Practical Lab

Cloud Systems Engineering

(cloud-lab)

Preliminary meeting

Chair of Decentralized Systems Engineering
https://dse.in.tum.de/

Welcome to the cloud lab!

Your instructors

Simon Ellmann

Dimitrios Stavrakakis

Dimitra Giantsidi

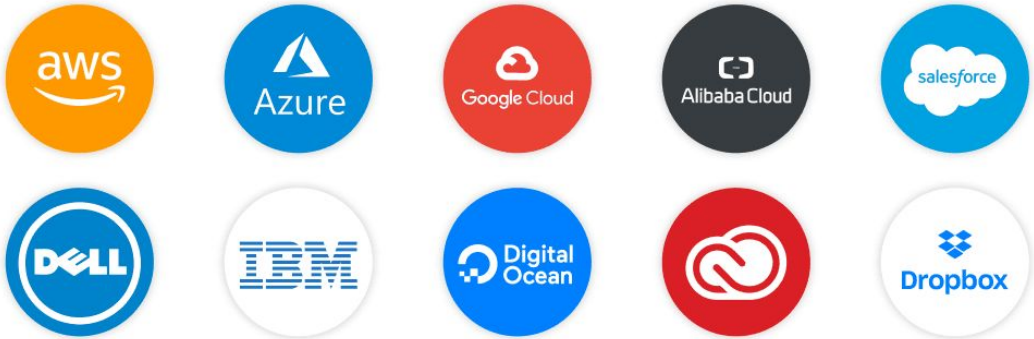
Jiyang Chen

Maurice Bailleu

Joerg Thalheim

Cloud computing

- Cloud computing is powering the Internet
  - Large-scale computing resources
  - On-demand and cost effective
  - Geo-distributed data centers



Motivation: Cloud systems engineering

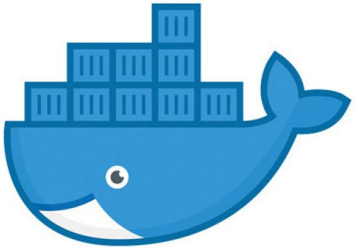
- Cloud systems
  - Modern cloud systems handle millions of users and TBs of data
  - Cloud software systems employ large geo-distributed data centers
- How can we build cloud systems that …
  - … scale seamlessly?
  - … are highly available?
  - … are fault tolerant?
  - … are easily configurable?
  - … are easily maintained?
- Cloud systems engineering aims to achieve all the above in a cost-effective manner

Our focus: Learning goals

- Part I: Cloud systems workflow
  - Container: How to build applications using containers?
  - Cluster orchestrators: How to deploy jobs?
- Part II: Distributed systems system architecture
  - Sharding / re-configuration of servers
  - Fault tolerance / replication
  - Consistent hashing
  - Consistency
  - Transactions / data management
  - Distributed locking / synchronization
  - Concurrency and high-performance architectures
  - Fault detection
  - Configuration management

Learn by building an end-to-end system!

Technologies



kubernetes

APACHE
ZooKeeper™

RocksDB

Format

- A set of four programming tasks:
  - Each related to a different aspect of distributed systems
  - Built on top of each other, like a stack
- For each task, we will provide
  - Necessary background via a lecture
  - Q&As: after lecture and online via Slack
- Submitted tasks will be evaluated by
  - Automated grading system
  - Instructors

Layered architecture

#4: Distributed TXs: w/ and w/o replication

#3: Replicated distributed KVS

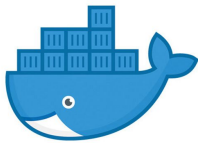
#2: Distributed KVS

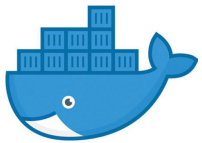
#1: Single-node KVS

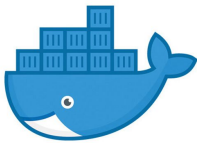
#1: Single-node KVS

...

