Advanced Seminar: Distributed Systems
Trends in Distributed and Context-Aware Systems

Distributed systems are a corner stone of many services today. Distribution provides scalability of cloud services, implemented atop a massive number of servers. For instance, Google's data centers host an estimated 2.5 million servers! At the same time replicating functions and data ensures reliability. This does not only apply to cloud services, but also to peer-to-peer networks as used for instance by the Bitcoin network and mobile systems such as vehicular networks or networks of unmanned aerial vehicles. As in the example in Figure 1, such mobile systems are inherently distributed geographically and are supported by edge cloud services located close to the mobile devices to reduce network latency. Last but not least, the Internet is evolving into an Internet of Things (IoT), where virtually everything can communicate through the Internet.

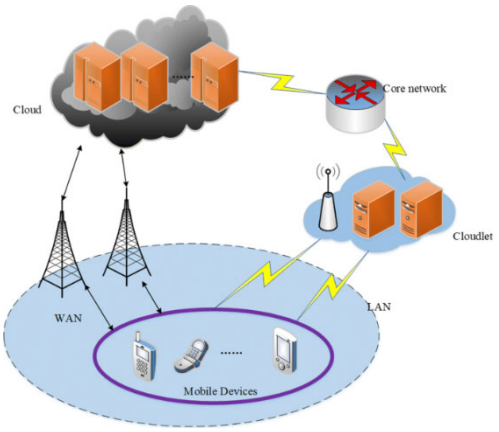

Figure 1: Energy- and cost-aware computation offloading approach

© Kai Peng et al., 2019: https://doi.org/10.1186/s13638-019-1526-x

Such distributed systems come with many challenges, as pointed out by Urs Hölzl (Senior Vice President for technical infrastructure at Google): "At scale, everything breaks ... Keeping things simple and yet scalable is actually the biggest challenge. It's really, really hard." Other challenges include consistency of replicated services, privacy, and protection against attacks if untrusted devices are involved.
Adaptation is one of the key mechanisms that enable distributed systems to cope with the demands of increasingly dynamic environments. Figure 2 shows an example of a system that monitors the user's context and adapts its layout and functions to provide a more efficient interaction.

Figure 2: Example of an adaptive user interface that monitors and tracks the user's interactions to provide assistive functionalities.

© Mainak Biswas, 2013: https://www.indusnet.co.in/what-is-an-adaptive-system-and-how-can-it-enhance-user-experience/

In this seminar, we take a deep dive into specific distributed and context-aware systems concepts that tackle the above challenges.
Some topics that might be covered include distributed ledger systems, consensus concepts, mobile sensing services, edge cloud services supporting resource-constrained devices, acquiring and using context information for adapting the appearance and/or functionality of systems. The final list of topics will be published on the course website.

Language
English

Organization
The seminar is organized in the style of a scientific conference. To pass the seminar, students must complete all of the accompanying activities: Following the submission of a written paper on the assigned topic, students write reviews for other seminar papers and participate in a final presentation session where they present their work and discuss the work of others. Attendance at the kick-off and final presentation session is mandatory.
Topics will be published on the course website and are assigned according to a standardized procedure as explained during the kick-off session.

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