• DPC (Distributed Computer)

* Serial Computer :- Computer s/w was handle initially for serial computing in serial computing an algorithm divides the problem into smaller instruction these discrete instruction executed on CPU of a Computer one by one only of one instruction if finished next one starts.

* In short serial computing :-

(i) In this problem statement broken into discreat problem and solved one by one. instructions.

(ii) then the instruction are executed by one.

(iii) only one instruction will executed it only time.

• Disadvantages :-

(i) It cause a huge problem in the computing instruction as only instruction executed at one time.

(ii) huge waste of h/w resource.

(3) It takes a lot of time to slove a problem.

(4) to reduces the problem of serial computing.

Application of parallel computing

1. Database and data mining
2. Science and Engineering.
3. Advance graphics virtual reality & Documented reality.
4. Real time simulation of system.
5. Weather for casting
6. Automobile assembly line.
7. Design of web search line.
8. Access of large database.
9. Engineering application.
10. Scientific image processing.
11. performance.
12. AI application.

★ High Program computer (HPC)
high performance computing generally refers to the prefic of computing power to deliver greater performance then a typical desktop or workstation. in order to solve complex problem in science eng and business.
processor, memory desk, and o/s are commonly high pc of interest to small and medium size business. each individual computer in a cluster has between one

★ Level of parallel computing:

(1) Bit level (2) Instruction level
(3) Loop level (4) Program level

(i) Bit level:- At this level consuqutive loop intruction are used for parallel execution.

(ii) Instruction level:- Instruction level is a parallel computing concept that focuses on running several instructions concurrently on a single processor. Instead of relying on numerous processors or computing resources. It seeks to utilize the natural parallelism present in a program at the instruction level.

(iii) Loop level:- loop level parallelism is a form of parallelism in s/w programming that is concerned with executing parallel tasks from loops.

) Programming level:- This is usually the

Responsibility of OS which runs process Concurrently different programs are independent of each other.

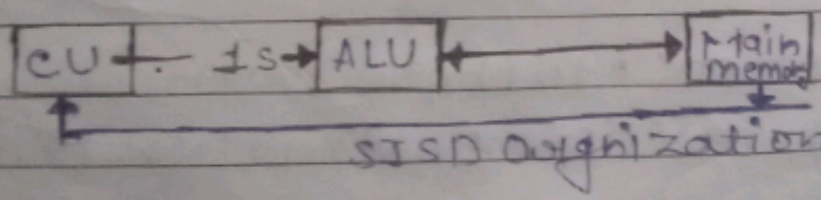
★ Classification of parallel computing:

① Feynn (1966) ② Feng (1972) ③ Bendley (handler) (1977)

① Feynn (1966):- The sequence of instruction read from memory constitutes an instruction stream.
the operation performed on the data in the processor constitute a data stream.
• Feynn classification divides computers into four major groups that are.

(1) SISD ② SIMD ③ MISD ④ MIMD

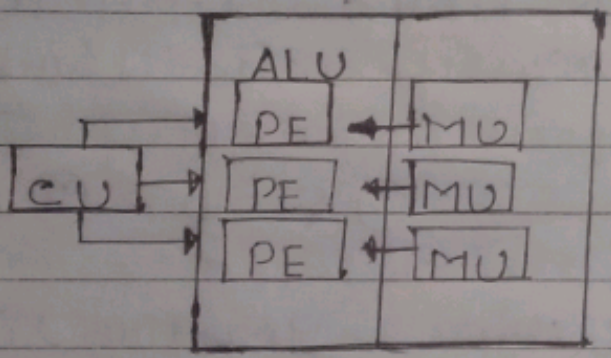
① SISD: (Single Instruction single data)
It is a Serial computer
ex:- most pc mean frame Computers.
In this Orgnization sequential execution of instruction is performed by one CPU



SISD Orgnization

② SIMD (Single instruction multiple data)
SIMD Instruction is capble of executing same instruction on all the CPU but operating on different data stream.

single instruction at processing unit executed the same instruction at any load cycle.
multiple data each processing unit can operate on different data item value.
SIMD computer has single content which issu one instruction at time but has multiple ALU all processing unit carry out multiple data.
Data stream:- array, processor & vector lines.

