

# Kaiyu Hou

Curriculum Vitae

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I am currently a 5th year Ph.D. candidate in the Computer Science Department at Northwestern University, advised by Prof. Yan Chen. I have a broad interest in various aspects of cloud networks, network protocols, and networked systems. My current research focuses on network optimization of serverless based cloud. I am also working for introducing formal methods into network protocol verification.

## Education

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- **Ph.D. in Computer Science** 2017 – 2022  
**Northwestern University** Evanston, IL
  - Advisor: Prof. [Yan Chen](#)
  - Area: Networked System, Cloud Networking, Network Protocols
  - Thesis Topic: Enabling Robust and Secure Edge-to-Cloud Communications
  - GPA: 3.97/4.00
- **Master's in Computer Science** 2014 – 2017  
**Xi'an Jiaotong University** Shaanxi, China
  - Advisor: Prof. [Chengchen Hu](#)
  - Area: Software Defined Networking (SDN)
  - Rank: 1<sup>st</sup>/89    GPA: 3.81/4.00    Average: 91.7
- **B.E. in Software Engineering** 2010 – 2014  
**Xi'an Jiaotong University** Shaanxi, China
  - Rank: 1<sup>st</sup>/78    GPA: 3.94/4.00    Average: 92.4 (in Junior and Senior years)

## Work Experiences

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- **SRI International** Menlo Park, CA  
Senior Research Intern, at Computer Science Laboratory Jun. 2021 – Sep. 2021
  - Advisor: Dr. [Vinod Yegneswaran](#) and Dr. [Phillip Porras](#)
  - Real-time anomaly detection with P4 switches and reinforcement learning for NextG networks
- **SRI International** Menlo Park, CA  
Research Intern, at Computer Science Laboratory Jun. 2020 – Sep. 2020
  - Advisor: Dr. [Vinod Yegneswaran](#)
  - Designed and implemented an enterprise-wide radio situational awareness system
  - Passively collected radio traffics, including Wi-Fi and Bluetooth, analyzed by AutoML and nPrint

## Research: Cloud Networks & SDN

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- **Network Optimizing for Microservices/Serverless Cloud** 2020 – 2022
  - Microservices/serverless architectures bring flexibility but introduce network communication delay
  - Integrated **QUIC** into **OpenFaaS/K8s**, improved serverless network performance by 28%
  - Designed a clean-slate serverless network architecture for direct function chain communications
  - Designed systematic benchmarks for the microservices network performance measurement*Publication: [CoNEXT'21 Poster] Accelerate and Secure Serverless Networks with QUIC*
- **Generic Security Policy Enforcement System for SDN-based Cloud** 2017 – 2018
  - Designed a **policy language** for resource protection and management of SDN-based Cloud
  - Implemented in the **OpenDaylight** controller, and deployed on **OpenStack***Publication: [IWQoS'18] Lightweight Resource Protection and Management System for SDN-based Cloud*
- **Routing Policy for Solving Reactive Model Overhead of SDN** 2016 – 2017
  - SDN control channel bandwidth is the major bottleneck of applying reactive forwarding
  - Proposed a routing policy to reduce the SDN control channel bandwidth consumption up to 80%
  - Implemented in the **Floodlight** controller under the **OpenFlow/P4** switch and **Open vSwitch***Publication: [ICNP'17] SoftRing: Taming the Reactive Model for Software Defined Networks*

## Research: Formal Methods for Network Protocols

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- **Formal Verification and Vulnerability Detection of LTE/5G Protocols** 2019 - 2020
  - Used **TLA+** to formally specify the emergency call systems in **4G/5G** cellular network protocols
  - Built a **complete cellular network testbed** (USRP, OpenAirInterface) for real-world verification
  - Discovered serious availability and security issues in real-world, **acknowledged by major carriers***Publication: [MobiSys'21] Discovering Emergency Call Pitfalls for Cellular Networks with Formal Methods*
- **Formal Secure Configuration Search for Network Protocols** 2020 - 2022
  - Traditionally, researchers use secure properties to verify a protocol is safe or find counterexamples
  - We convert this decision problem into a search problem. Given the model and the properties, we aim to search the boundaries of the configuration space where the system is always secure and reliable
  - We employ inductive generalization and improved IC3 algorithm to determine the space*Publication: [Sigcomm'20 Poster] Network Protocol Safe Configuration Search in One Shot*

