Dr. Matthias Rost

Software Engineer · Optimization Expert · Researcher

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Qualifications Summary

My passion is optimization. Being an avid software engineer and an award-winning researcher with a deep mathematical background, my main expertise lies in solving challenging real-world optimization problems.

- 10+ years of cloud optimization research experience with 20+ peer-reviewed publications
- 15+ years of software development experience (Golang, Python, Java, C/C++, SQL)
- Proven track record as algorithm engineer in 15+ projects (heuristics, approximations, exact algorithms)
- Mathematical optimization expert for (integer) linear programming and its applications (Gurobi, SCIP, CPLEX)
- Hands-on data science experience with exposure to Machine Learning (Pandas, Numpy, scikit-learn)

Professional Experience

Staff / Principal Software Engineer   Observe, Inc.   *09/2021 - present*

- Built integrated discrete-event simulator for task scheduling to analyze new scheduling algorithms. Implemented new scheduling algorithms to drastically reduce costs (up to 50%) and tail queueing latency (up to 100x).
- Architected and implemented a new cost-control feature end-to-end to bound customers' spend on background transformation costs. This feature includes usage predictions, a custom control logic and graph algorithms.
- Lead of resource optimization team to improve customers' experience and reduce costs for customers and us.

Senior Cloud Optimization Developer   Global Cloud Services, SAP SE   *01/2020 - 08/2021*

- As founding member of the Innovation Office I researched scalable cloud optimization algorithms to reduce TCO.
- Within 9 months, I developed an end-to-end prototype comprising data gathering and cleaning, optimization, and result analysis. Given my results, SAP's board accepted our business case and staffed the team with 30 FTEs.

Postdoctoral Researcher   Technische Universität Berlin (FG IMA)   *04/2019 - 01/2020*

Supervised student working on online strategies for wide-area analytics by replicating data to minimize traffic.

Optimization Consultant   Cyclever GmbH   *03/2018 - 06/2018*

Implemented optimization models for business validation of piggy-backing and exchanging parcels on the fly.

Research and Teaching Assistant   Technische Universität Berlin (FG INET)   *01/2014 - 03/2019*

- Successful completion of 10+ research projects with 20+ publications on various cloud resource allocation problems like virtual network embeddings, scheduling network updates, and middlebox placement.
- Solved decade-long research challenge by developing first approximations for embedding virtual networks.
- Awarded €100k Software Campus grant by the German Federal Ministry of Education and Research and led a team of 3-5 student workers to develop a large *algorithmic framework*🐙 for novel approximation algorithms.

Student Research Assistant   Technische Universität Berlin (FG INET)   *11/2011 - 12/2013*

Design and analysis of algorithms for multicast and aggregation trees and scheduling of network embeddings.

Student Tutor / Teaching Assignments   Freie Universität Berlin   *04/2009 - 09/2010*

Computer Architecture ('09, '10, '11), OSes and Computer Networks ('09), and Non-sequential Programming ('10).

Student Software Developer   IVU Traffic Technologies AG, Berlin   *08/2007 - 02/2009*

Implemented features for IVU.fleet.data using C/C++ and PL/SQL for the management of core data.

Education

Ph.D. in Computer Science (Dr. rer. nat.)	TECHNISCHE UNIVERSITÄT BERLIN	*01/2014 - 03/2019*

Thesis: Virtual Network Embeddings: Theoretical Foundations and Provably Good Algorithms ↗
Committee: Rolf Niedermeier · Thomas Zinner · Stefan Schmid · Anja Feldmann · Harald Räcke
Defense: March 25, 2019
Grade: SUMMA CUM LAUDE (WITH DISTINCTION)

Master of Science in Computer Science	TECHNISCHE UNIVERSITÄT BERLIN	*04/2011 - 01/2014*

Thesis: Optimal Virtualized In-Network Processing with Applications to Aggregation and Multicast ↗
Advisors: Anja Feldmann · Andreas Bley · Stefan Schmid
Final mark: 1.3 (VERY GOOD)

Study of Mathematics (undergraduate level)	FREIE UNIVERSITÄT BERLIN	*10/2010 - 09/2013*
Study of Computer Science (graduate level)	FREIE UNIVERSITÄT BERLIN	*10/2009 - 09/2010*
Bachelor of Science in Computer Science	FREIE UNIVERSITÄT BERLIN	*10/2006 - 09/2009*

