Chair of
Distributed Systems and Operating Systems

Sept 2020 --- present

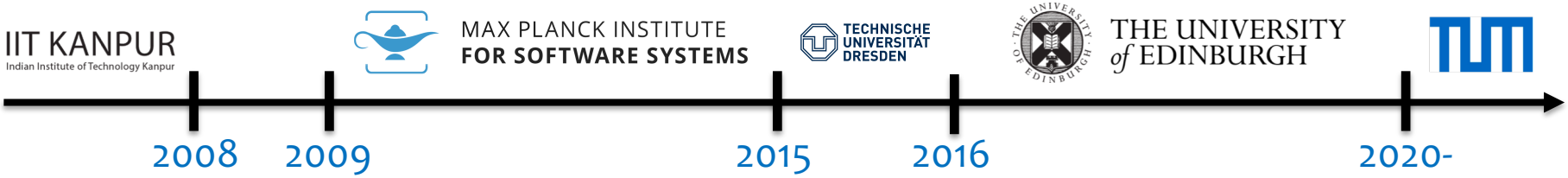
Prof. Pramod Bhatotia
Technical University of Munich
https://dse.in.tum.de/

Chair overview, 16th Dec 2022

Chair Professor

Prof. Pramod Bhatotia

- Full Professor at TUM (Sept 2020 ---)
  - Full Professor at the University of Edinburgh, UK (Jan 2021 ---)



IBM Research · Adobe · YAHOO! RESEARCH · Microsoft Research · NOKIA Bell Labs · HUAWEI

Chair's mission

Mission statement:

To excel in"systems research"!

Impact statement:

We seek impact through people, teaching, research publications, and open-source projects

Outline

#1: People

#2: Teaching

#3: Research

#4: Open-source

#1: People
(“The Team”)

The first retreat (2021) w/ Prof. Bruegge

Skiing retreat (2022)

Second retreat (2022)

Team

Chair consists of ~15 members

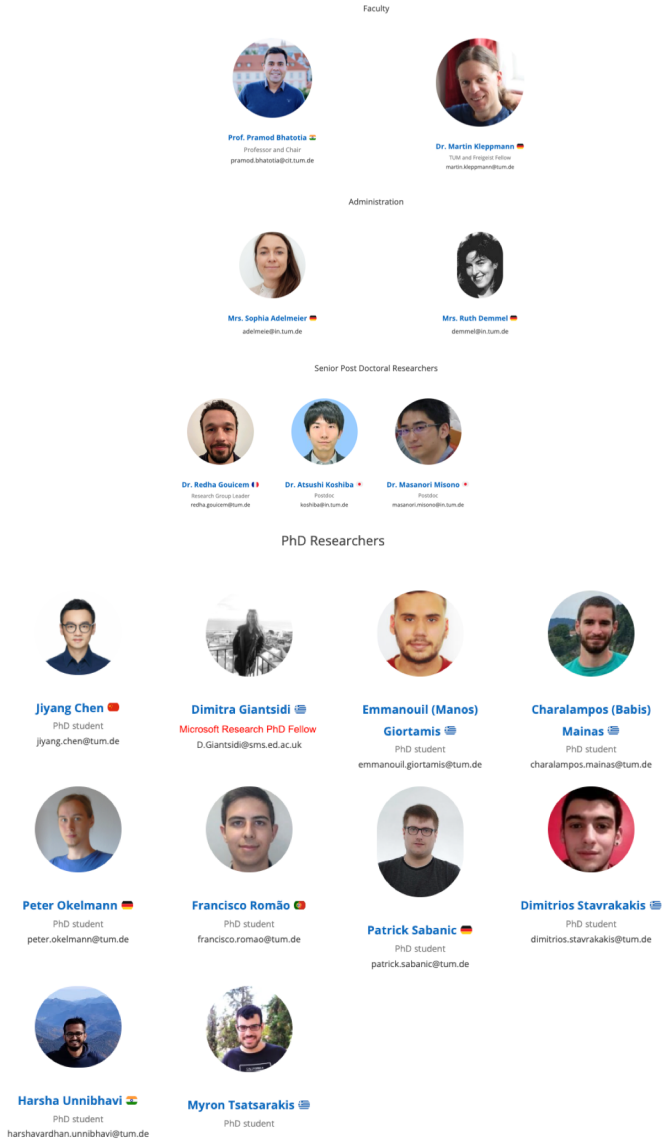
- 2 Faculty members
- 3 Senior researchers
- 10 PhD students
- 2 Administrative staff

