Kinan Dak Albab

http://cs-people.bu.edu/babman/

About

babman@bu.edu
github.com/KinanBab
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Languages

Fluent in English and Arabic. Basic French.

Research Interests

Formal Verification, Cybersecurity, Computer Systems.

Education

2016 – **PhD Computer Science** — Boston University

GPA: 3.9/4[1].

Research Fellow (Fall 2016). Teaching Fellow: Theory of Computation (Spring 2017). Software Engineering and Research Fellow at SAIL (Summer 2017-Summer 2018). Hariri Graduate Student Fellow (Fall 2017-).

Graduate-Level Coursework:

Complexity Theory, Programming Languages, Secure Multiparty Computation at Scale, Formal Reasoning about Programs (MIT), Formal Methods, Fundamentals of Cryptography, Probability in Computing, Cryptography 2, Operating Systems, Distributed Systems, Data Privacy In Machine Learning.

2015 – 2016 **MS of Computer Science (Transferred)** — American University of Beirut

GPA: 3.83/4[2].

Teaching Assistant: Operating Systems (Fall 2015), Discrete Structures (Spring 2016).

Graduate-Level Coursework:

Advanced Topics in Algorithms. Distributed Systems. Advanced Design and Analysis of Algorithms. Discrete Models for Differential Equations.

2012 – 2015 **BS in Computer Science** — American University of Beirut

Cummulative 3.58/4, Major 4/4[2]. Minor in Maths.

Notable Coursework:

Programming Languages, Operating Systems, Numerical Computing, Artificial Intelligence, Parallel Computing, Advanced Software Engineering[3], Special Topics: Theoretical Foundations of Computer Science[3].

Research Experience

11/18 – **Cloud Analytics Platform for Non-Contact Sensors** — Computer Systems

I am a visiting student at the Networks @ MIT research group working with Professor Dina Katabi on the Emerald project. A see-through-walls RF signal non-contact sensor developed by the research group, attached to a large scale cloud platform that enables complex Machine Learning analytics to run on the data collected by such sensors. Devices containing these sensors are installed at homes to collect and stream data about residents to the cloud where the analytics are run. Emerald is being used for medical application (e.g. studying sleep patterns, detecting when an aging person falls), and is the basis of a start-up with the same name. I am working on designing and implementing the back-end computer systems running on the device and the cloud, focusing on issues around stream processing, scalability, and security. https://www.emeraldinno.com/

[1] https://www.bu.edu/reg/academics/grades-gpa/
[2] Conversion of GPA: https://www.aub.edu.lb/registrar/Pages/academic-information.aspx
[3] Graduate level courses

6/17 – **Modern MPC Framework (JIFF)** Secure Multiparty Computation

I worked on the design and implementation of a modern Secure Multiparty Computation (MPC) framework named JIFF. The framework is written in Javascript, it allows developers to integrate MPC functionality into large modern web and mobile applications. The framework offers standard MPC features and primitives. In addition, the framework allows for dynamic computation where users join and leave the computation on the fly, asynchronous computation where parties may not be available online at the same time, as well as asymmetrical computation, where developers can explicitly encode the various asymmetries in capabilities and roles between the different parties, to speed up the computation and get better security guarantees. The framework is open-source and available at: https://github.com/multiparty/jiff

8/17 – 11/18 **Privacy Preserving Route Recommendation** Secure Multiparty Computation

I built a privacy preserving route recommendation system as part of a research effort supported by the Honda Research Institute (HRI), in collaboration with others in the MPC research group in the Hariri Institute for Computing. This involved designing an efficient MPC protocol for route recommendation that hides the source and destination (the user's query) from the service. The protocol relies on an efficient pre-processing step, and allows the route recommendation logic to be plugged in as a black box, to support complex and closed source routing algorithms (e.g. including traffic data). The pre-processing stage is executed once between the components of the service, and can be used for an unlimited number of queries and users. Our pre-processing and query times are practical and can be utilized in practice. In addition, the protocol and service architecture support scaling horizontally to ensure the service can handle a large number of simultaneous queries, and replication to ensure service reliability. The service is implemented using our in-house MPC framework JIFF.

10/16 – 5/17 **Fast Network Distance in MPC** Secure Multiparty Computation

I am currently working on performing iterative graph algorithms efficiently in Secure Multiparty Computation (MPC). Where multiple parties can collaborate to perform aggregates and analysis on their private networks without revealing them. This is a joint work with another PhD student (Rawane Issa), as well as the MPC group at the Hariri Institute for Computing (Prof. Bestavros and Dr. Lapets). We have developed a technique for partitioning the graph and only performing MPC on a small part of the graph. We use symbolic execution to unroll loops into expressions (parse-trees), optimize and simplify them, then evaluate them using MPC. We exploit algebraic properties of operators in the code to reduce the number of expensive operations.

