

TDDD25

Distributed Systems

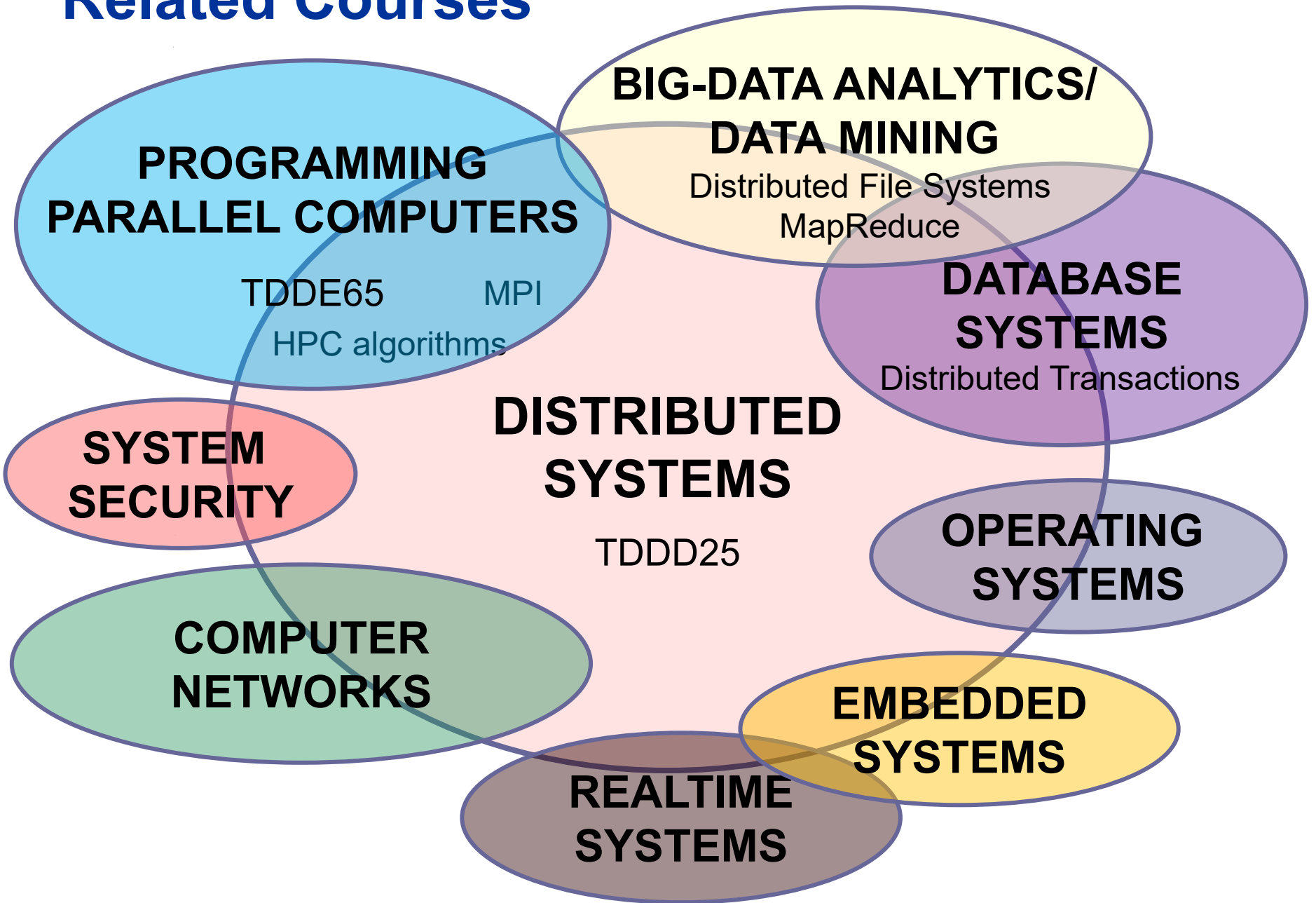
Outlook

Christoph Kessler

IDA
Linköping University
Sweden

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Related Courses

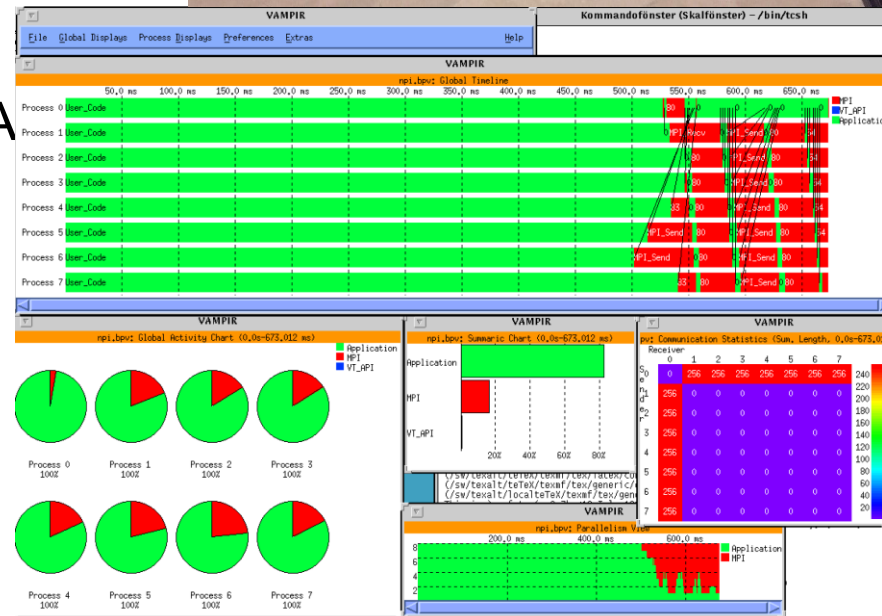
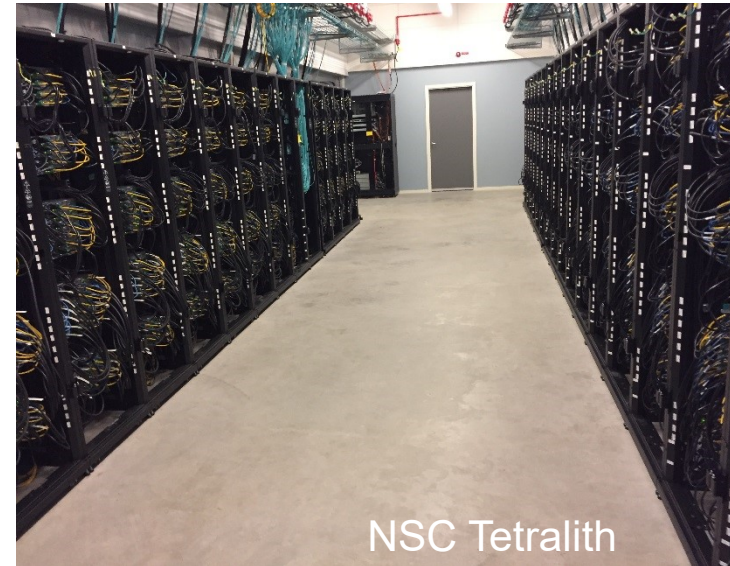


Distributed Parallel Computing in TDDE65

Programming parallel computers – methods and tools, 6hp, vt2

E.g.,

- **Cluster architecture** for high-performance computing
 - High-end nodes, scalable networks
- **Message Passing Interface (MPI)**, including
 - Collective (group) communication
 - One-sided communication (RDMA)
- **Distributed parallel algorithms**
 - esp., basic linear algebra computations
- **Cost models** for communication in distributed computations
- **Labs** on NSC cluster Sigma



Outlook:

The Edge-Cloud Computing Continuum

Current research project at IDA:

Adaptive Software for the Heterogeneous Edge-Cloud Continuum (ASTECC)