Full list of staff members

- https://dse.in.tum.de/team/

Diversity

- 10+ different nationalities



Adjunct faculty and alumni

- **3** Adjunct faculty members
  - Marco Elver (Google)
  - Antoine Kaufmann (MPI)
  - Anjo Vahldiek (Intel)

Adjunct Faculty

Dr. Marco Elver
Google
marco.elver@in.tum.de

Dr. Antoine Kaufmann
MPI-SWS
antoine.kaufmann@in.tum.de

Dr. Anjo Vahldiek-Oberwagner
Intel Research
anjo.vahldiek@in.tum.de

- Alumni:
  - 3 PhD students
    - Intel Labs
    - Huawei Research
    - Microsoft Research/NiXOS
  - 2 Post-doc
    - Oracle Labs
    - Huawei Research
  - 1 Staff
    - Helma Schneider (retired)

Alumni

Dr. Dmitrii Kuvaiskii (PhD)
Intel Labs
PhD thesis: *Hardware-Assisted Dependable Systems*
(Summa Cum Laude)

Dr. Le Quoc Do (PhD)
Huawei Research
PhD thesis: *Approximate Data Analytics Systems*
(Summa Cum Laude)

Dr. Shady Issa (Postdoc)
Oracle Labs

Dr. Jörg Thalheim (PhD)
NIX OS Consulting
PhD thesis: *Dependable Virtualised Systems*

Dr. Rodrigo Rocha (Postdoc)
Huawei Research

Mrs. Helma Schneider (Technician)
Retired

Matthias Hille (PhD)
Barkhausen Institut

Maurice Bailleu (PhD)
Microsoft Research PhD Fellow
M.Bailleu@ed.ac.uk

Graduating team members

Redha Gouicem
(Post-doc)

[ASPLOS'23] [PLDI'22]
[EuroSys'22]

Associate Professor (W2)
at RWTH Aachen

Maurice Bailleu
(PhD student)

[FAST'19] [DSN'19] [USENIX ATC'21]
[DSN'22] [USENIX ATC'23] *

Matthias Hille
(PhD student)

[USENIX ATC'19]
[EuroSys'22] [USENIX ATC'23] *

Research funding

Our research work is supported by:

Government organizations

- **German** (TUM, DFG, BMBF, Bayern, DAAD)
- **UK** (EPSRC, GCHQ/NCSC, Alan Turning Institute)
- **EU** (ERC)

Industry partners

- Microsoft Research, Arm, Amazon, Google

Non-profit foundations

- Volkswagen (M. Kleppmann), Humboldt

Affiliations

The Alan Turing Institute

RESEARCH INSTITUTE FOR SECURE HARDWARE & EMBEDDED SYSTEMS

Munich Data Science Institute (MDSI)
TU Munich

MIRMI
An Integrative Research Institute of TUM

[UK association]

[Interdisciplinary centers @ TUM]

6G-life

Munich Quantum Valley

relAI
Konrad Zuse School of Excellence in Reliable AI

CDTM CENTER FOR DIGITAL TECHNOLOGY AND MANAGEMENT

UnternehmerTUM VENTURE LABS

[Collaborative projects @ TUM]

[Entrepreneurship eco-system @ TUM]

nfdi Nationale Forschungsdaten Infrastruktur

SPP 2377
DISRUPTIVE MEMORY TECHNOLOGIES
DFG PRIORITY PROGRAM 2377

[DFG funded projects]

Hardware resources

All servers/hardware resources are publicly listed, and self-managed:

https://github.com/TUM-DSE/doctor-cluster-config/tree/master/docs/hosts

We primarily support four architectures:

#2: Teaching

Teaching

Lectures:

- **MSc:** Distributed systems (700+ students)
- **BSc:** Introduction to software engineering (2200+ students)

Practical labs:

