# **Thomas Lin**

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# **Education**

## **University of Toronto**

# Ph.D. (Electrical & Computer Engineering)

Sept. '14 - Nov. '21

- Supervisor: Professor A. Leon-Garcia
- Thesis: Client-centric Orchestration and Management of Distributed Applications in Multi-tier Clouds

### M.A.Sc. (Electrical & Computer Engineering)

Sept. '11 – Dec. '14

- Supervisor: Professor A. Leon-Garcia
- Thesis: Implementation and Evaluation of an SDN Management System on the SAVI Testbed

### B.A.Sc. (Computer Engineering)

Sept. '06 - Jun. '11

- Capstone: An iPad Application in Vehicular Networks
- Specializations: Computer Networking and Software Engineering

# Research Interests

Software-Defined Networking, Software-Defined Infrastructure, Cloud & Datacentre Control and Management, Virtualization of Unconventional Resources, Network Function Virtualization

# **Engineering Experience**

### Software Developer & Avionics Software Team Lead (SpaceRyde)

Nov. '21 - Present

- Represented avionics software team within a highly multi-disciplinary environment, liaising with other team leads in joint systems engineering designs of different vehicles
- Managed project timelines: reconciling milestones & objectives given constrained resources (human, time, and monetary)
- Led the design of flight vehicle avionics software, involving requirements formulation, component sourcing & validation, architectural design & layout, and integration & testing
- Developed C/C++ driver suite for within embedded Linux and over the ROS2 framework
- Designed networking solution for a multi-stage vehicle stack, and for groundstation-to-vehicle tracking, telemetry, and command (TT&C)
- Implemented continuous integration pipeline for automated build & tests; defined coding standards, best practices, and test targets

### Infrastructure Testbed Developer & SysAdmin (SAVI Network)

May '12 - Nov. '21

- Developed a cloud infrastructure control and management framework based on software-defined infrastructure; unified heterogeneous infrastructure telemetry using open-source software
- Extended OpenStack to support virtualized GPUs, FPGAs, SDRs, and Wi-Fi resources
- Supported operations and maintenance of the Canada-wide SAVI testbed; administered clusters of servers; configured and programmed network devices; and wired datacentres
- Supported students and researchers in designing and implementing novel experiments involving cloud orchestration, software-defined networking, network function virtualization, and 5G slicing

#### **Network Software Developer** (StreamWorx.AI)

May '21 - Sept. '21

- Collaborated with a small team, leading initial client requirements analysis, and performing exploratory research on client's tech stack to determine what is possible
- Developed a multi-layer (physical, virtual, application) network & compute telemetry framework, for a client's edge-networking product, using open-source tools
- Developed & deployed ingestion processors for real-time data pipelines and analytic dashboards

#### Research Assistant (ECE Control Group)

May '11 - Sept. '11

- Supervisor: Professor L. Pavel
- Verified a Python-based simulation suite (provided by Alcatel-Lucent), used to model and simulate the setup, and run-time physical behaviour of optical networks
- Documented various components of the simulation suite, their use cases, etc.

• Assess an in-lab optical network setup using optical spectral analyzers, lasers, variable optical attenuators, bandpass filters, optical couplers, and optical amplifiers

### Multimedia Software Engineering Intern (Qualcomm Canada)

May '09 - Aug. '10

- Developed and maintained the user-space layers for a video processing driver
- Liaised with engineers from client companies to ensure single code base can be used for a variety of smartphone operating systems
- Implemented a flexible OMX-based test application for regression testing
- Tracked and debugged build issues to ensure error-free code releases
- Supported out-of-country integration teams with any issues relating to the latest release of video driver code