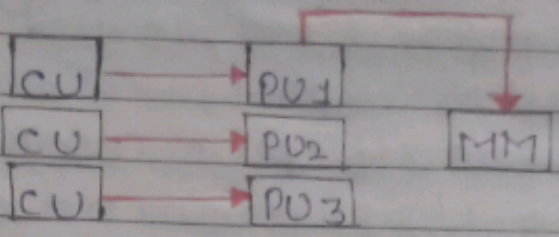


SISD	Load A1	Load A2
SIMD	Load B1	Load B2
MISD	C1 = A1+B1	C2 = A2+B2
MISD	Store C1	Store C2

MISD (Multiple Instruction Single Data)
In multiple Instruction operat on Single Data stream. MISD is capable of executing different instruction at one different processing element pe but all of them operate on same data set.
Each processing unit may executing

(1)

Different instruction stream. every processing unit can operate same data element system array.



- MIMD:- (Multiple instruction multiple data)
MIMD system is capable of execution multiple instruction multiple data.
Multiple data:- every processor may be executing different data stream.
Multiple data:- every processor may be working with a different data stream.
MIMD system are parallel computer capable of serval processing simulation program.
example:- supercomputer, network, parallel computer.

load A1	load B1
load A2	load B2
C1 = A1 + A2	C1 = A2 + B2
store C1	store = C2

Classification of flynn:-
(i) Instruction stream:- the instruction cycle consists of sequence of either steps needed for the execution of an

instruction in a program. A typical instruction in a program. ~~a typical~~ composed on operand B (INST) (c=a+b) out of code.
the CU of CPU of computer fetches instr in the program on at a time.

Data stream:- it is defined as the sequence of data including input, temporary result, portion called by the instruction stream. the term stream refers to sequence of all code or instruction, data operated by computer.

- HANDER'S CLASSIFICATION:-
In 1977, wolfgang hander prosed an elaborated an notation for expressing the pirallelism and pipelesim of computer hander's classification the computer at three distinct level:

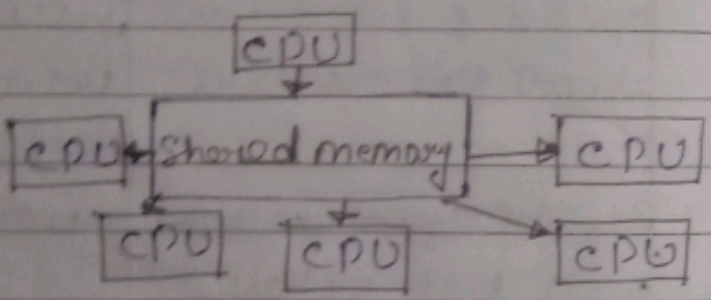
- Processor control unit (PCU)
- Arithmetic control unit (ALU)
- Bit - level circuit (BLC) (BLC) circuit

- Structural classification:-

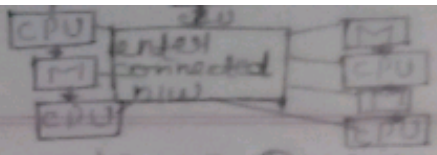
	Tightly couple/parallel/multiprocessor	loosely coupled/Distributed/multicomputer
(1)	It processor has shared memory.	it has distributed memory.
(2)	the degree of coupling b/w processor is high	The degree of coupling b/w processor is low.
(3)	CPU connected close communication.	CPU system located at diffrent location.
(4)	It is efficient high speed & used real true processor.	It is efficient in task running on diffrent processor.
(5)	Parallel communication with task other using shared memory.	using massage passing Technique.

- Multiprocesar & multicomputer
Multiprocessor:- Multiprocesar is a computer system with two or more CPU. share full ecess to work. full ecess (RAM) random Acess memory) the main memory Objective of using a multiprocesar is to boost

the system execution speed with other objective been fault tolerance and application.
there are two type of multiprocessor one is called shared memory multiprocessor and another is called distributed memory multiprocessor. (3)
in shared memory multiprocessor all the cpu share the common memory but in a distributed every (1)
cpu has it is non-private memory (2) (3)
multiprocess system is a single computer that operate with multiple cpu. it supports parallel computing.



multicomputer:— multicomputer is a system with multiple process that (1)
a connected together to solve problem. (1)
multiprocomputer cluster of computer each computer has its own memory and it is accessible by any particular processor all computer and those computer processor can be inter connection network in multicomputer communication is



done by massage passing between the processor. in which the task is divided between the processor to complete the task. it is cost effective and easier to built.

