Mobile & Cloud Computing Seminar

Pelle Jakovits

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https://mc.cs.ut.ee/
Course schedule

• Mondays at 12:15 – 13:45
  – Room: 1026 in Delta and Online in MS Teams

• Schedule of the sessions
  – Also submit your presentation slides, report, reviews through this web site

• MS teams chat for discussions, questions, and links to online meeting rooms
Aim of the seminar

• **Discuss research** in the Mobile, Cloud and IoT fields
• Introduce students to **newest advances** in these fields
• Provide an **overview of thesis topics** from Mobile & Cloud Lab
• Preliminary platform for **investigating prospective thesis topics**

• Get experience in **performing scientific literature search**
• Get experience in **making presentations**
• Get experience in **preparing technical reports** and **writing research papers**
Passing the seminar

- Choose a seminar topic
  - Introduce the topic to others
- Perform a literature search on the chosen topic
- Give a presentation on the topic
  - Teach other students the essence of the topic and its challenges
- Write a report on the chosen topic
  - 5 pages ACM double column format
  - Peer review the work of other students
- Participate actively in all the seminars
- Update seminar topic supervisor consistently
MOBILE & CLOUD LAB

RESEARCH DIRECTIONS
Cloud Computing

• Computing as a utility
  – Utility services e.g. water, electricity, gas etc
  – Consumers pay based on their usage

• Cloud Computing characteristics
  – Illusion of infinite resources
  – No up-front cost, Fine-grained billing

**Gartner:** “Cloud computing is a style of computing where massively scalable IT-related capabilities are provided ‘as a service’ across the Internet to multiple external customers”
Timeline

1990s

Grid Computing
- Solving large problems with parallel computing
- Made mainstream by Globus Alliance

Utility Computing
- Offering computing resources as a metered service
- Introduced in late 1990s

Software as a Service
- Network-based subscriptions to applications
- Gained momentum in 2001

Cloud Computing
- Next-Generation Internet computing
- Next-Generation Data Centers
Cloud Model management complexity

- **Own Hardware**
  - Applications
  - Data
  - Runtime
  - Middleware
  - Operating System
  - Virtualization
  - Servers
  - Storage
  - Networking

- **IaaS**
  - Applications
  - Data
  - Runtime
  - Middleware
  - Operating System
  - Virtualization
  - Servers
  - Storage
  - Networking

- **PaaS**
  - Applications
  - Data
  - Runtime
  - Middleware
  - Operating System
  - Virtualization
  - Servers
  - Storage
  - Networking

- **SaaS**
  - Applications
  - Data
  - Runtime
  - Middleware
  - Operating System
  - Virtualization
  - Servers
  - Storage
  - Networking
Emerging trends in cloud computing

- **Containers** – New type of virtualization technology with tiny memory footprint, lesser re-source requirement and faster startup
- **Edge & Fog Computing** – Computing at the edge of the network, Edge computing
- **Big Data** – Rapid escalation in the generation of streaming data from IoT and social networking applications
- **Serverless Computing** – Architectural pattern where the server is abstracted away and the resources are automatically managed for the user
- **Software-defined Cloud Computing** – Optimizing and automating the Cloud configuration and adaptation by extending the virtualization to compute, storage, and networks
- **Blockchain** – Distributed immutable ledger deployed in a decentralised network that relies on cryptography to meet security constraints
- **Machine and Deep Learning** – Algorithms and models for optimized resource management and ML services offered from Clouds
Internet of Things (IoT)

The Internet of Things allows people and things to be connected Anytime, Anyplace, with Anything and Anyone, ideally using Any path/network and Any service.

Internet of Things – Challenges

[Chang et al, ICWS 2015]

How to provide energy efficient services?

Sensors

[Chang et al, SCC 2015; Liyanage et al, MS 2015]

How to interact with ‘things’ directly?

Human

Appliances & Facilities

How do we communicate automatically?

