Exam 1 Reading Material

Exam 1 will be held on February 28th, as originally scheduled. The main topics to be covered in the exam are:

1. **Fundamentals**
   - Protocol Architecture and Layering
     - Understand the basic functionalities of each layer
     - Understand the concept of layering and the way layers interact with other
     - Issues include multiplexing, segmentation and reassembly, encapsulation, error and flow control, routing and congestion control, …
   - Switching Techniques.
     - Datagram vs. Message Switching vs. Circuit Switching
     - Comparison of the switching techniques in terms of the service they provide
     - Analysis of these techniques in terms of delays and overhead
   - Connection-Oriented vs. Connectionless
     - Service semantics and design issues related to each paradigm
   - Impact of bandwidth and physical characteristics on network design issues
   - Good understanding of the end-to-end argument and how it applies in different networking environments and for different application requirements
   - Good understanding of the main design issues that impact and differentiate multi-service, high-speed networks from earlier data communication networks
     - Good understanding of the simple models presented in the lecture notes
     - Ability to reason and discuss these differences and their impact of the network architecture and protocol design.
   - End-to-End argument and its role in designing network architecture
   - You should be able to work out problems similar to the ones asked in homework assignments.
     - Concepts such as propagation delay, transmission time and queuing delay should be well understood.
   - **Relevant Material**:
     - Lecture notes (Introduction)
     - Homework Assignments

2. **Routing in Computer Networks**
   - Design issues in routing protocols
     - Convergence, fairness, optimality,
   - Understanding the difference and tradeoffs between routing in circuit-switching and packet-switching networks
   - Be able to derive routing optimality and fairness for a given network topology and traffic patterns
   - Understanding the difference between distance vector and link state protocols

        - Asynchronous Bellman-Ford Algorithm vs. Dijkistra's Algorithm
            - Understand The difference between the two approaches, in terms of overhead, convergence rate, and handling loops
            - Understand and discuss the mechanisms to deal with loops: split horizon, poison reverse, etc.
    - **Relevant Material**
        - Lecture Notes
        - Homework Assignments

3. **End-to-End Flow Control**
    - Objectives of an End-to-End Flow Control
    - Reactive and Preventive Control
        - Why closed-loop control is problematic in high speed networks?
        - Levels of control - packet level, connection level, etc and associated design issues.
    - Understand the design and implementation of a basic sliding window protocol, including data structure, invariants, etc.
    - Discuss and derive the maximum throughput that can be achieved using a basic sliding window protocol, as a function of the round-trip delay, packet transmission time and window size.
    - Understand the basic properties of an "exponentially smoothed average" algorithm and how it is used to estimate rates in end-to-flow control.

    - **Relevant Material**:
        - Lecture notes (Introduction)
        - Supplemental homework

- **Internet Architecture and Protocols**
    - Understanding the basic functionalities of Internet Protocols (IPv4) and relate these functionalities to fields of the IP datagram:
    - Principles of best-effort service
        - How do the service semantics relate to E2E argument?
        - What are the limitations of such a service with respect to mobility, security, etc
    - Fragmentation and reassembly
        - Pros and Cons
    - IP Addressing
        - Stateful Addressing and limitation

- **Homework Practice**
    - The test will involve problems very similar to what has been asked in the homework assignments and practice assignment. You are strongly encouraged to re-work these problems and understand the techniques used for their solutions.