(3) Model of tight couple / shared memory / multiprocessor.

(1) UMA (Uniform memory access)
(2) NUMA (non-uniform memory access)
(3) COMA (Chase-only memory structure)

model of tightly couple / shere memory / multiprocessor.

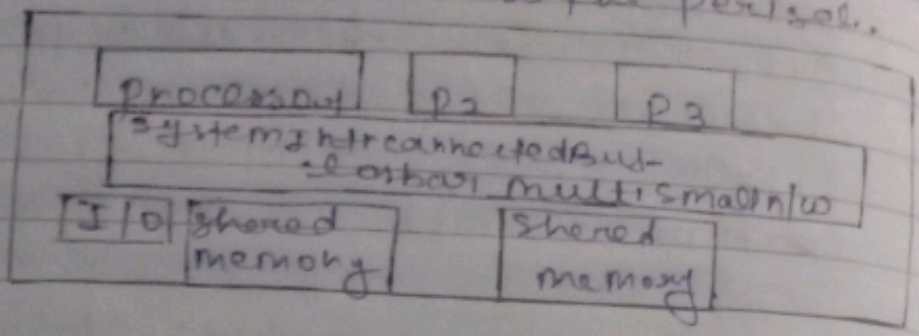
parallel processing has bein develop as an effcion technology in model computer to meet the demand of higher performance, course cost & accurate result in real life application it is classifier into 3 model.

(1) UMA (2) NUMA (3) COMA

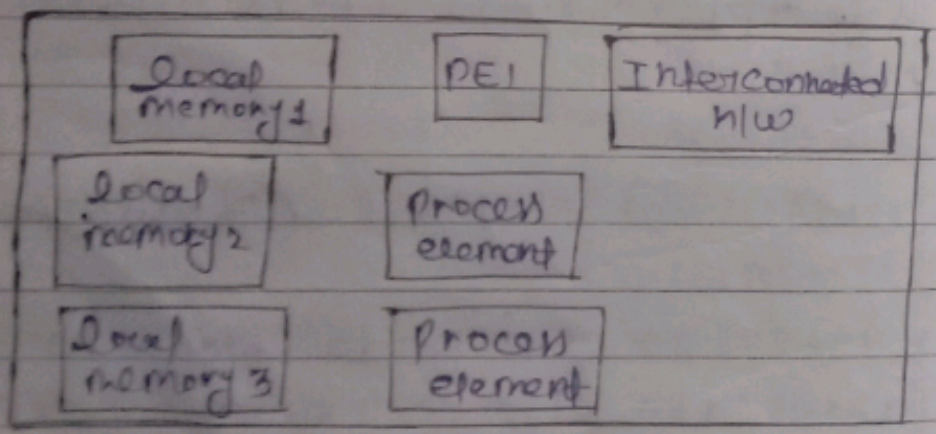
(1) UMA :- In this model all the processor shere the physical memory uniform all the processor has equal access time to all the memory word. when all the processor has equal all the memory davice. is symmetric.

(ii) A - Symmetric when only one or two

Process can be acess the perisal.

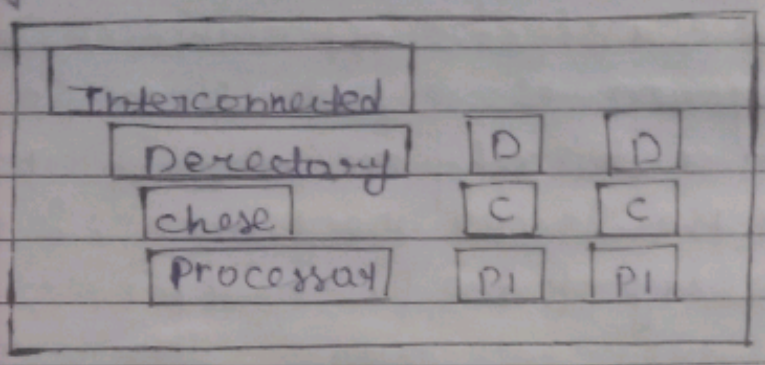


(ii) NUMA:- In the NUMA process model the acess time very with the location of memory word. here the shered memory is physically Disterbuted among all the processor as the local memary the collection of all local memary from a global address spece which can be acess by all the procen in NUMA Memory acess time is not equal and its faster than UMA.



