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EDUCATION

Carnegie Mellon University (CMU)

PhD in Electrical and Computer Engineering

PhD Dissertation: QoE based management and control for large-scale VoD in the Cloud

PhD Advisors: Hyong Kim (ECE, CMU), Ricardo Morla (FEUP, Porto, Portugal)

Pittsburgh, PA

August 2017

Carnegie Mellon University (CMU)

Master of Science in Electrical and Computer Engineering

GPA: 3.92/4.0

Pittsburgh, PA

May 2014

Xi'an Jiaotong University (XJTU)

Master of Science in Information Engineering

GPA: 90.2/100.0

Xi'an, Shaanxi, China

July 2010

Xi'an Jiaotong University

Bachelor of Science in Information Engineering

GPA: 87.1/100.0

Xi'an, Shaanxi, China

July 2007

WORKING EXPERIENCE

IBM Thomas J. Watson Research Center

Research staff member in the Container Cloud Platform

Yorktown Heights, NY

September 2017 - Now

- **Data driven Resource Management for Container Cloud**

- Model the execution results of resource requests as *rewards* in the container Cloud. Propose and develop *reward-based resource management framework* for the Kubernetes and apply *reinforcement learning techniques* in the control of resource management to prevent cascading failures.

- Apply statistical analysis to profile workload in Container Cloud based on resource utilization metric data. Propose an *intelligent resource profile advisor* in Kubernetes to ensure efficient resource utilization.

Carnegie Mellon University

Research assistant

Pittsburgh, PA

September 2016 - August 2017

- **QRank: Inferring ISP roles based on end-user QoE for large-scale VoD service**

- Propose and develop QRank, a scalable ranking system, to rank the ISPs based on end user QoE at run time. QRank uses run-time user QoE to study and discover the roles of ISPs in the video streaming services under the assumption of abolishing network neutrality.

- QRank is evaluated in production Cloud and interesting insights are obtained from extensive experiments. 91.4% of QoE anomalies are detected on 15.32% of users. These users experience QoE anomalies persistently and recurrently. More than 95% of persistent and recurrent QoE anomalies are identified in less than 10 transit networks. QRank results indicate that the limited capacity in transit networks are the major cause of QoE anomalies.

- **Evaluation of Production Cloud CDNs for Video Streaming Services**

- Compare Production Cloud providers including Amazon Web Service (AWS), Microsoft Azure, and Google Cloud regarding their geographical coverage, scalability, stability and cost for video streaming services. Users' Quality of Experience (QoE) are used as the evaluation metric.

- Interesting findings about these providers are obtained and presented in IEEE CLOUD 2018.

INESC Porto

Research assistant

Porto, Portugal

September 2013 - August 2016

- **QoE based Management and Control for VoD in the Cloud**

- Model user Quality of Experience (QoE) as rewards in the *Management* system of VoD. Propose and develop QoE based Management System for VoD in the Cloud (QMan). QMan monitors all users' QoE at run time and applies *reinforcement learning techniques* to adaptively select CDNs/servers for users to optimize the overall user QoE.

- QMan is evaluated with a VoD deployed in Clouds (servers/CDNs) with 300+ DASH clients worldwide emulated in PlanetLab. Results show that the QMan (with server selection) improved 90th percentile QoE more than 40% compared to the DNS based server selection system; QMan (with CDN selection) improves 90% percentile QoE over 20% compared to VoD using single CDN.

- **QWatch: Detecting and locating QoE anomalies for VoD in the Cloud**

- **QWatch:** Design a scalable monitoring system that detects and locates anomalies based on the end-user QoE at run time. Evaluate *QWatch* in a controlled VoD system and in a VoD system deployed in Microsoft Azure Cloud. *QWatch* correctly detects and locates QoE anomalies in servers, routers and client devices.

Chen Wang

Research Interest: Cloud Management and Control, Comparison of Cloud Systems, QoE driven Cloud Application Management

SKILLS

Programming Language: *Proficient* in C, C++, Java, Go, Python and Matlab; *familiar with* Django, AngularJS, D3.js, Node.js, jQuery, HTML, CSS, MySQL, Perl, Shell

Cloud/CDN Platform: *Experience* in IBM Cloud, Google Cloud, Amazon AWS, Microsoft Azure, Kubernetes, Docker, Hadoop

Knowledge: *Solid foundation* in cloud computing, networking, distributed systems, information theory, signal processing, video/image processing; *good understanding* in large-scale distributed system, load balancing, anomaly detection, fault tolerance, DASH streaming, Video-on-Demand system, Cloud resource management, CDN system and video search system.

