Distributed Shared Memory

Lecture-8

Parallel & Distributed Computing

Course Outlines

Course Name: Parallel and Distributed Computing
Credit Hours: 3(3-0)
Prerequisites: Data Communications and Computer Networks

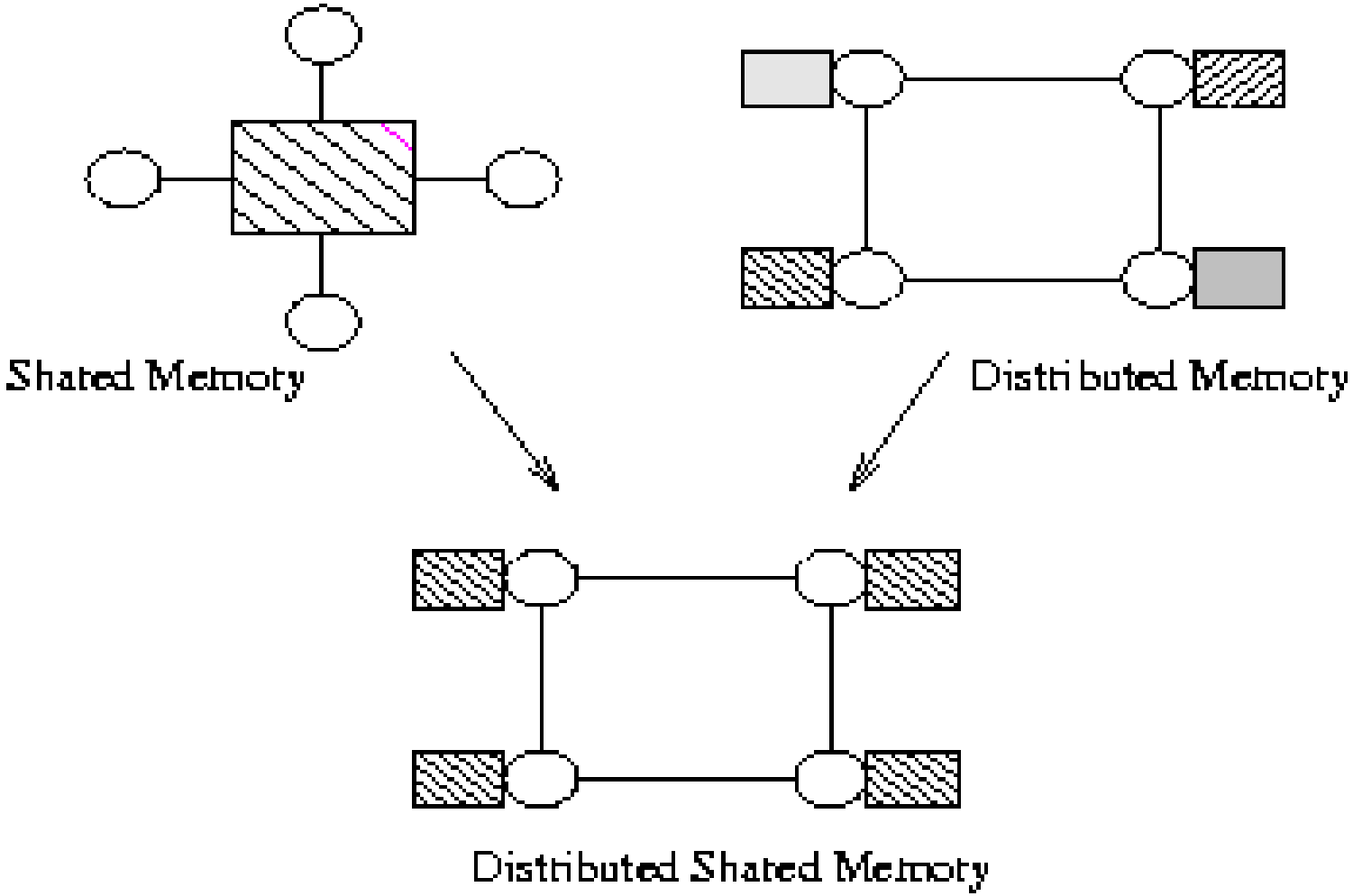
Course Outlines:

