EE 607: Advanced Network Algorithms Spring 2017

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- **Days and Times**: MW 130-245pm
- **Room**: Holmes 388
- **Brief Course Description:** The course will cover algorithms that are used in network research and implementation. These include graph algorithms, transmission scheduling, traffic management, and control algorithms for certain switch/router architectures. There is an emphasis on TCP/IP as a case study. See the list of topics below.
- **Prerequisite**: EE 367 (data structures) and knowledge of C programming, or consent of instructor. Knowledge of C programming is required of everyone. Knowledge of undergraduate probability (e.g., EE 342) will be helpful, but not necessary.
- **Textbooks:**
  - Stevens, TCP/IP Illustrated, Vol. 1, Addison-Wesley
  - Cormen, Leiserson, Rivest, and Stein (3rd edition), Introduction to Algorithms, MacGraw Hill.
- **Grading:** Grading will be based on a midterm exam [10%], a final exam [20%], homework [20%], midterm projects [30%], and final project [20%].
- **List of topics (there may be some minor changes):**
  - **Overview of the Internet Architecture**
    - Overview of computer commuication, computer networks, and TCP/IP
    - Packet switching, store-and-forwarding, connection-oriented and connectionless routing, routing tables, and source routing.
  - **Graph Algorithms**
    - Algorithms and their performance.
    - Graphs, breadth-first-search, spanning trees, minimum weighted spanning trees.
    - Shortest path problem, Dijkstra and Bellman-Ford algorithms, and applications to networks.
    - Max-flow problem, Ford-Fulkerson labeling algorithm, max-flow min-cut theorem, applications, bipartite matching, disjoint paths.
    - NP-Completeness, approximation algorithms, greedy algorithms.
    - Broadcasting and multicasting. Applications: Ethernet.
    - Mathematical programming
  - **TCP/IP/Ethernet**
    - IP architecture
    - Flow control algorithms: sliding window, max-min fairness, leaky-bucket, leaky-bucket traffic model, resilient packet rings, TCP flow control
    - Error control algorithms: CRC, stop-and-wait, go-back-N, selective repeat.
    - Ethernet
  - **Routers and Switches**
    - Router and switch architecture overview: bus, crossbars, input and output queueing
    - Nonblocking definitions, 3-stage clos, TSI algorithms
    - Regular interconnection topologies: hypercubes and other hypecubic topologies like the omega network, torus, grids, low-latency routing.
    - If time permits:
      - Link bandwidth/buffer scheduling, partitioning, management, active queue management (e.g., RED).
      - Earliest deadline first scheduling, virtual clock service, work conservation, statistical multiplexing, WFQ end-to-end performance
      - Software defined networks, Openflow