Cloud Computing

Winter Semester 2019/2020

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- **Topics**
  - Distributed Systems, State Machine Replication, Distributed Consensus
  - Virtual Machine Introspection, Cloud-Honeypots
  - Edge-Computing, Cloud, Fog, Blockchain

- **Language**
  - Seminar paper and presentation must be done in English

- **Eligibility**
  - Mandatory seminar for Master Computer Science
  - Seminar for Bachelor Computer Science or Internet Computing

- **Seminar Form**
  - Conference seminar (practical work, paper submission, review process, conference presentation, camera-ready version)

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- **Registration**
  - Course 5888S (Bachelor) / 5889HS (Master) in Stud.IP

- **Topic Assigment**
  - Stud.IP registration will be activated after the general faculty presentation
  - You have to attend the topic assignment session
  - Students can choose their topic according to their registration time in Stud.IP (first come, first served)

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- **Contact**
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- **Dates**
    - **17.07.2019** Topic Assignment (**14:00, ITZ SR010**)
    - **17.10.2019** Introduction (**14:00, ITZ SR010**)
    - **24.10.2019** Scientific Writing (**14:00, tba**)
    - **12.12.2019** Paper Submission (**12:00, Online**)
    - **23.12.2019** Review Submission (**12:00, Online**)
    - **16.01.2020** Slides Submission (**12:00, Online**)
    - **23 & 24**.01.2020 Presentations (**tba**)
      You must attend all presentations on both days!
    - **02.03.2020:** Final Paper Submission (**12:00, Online**)

▶ **Snapshot analysis in public cloud infrastructures**
  ▶ Investigate feasiblilty of obtaining memory snapshots in various public IaaS/PaaS cloud infrastructures
  ▶ Snapshot analysis with standard tools (e.g., volatility), if necessary implement snapshot conververter

▶ **Reconstructing Java objects from memory snapshots**
  ▶ Investigate state-of-the-art approaches for reconstructing Java object instances from a main-memory snapshot

▶ **Revisiting memory introspection on nested hypervisors**
  ▶ Which up-to-date hypervisors support nested virtualization?
  ▶ How efficient is memory introspection in a nested system?

Memory introspection

- **VMI and KVM (rVMI)**
  - Test the functions of rVMI
  - Implement a simple VMI example that works with rVMI and libVMI
  - Measure the performance
- **Linux Containers**
  - Analyze isolation mechanisms
  - Document how docker uses them
  - Find out how Linux distributions and browsers make use of the isolation (systemd)
- **eBPF**
  - Start reading the original paper about the BPF used by iptables
  - How does the virtual machine for eBPF in the Linux Kernel work?
  - Get in touch with bcc and play around the performance measurement tools

Resilient Distributed Systems

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- **Byzantine Fault-Tolerant Systems under Attack**
    - Create a survey on which performance attacks exist
    - Implement a prototype of an attacking tool (that allows so simulate some attacks, used for benchmarking purposes) for BFT-SMaRt and evaluate your approach
- **HotStuff: BFT Consensus in the Lens of Blockchain**
    - Analyze the HotStuff protocol and outline its key contributions for blockchain infrastructures
    - Compare HotStuff with other BFT protocols such as PBFT, Tendermint and LibraBFT
- **Resilient Internet of Things Infrastructures**
    - Identify requirements IoT applications have in terms of dependability
    - Regarding the design of resilient IoT services: discuss where to place resilience mechanisms (e.g. redundancy) to increase dependability: sensor landscape - edge - clouds

▶ **Extensible State Machine Replication**
  ▶ Analyze the BFT-SMaRt protocol as well as code injection techniques
  ▶ Integrate hooks into the BFT-SMaRt library to make it easily extensible

▶ **Load Control in Distributed System Evaluation**
  ▶ Analyze the requirements for dynamically limiting the system load to a saturated level
  ▶ Sketch an architecture, Implementation/Evaluation

▶ **Hot-Plugging Hardware Resources in Cloud environments**
  ▶ Analyze the hot-plugging support in current hypervisors and cloud management platforms
  ▶ Sketch an architecture, Implementation/Evaluation

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1. Snapshot analysis in public cloud infrastructures (1 student)
2. Reconstructing Java objects from memory snapshots (1 student)
3. Revisiting memory introspection on nested hypervisors (1 student)
4. VMI and KVM (rVMI) (1 student)
5. Linux Containers (1 student)
6. eBPF (1 student)
7. Byzantine Fault-Tolerant Systems under Attack (1 student)
8. HotStuff: BFT Consensus in the Lens of Blockchain (1 student)
9. Resilient Internet of Things Infrastructures (1 student)
10. Extensible State Machine Replication (1 student)
11. Load Control in Distributed System Evaluation (1 student)
12. Hot-Plugging Hardware Resources in Cloud environments (1 student)