

Review of Major Underlying Themes (II)

- standardization: allows systems to be reliably constructed from components (of various origins)
 - e.g. C language (ANSI), procedure call conventions (ABIs - application binary interfaces), TCP/IP and application-level protocols, network addressing conventions
 - also in computer architecture: standard components
- caching (memory hierarchy, including virtual memory):
 - blocking of data: *tradeoff* between reducing overhead / unit data and overhead due to fragmentation (loading unneeded data)
 - ◆ also occurs in disk access & organization (amortizes cost of positioning head)
- parallelization: pipelining, multiple instruction issue, multicore, clustering (e.g. WWW search servers)
- *tradeoffs* in many kinds of design, e.g. RISC vs CISC
 - decide what situations are most important, and tailor design choices accordingly

Outlook for Computer Systems

- processors: Moore's Law expected to continue for at least another 10 years
 - increasingly aggressive multicore systems (8, 32, 128, ...)
 - ◆ crisis (and opportunity!) in rewrite of applications (parallelize)
 - but the memory wall looms ever higher!
 - more serious still: the power wall! (and the end of 'overclocked' chips)
 - Moore's Law will also enable small, energy efficient chips
 - ◆ ⇒ increasing prevalence of embedded processors (mobile and ubiquitous computing)
- operating systems: increasing virtualization of all levels of services
- computer networks: increase of scale, complexity and integration
 - ascendancy of grid computing
- green computing:
 - reduce overall power consumption (e.g. 'smart' power-saving modes)
e.g. UltraSPARC T2 – 'CoolThreads'
 - must recycle the 10^9 's of (obsolete) computers – and safely!; also design for recycling
e.g. Dell recycling events (Canberra 27/05/07)
- rapidly increasing complexity and also human dependence on these systems!
 - *who will be able to understand them?*