Thesis: Modeling and Solving Evacuation Problems using Network Flows (translated)
Advisors: Günther Rote · Martin Skutella
Final mark: 1.2 (VERY GOOD)

Awards and Grants

Best PhD Thesis Prize	COMMUNICATION AND DISTRIBUTED SYSTEMS GROUP (KuVS)	*05/2020*
Best Paper Award	IFIP NETWORKING CONFERENCE 2018	*05/2018*
Hackathon Winner	GTM^3 HACKATHON @ OPERATIONS RESEARCH 2017	*09/2017*
Software Campus Grant	GERMAN FEDERAL MINISTRY OF EDUCATION AND RESEARCH	*03/2016*
Best Master Thesis Prize	COMMUNICATION AND DISTRIBUTED SYSTEMS GROUP (KuVS)	*03/2015*
Scholarship	GERMAN ACADEMIC SCHOLARSHIP FOUNDATION	*10/2009 - 3/2013*

Software Campus Management Trainings

Conflicts in Leadership Positions	DEUTSCHE POST AG	*11/2016*
Moderation for Professionals: **Mastering Complex and Tough Situations**	DATEV eG	*11/2016*
New as Executive - Basics for Tomorrow's Executive	HOLTZBRINCK PUBLISHING	*09/2016*
Projectmanagement Basics using the PMI-Standard	SCHEER HOLDING	*04/2016*
Intercultural Awareness	SAP SE	*04/2016*
Business meets Technology: **Business Understanding for Engineers and Non-Economists**	SIEMENS AG	*03/2016*

Extracurricular Activities

Amnesty International Deutschland e.V.   *10/2007 - present*
I was particularly active from 2007 to 2011 and mainly volunteered at Freie Universität Berlin's group and was the group's spokesperson, led the organization of lecture series and of the first Jugend@Amnesty event in Germany.

German Academic Scholarship Foundation   *10/2009 - 03/2013*
I participated in excursions and a two-week course on field-programmable integrated circuits (FPGAs).

Peer-Reviewed Publications

Journal Articles

Improved Throughput for All-or-Nothing Multicommodity Flows with Arbitrary Demands
Anya Chaturvedi, Chandra Chekuri, Andrea Richa, Matthias Rost, Stefan Schmid, Jamison Weber
ACM SIGMETRICS Performance Evaluation Review. ACM New York, NY, USA, 2022

On the Hardness and Inapproximability of Virtual Network Embeddings
Matthias Rost, Stefan Schmid
IEEE/ACM Transactions on Networking (TON). 2020

Parametrized Complexity of Virtual Network Embeddings: Dynamic & Linear Programming Approximations
Matthias Rost, Elias Döhne, Stefan Schmid
ACM SIGCOMM Computer Communication Review (CCR). 2019

Virtual Network Embedding Approximations: Leveraging Randomized Rounding
Matthias Rost, Stefan Schmid
IEEE/ACM Transactions on Networking (TON). 2019

Transiently Policy-Compliant Network Updates
Arne Ludwig, Szymon Dudycz, Matthias Rost, Stefan Schmid
IEEE/ACM Transactions on Networking (TON). 2018

Approximate and incremental network function placement
Tamás Lukovszki, Matthias Rost, Stefan Schmid
Journal of Parallel and Distributed Computing (JPDC). 2018

It's a Match!: Near-Optimal and Incremental Middlebox Deployment
Tamás Lukovszki, Matthias Rost, Stefan Schmid
ACM SIGCOMM Computer Communication Review (CCR). 2016

Beyond the Stars: Revisiting Virtual Cluster Embeddings
Matthias Rost, Carlo Fuerst, Stefan Schmid
ACM SIGCOMM Computer Communication Review (CCR). 2015

Network Service Chaining with Optimized Network Function Embedding supporting Service Decompositions
Sahel Sahhaf, Wouter Tavernier, Matthias Rost, Stefan Schmid, Didier Colle, Mario Pickavet, Piet Demeester
Computer Networks. 2015

Conference Proceedings

Optimal Virtual Network Embeddings for Tree Topologies
Aleksander Figiel, Leon Kellerhals, Rolf Niedermeier, Matthias Rost, Stefan Schmid, Philipp Zschoche
ACM Symposium on Parallelism in Algorithms and Architectures (SPAA). 2021

