ETH
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TIK
Institut für Technische Informatik
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Computer Engineering and
Networks Laboratory

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Semester Thesis:

I Bet My Plane Won't Crash

Motivation and Informal Description: Mixed Criticality systems are real-time systems that feature tasks of different criticality (or importance) levels, executing together on a common hardware platform. This makes these systems particularly interesting for e.g. avionics and automotive industries. In these industries there is a trend of consolidating different applications on the same hardware platform, to reduce the cost and size of ever more complex products. However, this integration brings challenges, as different levels of guarantees need to be given to tasks of different criticality levels. For example, in the avionics industry, Mixed Criticality scheduling has to guarantee that probability-of-failure-per-hour values for each criticality level is in line with existing standard specifications.

To provide such guarantees, the real-time community has traditionally used an abstraction called worst case execution time (WCET). In a nutshell, WCET analysis focuses on finding and analyzing the case with the longest possible execution time. However, due to the increasing complexity of modern hardware platforms, WCET based analyses has become increasingly pessimistic. As an alternative to this approach, an exotic paradigm has emerged which represents the execution time of a task as a random variable. This abstraction allows us to represent the likelihood of execution time values, allowing a less pessimistic analysis. This new approach can allow us to construct Mixed Criticality systems that are not over-provisioned, and still respect the corresponding industry standards.

This thesis is about learning theoretical concepts and applying them to build a stochastic analysis framework. You are expected to:

- Familiarize yourself with the state of the art Mixed Criticality scheduling techniques. (Including methods to guarantee a smaller probability of deadline miss for higher criticality tasks.)
- Explore probability theory, and the way it can be applied to real-time theory. (Especially Markov processes, Monte Carlo methods.)
- Build a framework that analyzes average and worst-case response times of sample task sets. This analysis can determine probabilities of deadline misses, for a Mixed Criticality system with two criticality levels. Your framework should be able to compare scheduling policies (i.e. EDF, Fixed Priority), and different policies for favoring higher criticality tasks (i.e. killing lower criticality tasks when higher might miss their deadline).

Requirements: You should have basic knowledge in Embedded Systems (scheduling), and high level programing. You should be motivated to work independently. Some familiarity in probability theory is an asset.

Interested? Please have a look at http://www.tec.ethz.ch/research.html **and contact us for more details!**

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