Midterm Review: Distributed Algorithms

Chapter 1. Introduction

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 activities
- 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 synchronous (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, loser, 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
  AsynchBeastAck (convergecast)
  STtoLeader (leader election in an unrooted spanning tree)
  AsynchBFS
  LayeredBFS
  HybridBFS
  AsynchBellmanFord
  GHS (merge and absorb)
  SimpleMST
Chapter 16. Synchronizers

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.