## Publication List

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- **QFaaS: Accelerating and Securing Serverless Cloud Networks with QUIC**  
Kaiyu Hou, Sen Lin, Yan Chen, Vinod Yegneswaran  
Under Review, ACM Symposium on Cloud Computing, 2022 (SoCC'22)
- **Property Guided Secure Configuration Space Search**  
You Li\*, Kaiyu Hou\*, Yan Chen, Hai Zhou (\*equal contribution)

Under Review, Formal Methods in Computer-Aided Design, 2022 (FMCAD'22)

- ***Accelerate and Secure Serverless Networks with QUIC***  
**Kaiyu Hou**, Sen Lin, Yan Chen, Vinod Yegneswaran  
ACM 17th International Conference on Emerging Networking Experiments and Technologies, Poster, 2021 (CoNEXT'21)
- ***Discovering Emergency Call Pitfalls for Cellular Networks with Formal Methods***  
**Kaiyu Hou\***, You Li\*, Yinbo Yu, Yan Chen, Hai Zhou (\*equal contribution)  
ACM 19th International Conference on Mobile Systems, Applications, and Services, 2021 (MobiSys'21)
- ***Network Protocol Safe Configuration Search in One Shot***  
You Li\*, **Kaiyu Hou\***, Hai Zhou, Yan Chen (\*equal contribution)  
ACM Special Interest Group on Data Communication, Poster, 2020 (SIGCOMM'20)
- ***State of the Art and Research Challenges in the Security Technologies of Network Function Virtualization***  
Xiaochun Wu, **Kaiyu Hou**, Xue Leng, Xing Li, Yinbo Yu, Bo Wu, Yan Chen  
IEEE Internet Computing, 2020
- ***CellScope: Automatically Specifying and Verifying Cellular Network Protocols***  
Yinbo Yu, You Li, **Kaiyu Hou**, Yan Chen, Hai Zhou, Jianfeng Yang  
ACM Special Interest Group on Data Communication, Poster, 2019 (SIGCOMM'19)
- ***A Lightweight Policy Enforcement System for Resource Protection and Management in the SDN-based Cloud***  
Xue Leng, **Kaiyu Hou**, Yan Chen, Kai Bu, Libin Song, You Li  
Computer Networks, Elsevier, 2019
- ***COIN: A fast packet inspection method over compressed traffic***  
Xiuwen Sun, Hao Li, Dan Zhao, Xingxing Lu, **Kaiyu Hou**, Chengchen Hu  
Journal of Network and Computer Applications, Elsevier, 2019
- ***SDNKeeper: Lightweight Resource Protection and Management System for SDN-based Cloud***  
Xue Leng, **Kaiyu Hou**, Yan Chen, Kai Bu, Libin Song  
IEEE/ACM 26th International Symposium on Quality of Service, 2018 (IWQoS'18)
- ***SoftRing: Taming the Reactive Model for Software Defined Networks***  
Chengchen Hu, **Kaiyu Hou** (1<sup>st</sup> student author), Hao Li, Ruilong Wang, Peng Zheng, Peng Zhang, Huan Zhao Wang  
IEEE 25th International Conference on Network Protocols, 2017 (ICNP'17)
- ***Towards A Fast Packet Inspection over Compressed HTTP Traffic***  
Xiuwen Sun, **Kaiyu Hou**, Hao Li, Chengchen Hu  
IEEE/ACM 25th International Symposium on Quality of Service, 2017 (IWQoS'16)

