2110793 Advanced topics in digital systems 2009

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Course description (official)

State of the art and current interest in digital systems.

lecture 3 hours per week

webpage of the course:
http://www.cp.eng.chula.ac.th/~piak/teaching/ads/ads2009/index.htm

This series of lecture aims to integrate the knowledge of building a computer system from the most bottom level: functional units, data path, microprogram, to the highest level: operating system, high level language and application programs. An executable abstract language is used to as a mean to explore all levels.

This course offers a "hand-on" approach. Students go through series of building and modifying a "system" simulator. The system simulation composed of: an instruction-level processor simulator, a compiler, a profiler, a real-time operating system includes task switcher and message passing. Real-time concurrent application programs such as multiple clocks will be run on this operating system. Obviously, to achieve the intended goal, the "breath" of exploration must be limited. The system will be rather modest in size but completed for the purpose of study.

The students will learn:

* How the instruction set affects the performance
* How to instrument the simulator to measure it
* How a compiler generates codes for a processor
* What operating system functions affect an instruction set
* How to support special functions through the design of instructions

The outline of the lecture is:

* instruction set
* microprogramming level
* high level language
* code generation
* performance measurement
* code optimisation
* kernel of OS
* task switcher
* running an OS on a processor simulator
* real-time OS

For students who prefer software or system building, this course can give an insight into how operating systems and high level languages work down to the clock-by-clock level. Code optimisation at a realistic level can be explored, based on the simulated processor, everything can be measured and modified.

For students who are inclined for hardware-related projects, the processor in this course can be implemented in a real FPGA. The chip will be able to run all programs illustrated in this course (but this is not required in the study!).

Assessment

weekly work	30%
midterm work	30%
final exam	40%

References

Chongstitvatana, P., Essence of Computer System Engineering, in preparation.

Computer languages

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Sebesta, R. Concepts of programming languages, 6th ed. Pearson/ Addison-Wesley, 2004.
Louden, K., Compiler Construction: Principles and Practice, PWS Pub., 1997.

Computer architecture

Katz, R., Contemporary Logic Design, Addison-Wesley Pub Co., 1993.
Hennessy, J., and Patterson, D., Computer Architecture: a quantitative approach, 3rd ed. Morgan Kaufmann, 2003.
Patterson, D., and Hennessy, J., Computer Organization and Design: the hardware/software interface, 2nd ed. Morgan Kaufmann, 1998.

Operating systems

Hansen, P. (ed.), Classic Operating Systems, Springer-Verlag, 2001.
Tanenbaum, A., Modern Operating Systems, Prentice Hall, 2001.
Silberschatz, A., Galvin, P., Gagne, G., Operating System Concepts, 6th ed. John Wiley, 2003.