



# Lecture 5

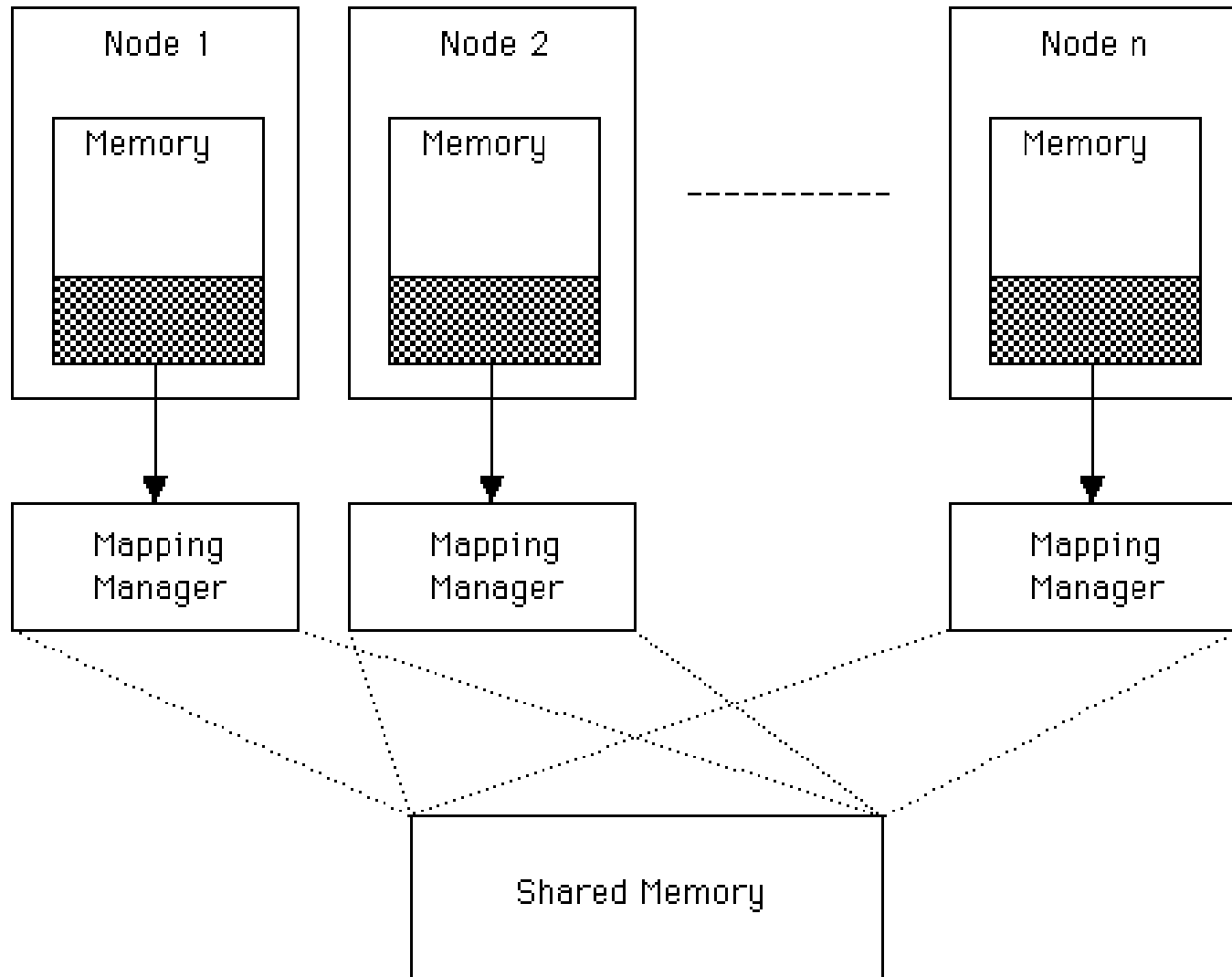
## Software Architecture

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# Distributed Shared Memory

- Distributed Shared Memory (DSM) is a resource management component of a distributed operating system that implements the shared memory model in distributed systems, which have no physically shared memory.
- The shared memory model provides a virtual address space that is shared among all computers in a distributed system.

# DSM(I)



# DSM (2)

- Distributed Shared Memory (DSM) is a form of memory architecture where physically separated memories can be addressed as one logically shared addressed 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”.
- In DSM, data is accessed from a shared address space similar to the way that virtual memory is accessed.
- Data moves between secondary and main memory, as well as, between the distributed main memories of different nodes.

# DSM (3)

- DSM system implements the share memory model on a physically distributed memory system.
- In DSM, addressing refers to the same physical address on two processor refers to the same location in memory.
- When implemented in the OS, 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.

# Advantages of DSM

1. Scales well with a large number of nodes.
2. Message passing is hidden - Hide data movement and provide a simpler abstraction for sharing data. Programmers don't need to worry about memory transfers between machines like when using the message passing model.
3. Allows the passing of complex structures by reference, simplifying algorithm development for distributed applications.
4. Takes advantage of "locality of reference" by moving the entire page containing the data referenced rather than just the piece of data.
5. Cheaper to build than multiprocessor systems. Ideas can be implemented using normal hardware and do not require anything complex to connect the shared memory to the processors.
6. Larger memory sizes are available to programs, by combining all physical memory of all nodes. This large memory will not incur disk latency due to swapping like in traditional distributed systems.
7. Unlimited number of nodes can be used. Unlike multiprocessor systems where main memory is accessed via a common bus, thus limiting the size of the multiprocessor system.
8. Programs written for shared memory multiprocessors can be run on DSM systems,

# Disadvantage of DSM

Few disadvantage of DSM are given below:

1. Generally slower to access than non-distributed share memory.
2. Must provide additional protection against simultaneous accesses to shared data.
3. May incur a performance penalty.
4. Little programmer control over actual messages being generated.
5. Programmers need to understand consistency model, to write correct programs
6. DSM implementation uses asynchronous message passing and hence cannot be more efficient than message passing implementations.

# Implementing DSM in software

- There are three ways of implementing a software distributed share memory:
  1. Page based approach using the system **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.



# Implementing DSM in Software (I)

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