- Systems programming (100+ students)
- Cloud systems engineering (75+ students)
- Computer systems lab (40+ students)

Seminars:

- (2x) System seminar (24 students)
- (2x) ”Topical” seminar (24 students)

Practical labs

Lab A: Systems programming
https://github.com/ls1-sys-prog-course

Lab B: Cloud lab
https://github.com/TUM-DSE/cloud-lab

Lab C: Systems lab
https://github.com/TUM-DSE/sys-lab

Lab A: Systems programming lab

- A set of 9 programming assignments
  - OS kernel and syscall
  - Filesystem
  - Processes
  - Concurrency and synchronization
  - Memory management
  - Network/socket programming
  - Performance/perf
  - Container + virtualization
  - LLVM compiler pass + runtime lib

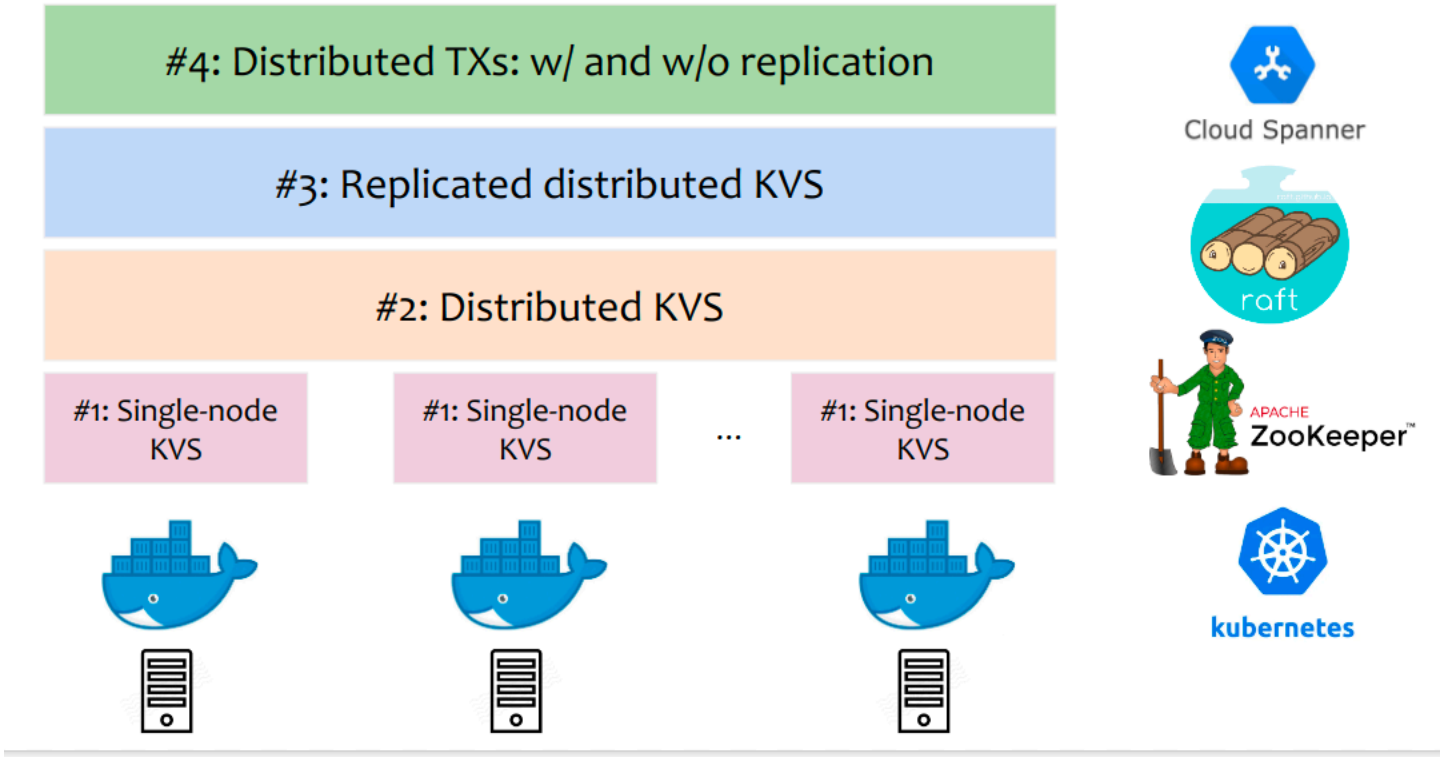
https://github.com/ls1-sys-prog-course

Lab workflow

Lab B: Cloud lab

- A set of 4 programming tasks

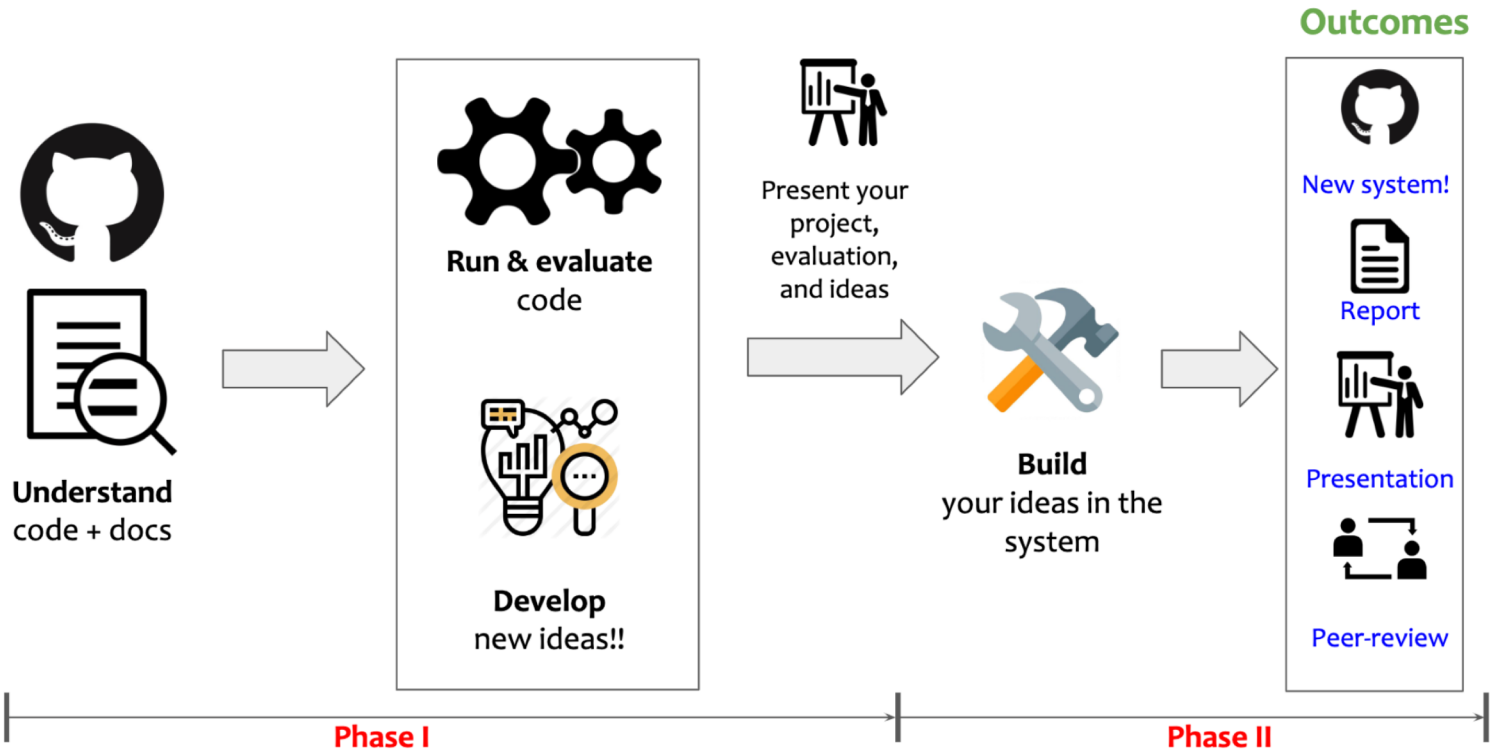
https://github.com/TUM-DSE/cloud-lab

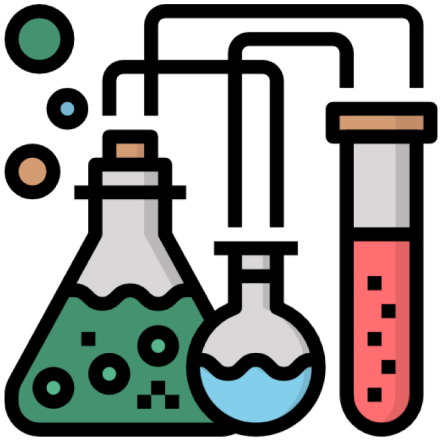


Lab C: Systems lab

- A project-oriented systems research lab

https://github.com/TUM-DSE/sys-lab





#3: Research

Research

We do systems research:

- *We like to design, build, break, and evaluate systems!*

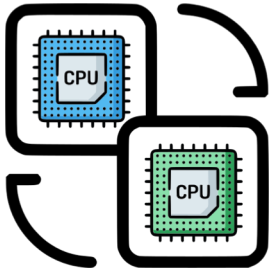
Research areas:

- Distributed systems