# **Technical Skills & Knowledge**

#### **Programming and Scripting**

• C, C++, Python, Go, Node.js, Java, Matlab, CUDA-C, Obj-C, Assembly, Bash

#### **Web Development**

HTML5 and JavaScript

#### Other CLI Systems and Languages

• Cisco IOS, Dell NOS, SQL

### **Operating Systems**

Debian and CentOS-based Linux systems, Windows

#### **Communication Standards**

TCP/IP stack, I2C, RS-232 & 422 via UART, CAN

### **Publications**

#### **Conference Papers**

- T. Lin, W. Zhao, I. Co, A. Chen, H. Xu, and A. Leon-Garcia, "PhysarumSM: P2P Service Discovery and Allocation in Dynamic Edge Networks," *IFIP/IEEE International Symposium on Integrated Network Management (IM)*, Virtual, 2021
  - o Acceptance rate: 24.1%
- T. Lin, S. Marinova, and A. Leon-Garcia, "Towards an End-to-End Network Slicing Framework in Multi-Region Infrastructures," *IEEE Conference on Network Softwarization (NetSoft)*, Virtual, 2020
  - Acceptance rate: 20.0%
- **T. Lin**, and A. Leon-Garcia, "Towards a Client-Centric QoS Auto-Scaling System," *IEEE/IFIP Network Operations and Management Symposium (NOMS)*, Virtual, 2020
  - o Acceptance rate: 29.6%
- L. Gavrilovska, A. Leon-Garcia, V. Rakovic, D. Denkovski, S. Marinova, V. Atanasovski, T. Lin, and H. Bannazadeh, "Flash Crowd Management via Virtualized Network Resources (FALCON)," NATO Science for Peace and Security (SPS) Cluster Workshop on Advanced Technologies, Leuven, Belgium, 2019
- S. Marinova, T. Lin, H. Bannazadeh, A. Leon-Garcia, "End-to-end Network Slicing for 5G in Multi-Region, Multi-Tenant Cloud Platform," 3rd International Balkan Conference on Communications and Networking (BalkanCom), Skopje, North Macedonia, 2019
- T. Lin, B. Park, H. Bannazadeh and A. Leon-Garcia, "Deploying a Multi-Tier Heterogeneous Cloud: Experiences and Lessons from the SAVI Testbed," *IEEE/IFIP Network Operations and Management Symposium (NOMS)*, Taipei, Taiwan, 2018

- o Acceptance rate: 29.6%
- **T. Lin**, N. Tarafdar, B. Park, P. Chow and A. Leon-Garcia, "Enabling Network Function Virtualization over Heterogeneous Resources," *19th Asia-Pacific Network Operations and Management Symposium (APNOMS)*, Seoul, South Korea, 2017
  - Acceptance rate: 36%
- N. Tarafdar, T. Lin, N. Eskandari, D. Lion, A. Leon-Garcia and P. Chow, "Heterogeneous Virtualized Network Function Framework for the Data Center," 27th International Conference on Field Programmable Logic and Applications (FPL), Ghent, Belgium, 2017
  - o Acceptance rate: 24%
- P. Spachos, T. Lin, W. Li, M. Chignell, A. Leon-Garcia, J. Jiang and L. Zucherman, "Subjective QoE Assessment on Video Service: Laboratory Controllable Approach," *IEEE International Symposium on a World of Wireless Mobile and Multimedia Networks (WoWMoM)*, Macau, China, 2017
  - o Acceptance rate: 27%
- **T. Lin**, B. Park, H. Bannazadeh and A. Leon-Garcia, "Enabling L2 Network Programmability in Multi-Tenant Clouds," *IFIP/IEEE International Symposium on Integrated Network Management (IM)*, Lisbon, Portugal, 2017
  - o Acceptance rate: 29%
- N. Tarafdar, T. Lin, E. Fukuda, H. Bannazadeh, A. Leon-Garcia and P. Chow, "Enabling Flexible Network FPGA Clusters in a Heterogeneous Cloud Data Center," ACM/SIGDA International Symposium on Field-Programmable Gate Arrays (FPGA), Monterey, California, USA, 2017
  - o Acceptance rate: 24%
- B. Park, T. Lin, H. Bannazadeh and A. Leon-Garcia, "JANUS: Design of a Software-Defined Infrastructure Manager and its Network Control Architecture," *IEEE NetSoft Conference and Workshops* (NetSoft), Seoul, South Korea, 2016
  - o Acceptance rate: 19%
- T. Lin, B. Park, H. Bannazadeh and A. Leon-Garcia, "SAVI Testbed Architecture and Federation," EAI International Conference on Future Access Enablers of Ubiquitous and Intelligent Infrastructures (FABULOUS), Ohrid, Macedonia, 2015
- T. Lin, H. Bannazadeh and A. Leon-Garcia, "Introducing Wireless Access Programmability using Software-Defined Infrastructure," *IFIP/IEEE International Symposium on Integrated Network Management (IM)*, Ottawa, Canada, 2015
  - Acceptance rate: 27%
- J. M. Kang, T. Lin, H. Bannazadeh and A. Leon-Garcia, "Software-Defined Infrastructure and the SAVI Testbed," EAI International Conference on Testbeds and Research Infrastructures for the Development of Networks & Communities (TRIDENTCOM), Guangzhou, PRC, 2014
  - o Acceptance rate: 33%
  - o Best Paper Award
- T. Lin, J. M. Kang, H. Bannazadeh and A. Leon-Garcia, "Enabling SDN Applications on Software-Defined Infrastructure," *IEEE Network Operations and Management Symposium (NOMS)*, Krakow, Poland, 2014
  - Acceptance rate: 29%
- J. M. Kang, H. Bannazadeh, H. Rahimi, **T. Lin**, M. Faraji and A. Leon-Garcia, "Software-Defined Infrastructure and the Future Central Office," *IEEE International Conference on Communications Workshops (ICC)*, Budapest, Hungary, 2013
  - o Acceptance rate: 39%