1/15 – 1/17 **Eshmun**[4] Formal Verification

An algorithm and tool for *subtractive model repair* through SAT solving, the algorithm was implemented in a Swing-based GUI tool. The algorithm reduced the problem of subtractive model repair (which we show to be NP-Complete) to SAT, then used a SAT solver to attain a satisfying assignment which determines the states/transitions to be deleted in the model. The algorithm was extended to abstraction for reducing the size of the model, as well as concurrent model repair to avoid state explosion. For more info visit http://eshmuntool.blogspot.com/. An initial paper discussing the initial work was published in *MEMOCODE15*. A more in depth paper with detailed proofs and bigger examples was published in *ACM Transactions on Embedded Computing Systems*.

[4] Under supervision of Dr. Paul Attie, Associate Professor, AUB; pa07@aub.edu.lb

9/14 – 1/15 **Pairwise Refactoring**[4] Formal Verification

A refinement of a design pattern that models concurrent programs as I/O Automata, I designed an algorithm for refactoring models to comply with the pairwise design pattern. I wrote a correctness proof through constructing a weak forward simulation relation from the resulting model to the original.

1/14 – 9/14 **MoDroid**[5] Programming Languages and Software Engineering

A Framework for efficient Design, implementation, and testing of Android Applications. MoDroid contains many important features such as automatic permissions detection, a Unit-testing framework, and a model-composition utility. Development of MoDroid required Development of a java parser, syntax translator, symbol tables and type detection mechanisms. The research leading to these results has received funding from University Research Board (URB) at AUB, in collaboration with UJF-Grenoble University. A paper detailing the architecture and implementation was published in the *International Journal on Software Tools for Technology Transfer* (STTT). https://ujf-aub.bitbucket.io/modroid/

Work Experience

6/17 – **Software Engineering Fellow at Software Application & Innovation Lab (SAIL) at Boston University** Internship/Fellowship

I worked on multiple research and development project including: (1) Implementing and Designing a modern MPC framework in Javascript (2) Designing an algorithm for a privacy preserving route recommendation service (3) A privacy preserving mobile application that helps people suffering from substance abuse in their rehabilitation process (4) Full stack development work on an MPC application for aggregating and analyzing salary data to analyze pay equity in the Greater Boston Area (Deployed in September 2017 for the City of Boston's 100% Talent initiative, and in February 2018 for the Boston Chamber of Commerce's Pacesetters initiative). I led the development effort on several MPC projects, and presented several workshops about the projects and the technologies used. I managed several undergraduate inters in collaboration with other full time team members.

8/15 – 8/16 **Full-Stack Senior Software Engineer at Interactivelife Beirut**[6] Full-time Job

Interactivelife is a start-up based in Mercer Island, Washington. The start-up provides applications for real-time event-based engagement and content-delivery to users. The start-up provides apps for many businesses including Churches, Hospitals and Clinics, Conferences/Events, Education, and Live-streaming. I worked on designing a general-purpose web and mobile architecture: 1-) A mobile-side SDK that implements common features. 2-) Mobile apps that provide specializations and extensions to the SDK. 3-)A web-CMS where clients can manage their applications content, appearances, and settings. 4-)A scalable back-end which is responsible for content delivery to the mobile apps, in addition to various common features like user-authentication, statistics, and data triggers based on the end-user's data, location, or behavior in the apps. The company's main projects were in partnership with TV stations and And Ads agencies to create interactive TV applications that combine live-streams, chat, and other interactive features with TV-based programs to achieve high levels of engagement with the viewers.

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[4] Under supervision of Dr. Paul Attie, Associate Professor, AUB; pa07@aub.edu.lb

[5] Under supervision of Dr. Mohamad Jaber, Assistant Professor, AUB; mj54@aub.edu.lb

[6] Reference: Joe Harb, CEO; joe@interactivelife.com

1/15 – 8/15 **Freelance Web Developer** Freelancer

Developed a number of web applications with responsive design, including developing a web-scraper for Booking.com using scrapy, Dealing with payment gateways (Stripe), Integration of C# .NET DLL files in Python web-application, Emulating Excel sheets with VB.NET, and building a java desktop client (for takers of certain personality tests) that communicates with a server through encrypted messages.

7/14 – 9/14 **Fetch Media Intelligence**[7] Summer Job

Web Developer. Worked on developing a Web application for gathering and analyzing reviews and responds on social media and review sites to certain services or products, dealt with GUI-interfaces and reports generation for services/products providers/owners, social media APIs, and Queuing Systems (Celery & Redis).

