Chapter 5

Limitations of a Distr. System

- Lack of global clock
  - common clock ? Synchronized clocks ?
- Absence of shared memory
  - cannot obtain a “coherent” view of “global” state
  - coherence ==> state observations made at the same time.

Temporal fundamentals

- *Happened before* relation (-->)
  - a --> b iff
    - a occurred before b in the same process
    - a is the event of sending a message in a process and b is the event of receiving the same message by another process
  - --> is transitive
  - a can causally affect b if a --> b
  - if ! ((a --> b) and (b --> a)) then a || b (concurrent). a and b do not have a causal relationship.

Lamport's Logical Clocks

- Conside a "clock" Ci associated with process Pi. It is simply a process which assigns a number Ci(a) to any event a in the process such that C(a) < C(b) if a --> b
  - Ci(a) < Ci(b) if a and b in the same process and a --> b
  - Ci(a) < Cj(b) if a is send(m) in Pi and b is recv(m) in Pj
- To make the above true
  - Ci should monotonically increase between successive events within a process (Ci = Ci + d)
  - every message sent is stamped with the Ci of the sending process. On receipt, the receiver sets its Cj to the greater of its present value or the received timestamp (max (Cj, tstamp+d)
- This can be thought of as "virtual" time, but it moves only in response to events.

Limitations

- Since each clock can “independently” advance, we cannot in general infer happened before, and hence causality from clock value relations