#### **Journals and Magazines**

• S. Marinova, **T. Lin**, H. Bannazadeh, A. Leon-Garcia, "End-to-End Network Slicing for Future Wireless in Multi-Region Cloud Platforms," in *Elsevier Computer Networks*, vol. 177, May 2020

- S. Marinova, V. Rakovic, D. Denkovski, T. Lin, V. Atanasovski, H. Bannazadeh,
  L. Gavrilovska, A. Leon-Garcia, "End-to-End Network Slicing for Flash Crowds," in *IEEE Communications Magazine*, vol. 58, no. 4, pp. 31-37, Apr. 2020
- N. Tarafdar, N. Eskandari, **T. Lin** and P. Chow, "Designing for FPGAs in the Cloud," *IEEE Design & Test*, vol. 35, no. 1, pp. 23-29, Feb. 2018

### **Book Chapters**

 N. Tarafdar, T. Lin, D. Ly-Ma, D. Rozhko, A. Leon-Garcia and P. Chow, "Building the Infrastructure for Deploying FPGAs in the Cloud," in *Hardware Accelerators in Data Centers*, C. Kachris, B. Falsafi, D. Soudris, Eds. Cham, Springer, 2018, pp. 9-33

#### **Demos & Poster Presentations**

- T. Lin, B. Park, H. Bannazadeh and A. Leon-Garcia, "Demo Abstract: End-to-End Orchestration across SDI Smart Edges," IEEE/ACM Symposium on Edge Computing (SEC), Washington, DC, USA, 2016
- B. Park, **T. Lin**, H. Bannazadeh and A. Leon-Garcia, "OpenFlow Conflict Detection and Authorization in Multi-Tenant Clouds," 2016 SAVI AGM & Workshop
- B. Park, **T. Lin**, H. Bannazadeh and A. Leon-Garcia, "SDI Manager Architecture and its SDN Functionalities," 2015 SAVI AGM & Workshop
- T. Lin, H. Bannazadeh and A. Leon-Garcia, "End-to-End Traffic Control in the SAVI Testbed," 2014 SAVI AGM & Workshop

## **Invited Talks**

• "The SAVI Testbed for Software-Defined Infrastructure," IEEE Canadian Conference on Electrical and Computer Engineering (CCECE), Toronto, Canada, 2014

# **Teaching Experience**

#### **Course Development**

#### ECE361: Computer Networks I

Fall '16; Summer '19 – Winter '20

- Created new set of OpenFlow-based labs, creating solutions, and thoroughly testing new lab environments prior to release to students
- Complete course re-design (lectures, tutorials, and labs) focusing on solving fundamental problems in networking
- Set of technical demos to show in tutorials and lectures to bring theory to reality

#### ECE1508: Network Softwarization: Technologies and Enablers

Winter '18, '19

- Aided the design of the course syllabus and the schedule of lectures, involving instructors across 4 different universities
- Created lecture materials pertaining to SAVI, overlays, NFV, SDN, and orchestration
- Designed set of hands-on labs on SAVI related to the previous topics