(iii) COMA:- COMA model spcial case of form NUMA model here are HD disterbuted to main memory all converted to chase memory and NUMA. it is

faster than UMA & NUMA.



(3) classification of grain size:
Grain Size is a major of which determine how much computation is involved in a process grain size is determine by counting the no of instruction in a program segment. this classification is based on recognize this parallelism in a program to be executed on multiprocessor system this idea is to identify the subtask or instruction in a program. that can be executed in parallel.

type of Grain Size

(1) fine grain
(2) medium grain
(3) Coarse grain (cross grain)

fine grain:- this type contain instruction >20

medium:- this type contains instruction >500

coarse grain:- this type contain >1000

Based on these grain size parallism can be classified at various level in a program these parallism level form a hirachy according - to which lower the level the finner, & the granuality of the process.

★ Scope of Parallel computing :-
Parallel Computing has tremdis may impact on a variety of aces ranging from Computational. Simulation for scientific & engineering applications. to the application in determining transitor processing the cost benifit of time parallism.

⇨ Application in engeneering and design parallel computing have been employeed with great sucess in design of internal combination engine a high speed circuit, design of air foil and structure etc. most recently design of micro electromacanical ~~and~~ electromedical system has attracted significant attention. other application and engineering design focus on optimization of

variety of processor.
parallel computer have been used to solve a variety of discrete & continuous optimization problem.

⇨ Scientific application:- The past few year have seen a revolution in high performance scientific computing application.
the sequencing of human genom by the international human genom sequencing consurtium & celera has opened new in bio informatics functional & structure charatrisation in bio informatics functional & structure characterization genes & hold the promise of understanding (fundamentey biological process it is used in developing new drugs & cure of disease and medical condition & bioinformatics.

⇨ Commerical application:- with the wide spread use of web & associated static & dynmic content there is increasing emphasis on cost effective server capble of procesding scalable performance platforms ranging from multiprocess to linux cluster are mostly used as

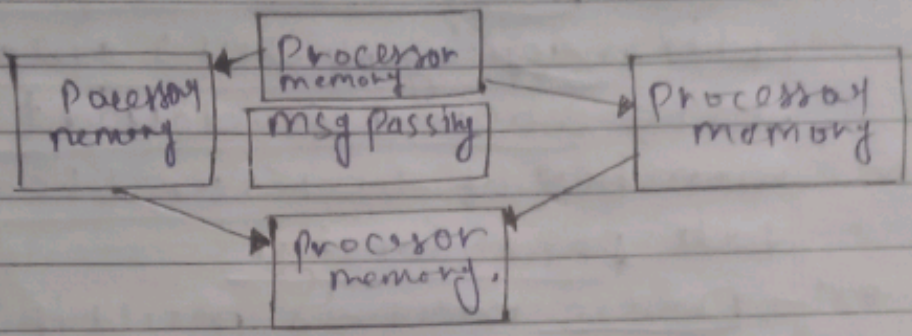
web and database servers.

Application in Computer system:-
As Computer system become more perbasic & computation speed our the network parallel processing issues become ingrain into a wareety of application. Morden automobile consists of tooos of processor Computer to perform computer store as optimizing & handling perfaormance.

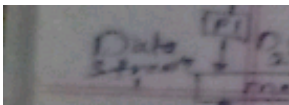
Distributed Computer:- it refers to a system where processing and data store is distributted across multiple device our system rather being handle by singee contral device.
in a D/s each device our system has its own processing capabilities & class store & manages its own data. these device works together to perform task & share resources.

device work together to perform task & share resource the Computer & D/s work in the same program the divided into different task & allocated

to different computers. the computers communicate with each other with the help of massage passing other computation of tasks the result is presented to the user.
Distributed system has multiple computers located in different locations.



- Parallel programming model:
principle of parallel algorithm design
Algorithm development is design to solve problem using algorithm it is a sequence of basic setup for solving given problem using serial number.
dividing a computation into smaller computation and dsign then different processor for parallel in design of parallel algorithm.



Parallel algorithm model

- types of parallel models

(1) the Data-parallel model :- the data parallel model algorithm is one of the simplest models and other parallel algorithm model. In this model, the tasks that need to be out are identified first and then mapped to the processes. this mapping of tasks onto the Problem to be solved is divided into a number of tasks on the basis of data partitioning.

