

I am currently a 4th 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 and network protocols. My current research focuses on network optimization of microservices/serverless based cloud. I am also working for introducing formal methods into network protocol verification.

## Education

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- **Ph.D. Student in Computer Science** 2017 – (2022)  
**Northwestern University** Evanston, IL  
- Advisor: Prof. [Yan Chen](#) Area: Network Protocols, Cloud Networking GPA: 3.97/4.0
- **Master's in Computer Science** 2014 – 2017  
**Xi'an Jiaotong University** Shaanxi, China  
- Advisor: Prof. [Chengchen Hu](#) Area: SDN Rank: 1<sup>st</sup>/89 GPA: 3.81/4.0 Average: 91.7
- **B.E. in Software Engineering** 2010 – 2014  
**Xi'an Jiaotong University** Shaanxi, China  
- Rank: 1<sup>st</sup>/78 GPA: 3.94/4.0 Average: 92.4 (in Junior and Senior year)

## Work Experiences

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- **SRI International** Menlo Park, CA  
Research Intern, at Computer Science Laboratory, Jun. 2020 – Sep. 2020  
- Designed and implemented an enterprise-wide radio situational awareness system  
- Passively collected radio traffics, including Wi-Fi and Bluetooth, analyzed by deep learning

## Research: Cloud Networks & SDN

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- **Network Optimizing for Microservices/Serverless Cloud** (work in progress) 2020 – Present  
- Microservices/Serverless architectures bring flexibility but introduce network communication delay  
- Designed systematic metrics to provide a benchmark for the microservices network performance  
- Integrated QUIC into **OpenFaaS/Kubernetes** to improve serverless network performance
- **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**
- **Routing Policy for Solving Reactive Model Overhead of Software Defined Networks** 2016 – 2017  
- Proposed a routing policy to reduce the control channel bandwidth consumption up to 80%  
- Implemented in the **Floodlight** controller under the **OpenFlow** protocol with **Open vSwitch**  
- Deployed on the ONetSwitch, an OpenFlow white-box switch with Xilinx FPGA

## 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**

- **Formal Secure Configuration Search for Network Protocols** (work in progress) 2020 - Present
  - 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

## Selected Publications

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- You Li\*, **Kaiyu Hou\***, Yan Chen, Hai Zhou (\*equal contribution), *Property Guided Secure Configuration Search*, Under Review, CAV'21
- **Kaiyu Hou\***, You Li\*, Yinbo Yu, Yan Chen, Hai Zhou (\*equal contribution), *Discovering Emergency Call Pitfalls for Cellular Networks with Formal Methods*, Under Review, MobiSys'21
- You Li\*, **Kaiyu Hou\***, Hai Zhou, Yan Chen (\*equal contribution), *Network Protocol Safe Configuration Search in One Shot*, SIGCOMM'20, Poster
- Xiaochun Wu, **Kaiyu Hou**, Xue Leng, Xing Li, Yinbo Yu, Bo Wu, Yan Chen, *State of the Art and Research Challenges in the Security Technologies of Network Function Virtualization*, Internet Computing, 2020
- Yinbo Yu, You Li, **Kaiyu Hou**, Yan Chen, Hai Zhou, Jianfeng Yang, *CellScope: Automatically Specifying and Verifying Cellular Network Protocols*, SIGCOMM'19, Poster
- Xue Leng, **Kaiyu Hou**, Yan Chen, Kai Bu, Libin Song, *SDNKeeper: Lightweight Resource Protection and Management System for SDN-based Cloud*, IWQoS'18
- Chengchen Hu, **Kaiyu Hou** (1<sup>st</sup> student author), Hao Li, Ruilong Wang, Peng Zheng, Peng Zhang, Huan Zhao Wang, *SoftRing: Taming the Reactive Model for Software Defined Networks*, ICNP'17
- Xiuwen Sun, **Kaiyu Hou**, Hao Li, Chengchen Hu, *Towards A Fast Packet Inspection over Compressed HTTP Traffic*, IWQoS'17

## Awards & Honor

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- **Best Teaching Assistant Award**, Northwestern University 2020
- **Graduate with Honor**, Xi'an Jiaotong University 2014, 2017
- **Excellent Student Award**, Xi'an Jiaotong University 2011, 2012, 2013, 2015, 2016
- **Google Excellence Scholarship**, Awarded to 3 students from each of 20 top Chinese universities 2013
- **Meritorious Winner**, Mathematical Contest in Modeling (MCM) 2013
- **Silver Medal**, ACM-ICPC China Province Contest 2012, 2013

## Activities & Experiences

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- **Reviewer/Sub-reviewer** of CCS (18', 19'), ICDCS ('18), IEEE ToN
- **Teaching Assistant**, Northwestern University
  - CS 212: Discrete Mathematics (Rating: 5.1/6.0), CS 214: Data Structures (Rating: 5.3/6.0)
  - CS 340: Introduction to Networking (Rating: 5.4/6.0)
- **Student President of Computer Science Dept.** (Class 2017), Xi'an Jiaotong University 2014 - 2017
- **Chair, the ACM-ICPC Club**, Xi'an Jiaotong University 2012 - 2013

## Skills

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- Serverless Platforms, Microservices Networks, Cloud Networks, SDN | Python, Go-lang
- L2/L3/L4, 3GPP, 802.11, and QUIC Protocols | Formal Methods for Network Protocols