Networks

Be aware of inherent distributed system issues (notes on distributed systems) - what do these mean? Examples of
how protocols deal with these issues:

- concurrency,
- partial failure,
- asynchrony,
- impossibility of determining global state

Be aware of Internet issues

- decentralization
- scale
- interoperation
- extensibility
- maintainability

How do these impact network and protocol design??

- Why do we have multiple redundant paths?
- Why do we construct a spanning tree? What makes it hard?
- Why do we need to find out who has an IP address?
- Why do we use switching?
- Why do we use routing?
- What problems does ARP/TCP/UDP/DHCP have to solve?

Standard problems:

- Leader election - why?
- Agreement
- Broadcast communication - why?
- Routing
- Failure recovery
- Resource allocation - exactly once allocation

Performance issues

- Definitions: bandwidth, throughput, latency, delay, measurement
- Response time
- Throughput
- Utilization
- Congestion

Principles

- Filling the pipe
- Encapsulation

Layering - principle and what are the layers, what do they provide
Protocols

- Link layer - ARQ, ARP, STP, Learning Bridge Algorithm, Sliding Window
- Network layer - IP, RIP, distance vector vs shortest path routing algorithms
- Transport layer - UDP, TCP
  - TCP reliability, flow control, congestion control
- Application layer - DHCP

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Asynchronous Network

Definitions:
I/O automaton - sig, states, start states, transitions, tasks
executions, execution fragments - alt. states and actions
traces - external actions only
fair execution / trace - finite, infinite and inf steps in each task, infinite and inf. states with task not enabled
compatible automata: empty int of locally-controlled
composition: union of actions, c. p. of states, transitions, union of tasks

hiding
implements (as in A implements B)
invariants
trace properties
safety
liveness
simulation relation

System composed of processes and channels

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1) Reliable FIFO
2) Lossy channel (loses messages): internal delete action
3) Duplicative channel (duplicates messages): model Queue as a MSet and add each message a random number of times
4) Unordered channel (messages delivered out of order): model Queue as a Set

Should allow correct exec as well as incorrect ones

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Be able to prove

Simulation relation used in hierarchical proofs

Be able to define a simulation relation eg for FIFO implementing a lossy channel

Be able to use induction or case analysis

Remember to think through what a protocol does!!

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Specs and Algorithms:

Reliable FIFO Channel - both as automaton and axioms
be ready to define varioius kinds of channels
Leader Election
BFS
Broadcast
Broadcast/convergecast
Determining network diameter
Cisco spanning tree/min-weight spanning tree

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