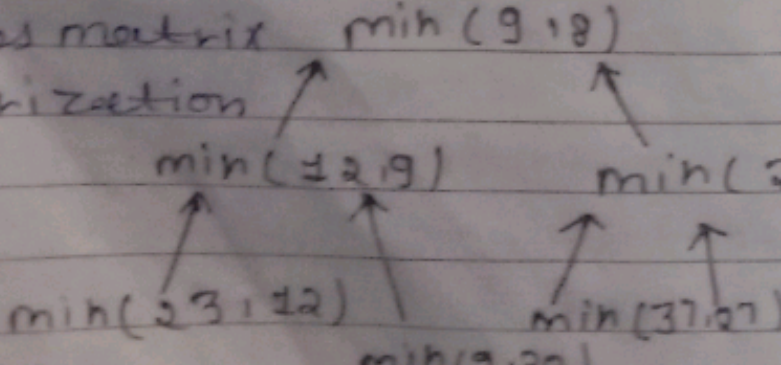
ex:- Dense matrix multiplication.

(2) the task graph model :- the task dependency graph is beign used by the parallel algorithm for describing to computations it performs. therefore, the use of interrelationship among the tasks in the task dependency graph can be used for reducing the interaction costs.

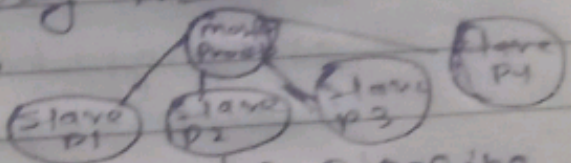
ex:- parallel quick B

start

sparse matrix factorization



(3) Master-slave model:- Master slave model also known as manager-worker model. the work is beigh devided among the Proccors. In this model, there are two different types of processes namely master process and slave procces.



(4) the Repeline model:- the pipeline model is also known as the producer - consumer model. this model is based on the passing of a stream through the processes that are arranged in successoin. here a single task go as through all the other processes. they are then accessed by the requried the process in a seqential manner.
Ex:- Parallel LU factorization algorithm.

(5) Hybrid Model.

(6) Workpoof model.

- sources of overhead in // computing
1. Interprocess Communication
2. Ideling
3. excess computing.

source of overhead :- using tools as many hardware resources one can reason maily aspect a program to run choose as fast.
however intipoical parallel programs there is really the case due to a rinty a overhead associated with parllesion.

there are three overhads // computing
1. Interprocess:- any non trivial parllel system requires it process elements to order and communicated data to perduce intermedeate research.
the time speed in communicating is usually largen than the execution result. thus the Communication become mare and the execution become less.

2. Ideling :- Processing element in a parllel system may become idle due to may reson such as load

Synchronization and presence of several component in a program if different processing element have different work load some processing element may be idle during part of the time that others are working on the problem.
In some parallel program PE must synchronize and certain point during parallel program execution.
If all processing element are not ready for synchronization, then creating point then the one the ready will be idel until all the rest are ready.

(3) Exest Computing :- the fastest non synchronization algorithm for a problem may be difficult parallel parsing to use the parallel algorithm based on parallel but easily parallelizable. The different program is across computation overhead created parallel program.

DPC

* Performance matrices for parallel system
A number of matrices have been used for the design and one of performs execution time. A serial runtime of a program is a time between begning and the end of execution on a sequential computer, the parallel runtime is a time. from the moment a pallel computation start the moment the last processing element finished execution. be denot the serial runtime Ts and parallel runtime by Tp total Ts x Tp.

- Total parallel overhead :- the overhead by a parallel program are teamed into single expression known as overhead function. it is a total time collectivity spend by all the processing element over and above the required sequential algorithm for solving same problem on a singe processing element. it is denoted by symol To the total time spend in solving problem over all processing elem

is $T_s \times T_p$.

The unit is this time are spend performing useful work and the redundacy overhead.

total overhead =

$$T_o = T_{total} - T_n$$

$$T_o = pT_p - T_s \quad \text{or} \quad T_s T_p - T_n$$

- Performance matrics // computing

(1) Execution time (2) Total // Parallel overhead

(3) speedup (4) Efficiency (5) cost

(1) execution time :- the serial runtime of a program is the time elapsed between the beginning and the end of its execution on a sequential computer. the parallel runtime.