### APS105: Computer Fundamentals

Winter '16, '17

- Designed, implemented, and trial-ran a new computer-based examination system
- Designed and implemented a computer-based student survey system for in-lab hours

#### **Teaching**

#### IEEE ComSoc Summer School

Summer '17

- Created and presented day-long series of lectures pertaining to SAVI, NFV, SDN, orchestration, monitoring, and container technology
- Created set of hands-on tutorials on SAVI related to the above topics and guided students through exercises to bring theoretical concepts to reality

Presented set of demos to showcase SAVI SDI and use of heterogeneous resources

#### **Teaching Assistant**

### ECE244: Programming Fundamentals

Fall '15 - '20

- Supported students in creating and debugging C++-based object-oriented programs
- Marked laboratory assignments, midterms, and finals

### ECE1508: Network Softwarization: Technologies and Enablers

Winter '18, '20

- Created and presented lectures pertaining to SAVI, overlays, NFV, SDN, and orchestration methods
- Presented set of demos to showcase SAVI SDI and use of heterogeneous resources
- Provided technical advice and assistance to student projects
- Evaluated student's project presentations and reports

### APS105: Computer Fundamentals

Fall '14, '15; Winter '16 - '20

- Guided students in resolving and debugging issues regarding during lab hours
- Led tutorial sessions for groups of up to 30 students, as well as 1-on-1 sessions
- Created new lab assignments and created questions for midterm and finals
- Marked assignments, quizzes, midterms, and finals

## ECE297: Communication and Design

Winter '14 - '20

- Supervised 4 to 5 groups of students in semester-long software project
- Advised students on best approaches for tackling certain problems and suggested improvements on various aspects of their software
- Marked milestones, code reviews, technical presentations, and final pitches

#### ECE361: Computer Networks I

Winter '15; Fall '12, '16, '18, '19

- Led tutorial sessions and organized weekly TA meetings
- Assisted students in resolving issues regarding labs and conducting in-lab grading

### ECE1548: Advanced Network Architectures

Fall '12, '13, '15 - '17

- Designed and implemented new cloud computing labs for the SAVI testbed, with topics on: OpenFlow, Orchestration, Monitoring, Testbed Federation
- Consulted and aided students in overcoming various issues in their final projects
- Extended and maintained capabilities of the SAVI network testbed upon which the student's final projects were deployed and tested on
- Marked laboratory assignments and provided feedback on final projects

#### ECE461: Internetworking

Fall '13, '14

- Assisted students in resolving issues regarding the labs during practical hours
- Marked laboratory assignments

## APS106: Fundamentals of Computer Programming

Winter '12

- Conducted tutorials to a group of roughly 30 students
- Assisted students in resolving issues regarding labs and conducting in-lab grading

## ECE466: Computer Networks II

Winter '12

- Thoroughly tested a new lab prior to release to students
- Assisted students in resolving issues regarding the labs during practical hours

#### **Tutoring**

#### APS106: Fundamentals of Computer Programming

Winter '12

- Volunteer basis
- Assessed and identified knowledge gap of the students
- Prepared customized exercises and lesson plans in 1-on-1 and small group sessions

## APS105: Computer Fundamentals

Fall '11

- Set up material review sessions with student along with sample code snippets
- Assisted student in resolving issues regarding labs

# **Volunteering Experience**

# Elected Residence House Representative (New College)

'08 – '09, '10 – '11

- Represent the house in meetings with the campus residence council
- Liaise with other House Reps in organizing joint events, expressing the interests of the house and planned an approximate schedule for the upcoming weeks
- Created and organized an informative welcoming event for new residents

### Operations Coordinator - Christmas In July Food Drive

Summer '08

- Corresponded with various groups and companies throughout the Greater Vancouver region to inform them of the food drive
- Spread awareness of the event, advertising its purpose and goals to the public
- Collected donations from homes and groups for delivery to the local food bank

## Elected Residence House Treasurer (New College)

*'*07 – *'*08

- Managed the bank account for one of the houses on campus residence
- · Collected funds, distributed reimbursements and subsidies
- Reported up to date records of expenditures and income on a ledger form