Mobile Things

Tags
Cloud-based IoT

Remote Cloud-based processing

Connectivity nodes & Embedded processing

Sensing and smart devices

[Source: Srirama, CSIICT 2017]
Issues with Cloud-centric IoT

- Moving all data to cloud is slow and expensive.
- Issues with application autonomy in case of network failures
- Certain scenarios do not allow moving data to cloud

- Edge Computing
  - Processing data near the source
- Mist computing
  - Co-operative processing among the edge devices
- Fog computing
  - Processing across all the layers, including network switches/routers
- Edge/Fog process management and scheduling
- Serverless Edge Computing

What can be improved?
IoT Big Data analytics on cloud

• QoS guarantees of streaming data
  – Dynamic allocation and reallocation of resources

• Data pipelines
  – Orchestration of end-to-end data pipelines from data source to cloud
  – AWS Data pipeline, Apache NiFi

• Edge analytics

• Serverless Big Data Processing
  – Mist - Serverless proxy to Apache Spark
  – Distributed Data processing across Fog & IoT networks
Research Roadmap

Distributed data processing on the Cloud
E.g. MapReduce, Spark

Distributed data processing across the Cloud and Fog layers
E.g. Personalized data, privacy etc.

Fog topology management and scheduling the tasks
E.g. tasks run across the fog topology such as stream data processing, smart streetlights etc.

Edge analytics
E.g. filter, error detection, consolidation etc.

Intelligent sensors
E.g. vehicular networks

Cloud
Core Network
Edge Nodes
Fog
Gateways
End points
Mobile Computing

• Mobile Cloud Computing
• Today's mobiles have high performance
  – But issues with energy efficiency & battery life
• Invocation of web services from smart phone
• Mobiles as sensor platforms or Edge devices
• Mobile positioning (Indoor and Outdoor)
• Augmented Reality
Pelle Jakovits

- Lecturer of Distributed Computing

- **Topic fields:**
  - Real-time distributed data processing
  - Big Data in the cloud
  - Cloud Computing frameworks
  - IoT frameworks
  - FaaS at the Edge
Chinmaya Dehury

• Lecturer of Distributed Systems
• Topics:
  – Blockchain
  – DevOps
  – Machine learning models for Cloud resource management
  – Efficient task scheduling
  – IoT and Fog computing
Jakob Mass

• PhD student
• Adaptive Integration of Abundant Cyber Physical Systems for Reliable Internet of Things

• Topics:
  – Internet of Things
  – IoT Frameworks, Wireless protocols
  – BPMN models for managing IoT data and processes
  – Mobile computing
Shivananda Poojara

- PhD Student
- Design and orchestration of Scalable, Event-driven Data Pipelines
- Topics:
  - Data integration & pipelines
  - Predictive maintenance
  - Serverless computing at the Edge
  - Container/VM migration
  - Edge Analytics
Satish Sriama

Founder and Honorary head of the group
Seminar topics

• Topics are available at

• Session 2 (13 September)
  – Finalizing the seminar topic choices
  – Email jakovits@ut.ee and topic supervisor by 15 Sept

• Session 3 (20 September) -
  – Seminar talk by students about their topic
  – 5 min per person
  – Backed by slides
Further schedule

• 27.09 - How to perform literature search
• 11.10 - How to prepare and give presentations
• 08.11 - How to write reports, scientific papers, thesis
• 13.12 - How to review reports and scientific literature
• Possibly 1-2 more general seminar discussions

• In the meantime:
  – 25.10 to 6.12 - Student seminar talks, 2 per week.
  – One week before your presentation
    • Submit presentation structure/draft to topic supervisor for feedback
Deadlines

• **15.09** - Decide and notify which seminar topic you picked
• **11.10** - Literature review summary
• **22.11** - Initial structure, Introduction, background of the report
• **13.12** - Send completed report for peer review
  – **20.12** - Submit peer reviews
  – **10.01** - Modified, final report
Related Courses

• LTAT.06.009 - Mobile Computing and Internet of Things (6 ECTS) - Autumn semester

• LTAT.06.008 - Cloud Computing (6 ECTS) – Spring 2022
THANK YOU