(2) speedup :- when evaluating a parallel system, we are often by parallelizing a given application over a sequential implementation, speedup is a measure that captures the relative benefit of solving a problem in parallel, it is defined as the ratio of the time taken to solve the same problem on a single processing element to the time required to solve the same

problem on a single processing element as the time required to solve the same problem on a parallel computer with p identical processing elements. we denote speedup by the symbol S.

it is a ratio of the time required executed a given program using specific algorithm on machine with a single processor T_1 or T_s to the time required to executed the same program using specific algorithm on a machine with multiple processor T_n.

$S = \frac{T(1)}{T(n)}$ or $\frac{T_s}{T_P}$ — Single / Parallel

(4) Efficiency (throughput) only an ideal parallel system containing p processing element can deliver a speedup equal to p. it a practical ideal [illegible]. fraction of time with processing element is using employed. it is define ratio of speedup to the no of processing element. an speedup is = p and efficiny = 1

Efficiny is denoted by symbol E

$E = \frac{Ts}{TP}$ $E = Ts/TP \times P$

P = total no of Processing element.

(5) Cost :- To be defined the cost of solving a problem on a parallel systems the product of parallel runtime an the no the processing element use.

cost reduce the some of the time that each proccessing element speed solving the problem. the cost of solving a problem on a single processing element is the execution time of the fastest known sequence algorithm. it is denoted the symbol C.

$$C = pTp$$

★ Basic Communication operations

In most parallel algorithms, processes need to exchange data with other processes. This exchange of data can significantly impact the efficiency of parallel programs by introducing interaction delays during the execution.

1) One-to-all Broadcast and All-to-one Reduction.

Parallel algorithm often require a single process to send identical data to all other processes or to subset of them. This operation is known as one-to-all broadcast (2.)

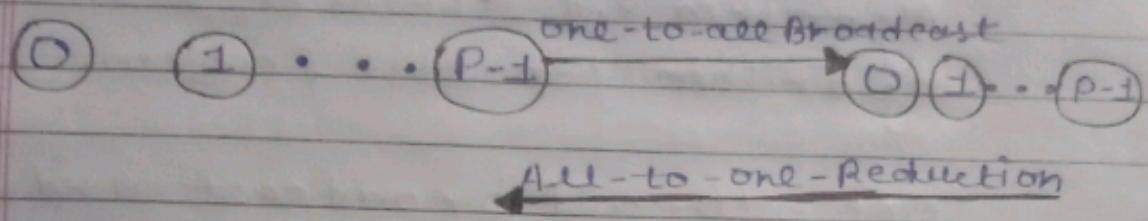
Initially only the source process has the data of size m that need to be broadcast.

At the termination of the procedure there are p copies of the initial data — one belonging to each process.

The dual of one-to-all broadcast is all-to-one reduction.

In an all to one reduction broadcast operation, each of the p participating process starts with a buffer M

containing m words. the Data from all processes are combined through an associative can be used to find the sum, product, maximum, or minimum of set of number.



one-to-all broadcast and all-to-one reduction are used in several important parallel algorithms including matrix-vector multiplication, Gaussian elimination, shortest paths, and vector Inner product.

