Nabeel Akhtar

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Summary of Qualifications

- **Specialization**: Network Optimization, Network Anomaly Detection, Distributed Systems, Optimization Models, Network Virtualization, Cloud Resource Management, SDN, Network Function Virtualization (NFV), Edge Computing, Machine Learning
- **Programming**: Python, Java, C/C++, Matlab, SQL
- **Big Data**: Hadoop, SPARK, Pig, SPARQL
- **Optimization**: CPLEX, LP, ILP, MIP, PuLP python, docplex, MATLAB optimizer
- **Others**: Control Theory, AWS, OpenStack, OpenWhisk, GENI, ChameleonCloud

Education

- **Ph.D. Computer Science** — Expected August 2019
  Boston University — *Boston, MA*
- **M.S. Computer Science** — August 2013
  Koç University — *Istanbul, Turkey*
- **B.Sc. Computer Science** — July 2011
  Lahore University of Management Sciences (LUMS) — *Lahore, Pakistan*

Relevant Experience

- **Akamai Technologies** — Cambridge, MA, USA
  Two Research Internships | Mentor: Karim Mattar — *Summer 2015 & Summer 2016*
  - **Anomaly Detection System**: Worked with the *Akamai Media Performance* team to design and develop a distributed system to detect problems (anomalies) in Akamai's media delivery. The system is designed to run on a SPARK cluster. System ingests Akamai/customer logs in CSV format. User inputs "badness" definition for sessions, *e.g.* video session with re-buffering is defined as "bad". The system initially runs ***Feature Selection*** for dimensionality reduction. The ***Anomaly Detection*** finds the irregularities for the selected features. The ***Change Detection*** module detects feature values that trigger change in performance. The system has a web interface, standalone API, SPARK cluster API, and Interactive Mode
- **CREATE-NET** — Trento, Italy
  Visiting Research Scientist — *Jan. 2016 - May 2016*
  - **Virtual Network Function management and deployment for 5G network**: The management of a multi-technology intelligent transport network, with compute and network resources, for future 5G technology. I developed algorithms, which use optimization theory to place network, storage and compute resources on the edge of the network. Problem is formulated using mixed-integer programming (MIP) and solved using CPLEX solver. Proposed heuristic provides close to optimal results at order of magnitude faster time.
- **Boston University** — Boston, MA, USA
  Research Assistant | Advisor: Ibrahim Matta — *Aug. 2013 - Present*
  - **Placement and Traffic steering of Application Functions over a Virtualized Cloud Infrastructure**: We show that dividing an application into multiple smaller modules (virtual functions) and running them over the edge network can decrease latency and increase throughput. The joint optimal placement of application virtual function modules and the steering of traffic through them, over a multi-technology edge network, consisting of both wired and wireless, is an NP-hard problem. We provide a mathematical formulation using mixed-integer programming (MIP) and propose a faster heuristic solution to solve this problem.
  - **Adaptive configuration finder for Serverless Functions using statistical learning**: To run a job as a serverless function, the user requests the function's configuration from the cloud provider. These configurations include memory, location, edge vs core, etc. Requesting the "best" configuration from the cloud providers, which minimizes the price paid and fulfills the QoS requirements for a function, is a hard problem to solve. The user has little information about the underlying hardware, co-location of functions, edge vs core execution, etc. Moreover, predicting the exact amount of resources needed by user function is hard. In this work, we use Bayesian Optimization (a statistical learning technique) to intelligently sample different configuration parameters for a serverless function. Within as few as 15 samples, we predict the optimal/near-optimal configuration in 75%-90% of the time.
  - **EL-SEC: ELastic Management of SECurity Applications on a Virtualized Infrastructure**: Designed and implemented the EL-SEC architecture that enables the elastic management of a virtual network/application function (VF) over SDNs. It involves a distributed monitoring application to measure the state of VF (e.g., Snort intrusion detection system) instances, an attack analyzer and a load balancer on the controller node to analyze traffic/access patterns/intrusion alerts, and to dynamically increase/decrease the number of VF instances in response to load conditions and QoS requirements. The controller node also involves a process that communicates using the OpenFlow protocol with underlying switches to install traffic forward rules to steer traffic toward one of the VF instances and to block attack traffic.