- Operating systems and virtualization
- Cloud computing and scalable data analytics
- Storage and networked systems
- Reliability and security

Hardware-assisted software systems

Hardware-software co-design systems

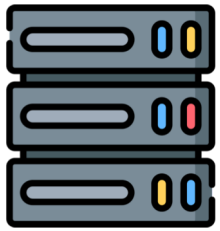
Active research projects



Weak memory architectures/memory model

--- Binary translation for strong-on-weak architectures: x86 -> Arm/RISC-V [PLDI'22] [ASPLOS'23]

--- Linux kernel memory model



OS/Virtualization: Lightweight, secure, and reliable

--- Virtual machines [EuroSys'22] (Artifact award paper!)

--- Unikernels [USENIX ATC'23]*

--- Containers/Cluster orchestration engines

Hardware security: Silicon root of trust

--- HW/OS for secure accelerators

--- Trusted NIC architecture + distributed systems [DSN'22] (Award paper!)

--- Trusted disaggregated systems

--- Policy compliance systems [SIGMOD'22]

Active research projects

FPGA-accelerated systems

--- OS support for (heterogenous) FPGAs
--- I/O support for FPGAs
--- Serverless support for FPGAs

Emerging memory technologies

--- Persistent memory [EuroSys'22] (Artifact award paper!)
--- Compiler-assisted memory management
--- CXL-based interconnects (DFG SPP)

System software for quantum computing

--- QVM: Quantum Virtual Machine
