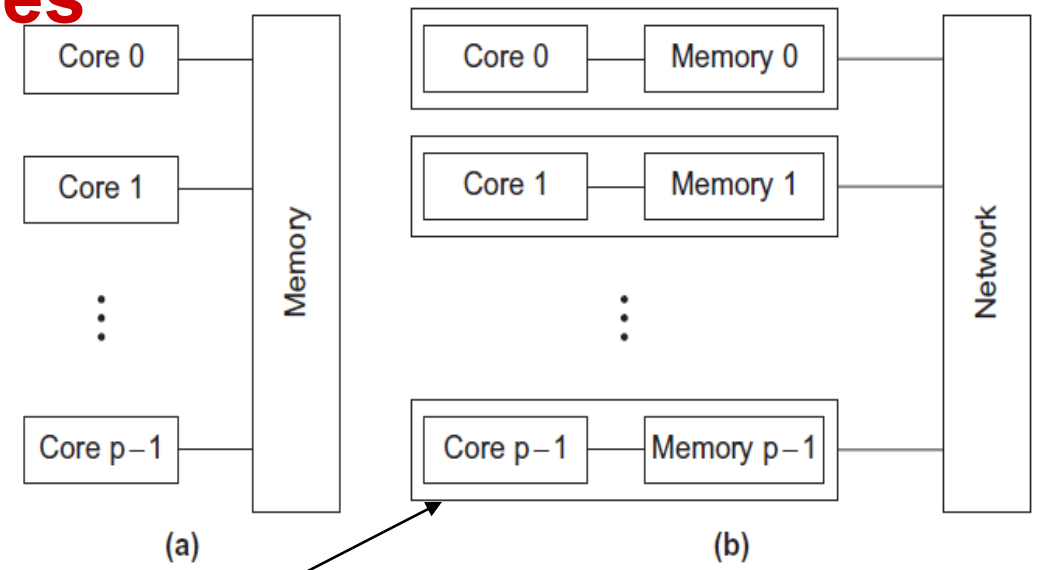
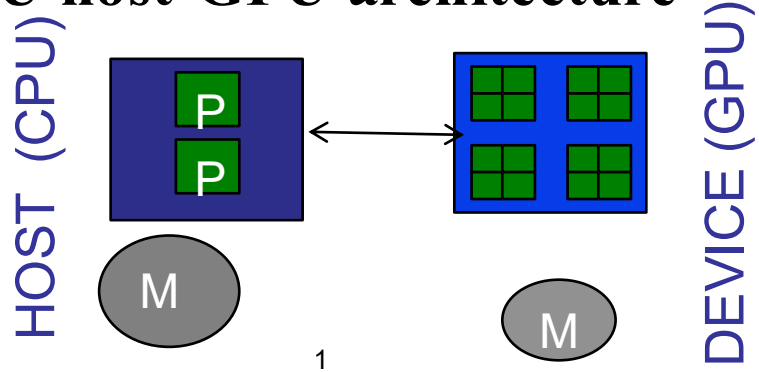
CS140 Midterm Summary: Parallel Architectures

- **Shared-memory**
  - Cache coherence
  - False sharing



- **Distributed-memory**
  - Topology, bisection bandwidth, networking cost.

CPU host-GPU architecture



Impact to paralel software: Hardware resource available (#cores). Memory location/access performance. Support coarse grain vs fine-grain paralleism?

Parallel Software

- **Task graph model. SPMD programming style**
  - Task granularity. Fine grain vs. coarse grain
  - Shared memory access or message passing
- **Performance evaluation**
  - Complexity analysis and performance assessment: Parallel time, speedup, efficiency
  - What limits parallel performance
- **Program analysis and transformation**
  - Dependence analysis (dataflow, anti, output dependence). Task dependence graph. Task scheduling
  - Program/data partitioning with cyclic/block mapping. Data distribution on distributed memory machines
    - 1D and 2D mapping
  - Loop interchange, unrolling, blocking

Programming

- **Basic C programming**
  - Pointers and memory allocation
  - Memory layout: Global, heap, stack, code
- **Distributed memory programming with MPI**
  - Process-based parallelism. Consider global to local data mapping to distribute data to many processes that do not share memory.
  - Communication primitives/algorithms
    - Collective communications involve all the processes in a communicator.
- **Core computing algorithms:** Matrix-matrix and matrix-vector multiplication

Midterm Exam Format

- **In class:** 1 hour 15 minutes. Bring a pencil and an eraser
- **Open book** (laptops for class material are allowed, but not for communication and other internet access)
- **Multiple choice/short-answer questions**
  - C functions/pointers/memory layout
  - Parallel architectures. Networks. Shared and distributed memory architectures
  - Task graphs/dependence analysis
  - Parallel program: data/program mapping. Loop transformation
  - Speed/efficiency. Bounds
  - MPI code tracing and parallel code design
    - Send, receive, collective communication