- **EcoForecast: Serverless Cyberinfrastructure for Ecological Research**: My team and I designed and implemented EcoForecast, a serverless system for supporting ecological research. We deployed the Apache OpenWhisk serverless framework on GENI Edge nodes and Chameleon Cloud Core nodes. To run Ecological models, users submit code, along with dependencies, via the web interface. The Orchestrator installs user dependencies and finds the "best" place to run the user code either on an Edge node or Core node. The code runs as a "Serverless" function in a containerized environment in the cloud. The output of the function is sent to the user, where the user can plot and compare it using the web interface, or download it for further analysis.

- **Koç University** — Istanbul, Turkey
  Research Assistant | Advisors: Sinem Ergen & Oznur Ozkasap — *Sep. 2011 - Aug. 2013*
  - **Analysis of realistic Channel Models for VANETs**: This project deals with analyzing different channel models and proposing a realistic model for the vehicular ad-hoc network (VANET).
  - **Realistic Mobility Modeling for VANETs**: In this project, we integrate real-world road topology and real-time data extracted from the Freeway Performance Measurement System (PeMS) database into a microscopic mobility model in order to generate realistic traffic flows along the highway.
  - **Distributed Algorithms for density estimation in VANETs**: The project deals with proposing fully distributed and infrastructure-free mechanisms for the density estimation in vehicular ad-hoc networks. This study is inspired by the mechanisms proposed for system size estimation in peer-to-peer networks.

Selected Publications [Google Scholar]

- **N. Akhtar**, I. Matta, A. Raza, L. Goratti, T. Braun and F. Esposito, "Virtual Function Placement and Traffic Steering over 5G Multi-Technology Networks". *IEEE Conference on Network Softwarization (NetSoft), 2018, Montreal, Canada., June 2018* (pdf)
- **N. Akhtar**, I. Matta, A. Raza and Y. Wang, "EL-SEC: ELastic Management of SECurity Applications on Virtualized Infrastructure". *IEEE INFOCOM International Workshop on Computer and Networking Experimental Research Using Testbeds (CNERT), 2018, Honolulu, Hawaii, USA, April 2018.* (pdf)
- Z. Zhao, E. Schiller, E. Kalogeiton, T. Braun, S. Burkhard, M. Garip, J. Joy, M. Gerla, **N. Akhtar**, I. Matta. "Autonomic Communications in Software-Driven Networks". *IEEE Journal on Selected Areas in Communications (JSAC), 2017.* (pdf)
- **N. Akhtar**, I. Matta, Y. Wang, "Managing NFV using SDN and Control Theory". *IEEE/IFIP International Workshop on Management of the Future Internet (ManFI 2016), co-located with NOMS 2016, Istanbul, Turkey, April 2016.* (pdf)
- Y. Wang, I. Matta, **N. Akhtar**, "Application-Driven Network Management with ProtoRINA". *IEEE/IFIP Network Operations and Management Symposium (NOMS 2016), Istanbul, Turkey, April 2016.* (pdf)
- **N. Akhtar**, S. Coleri Ergen, and O. Ozkasap, "Vehicle Mobility and Communication Channel Models for Realistic and Efficient Highway VANET Simulation," *IEEE Transactions on Vehicular Technology (TVT), vol.64, no.1, pp.248-262, January 2015* (pdf)
- Y. Wang, **N. Akhtar**, I Matta, "Programming Routing Policies for Video Traffic," *International Workshop on Computer and Networking Experimental Research using Testbeds (CNERT), co-located with ICNP, Raleigh, NC. Oct. 2014.* (pdf)
- Y. Wang, I. Matta, **N. Akhtar**, "Experimenting with Routing Policies using ProtoRINA over GENI," *GENI Research and Educational Experiment Workshop (GREE2014), Atlanta, Georgia. March, 2014* (pdf)
- **N. Akhtar**, O. Ozkasap, & S. Coleri Ergen, "VANET Topology Characteristics under Realistic Mobility and Channel Models," *IEEE Wireless Communication and Networking Conference (WCNC 2013)*, Shanghai, China, April 2013 (pdf)
- **N. Akhtar**, S. Coleri Ergen, & O. Ozkasap, "Analysis of Distributed Algorithms for Density Estimation in VANETs," *IEEE Vehicular Networking Conference (VNC 2012)*, Seoul, Korea, Nov. 2012 (pdf)