--- QOS: Quantum Operating System

Open-source impact

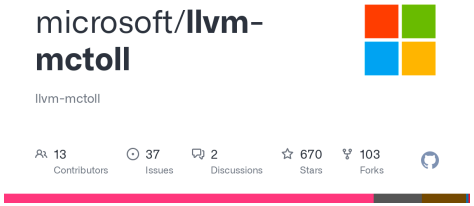
Open-source impact (2020 --)

All projects are publicly available:

- https://dse.in.tum.de/publications/

NixOS

Maintainer of Linux distribution



Microsoft's Binary lifting tool

arm

Arm memory model

QEMU

QEMU binary translator

Unikraft

Unikraft unikernel OS shell

Linux memory model

LLVM sanitizer

intel

Intel PMDK

docker

The Cntr project

intel SGX Tool

Intel SGX-LKL

Department of Computer Science, TUM

Interested in joining us?

- Life of a PhD student
  - To pursue impactful research projects
  - Actively publish papers in top systems conferences
  - Publish your code in open source and build a community
  - Participate in teaching lectures, labs, and seminars
  - Supervise BSc/MSc projects (build a community/team around your research projects)
  - Travel the world, yes paid by your advisor!
  - Enjoy happy and healthy life in Munich and the Alps!
- Benefits
  - TVL-13 (100%) salary, around 55,000 Euros salary
  - Pension and health insurance contributions
  - State-of-the-art office spaces, research infrastructure, and a top university
  - Fully sponsored conference trips
- Please contact Prof. Bhatotia
  - pramod.bhatotia@cit.tum.de