Distributed Fault-Tolerant Clock Synchronization

Abstract for November 15 and 17 Comp 243 lectures

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The problem of synchronizing independent processor clocks in a distributed system is of practical use and theoretical interest. Synchronized clocks are needed for controlling real-time processes, assigning consistent timestamps and version numbers, and providing synchronous "rounds" of computation. We consider the software approach (i.e., algorithms) to solving this problem, assuming "Byzantine" processor faults. In this fault model, faulty processors can send arbitrary messages, possibly those that cause the most trouble for the algorithm.

The first lecture will cover basic assumptions and terminology. The algorithms of Lamport and Melliar-Smith and of Welch and Lynch will be presented. Other algorithms, and their major properties, will be mentioned as well.

In the second lecture, two lower bounds related to clock synchronization will be presented. The first result, by Lundelius and Lynch, is a lower bound on how closely clocks can be synchronized in the presence of uncertainty in the message delivery times. The second result is a lower bound on how many processors total are required to tolerate a fixed number of faults. This result was first proved by Dolev, Halpern, and Strong, but the simpler proof due to Fischer, Lynch, and Merritt will be presented.

References

D. Dolev, J. Halpern, and H. R. Strong, "On the Possibility and Impossibility of Achieving Clock Synchronization", *Journal of Computer and System Sciences 32* (2), pp. 230-250, 1986.

M. Fischer, N. Lynch, and M. Merritt, "Easy Impossibility Proofs for Distributed Consensus Problems", *Distributed Computing 1* (2), pp. 26-39, 1986.

L. Lamport and P. Melliar-Smith, "Synchronizing Clocks in the Presence of Faults", *JACM 32* (1), pp. 52-78, Jan. 1985.

J. Lundelius and N. Lynch, "An Upper and Lower Bound for Clock Synchronization", *Information and Control 62* (2/3), pp. 190-204, Aug./Sep. 1984.

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