime Earthquakes Notifications

- An Android app for real-time earthquake notification -- developed as part of my final MS project. I constructed the app using Serverless Technology and integrated APIs such as Firebase Realtime Database, Google Firebase Analytics, Google Distance Matrix, Geofencing, and United States Geological Survey (USGS). I developed a novel and pivotal algorithm for the selection of servers from among active Android clients, making it a crucial and innovative component of the project. The effort resulted in a stable Android app that provides earthquake notifications milliseconds after they occur.

Certifications

CI/CD DevOps, React Native, Software Architecture, Scrum Master, Decision Making, Delegating Tasks, Deep Learning by NVIDIA, Java/Kotlin Design Patterns, various Microsoft Certifications etc.

Publications

[1] S. Akailvi, U. Gautam et al. "HELOT–Hunting Evil Life in Operational Technology," in *IEEE Transactions on Smart Grid*, vol. 14, no. 4, pp. 3058-3071, July 2023, doi: 10.1109/TSG.2022.3222261.

[2] M. Craun, K. Hussain, U. Gautam, Z. Ji, T. Rao, and D. Williams, "Eliminating eBPF Tracing Overhead on Untraced Processes," *Proceedings of the ACM SIGCOMM 2024 Workshop on EBPF and Kernel Extensions*, Sydney, NSW, Australia, 2024, pp. 16–22, ISBN 9798400707124, Association for Computing Machinery, New York, NY, USA. [Online]. Available: https://doi.org/10.1145/3672197.3673431, doi: 10.1145/3672197.3673431.