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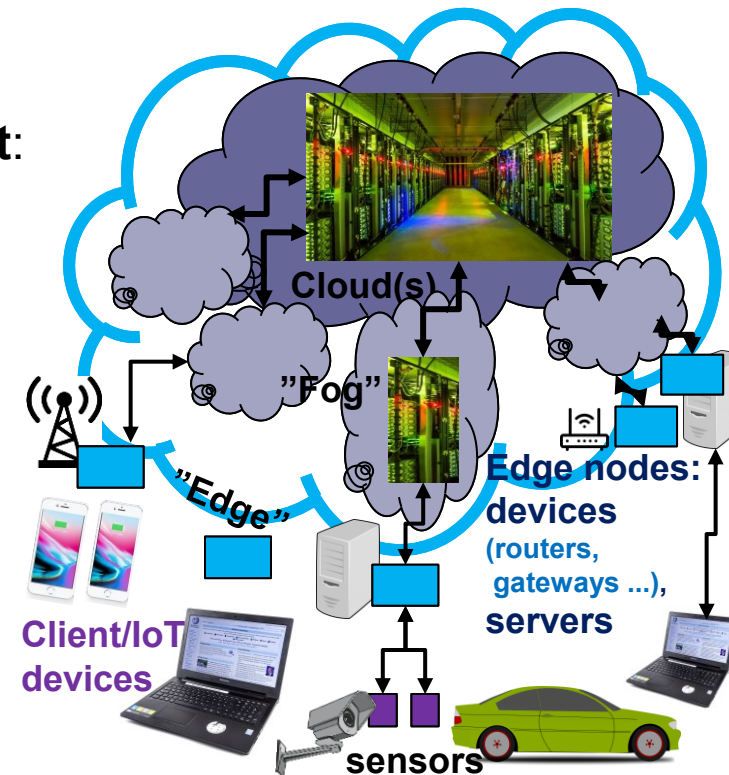
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The heterogeneous edge-cloud continuum

- **Cloud computing:** centralized processing and storage is convenient, but faces fundamental problems in scalability, energy efficiency, privacy, safety (real-time guarantees), and security
 - Variations: private clouds; fog computing; ...
- Trend towards **edge computing as a complement:** process / store data closer to where it originates – at the edge of the network
 - **Edge nodes** (devices / servers / resources)
 - + Data locality, network traffic efficiency, energy-efficiency, privacy
 - Resource-constrained, e.g. memory (RAM/Flash), battery, cooling capacity, size
- Lots of **distributed** heterogeneous device, edge and cloud resources from different administrative domains aggregated to the **“heterogeneous edge-cloud continuum”**
 - No central manager, no shared memory
 - Portability challenges
 - **Multi-provider, multi-tenant** resources
 - **Dynamic, multi-application, multi-criteria** execution scenarios
 - Complex **multi-service** applications



Vision: Autonomous adaptive software for the heterogeneous edge-cloud continuum

- Uniform specification and tool/system support for **portable, autonomous, resource-efficient adaptive** execution of applications over the entire continuum
 - The **programmer** specifies *what* to do, the objectives (e.g. QoS) and other constraints for execution
 - The **system** decides *where* to execute, *when* and *how* to migrate tasks, move data etc.
- Equip application software components/microservices, their **interfaces** and their compositions to **workflows** with sufficient **metainformation** about own structure and **adaptivity options with exploitable trade-offs** to support its autonomous execution in the continuum
- **Virtual execution environment** in the continuum
 - **Distributed monitoring**
 - ▶ load on resources, QoS, new tasks, changing requirements, intrusion/threat detection, ...
 - ▶ no shared memory, no central coordinator
 - **Prediction**
 - **Orchestration and distributed resource management**
 - ▶ (self-)adaptation/reconfiguration, resource allocation, mapping, scheduling, migration, ...
 - ▶ Coordinating adaptation mechanisms of different layers in the SW/HW stack
- **Security by design**
 - Application security
 - System security

Outlook:

The Edge-Cloud Computing Continuum

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Adaptive Software for the Heterogeneous Edge-Cloud Continuum (ASTECC)



- <https://astecc.gitlab-pages.liu.se/>
- Funded by SSF in the *Future Software Systems* programme
- Methods for the design, automated orchestration and dynamic adaptation of software to enable its autonomous, efficient and secure execution in dynamic, heterogeneous, **distributed** device-edge-cloud environments, i.e., in multi-provider, multi-service, and multi-criteria scenarios, without relying on a global resource manager.
- Cooperation by 4 research groups from IDA
- 4 industrial domains for use cases: computer networks and applications, smart energy grids, automotive, aviation
- **Final thesis projects available!**