Cost-Efficient Embedding of Virtual Networks With and Without Routing Flexibility
Balázs Németh, Yvonne-Anne Pignolet, Matthias Rost, Stefan Schmid, Balázs Vass
IFIP Networking. 2020

A Constant Approximation for Maximum Throughput Multicommodity Routing And Its Application to Delay-Tolerant Network Scheduling
Mengxue Liu, Andrea Richa, Matthias Rost, Stefan Schmid
IEEE Conference on Computer Communications (INFOCOM). 2019

Modeling Adaptive Video Streaming Using Discrete-Time Analysis
Susanna Schwarzmann, Paula Breitbach, Thomas Zinner, Matthias Rost
International Teletraffic Congress (ITC). 2019

Charting the Complexity Landscape of Virtual Network Embeddings
Matthias Rost, Stefan Schmid
IFIP Networking. 2018

Virtual Network Embedding Approximations: Leveraging Randomized Rounding
Matthias Rost, Stefan Schmid
IFIP Networking. 2018

An Approximation Algorithm for Path Computation and Function Placement in SDNs
Guy Even, Matthias Rost, Stefan Schmid
Structural Information and Communication Complexity (SIROCCO). 2016

Stitching Inter-Domain Paths over IXPs

Vasileios Kotronis, Rowan Klöti, Matthias Rost, Panagiotis Georgopoulos, Bernhard Ager, Stefan Schmid, Xenofontas Dimitropoulos
ACM Symposium on SDN Research (SOSR). 2016

Transiently Secure Network Updates
Arne Ludwig, Szymon Dudycz, Matthias Rost, Stefan Schmid
ACM SIGMETRICS International Conference on Measurement and Modeling of Computer Systems. 2016

It's About Time: On Optimal Virtual Network Embeddings under Temporal Flexibilities
Matthias Rost, Stefan Schmid, Anja Feldmann
IEEE International Parallel and Distributed Processing Symposium (IPDPS). 2014

VirtuCast: Multicast and Aggregation with In-Network Processing
Matthias Rost, Stefan Schmid
Principles of Distributed Systems (OPODIS). 2013

WORKSHOPS, POSTERS, AND SHORT PAPERS

It's Good to Relax: Fast Profit Approximation for Virtual Networks with Latency Constraints
Robin Münk, Matthias Rost, Harald Räcke, Stefan Schmid
IFIP Networking. 2021

Edge Replication Strategies for Wide-Area Distributed Processing
Niklas Semmler, Matthias Rost, Georgios Smaragdakis, Anja Feldmann
ACM International Workshop on Edge Systems, Analytics and Networking (EdgeSys@EuroSys). 2020

Fast and Efficient Network Service Embedding Method with Adaptive Offloading to the Edge
Balázs Németh, Mark Szalay, Janos Doka, Matthias Rost, Stefan Schmid, Laszlo Toka, Balázs Sonkoly
IEEE INFOCOM Workshop on Int. Edge Computing, Caching, and Offloading in Next Generation Networks. 2018

Efficient service graph embedding: A practical approach
Balázs Németh, Balázs Sonkoly, Matthias Rost, Stefan Schmid
IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN). 2016

Investigating the Potential of the Inter-IXP Multigraph for the Provisioning of Guaranteed End-to-End Services
Vasileios Kotronis, Rowan Klöti, Matthias Rost, Panagiotis Georgopoulos, Bernhard Ager, Stefan Schmid, Xenofontas Dimitropoulos
ACM SIGMETRICS International Conference on Measurement and Modeling of Computer Systems. 2015

Good Network Updates for Bad Packets: Waypoint Enforcement Beyond Destination-Based Routing Policies
Arne Ludwig, Matthias Rost, Damien Foucard, Stefan Schmid
ACM Workshop on Hot Topics in Networks (HotNets). 2014

Towards Unified Programmability of Cloud and Carrier Infrastructure
P. Sköldström, B. Sonkoly, A. Gulyás, F. Németh, M. Kind, F. J. Westphal, W. John, J. Garay, E. Jacob, D. Jocha, J. Elek, R. Szabó, W. Tavernier, G. Agapiou, A. Manzalini, M. Rost, N. Sarrar, S. Schmid
European Workshop on Software Defined Networks (EWSDN). 2014