Teaching Experience

6/17 – 8/17 **Computer Science Instructor - Boston University Summer Challenge**
6/18 – 8/18

Summer Challenge is a BU program for rising high school students (15-18 years old), that allows them to experience university life and take on interesting academic challenges. I instructed all three sessions for Computer Science during the 2017 program. Each session was an intensive 2-weeks introductory course to Computer Programming and the various fields in Computer Science. I designed the lectures to include a conceptual portion focused on giving students a taste of the various areas in Computer Science (e.g. algorithm design and analysis, programming languages, cryptography, machine learning, systems), as well as a hands-on lab portion where students solved programming exercises in Javascript. In addition to design the course and its materials, my responsibilities included guiding the students as they worked on a programming project of their choosing, and present it at the end of the session, and evaluating their performance. The course website can be found at http://cs-people.bu.edu/babman/teaching/summer17/

Skills

- *Languages:* Java, Python, Javascript, nodejs, C, Golang, MATLAB, Bash, Coq.
- *Operating Systems:* Linux (Ubuntu, Fedora), Windows.
- *Databases:* MySQL, Postgres, SQLALCHEMY (ORM), MongoDB. Familiar with Neo4j.
- *Parallel & Distributed Frameworks:* BSP, MPI, CILK, Amazon AWS. Limited experience in AUB's HPC, Hadoop.
- *Markup Language:* LaTeX, HTML5, CSS.
- *Tools:* Git, Eclipse, IntelliJ/WebStorm, Gradle, Android Studio, Jasmin, BCEL.
- *Frameworks:* Javax Swing, Flask, JQuery, ANTLR, Processing and Processing.js. Express.
- *Mobile Development:* Android Development.

[7] Reference: Michael Chaftari, Founder; michael@fetch.im

Projects

2015 **2D Piping Drawing White Space Management** Industry

I created a customized algorithm (based on a force-directed graph drawing algorithm) to automatically format/draw autocad sheets, in order to minimize the overlap of annotations and line segments that point annotations to their components. This project is part of a collaboration[8] effort between CCT international and the AUB Computer Science department.

2015 **Byte code manipulation with BCEL and Jasmin** Course-based Project

The project used an ANTLR parser to parse a restricted version of Java Syntax, then used Jasmin to generate java class files. It also used BCEL to perform primitive analysis of the byte code and modify it to avoid simple bugs (for example, avoid division by zero by checking the denominator, checking if objects are null before using them). I was inspired to do this project after I have dealt with Google's Gson library (reflection based library for parsing json for android), this project was a small exercise for me to understand the JVM and the Java byte code better.

Awards

- Hariri Institute for Computing Gradute Student Fellow (BU 2017).
- Mark Sawaya Excellence Award, Best Graduating Student in CS (AUB 2015).
- AUB Dean's Honor List: Fall 2013, Spring 2014.
- 1st Place: ACM Lebanese Collegiate Programming Contest (Team Khawarizmi, 2015).
- 1st Place: AUB Supernacci Math Programming Competition (Team 0xdeadbeef, 2015).

Publications reverse chronological order

- Lapets, Andrei; Jansen, Frederick; Dak Albab, Kinan; Issa, Rawane; Qin, Lucy; Varia, Mayank; Bestavros, Azer. *Accessible Privacy-Preserving Web-Based Data Analysis for Assessing and Addressing Economic Inequalities*. *Proceedings of the 1st ACM SIGCAS Conference on Computing and Sustainable Societies*. San Jose, CA, USA, 2018. Article 48.
- Jansen, Frederick; Dak Albab, Kinan; Lapets Andrei; Varia, Mayank. *Brief Announcement: Federated Code Auditing and Delivery for MPC*. *Stabilization, Safety, and Security of Distributed Systems*. SSS 2017. Lecture Notes in Computer Science, vol 10616. Springer, Cham.
- Dak Albab, Kinan; Issa, Rawane; Lapets, Andrei; Bestavros, Azer; Volgushev, Nikolaj. *Scalable Secure Multi-Party Network Vulnerability Analysis via Symbolic Optimization*. In Proceedings of *Security and Privacy Workshops (SPW), 2017 IEEE*. San Jose, CA, USA, 2017. Pages 211-216.
- Attie, Paul; Dak Al Bab, Kinan; Sakr, Mohamad. *Model and Program Repair via SAT Solving*. *ACM TECS: Transactions on Embedded Computing Systems*. Volume 17, Issue 2, December 2017.
- Abou-Jaoudeh, John; Dak-Al-Bab, Kinan; El-Katerji, Mostafa; Falcone, Yliès; Jaber, Mohamad. *A High-Level Modeling Language for the Efficient Design, Implementation, and Testing of Android Applications*. *STTT: International Journal on Software Tools for Technology Transfer*. Volume 20, Issue 1, PP 1-18. November 2016.

[8] CCT & AUB Collaboration: http://www.cctintl.com/news/cct-and-aub-sign-mou-and-collaboration-agreement

- Attie, Paul; Cherri, Ali; Dak Al Bab, Kinan; Sakr, Mohamad; Saklawi, Jad, *Model and program repair via SAT solving*. *Proceedings of MEMODCODE 2015: The ACM/IEEE International Conference on Formal Methods and Models for Codesign*. Austin, Texas, USA. September 2015.