Electrical, Computer And Systems Engineering Department

ESCE-4670 Computer Communications Networks (CCN)

Fall 1999 Syllabus

Course Description

This course will provide a broad, yet design-based, introduction to the wonderful field of data networking. Concepts will be taught using a "building block" approach, which means that you should be able to identify how to flexibly put together concepts to understand complex network protocols. Comparison to telephony concepts will be made where relevant. Certain mathematical tools for design and analysis of networking systems will also be introduced.

Specifically, we will study core problems such as framing, error recovery, multiple-access, flow control, congestion control, routing and end-to-end reliability. At the same time, we will organize concepts learnt into a set of abstract layers (called the OSI 7-layered model), and get a firm understanding of the data-link, network and transport layers. We will also have a gentle introduction to useful mathematical tools like probability, statistics, queuing and graph theory, with a keen focus on how these tools are applied in quantitative modeling and analysis of networks. We will have an epilogue on Internet economics which will provide insights for entrepreneurial activity in the IT revolution.

Prerequisite

- Background in elementary probability (***Probability for Engineering Applications, ECSE-4500***, ***Discrete structures, CSCI-4320,*** or ***Modeling and Analysis of Uncertainity, ENGR-2600)***
- Knowledge of basic computer organization (***ECSE-2660 Computer Architecture, Networks and Operating Systems or CSCI-2500 Computer Organization***)

Instructor

Prof. Shiv Kalyanaraman. (Call me "**Shiv"**).
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Office Hours: **M W F: 11 am – 12 pm or by appointment**

Teaching Assistant(s)

TBD

Required Text

1. A.S. Tanenbaum, "Computer Networks," **3rd Edition**, Prentice-Hall, ISBN 0-13-349945-6, 1996.

Recommended Resources:

2. S. Keshav, "An Engineering Approach to Computer Networking," Addison-Wesley Professional Computing Series, ISBN 0-201-63442-2, 1997.

3. L. Peterson and B. Davie, "Computer Networks: A Systems Approach," Morgan-Kauffman, ISBN-1558603689, 1996. (second edition due 1999)

Tentative Schedule of topics:

- Introduction
- Design and Performance Issues
- Physical Layer: communications issues, physical media
- Data Link Layer. Framing, Error control, Flow Control
- Network Layer: Routing: link state, distance vector
- Performance I: Probability and Statistics
- Performance II: Inside a Router
- Performance III: Network Analysis* [optional: may omit]
- Medium Access Control I: Multiple Access Protocols
- Medium Access Control II: Local Area Networks
- Medium Access Control III: Wireless Networks * [Optional: may omit]
- Internetworking
- Transport Layer, Part I
- Transport Layer, Part II
- Advanced topics: Security, Quality of Service, Multicast
- Epilogue: Information Economics and opportunities

The class slides have been adapted, in part, from slides of Prof. Raj Jain, CIS, OSU, Prof. Ken Vastola, ECSE, RPI, Prof. S. Keshav of Cornell, and Prof. Larry Peterson of U Arizona. Acknowledgements will also be included in the slides themselves.

Tentative Grading Percentages

Exams (Quizzes)	50% (best two out of three)
Homeworks (6 homeworks: 6.5 points ea):	39%
Case study:	11% [5 % bonus points opportunity available]

Course Delivery Format/Policies:

This course will consist of lectures, in-class exercises, informal quizzes, problem sets, a case study and examinations (quizzes).

- **Lectures** will be consist of upto 75% of class time. I want to promote an **interactive learning experience**. We will try to pose problems TOGETHER and DISCOVER together how the solutions have evolved in the Internet. Please participate to enrich your learning experience.