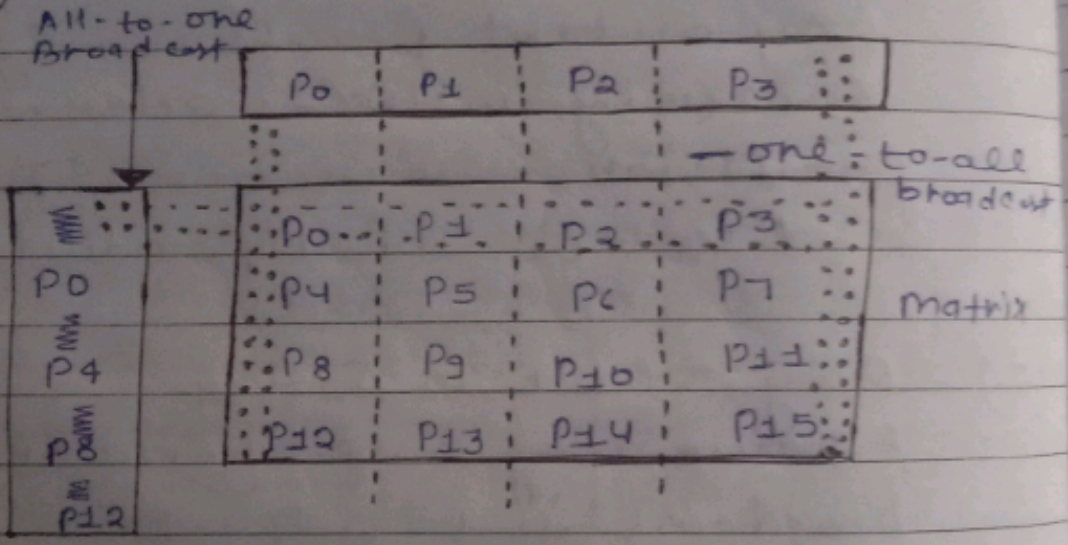
(2.) Ring or Linear Array

A naive way to perform one-to-all broadcast is to sequentially send p-1 message from the source to the other p-1 processes. however, this is inefficient because the source process becomes a ~~bottleneck~~ bottleneck moreover, the communication network is underutilized because only the connection between a single pair of nood is used at a time.

* Example 4.1 matrix-vector multiplication

Consider the problem of multiplying an $n \times n$ matrix A with an $n \times 1$ vector x on an $n \times n$ mesh of nodes to yield an $n \times 1$ result vector y. Algorithm 8.1 shows a serial algorithm for this problem.

one-to-all broadcast and all-to-one reduction in the multiplication of a 4×4 matrix with a 4×1 vector.



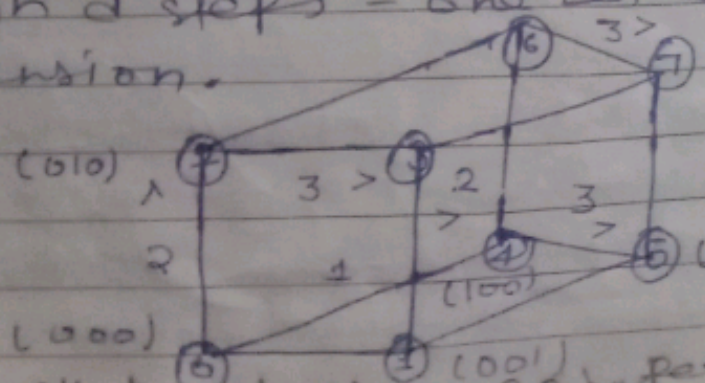
(4)

(3) Mesh:- We can regard each row and column of a square mesh of nodes as a linear array of $\sqrt{p}$ nodes. So a number of communication algorithm on the mesh are simple extension of their linear array

Communication operation can be performed in two phases on a mesh. In the first phase, the operation is performed along one or all rows by treating the rows as linear array. In the second phase, the columns are treated similarly.

(4) Hypercube :- The previous subsection showed that one-to-all broadcast is performed in two phases on a two-2D mesh, with the communication taking place along a different dimension in each phase. Similarly, the process is carried out in three phases on a three-3D mesh.

A hypercube with 2^d nodes can be regarded as a d-dimensional mesh with two nodes in each dimension hence, the mesh algorithm can be extended the hypercube, except that the process is now carried out in d steps - one in each dimension.



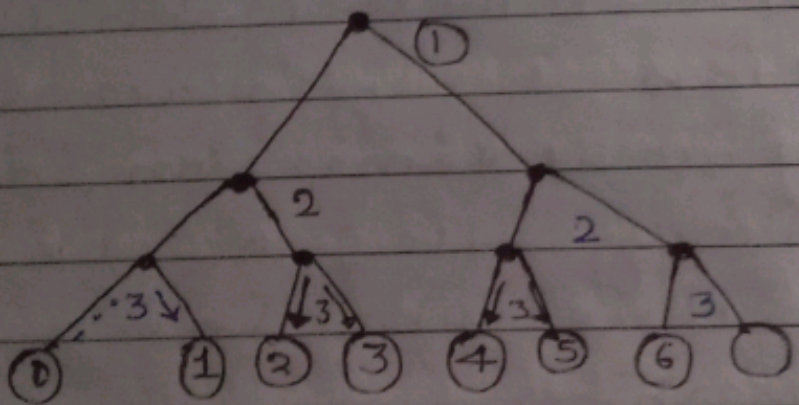
One-to-All broadcast on a 3D hypercube.

The Binary representations of node labels are shown in parentheses.