#1: Single-node KVS







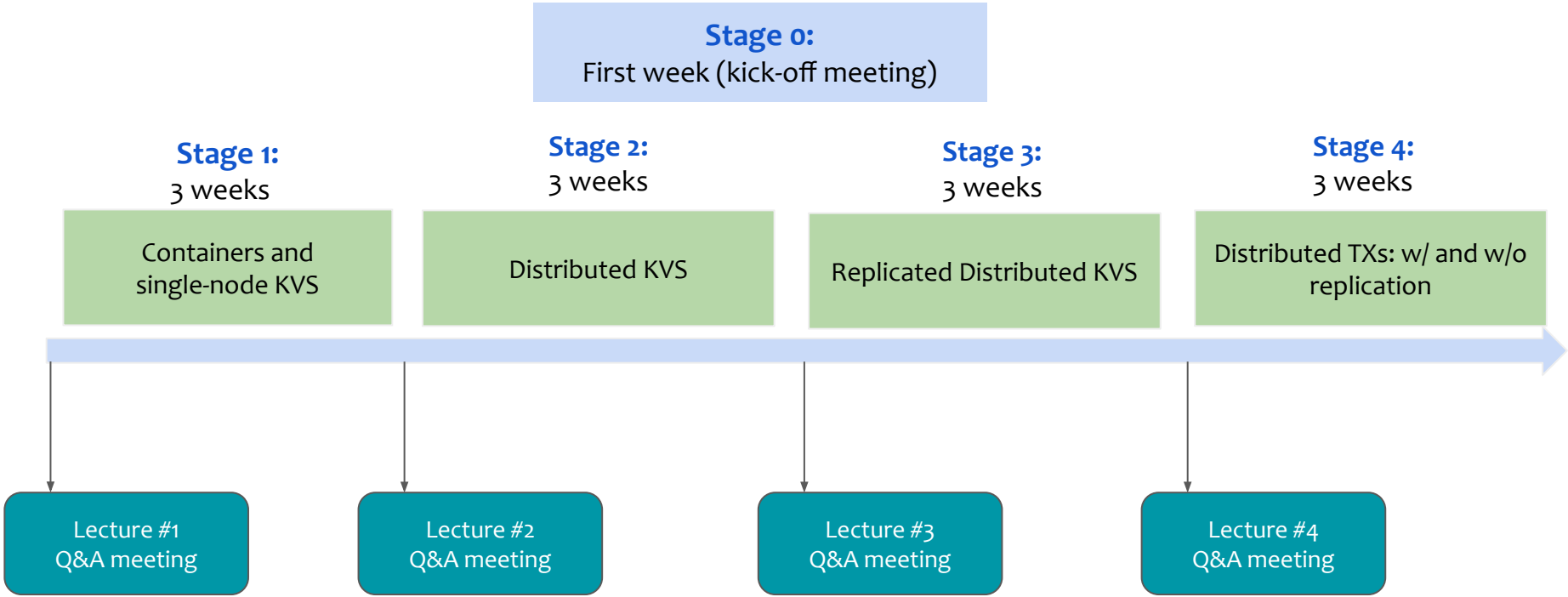
kubernetes

APACHE ZooKeeper™

Grading

Lecture	Category	Details	Grade
#0	Kick-off meeting	Introduction Write a client-server application	10%
#1	Single-node KVS setup	Build and deploy a single node KVS	20%
#2	Distributed KVS	Shard the keys across multiple nodes: fault detection and server reconfiguration	20%
#3	Replicated distributed KVS	Replicate the KVS instances across these nodes for fault tolerance	20%
#4	Distributed Transactions	Support distributed transactions across keys and nodes: w/ and w/o replication	30%

