Chapter 6

Selected topics from Parallel Processors from Client to Cloud

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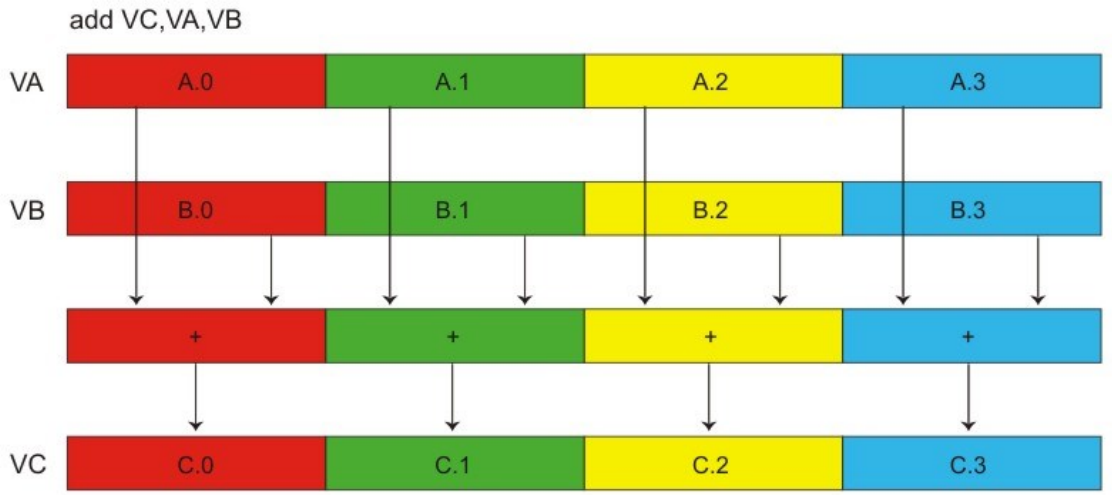
Contents

SIMD

- Modern processors feature single instruction, multiple data (SIMD) instruction extensions.
- Operate elementwise on vectors of data
  - E.g., MMX and SSE instructions in x86
    - Multiple data elements in 128-bit wide registers



Hardware Multithreading

- The processor executes multiple threads of execution in parallel
  - Replicate registers, PC, *etc*.
  - Fast switching between threads
- **Fine-grain multithreading**
  - Switch threads after each cycle
  - Interleave instruction execution
  - If one thread stalls, others are executed
- **Coarse-grain multithreading**
  - Only switch on long stall (*e.g.*, L2-cache miss)
  - Simplifies hardware, but doesn't hide short stalls *(e.g.*, data hazards)

Hardware Multithreading

- **Simultaneous Multithreading (SMT)**: In multiple-issue dynamically scheduled processor
  - Schedule instructions from multiple threads
  - Instructions from independent threads execute when function units are available
  - Within threads, dependencies handled by scheduling and register renaming
- Example: Intel Pentium-4 HT
  - Two threads: duplicated registers, shared function units and caches

Multithreading Examples