Midterm Review: Distributed Algorithms

Chapter 1. Introducation

Attributes of distributed algorithms:

Interprocess communication method: shared-memory, point-to-point, and broadcast

The timing models:

Synchronous (lock-step synchrony), completely asynchronous, and partial asynchronous.

The failure models:

Stopping failures vs. Byzantine failures

Distributed algorithms vs. concurrent algorithms:

- Higher degree of uncertainty and more independence of activites
  - Unknown # of processes, unknown network topology, several programs executing at once, starting at different times, and operating at different speeds, processor non-determinism, uncertain message delivery times, unknown message ordering, and processor and communication failures.

Four models:

Synchronous model, asynchronous model (shared memory vs. network), and partially synchronus (timing-based) model.

Chapter 2. Synchronous Network Model

Chapter 3. Leader Election

Algorithms:

- LCR
- HR (O(n log n) communication complexity)
- Timeslice (non-comparison-based with known n)
- VariableSpeeds (non-comparison-based with unknown n)

Chapter 4: Algorithms

Algorithms:

- FloodMax
- OptFloodMax (reducing comm. complexity)
- SynchBFS (breadth-first tree)
- BellmanFord (shortest path)
- General strategy for MST (minimum spanning tree)
- SynchGHS
- LubyMIS (maximal independent set, winner, lser, and losers' neighbors)

Chapter 5 Distributed Consensus with Link Failures

Agreement-Validity-Termination

Impossibility result

Chapter 6. Distributed Consensus with Process Failures

Stopping failure vs. Byzantine failure
(Weak) validity condition vs. stronger validity condition

Algorithms
- FloodSet (stopping failure)
- OptFloodSet (broadcast at most two values)
- EIG (Exponential Information Gathering): EIGStop
- OptEIGStop (broadcast at most two values)
- EIGByz (Binary Byzantine failure)
- TurpinCoan (General Byzantine failure)
- Byzantine Agreement in General Graphs (connectivity requirement)
- Weak Byzantine Agreement

Chapter 7: More Consensus Problems

Algorithms
- ByzApproxAgreement (Approximate Agreement)

Chapter 9* Asynchronous Shared-Memory Model

Chapter 14 Asynchronous Network Model

Chapter 15 Asynchronous Network Algorithms

Algorithms
- AsynchLCR
- PetersonLeader (unidirectional ring)
- AsynchSpanningTree
- AsynchBcastAck (convergecast)
- STtoLeader (leader election in an unrooted spanning tree)
- AsynchBFS
- LayeredBFS
- HybridBFS
- AsynchBellmanFord
- GHS (merge and absorb)
- SimpleMST

Chapter 16. Synchonizers

Algorithms

- GlobSynch
- LocSynch
- SimpleSynch (virtual round)
- SafeSynch (Opt version)
- Alpha synchronizer
- Beta synchronizer
- Gamma synchronizer

Chapter 17. Shared Memory vs. Networks

Two models (with fault tolerance) are pretty much the same.