EEE 598: System-Level Design for Multicore Architectures

This course is an in-depth introduction to multicore computing architectures ranging from low-power multiprocessor systems-on-chip (MpSoC) to high-performance chip-multiprocessors (CMP). This course covers the fundamental topics on modeling, analysis and optimization of multicore systems. This course does not only address cross-cutting design problems common to both MpSoCs and CMPs, but also underlines their distinct characteristics. Particular attention is given to low-power and communication-centric design of multicore systems.

The first half of the course is theory oriented, while the second part is project oriented to provide extensive hands-on experience. During the first part, the students receive classical homework sets and a midterm test. In the second half, teams of three to four students need to complete a project with clearly defined milestones. The students can select their project from a list of suggested pool of projects or define their own project, which is aligned with the course topics.

Prerequisites: EEE 425/591 Digital Systems and Circuits
Background in HDL, Matlab and C++, and passion for analytical modeling and optimization are required.

Course Topics: Topics to be covered include models of concurrency and embedded applications, network-on-chip communication, many-core architectures, cache hierarchy, performance analysis, scheduling, low-power and reliable design, dynamic power and thermal management, clocking. From a practical standpoint, the course explores the use of hardware description languages (HDLs), FPGA prototyping, C++/SystemC and embedded multiprocessor platforms to implement complex applications.

Textbook: There is no required textbook. Research papers will be assigned throughout the semester. Optional reference books are:

1. Umit Y. Ogras and Radu Marculescu. Modeling, Analysis and Optimization of Network-on-Chip Communication Architectures. Lecture Notes in Electrical Engineering, Vol. 184, Springer, 2013.
2. William Dally and Brian Towles. Principles and Practices of Interconnection Networks. Elsevier, 2004.
3. Jose Duato, Sudhakar Yalamanchili, and Lionel M. Ni. Interconnection Networks: An Engineering Approach. Morgan Kaufmann, 2003.