TEACHING EXPERIENCE

Carnegie Mellon University

Pittsburgh, PA, US

18757 – Network Management and Control

Spring 2013

18345 – Introduction to Telecommunication Networks

Spring 2013

PUBLICATIONS

1. M. F. Aktas, **C. Wang**, A. Youssef, M. Steinder, "Resource Profile Advisor for Containers in Cognitive Platform", *Proceedings of the ACM Symposium on Cloud Computing (SOCC)*. ACM, 2018.
2. **C. Wang**, A. Yayaseelan, H. Kim, "Comparing Content Delivery Networks for Adaptive Video Streaming", in *IEEE 11th International Conference on Cloud Computing (CLOUD)*. IEEE, 2018
3. **C. Wang**, H. Kim and R. Morla. "Identifying Persistent and Recurrent QoE anomalies for DASH streaming in the Cloud", in *9th International Conference on Cloud Computing Technology and Science (CLOUDCOM)*. IEEE, 2017
4. **C. Wang**, H. Kim and R. Morla. "QWatch: Detecting and Locating QoE anomaly for VoD in the Cloud", in *8th International Conference on Cloud Computing Technology and Science (CLOUDCOM)*. IEEE, 2016
5. **C. Wang**, H. Kim and R. Morla. "Users Know Better: A QoE based Adaptive Control System for VoD in the Cloud", in *Global Communication Conference (GLOBECOM)*. IEEE, 2015
6. **C. Wang**, H. Kim, and R. Morla. "QoE driven Server Selection for VoD in the Cloud", in *International Conference on Cloud Computing (CLOUD)*. IEEE, 2015.
7. **C. Wang**, H. Wang. "Utilization of Temporal Continuity in Video Text Detection", in *Second International Conference on Multimedia and Information Technology (MMIT)*. IEEE, 2010.
8. **C. Wang**, H. Wang, Y. Zhang. "Saliency map-based image segmentation using level set", in *International Symposium on Image Analysis and Signal Processing (IASP)*, 2010
9. N. Nan, G. Liu, **C. Wang**. "A BoF model based CBCD system using hierarchical indexing and feature similarity constraints", in *Second International Conference on Internet Multimedia Computing and Service (ICIMCS)*. ACM, 2010.
10. Z. Li, G. Liu, X. Qian, **C. Wang**. "Scale and rotation invariant Gabor texture descriptor for texture classification", *Visual Communications and Image Processing (VCIP)*. SPIE, 2010.
11. Z. Li, G. Liu, X. Qian, **C. Wang**, Y. Ma and Y. Yang. "A video text detection method based on key text points", *Advances in Multimedia Information Processing-PCM*. Springer, 2010.
12. N. Nan, G. Liu, X. Qian, **C. Wang**. "An SVM-based soccer video shot classification scheme using projection histograms", *Advances in Multimedia Information Processing-PCM*. Springer, 2008.

IN PREPARATION

13. **C. Wang**, H. Kim and R. Morla. "QMan: A QoE based Management and Control System for VoD in Cloud"
 14. **C. Wang**, H. Kim and R. Morla. "QRank: Inferring ISP roles based on end-user QoE for large-scale VoD service"
 15. **C. Wang**, S. Simhadri, Hyong Kim, "QSwarm: A QoE based collaborative multi-CDN adaptation system for VoD in the Cloud"
 16. **C. Wang**, H. Kim and R. Morla. "Virtual Revenue Model for VoD Free-Trial Subscription"
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LEADERSHIP EXPERIENCE

CMU Summit on US-China Innovation and Entrepreneurship (<http://cmu-summit.org/>)

Pittsburgh, PA

Internet Service & Cloud Computing Panel Leader

Nov. 2011 to May 2012

- Led and recruited organization teams for the Internet Service & Cloud Computing Panel in the 1st CMU-Summit Conference.
- Successfully invited speakers and panelists from senior executives in Baidu, EMC, Huawei, Tencent and Intel.
- CMU Summit attracted over 500 participants across U.S. and from China. The event was featured in many medias including CCTV, Xinhua and Pittsburgh Post-Gazette and became an annual event since then.