

Parallel and Distributed Computing (WQD7008)

Quiz 1

Fill in the blanks.

1. In the **UMA** system, all processors have equal access time to any memory location. (5 Marks)
2. Parallel computers are either **SIMD** or MIMD. (5 Marks)
3. A shared memory system typically accomplishes **Array Processor** coordination through a global memory shared by all processors. (5 Marks)
4. A **Cluster** is a collection of stand-alone computers connected using some interconnection network. (5 Marks)
5. A distributed system is a collection of computers that do not share **common memory** or **common physical clock** that communicate by **message passing** over a communication network, and each computer has its own **memory** and runs its own operating system. (20 Marks)

Answer the Question.

6. Explain models of parallel system. (12 score)
7. Draw an Omega Network model with $n = 16$ in two stages. (10 score)
8. How many processor and memory exist in a four-dimensional $k \times k$ hypercube. What is the length of the shortest path in the network? (6 score)
9. Describe the advantages and Disadvantage of Distributed Memory Machines. (10 score)
10. Explain how cluster's packaging effects on the attributes of a cluster (12 score).
11. Describe the differences between a process and thread. (10 score)

Total marks: 100

6. Week 2 – Parallel and Distributed Computing – Power point slides – page 4

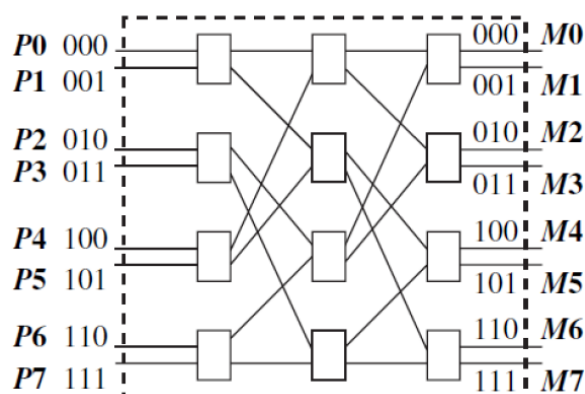
Multiprocessor system: 1) processors are in very close physical proximity and are connected by an interconnection network. 2) Interprocess communication across processors is traditionally through read and write operations on the shared memory. although the use of message-passing primitives such as MPI, is also possible (using emulation on the shared memory). 3) All the processors usually run the same operating system, and both the hardware and software are very tightly coupled. 4) The processors are usually of the same type. 5) The processors housed within the same box/container with a shared memory. 6) The interconnection network to access the memory may be a bus, although for greater efficiency, it is usually a multistage switch with a symmetric and regular design

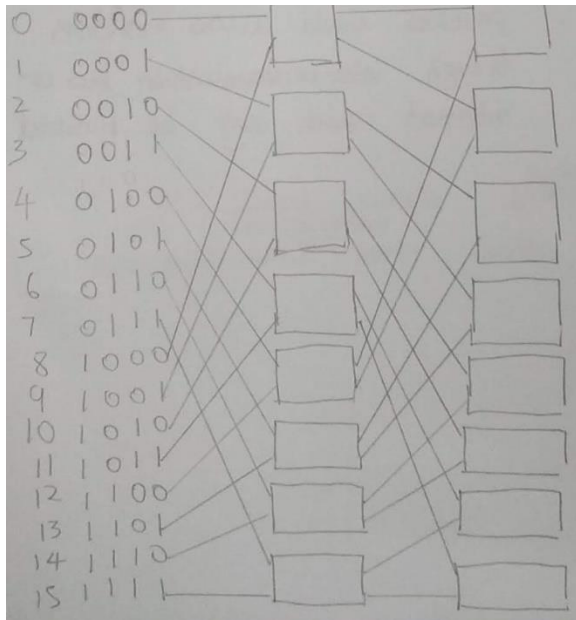
Multicomputer system: 1) Made up of several computers. 2) A multicomputer system is a cluster of computers that operate as a singular computer. 3) Multiple processors do not have direct access to shared memory. 4) The memory of the multiple processors may or may not form a common address space. 5) The processors are in close physical proximity and are usually very tightly coupled (homogenous hardware and software), and connected by an interconnection network. 6) The processors communicate either via a common address space or via message-passing. 7) A multicomputer system that has a common address space usually corresponds to a non-uniform memory access (NUMA) architecture. 8) In NUMA, the latency to access various shared memory locations from the different processors varies.

Array processors: Array processors and systolic arrays that perform tightly synchronized processing and data exchange in lock-step for applications such as Digital Signal Processing (DSP) and image processing belong to this category. These applications usually involve a large number of iterations on the data. This class of parallel systems has a very niche market.

7. Week 2 – Parallel and Distributed Computing – Power point slides – page 9

$$j = \begin{cases} 2i, & \text{for } 0 \leq i \leq n/2 - 1, \\ 2i + 1 - n, & \text{for } n/2 \leq i \leq n - 1. \end{cases}$$





8. Week 2 – Parallel and Distributed Computing – Power point slides – page 15

A k -dimensional hypercube has 2^k processors and memory units.

The shortest path is one (1) Because:

The processors are labelled such that the shortest path between any two processors is the Hamming distance (defined as the number of bit positions in which the two equal sized bit strings differ) between the processor labels.

$$B-A = 1 \rightarrow 1011-1010 = 1$$

9. Week 2 – Parallel and Distributed Computing – Power point slides – page 33

Advantage: 1) Memory is scalable with the number of processors. 2) Increase the number of processors, the size of memory increases proportionally. 3) Each processor can rapidly access its own memory without interference and without the overhead incurred with trying to maintain cache coherence. 4) Cost effectiveness: can use commodity, off-the shelf processors and networking.

Disadvantage: 1) Difficult to program: Programmer has to handle data communication between Processors. 2) Nonuniform memory access (NUMA) times. 3) It may be difficult to map existing data structures, based on global memory, to distributed memory organization.

10. The question is conceptual and explanatory. Week 4 – Computer cluster for scale computing – Power point slides – page 7

Compact The nodes are closely packaged in one or more racks sitting in a room, and the nodes are not attached to peripherals (monitors, keyboards, mice, etc.).

Slack fashion The nodes are attached to their usual peripherals (i.e., they are complete SMPs, workstations, and PCs), and they may be located in different rooms, different buildings, or even remote regions.

In terms of Scalability: In both approach the cluster can be scaled up or down.

In terms of Control: Compact fashion is a centrally controlled whereas slack fashion cannot be centrally controlled.

In terms of Security: Compact mode has a lower risk for security treats as it is not exposed to the outside world.

Slack fashion is an enterprise type coz:

- Is Typically installed in a deskside rack in a central computer room.
- It is homogeneously configured with the same type of computer nodes and managed by a single administrator group like a frontend host.
- are used as substitutes for traditional mainframes or supercomputers.
- is installed, used, and administered as a single machine.
- Users can log into the cluster to execute both interactive and batch jobs.
- Offers much enhanced throughput, as well as reduced response time.