

Concurrency, intro

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Why is concurrency tricky?

1. We use threads or processes as powerful concept to keep threads of control apart, looking at sequential processes instead of arbitrarily interleaved thread of execution
2. Yet, in reality interleaved, any process may be interrupted at any time
3. Subtle, hard-to-identify, programming errors including race-conditions are introduced

What remedies do we need?

- Low level mechanisms to temporarily prohibit the interleaving of threads, removing the vulnerability of being interrupted
- Higher-level programming constructs to make programming
 - more convenient
 - less error-prone
 - ... and other requirements, incl. Efficiency

Low level mechanisms

- Atomic read and atomic write, memory coherency (...hang on)
- Turning interrupts off
- Atomic read-write operations

High level mechanisms

- Semaphors
- Mutexes
- Monitors
- Message passing

Progress

- This week
 - Motivation plus low-level stuff
- Next week(s)
 - The higher level constructs

Two basic issues

- Protecting control flows in the multitasking environment
- Memory coherency
 - Quality of computer system we're using
 - "A read from any given address always returns the value of the latest write to that address"
 - Guaranteed by HW for single CPU systems and shared memory multiprocessors (SMPs)

Two issues, cont.

- Memory coherency
 - HW guarantee comes at a cost and/or performance penalty, particularly for SMPs. We should try to reduce the incurrance of performance penalties
- Consistency
 - Rules for allowing memory references to be reordered, that may lead to observed differences in memory state by multiple processors.

Literature

- A lot exists!
- Early/first(?) textbook devoted to concurrency was Per Brinch Hansen “The Architecture of Concurrent Programs”
 - » <http://web.syr.edu/~pbhansen/html/book2.html>
- Ben-Ari “Principles of Concurrent and Distributed Programming,” is an old title that many still find useful
 - » http://www.amazon.com/exec/obidos/tg/detail/-/013711821X/qid=1063188412/sr=1-4/ref=sr_1_4/104-5762746-9774342?v=glance&s=books
- Fred Schneider, “On Concurrent Programming” (strong on theory aspects)
 - » <http://www.springer-ny.com/detail.tpl?cart=989601891383187&ISBN=0387949429>