- **Informal quizzes** will be held once every two weeks, just to quickly recap material. Informal quizzes will consist of true/false answers. There is no grading of informal quizzes.
- **Homeworks** will contain problems, short-answer questions and reading exercises. One of the homeworks (on routing) will use the LINKS project. Homeworks account for 39% of the final grade.
  - Homeworks should be **handed in at the beginning of lecture on which it is due.**
  - Any homework submitted later than this will be marked as late. There won't be a penalty for one or two late submissions. However if you make a habit of late submissions, there will be a **penalty of 10% for lateness** (includes homeworks slipped under the door etc). No makeups for homeworks.
  - Late submissions **will NOT BE accepted** after the day solutions are made available to the class.
  - If you feel that an error was made in grading, do not wait toward the end of the semester to tell us about it. **PLEASE DIRECT ALL GRADING RELATED REQUESTS TO THE TA.** You should submit a regrading request to the TA within a week of the date the graded material was returned to the class. Requests for regrading will not be accepted after that time. Any graded material that is not picked ***up within two weeks will be discarded***.
- **Quizzes** will contain true/false questions, short-answer questions, and quantitative problems. The focus will be on understanding of concepts, and problem-solving skill. Quizzes account for 50% of the final grade.
  - Exams will be **open-book/notes**, but will be extremely time-constrained ("short-and-sweet").
  - Exams will be held **during class hours** on **Oct 1st, Nov 1st and Dec 1st** (easy to remember).
  - **Best two out of three exams** will be considered for final grading (see below).
  - **NO MAKEUPS EXAMS – you are free to miss one exam and make it up in another.** However, if you do have a scheduled conflict for the exam period with a lower-numbered course, see the instructor.
  - Material from both slides, text and reading/homeworks will be included in the scope of exams.
- **Case Study:** The case study is an **INDIVIDUAL** project where you apply the concepts you have learnt in class.
  - Specifically, you need to first choose any two of the following networks: ***Internet, ATM network, Telephone network.***
  - ***References:***
    - ***S. Keshav's book (recommended above)***
    - ***Digital Telephony by John Bellamy (John***
  - Then, you need to analyze the similarities and differences between these two networks for each of the following networking problems:
    - Addressing, naming, bit-error detection, framing, medium access control, routing, congestion control, traffic management, connection setup and management, internetworking capabilities (heterogeneity and scale), and reliability.
    - Analysis of advanced topics such as support for advanced features like security, QoS and multicast will allow you to contend for upto 5% bonus points.
    - Be crisp, clear, and brief in your analysis. Lengthy, winding, or unclear analysis will lose points because it reflects inaccurate understanding of concepts. I will be very strict in the grading of case studies.
- You need to decide on the topics (choice of any two networks) by September 29th; and the final case study is due on November 22nd. The rules reg homeworks apply to case studies too.
  - Since you have a lot of time for the case study, it is a good idea to build a skeleton as you go along in

the course. By a “skeleton” I mean an outline which has just bullets/points organized under section headings. You can then quickly add flesh around this and make the writing crisper towards the submission date. DO NOT ATTEMPT TO DO THE WHOLE STUDY AT THE LAST MINUTE. Th quality will lack and you will lose points.

Miscellaneous:

- The purpose of these different instruments is to have a positive learning experience, critical thinking abou networking issues, and sound grasp of fundamentals. **If you feel any of these instruments is not workin for any reason, please send me an email and I will consider a change in the format of delivery. Ther is always an ANONYMOUS feedback form on the course web page for your convenience.**
- You will also have an opportunity to express your opinion on course format and delivery in an **informal mid-semester feedback** sheet.
- Important: Course materials will be put up on the **course homepage** which will be available through: http://www.ecse.rpi.edu/Homepages/shivkuma
- We will also set up a **mailing list** for administrative and discussion purposes. If you have questions which might be of interest to the entire group of students, please post to the mailing list and not send me the questions directly. Any one can reply to your questions, and you can reply to any one’s questions. **PLEASE SEND AN EMAIL ASAP TO THE TA TO ALLOW US TO QUICKLY SETUP THE MAILING LIST.**

Academic Integrity

Student-teacher relationships are based on trust. Acts which violate this trust undermine the educational process. Violations of academic integrity will not be tolerated by your classmates, teaching assistants, nor instructors. Please refer to the *Rensselaer Handbook* for definitions of various forms of academic dishonesty and the applicable penalties. We take cheating very seriously; you can expect to be punished for violations of academic integrity.