Advanced Software Engineering is the application of engineering principles to software development. It is the process of analyzing user needs and designing, constructing, and testing end user applications. Those principles have been used for complex software systems, which run businesses of organizations.

System engineering is broadly divided into functional requirements and non-functional requirements. The functional requirements define specific behavior or function (what a system is supposed to do?). Non-functional requirements specify criteria that can be used to judge the operation of the system, rather than specific behaviors (how a system is supposed to be). Non-functional requirements are often called Quality Attributes of the system.

The quality attributes of a system can be categorized as follows:

1. Evolution qualities, such as performance, maintainability, extensibility, scalability, testability etc.
2. Evolution qualities, such as elasticity, safety, security, usability etc.

Ensuring the quality is crucial in several domains such as online banking, e-commerce, online booking and reservation, car and airplane control systems, remote surgery, high availability systems, such as e-mail servers, or adaptive systems, such as cloud computing controllers. Software quality verification and forecasting are branches of software engineering concerned with the assurance of requirements satisfaction during both development and production phases. A broad range of techniques are involved in verification and forecasting.

This seminar will focus on:

- **Self-adaptive Cloud systems**: Due to the complex characteristics of self-adaptive cloud system, these systems are not easily testable. Therefore, we investigate more on testing strategy.
- **Systematic testing**: Methods for automatic test case generation, including model-based testing, random testing, mutation testing, search-based techniques, non-functional testing.
- **Software analysis**: symbolic execution, abstract interpretation, anti-patterns detection.
- **Model-based prediction**: workload prediction, software performance monitoring and prediction, modeling attacker behavior.
- **Continuous software engineering and DevOps**: Continuous Delivery, live experimentation, chaos engineering.
- **Statistical forecasting and machine learning**: online failure prediction, proactive failure management, cyber security analytic, cyber defense and situational awareness.

Bachelor students who want to attend this seminar should be interested in some, but not necessarily all of the following topics: critical systems design, formal methods, software
performance, statistical and machine learning methods, as well as basic notions on logics, probability, testing, object-oriented programming, and a high interest in system analyses tools.

Language: English

Organizational Matters: Seminar will be on the Bachelor level with dedicated blocks for introduction (2-3 sessions) at the beginning of the term and seminar presentations at the end of the lecture period.

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Topics: Topics will include:
Self-adaptive Cloud systems
Systematic testing
Software analysis
Model-based prediction
Continuous software engineering and DevOps
Statistical forecasting and machine learning