Why use parallel and distributed systems? Why not use them? Speedup and Amdahl's Law, Hardware architectures: multiprocessors (shared memory), networks of workstations (distributed memory), clusters (latest variation). Software architectures: threads and shared memory, processes and message passing, distributed shared memory (DSM), distributed shared data (DSD). Possible research and project topics, Parallel Algorithms, Concurrency and synchronization, Data and work partitioning, Common parallelization strategies, Granularity, Load balancing, Examples: parallel search, parallel sorting, etc. Shared-Memory Programming: Threads, Pthreads, Locks and semaphores, Distributed-Memory Programming: Message Passing, MPI, PVM. Other Parallel Programming Systems, Distributed shared memory, Aurora: Scoped behaviour and abstract data types, Enterprise: Process templates. Research Topics.

Distributed Shared Memory

- Distributed shared memory (DSM) is a form of ***memory architecture*** where ***physically separated memories*** can be ***addressed as one logically shared address space***.
- As the word "***distributed***" is attached with the term "***shared***" so it does not mean that ***there is a single centralized memory***, but that ***the address space is "shared".***

Distributed Shared Memory cont...



Distributed Shared Memory cont…

- A **distributed shared memory** (DSM) system implements the ***shared-memory model*** on ***a physically distributed memory system***.
- In DSM, addressing refers to the ***same physical address*** on ***two processors*** **refers to the** ***same location in memory***.