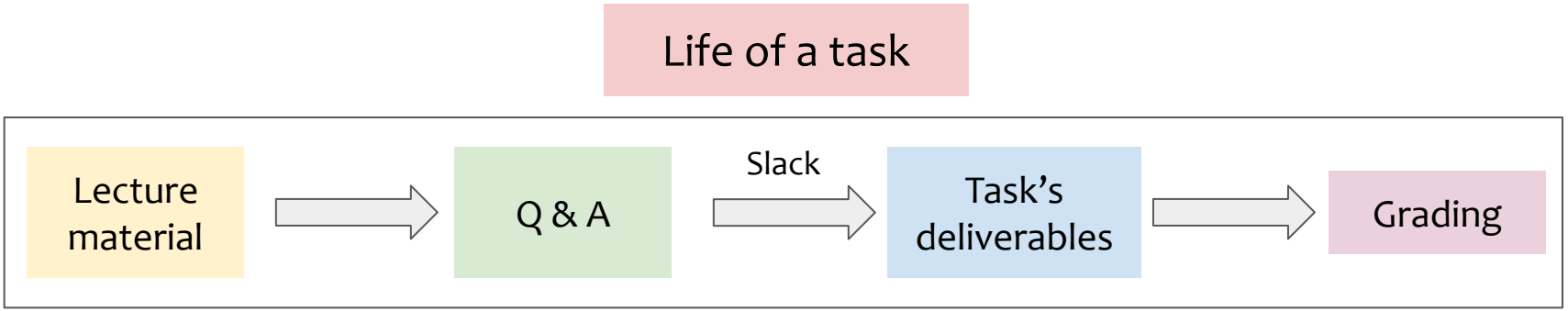
Timeline


Stage 0:
First week (kick-off meeting)
Stage 1:
3 weeks
Containers and single-node KVS
Stage 2:
3 weeks
Distributed KVS
Stage 3:
3 weeks
Replicated Distributed KVS
Stage 4:
3 weeks
Distributed TXs: w/ and w/o replication
Lecture #1 Q&A meeting
Lecture #2 Q&A meeting
Lecture #3 Q&A meeting
Lecture #4 Q&A meeting

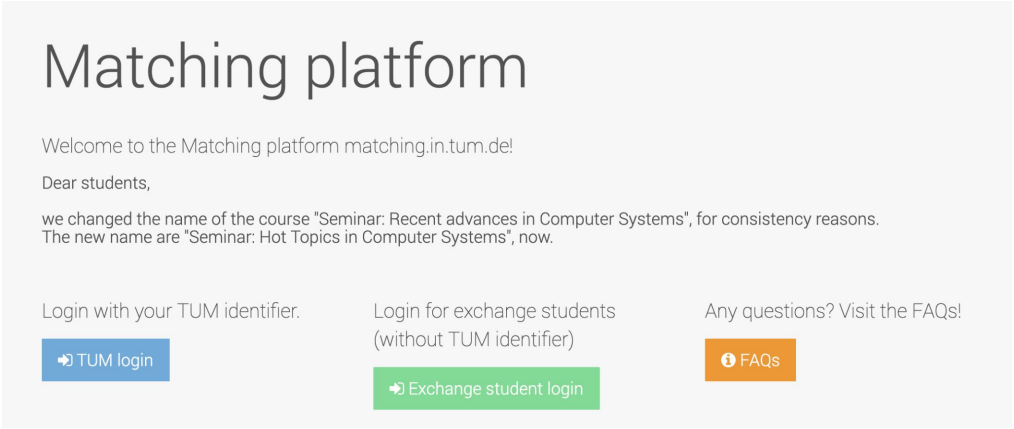
Organization

- Four lectures
  - One before each task – Recorded videos
    - Necessary material and deliverables will be explained
  - Q&A – Online on Thursdays via Zoom
- Online help
  - Slack channel will be monitored by the instructors/tutors

- Format:



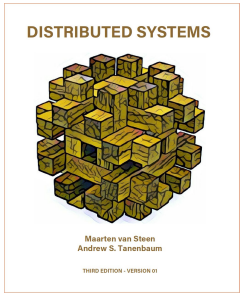
Interested?



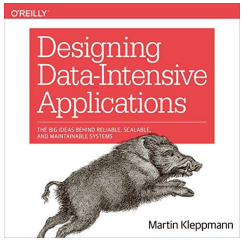
Sign up on the TUM matching platform

Recommended readings

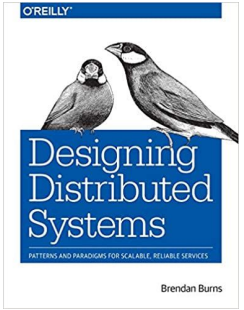
“Distributed Systems”
— Maarten van Steen and Andrew s. Tanenbaum



“Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems”
— Martin Kleppmann



“Designing Distributed Systems: Patterns and Paradigms for Scalable, Reliable Services Book”
— Brendan Burns



Code of conduct

- University plagiarism policy
  - https://www.in.tum.de/en/current-students/administrative-matters/student-code-of-conduct/

- Decorum
  - Promote freedom of thoughts and open exchange of ideas
  - Cultivate dignity, understanding and mutual respect, and embrace diversity
  - Racism and bullying will not be tolerated

Contacts

- Simon Ellmann
  - simon.ellmann@tum.de
- Prof. Pramod Bhatotia
  - pramod.bhatotia@in.tum.de

Workspace: http://ls1-courses-tum.slack.com/

Website: https://dse.in.tum.de/

GitHub: https://github.com/TUM-DSE/cloud-lab/

Channel: #ws-22-cloud-lab

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