24 Lectures

1. Concurrency [3]
   1.1. Forms of concurrency [1]
       Coupled dynamical systems
   1.2. Models and terminology [1]
       Abstractions
       Interleaving
       Atomicity
       Proofs in concurrent and distributed systems
   1.3. Processes & threads [1]
       Basic definitions
       Process states
       Implementations

   2.1. by shared variables [1]
       Failure possibilities
       Dekker's algorithm
   2.2. by test-and-set hardware support [0.5]
       Minimal hardware support
   2.3. by semaphores [0.5]
       Dijkstra definition
       OS semaphores

   3.1. Shared memory synchronization [2]
       Semaphores
       Cond. variables
       Conditional critical regions
       Monitors
       Protected objects
       Asynchronous / synchronous
       Remote invocation / rendezvous
       Message structure
       Addressing

   4.1. Correctness under non-determinism [1]
       Forms of non-determinism
       Non-determinism in concurrent/distributed systems
       Is consistency/correctness plus non-determinism a contradiction?
   4.2. Select statements [1]
       Forms of non-deterministic message reception

5. Scheduling [2]
   5.1. Problem definition and design space [1]
       Which problems are addressed / solved by scheduling?
   5.2. Basic scheduling methods [1]
       Assumptions for basic scheduling
       Basic methods

   6.1. Safety properties
       Essential time-independent safety properties
   6.2. Livelocks, fairness
       Forms of livelocks
       Classification of fairness
   6.3. Deadlocks
       Detection
       Avoidance
       Prevention (& recovery)
   6.4. Failure modes
   6.5. Idempotent & atomic operations
       Definitions

7. Architectures for CDS [1]
   7.1. Hardware architecture
       From switches to registers and adders
       CPU architecture
       Hardware concurrency
   7.2. Language architecture
       Chapel
       Occam
       Ada
       Rust
       C++

8. Distributed systems [7]
   8.1. Networks [1]
       OSI model
       Network implementations
   8.2. Global times [1]
       Synchronized clocks
       Logical clocks
   8.3. Distributed states [1]
       Consistency
       Snapshots
       Termination
   8.4. Distributed communication [1]
       Name spaces
       Multicasts
       Elections
       Network identification
       Dynamical groups
   8.5. Distributed safety and liveness
   8.6. Forms of distribution/redundancy
   8.7. Transactions [2]