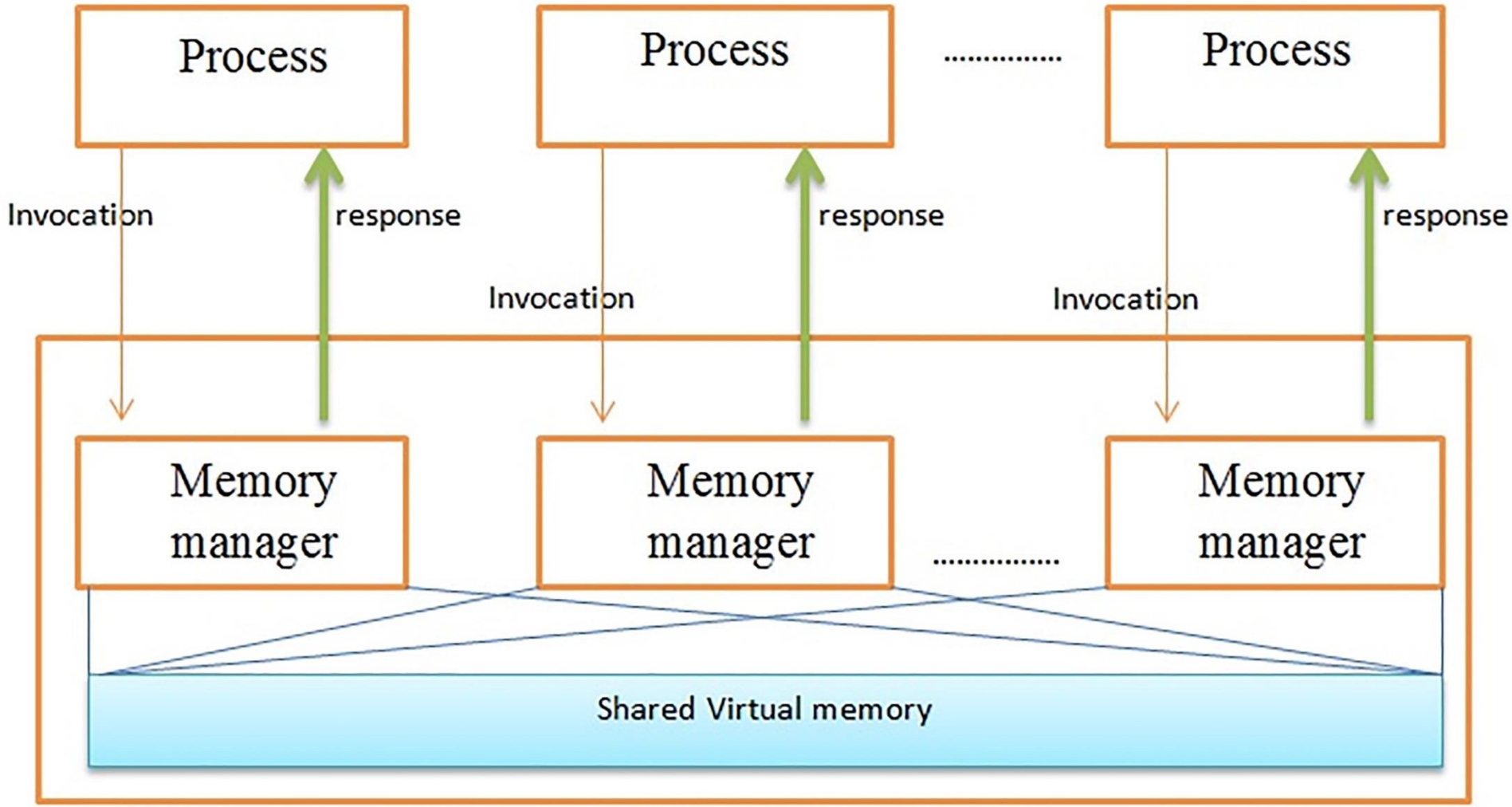
Distributed Shared Memory cont…

- A **distributed-memory system**, often called ***a multicomputer***, ***consists of multiple independent processing nodes*** with ***local memory modules*** which ***is connected by a general interconnection network***.
- **Software DSM systems** can be ***implemented in an operating system***, or ***as a programming library*** and ***can be thought of as*** **extensions** of the ***underlying virtual memory architecture***.

Distributed Shared Memory cont…

- When **implemented** in the ***operating system***, such systems are ***transparent to the developer***; whereas the ***underlying distributed memory*** is ***completely hidden from the users***.
- In contrast, **software DSM** systems ***implemented at the library or language level*** are ***not transparent*** and developers usually ***have to program them differently***.

Distributed Shared Memory cont...



Distributed Shared Memory cont…
Methods of implementing DSM

- There are usually two methods of achieving distributed shared memory:

1. **Hardware**
    - such as ***cache coherence*** circuits and ***network interfaces.***
2. **Software**

Distributed Shared Memory cont…
Methods of implementing DSM (Software)

- There are three ways of implementing a software distributed shared memory:

1. **Page based approach** using the system's ***virtual memory***;
2. **Shared variable approach** using some ***routines to access shared variables***;
3. **Object based approach** ideally accessing shared data through object-oriented discipline.

Distributed Shared Memory cont…
Methods of implementing DSM (Software)

- Software DSM systems also have the flexibility to organize the shared memory region in different ways.
- The page based approach organizes shared memory into pages of fixed size.

Distributed Shared Memory cont…
Methods of implementing DSM (Software)

- In contrast, the object based approach organizes the shared memory region as an abstract space for storing shareable objects of variable sizes.
- Another commonly seen implementation uses a tuple space, in which the unit of sharing is a tuple.

Distributed Shared Memory cont…
DSM Advantages

- The advantages of DSM are given below:

1. Scales well with a large number of nodes
2. Message passing is hidden
3. Can handle complex and large databases without replication or sending the data to processes

Distributed Shared Memory cont…
DSM Advantages

4. Generally cheaper than using a multiprocessor system
5. Provides large virtual memory space
6. Programs are more portable due to common programming interfaces

Distributed Shared Memory cont…
DSM Disadvantages

- The disadvantages of DSM are given below:

1. Generally slower to access than non-distributed shared memory
2. Must provide additional protection against simultaneous accesses to shared data
3. May incur a performance penalty

Distributed Shared Memory cont…
DSM Disadvantages

4. Little programmer control over actual messages being generated
5. Programmers need to understand consistency models, to write correct programs
6. DSM implementations use asynchronous message-passing, and hence cannot be more efficient than message-passing implementations