Technical Reports

- **N. Akhtar**, I. Matta, Y. Wang, "Managing NFV using SDN and Control Theory," *Technical Report BUCS-TR-2015-013, Boston University, 2015* (pdf)
- Y. Wang, I Matta, **N. Akhtar**, "Application-Driven Network Management with ProtoRINA," *Technical Report BUCS-TR-2015-003, Boston University, 2015* (pdf)
- Y. Wang, **N. Akhtar**, I Matta, "Programming Routing Policies for Video Traffic," *Technical Report BUCS-TR-2015-005, Boston University, 2014* (pdf)

Teaching Experience

Teaching Fellow
Department of Computer Science, Boston University

CS101 Introduction to Computing	Fall 2013
CS105 Introduction to Databases and Data Mining	Fall 2015
CS655 Computer Networks	Fall 2016
CS210 Computer Systems	Spring 2018

Department of Computer Engineering, Koç University

ENG 200 Probability	Spring 2013
COMP 416 Computer Networks	Fall 2012

COMP 202 Data Structures and Algorithm Spring 2012
COMP 132 Advanced Programming Fall 2011

Department of Computer Science, LUMS

CS 212 Computational Problem Solving Spring 2011
CS 371/ CMPE 371 Computer Networks Fall 2010

Services

Reviewer:

IEEE Networking Letters, 2019
IEEE NetSoft, 2019
IEEE ITS, 2018
IEEE INFOCOM, 2017
ITC 29 Soft5 Workshop, 2017
IEEE NFV-SDN 2018
IEEE ITST, 2012
IEEE GCC, 2019
IEEE CNERT, 2019
IEEE CNERT, 2018
Elsevier FGCS, 2017
IEEE ITST, 2017
IEEE Communications Letters, 2016
IEEE ICVES, 2012
IEEE NetSoft (Demo), 2019
IFIP WWIC, 2018
IEEE NFV-SDN 2018
IEEE Communications Letters, 2017
IEEE TMC, 2017
IEEE ICNP, 2014

Others:

- Technical Program Committee (TPC) member for IEEE NetSoft, 2019
- Technical Program Committee (TPC) member for IEEE IEEE MENACOMM, 2019
- Publicity Chair for IEEE CNERT, 2019
- Chaired *Design, Management and Orchestration of Edge Computing and Tactile Internet* session at *Smart network Technologies and Edge computing for the Tactile Internet (STET 2018)*, Montreal, Canada.
- CS Department Student Representative
- Organizer for Network Reading Group (NRG) in CS@BU
- Organizer for GENI Regional Workshop and Camp, Texas A&M University, TX

Awards

First Place Award for **EL-SEC** project at IEEE INFOCOM 2018, Hawaii March 2018
Best Project Award at International Conference on Machine Vision (ICMV 2010) 2010
Ph.D. Fellowship at Boston University 2013-present
M.Sc. Vehbi Koç Fellowship 2011-2013
B.Sc. merit scholarship at LUMS University 2008-2013
Top 50 in National Science Talent Contest (NSTC) for International Physics Olympiad (IPhO) 2007

Relevant Coursework

Computer Networks
Advanced Algorithms
Distributed Comp. Systems
Advanced Networks
Operating Systems
Parallel Programming
Network Security
Wireless Networks

References

Karim Mattar, Manager during internships at Akamai. Currently working at Uber. kmattar@uber.com
Prof. Ibrahim Matta, Ph.D. Thesis Advisor, CS Department chair, Boston University. matta@bu.edu
Vatche Ishakian, Assistant Professor, Computer Information Systems, Bentley University. vishakian@bentley.edu
Prof. Oznur Ozkasap, M.S. Thesis Advisor, Koç University. oozkasap@ku.edu.tr
Prof. Sinem Ergen , M.S. Thesis Advisor, Koç University. sergen@ku.edu.tr