## Teaching Experiences

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- CS 214: Data Structure and Data Management Spring, 2022  
Teaching Assistant, Northwestern University

- CS 214: Data Structure and Data Management Spring, 2021  
*Teaching Assistant, Northwestern University*
- CS 214: Data Structure and Data Management Winter, 2021  
*Teaching Assistant, Northwestern University*
- CS 214: Data Structure and Data Management Fall, 2020  
*Teaching Assistant, Northwestern University*
- CS 212, Mathematical Foundations of Computer Science Spring, 2020  
*Teaching Assistant, Northwestern University*
- CS 340, Introduction to Networking (**Best Teaching Assistant Award**) Winter, 2020  
*Teaching Assistant, Northwestern University*
- CS 214, Data Structure and Data Management Fall, 2019  
*Teaching Assistant, Northwestern University*
- EECS 343, Operating Systems Spring, 2019  
*Teaching Assistant, Northwestern University*
- EECS 340, Introduction to Networking Winter, 2019  
*Assistant Lecturer, Northwestern University*
- EECS 340, Introduction to Networking Fall, 2018  
*Teaching Assistant, Northwestern University*
- IT 458, Information Security and Assurance Winter, 2018  
*Teaching Assistant, Northwestern University*
- Computer Programming (C++) for CS Honored Class Fall, 2016  
*Teaching Assistant, Xi'an Jiaotong University*

## Professional Services

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- Sub-reviewer of ACM ASIA-CCS (2021)
- Sub-reviewer of ACM CCS (2018, 2019)
- Sub-reviewer of IEEE ICDCS (2018)
- Reviewer of IEEE/ACM Transactions on Networking (ToN)

## Awards

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- **Bronze Medal**, ACM-ICPC Asia Regional Contest 2012, 2013, 2014
- **Silver Medal**, ACM-ICPC China Province Contest, Chengdu 2012, 2013
- **Meritorious Winner**, Mathematical Contest in Modeling (MCM) 2013

## Honor

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- **Terminal Year Cabell Fellowship** 2021  
*Northwestern University*
- **Best Teaching Assistant Award** (*Peter and Adrienne Barris Outstanding TA*) 2020  
*Northwestern University*
- **Outstanding Graduate (Cadre) Award** 2017  
*Xi'an Jiaotong University*
- **Excellent Postgraduate Student Leader Award** (each year) 2015, 2016  
*Xi'an Jiaotong University*
- **Outstanding Graduate Award** 2014  
*Xi'an Jiaotong University*
- **Excellent Student Model Nomination** (16/13000) 2013  
*Xi'an Jiaotong University*
- **Google Excellence Scholarship** 2013  
*Awarded to 3 students from each of 20 top Chinese universities*
- **Excellent Student Award** (each year) 2011, 2012, 2013  
*Xi'an Jiaotong University*

## Social Activities

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- **Student President** of the Computer Science Dept., (Class 2017) 2014 – 2017  
*Xi'an Jiaotong University*
- **Student Councilor**, the Student Congress of ChungYing College 2013 - 2014  
*Xi'an Jiaotong University*
- **Chair**, the ACM-ICPC Club 2012 - 2013  
*Xi'an Jiaotong University*
- **Science and Education Minister** of the Student Union 2011 - 2012  
*Xi'an Jiaotong University*
- **Co-Founder & the 2<sup>nd</sup> Store Manager** of *Bingo Cafe* 2010 - 2013  
*ChungYing College, Xi'an Jiaotong University*

## Skills

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- QUIC Protocol, TCP/IP Protocols, 3GPP Cellular Network Protocols (NAS layer), 802.11 Protocols
- Serverless Computing, Serverless Network Architecture, Cloud Networks, SDN, P4
- Formal Methods for Network Protocols, TLA+, IC3, NuSMV
- Python, Go-lang | Container, Microservices, Kubernetes, CNI