CSC6290: Data Communication and Computer Networks

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Objectives of the course

- You may have gained basic understanding of computer networks in undergraduate study, but not yet written any foundational networking software yet …

- Science and art of networking protocol design and implementation
  - Key network protocols
  - Network protocol reasoning from “distributed systems” point of view
    - Think distributedly!
  - Efficient, reliable protocol implementation
    - Think running-code!
Topics to cover

- **Prelude**: history, current status, and future directions of computer networks

- **Foundation**: system requirements, network architecture, implementation issues, performance metrics and evaluation
Topics (contd.)

- Network protocol design
  - *Direct link networks*: error detection, reliable transmission, media access control
  - *Packet switching*: store-and-forward switches, bridges and extended LANs
  - *Internetworking*: best-effort service model, global addressing scheme, IP, ARP, DHCP, ICMP, virtual networks, Internet routing, multicast
  - *End-to-end protocols*: TCP (connection establishment/termination, sliding window, flow control, adaptive timeout), UDP, remote procedure call
  - *Congestion control and resource allocation*: queuing discipline, TCP congestion control, congestion avoidance, quality of service control (integrated services, differentiated services)
  - *Elements of distributed computing*: naming, caching, replication
Topics (contd.)

- Network algorithmics/implementation
  - *Rules of the game*: network implementation models, implementation principles, practice
  - *Playing with endnodes*: copying data, transferring control, maintaining timers, demultiplexing, protocol processing
  - *Playing with routers*: exact-/prefix-match lookups, packet classification, switching, packet scheduling
  - *Endgame*: measuring network traffic, network security
Perspectives

- Internet

- Emerging networking technologies
  - vehicular networks
  - wireless sensing and control networks
  - disruption tolerant networks
  - mobile ad hoc networks
  ...

Textbooks

Required:
- [R0] Larry Peterson and Bruce Davie, *Computer Networks: A Systems Approach* (5th edition), Morgan Kaufmann.

Recommended references:
Logistics

- **Class timings**
  - MW 3:00pm-4:20pm

- **Office hours**
  - MW 4:30pm-5:30pm in *Suite 14101.3, Maccabees Building*, or by appointment

- **Teaching Assistant**
  - TBA
Logistics (contd.)

- **Prerequisites**
  - Undergraduate courses in algorithms, computer architecture, and operating systems (e.g., CSC 4420, CSC 4100, CSC 5050, or equivalent)
  - Or consent of instructor

- **Course website**

- **Course mailing list**
  - csc6290@lists.wayne.edu
  - Web-section only: csc6290-web@lists.wayne.edu
Logistics (contd.)

- Grading
  - Class participation: 10%
  - TinyExams: 40%
  - TinyLabs: 25%
  - Project: 25%

- Letter grades will be assigned based on performance relative to other students;
  A tentative grading scale:
  - A: 93-100
  - A-: 90-92
  - B+: 85-89
  - B: 80-84
  - B-: 75-79
  - C+: 70-74
  - C: 65-69
  - C-: 60-64
  - F: 0-60
TinyLabs

- Hands-on labs with Contiki, an operating system for networked embedded systems
Project

- Literature review, code review, and experimentation with IoT/CPS networking
  - Literature review of topics such as *MAC, interference management and control, routing, transport control, applications* in Internet of Things (IoT) and Cyber-Physical Systems (CPS)
  - Examine the implementation of a specific IoT/CPS protocol in Contiki (or another OS such as TinyOS, Linux, UT-Kernel, Nono-RK, VxWorks, FreeRTOS) and give a tutorial on its internals (e.g., software system architecture)
    - Contiki: Rime network stack vs. IETF standards-conforming implementation (e.g., TSCH, RPL, 6LowPAN, CoAP etc)
  - Experimentally evaluate (e.g., via simulation) the behavior of the protocol(s) selected above, for instance, measuring the communication reliability of a MAC protocol in a specific network setting
Project (contd.)

- **Rules**
  - Students are allowed to form groups in doing projects, but the number of students per group should be no more than 3
  - First choose one of the protocol topic (e.g., MAC, interference control, routing, transport control), and then start surveying the literature to understand the state of the art in the corresponding protocol design and implementation
  - Study one protocol implementation in Contiki (or another OS)
Project (contd.)

- **Deliverables**
  - Written project report
    - Literature survey, protocol architecture & implementation, performance evaluation
  - In-class presentation

- **Timeline**
  - Select the topic and form your project group by 09/30/2016
  - Detailed project report outline & list of references are due on 10/31/2016
  - Submit slides for your presentation at least one day before your presentation (date to be decided)
  - Submit your project report electronically by midnight 12/18/2016

- **Evaluation criteria**
  - Breadth and depth of your understanding of the literature and a specific protocol as well as its implementation, as evidenced by your presentation and project report
  - Presentation quality (e.g., clarity, readability, and conciseness) of your talk and written report
What is this course NOT for?

- Network programming
- Assemble networks with switches, routers, firewalls, etc.
- Design websites
Policies

- Frequently check out the course website for updated information
- Exercises strongly recommended
- TinyExams, TinyLabs, project required
- Other WSU polices
How to succeed in this course?

- Attend/follow lectures, read books
- Work on exercises, project, and TinyLabs
- Ask questions!!!

Questions?
Student questionnaire

- Name (optional):                                        E-mail (optional):
- Major:                                                Degree/Expected Year:
- Operating Systems/Architecture/Algorithm courses taken:
- Computer Networking courses taken:
- What do you expect to learn from this course? How do you think this course should be taught?
- How might this course contribute to your career objectives?