

Network System Design: Methodologies and Tools, Spring 2009

Instructor: Prof. Ying-Dar Lin, ydlin@cs.nctu.edu.tw

Course Objective:

This unique course aims to prepare students with skills and disciplines, *instead of* domain knowledge, in network system design and evaluation. The skills and disciplines would enable students to do both *system* development/research and *algorithmic* research in either *academia* or *industry*. 6 topics are covered in two tracks. In the design track, we cover major system development issues from IC design to software techniques for BSP (board support package) and turn-key solutions, with each one lectured in 2 or 3 weeks where the front part and rear part are on concepts and tools/projects, respectively. In the evaluation track, the skills of benchmarking, simulation, and modeling are presented, with each one lectured in 2 weeks. 2 weeks are allocated, before the final exam, for student presentations of their term projects.

Students are asked to do a mini-project (could be finished in 3 hours) after the lecture of *each* topic, demo and turn in a 2-page report to TA 2 weeks later. Students need to select one term-project topic before 4/15, and turn in an 8-page report and present in the class on 6/1 or 6/8. Both mini-projects and term-projects are done individually. The final exam is open-book and contains 6 problems asking *how* and *why* on the covered 6 methodologies and their tools.

Prerequisite: Computer Networks or equivalent

Textbook: On-line course slides

Grade: 6 mini-project reports (42% = 7% x 6), 1 8-page term-project report & presentation (30%), and 1 final exam (28%)

Course homepage: <http://speed.cis.nctu.edu.tw/~ydlin/course/cn/nsd.html>

Class hours: Monday 9:00AM-12:00NN in EC427

Course agenda:

	Topic	Date
1	Network IC Design	3/2, 3/9
2	BSP (Board Support Package)	3/16, 3/23, 3/30
3	Turn-Key Solutions	4/6 & 4/13
5	Benchmarking	4/27 & 5/4 (part of)
6	Simulation	5/4 (part of) & 5/11
7	Modeling	5/18 & 5/25
8	Term-Project Presentations	6/1 & 6/8 (8 min per student)
9	Final Exam	6/15

Course Outline:

I. Design Track

1. NIC (Network Interface Card):

Topics: Hardware design, block diagram, state machine, Verilog programming, Ethernet MAC

Tools: Verilog related tools

Mini-Project: Compile/simulate/synthesize Ethernet MAC at opencores.org

Term-Project: Write a simulation or testing module for Ethernet MAC

2. BSP (Board Support Package):

Topics: BSP, bootloader, embedded OS and device drivers

Tools: GNU tool chain, iBoot, embedded Linux for ARM

Mini-Project: Compile/Install/Configure bootloader and embedded Linux kernel on target

Term-Project: Modify driver or bootloader to enhance its functions or performance

3. Turn-Key:

Topics: Integrating connectivity, QoS, and Security, and Image building

Tools: CVS, uclibc/glibc, binutils, gcc, buildroot, and application packages

Mini-Project: Build an embedded Web server (tthttpd) image with a video content by BuildRoot

Term-Project: Build an embedded firewall (iptables) with transparent proxies (squid, dansguardian) by BuildRoot

II. Evaluation Track

4. Benchmarking:

Topics: Black box testing and white box profiling

Tools: WebBench, Email Test Tool, Smartbits, Avalanche, gprof, kprof

Mini-Project: Benchmarking the Apache Web server by WebBench

Term-Project: Bottleneck analysis of the anti-virus proxy (Postfix + AmaVis + ClamAV) by gprof and mail testing tool

5. Simulation:

Topics: Simulation models, and result interpretation

Tools: ns-2 and CPN (Color Petri Net)

Mini-Project: Simulating TCP on ns-2 & simulating a simple protocol on CPN

Term-Project: Simulating and comparing RED and FIFO on ns-2,
Or simulating dining philosophers on CPN

6. Modeling:

Topics: System modeling and Markov chain

Tools: Mathlab7

Mini-Project: Computing the Markov chain steady state probability of a dual-core processor with a coprocessor

Term-Project: Extend the mini-project by automatically generating the transition rate matrix and comparative analysis