4 Blanced Binary tree.

The hypercube algorithm for one-to-all broadcast maps naturally onto a balanced binary tree in which each leaf is a processing node and intermediate nodes serve only as switching units. This is illustrated for eight node.

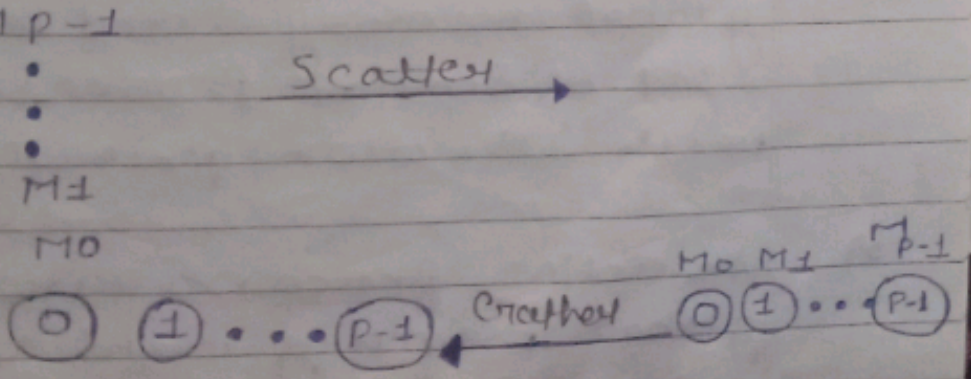
one-to-all broadcast on an eight-node tree.



1.4 Scatter and Gather:-

In the scatter operation a singee node sends a unique message of size m to every other node. this operation is also known as one-to-all personalized communication. one-to-all personalized communeiation is different one-two all broadcast in that the source node starts with p unique messages, one destined for each node. unlike one-to-all broadcast, one-to-all personalized communication or the scatter operation is the gather operation, or concatenation, in which a single node collects a unique message from each node.

figure Scatter & gather operation.



PRAM

* Parallel random Access machine also called PRAM is a model considered for most of the Parallel algorithms. it help to write a Processor Parallel alg. without any architecture constraint and also allows Parallel-algorithm designers to treat processing power as unlimited. it ignores the complexity of inter-Process Communication.

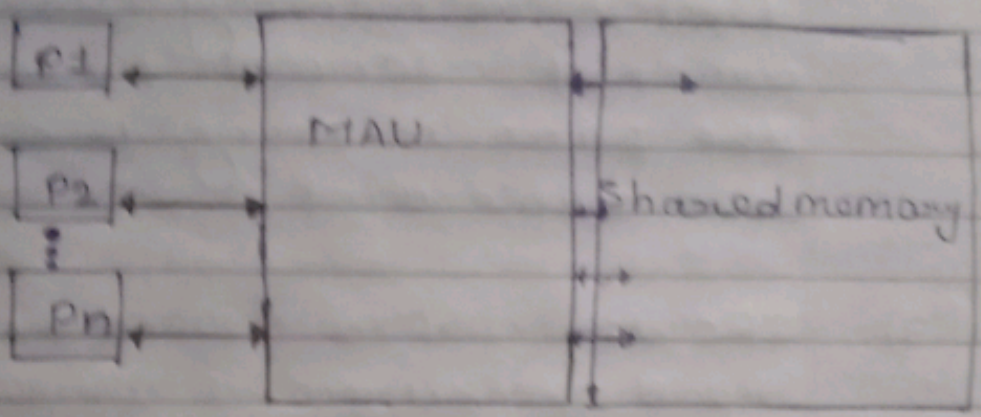
PRAM algorithm are mostly theoretical but can be used as a basis for developing an efficient Parallel algorithm for Practical machines and can also motivate building specialized machines.

- PRAM Architecture model

1) It Consists of a Control unit, global memory, and an unbounded set of Similar processors, each with its own private memory.

2) An active processor reads from global memory, and an unbounded set of Similar processors, each with its own private memory.

(3) The architecture of where one N processors in a PRAM where N number of independent operations can be performed a particular unit of time.



- Model of PRAM

while accessing the shared memory, there can be conflicts while performing the read and write operation (i.e), a processor can access a memory block that is already being accessed by another processor.

there are various constraints on PRAM model which handles the read or write conflicts. They are:

(1) EREW:- also called exclusive Read Exclusive write is a constraint that doesn't allow two processor

to read or write from the same memory location at the same instant.

(2) CREW:- also called concurrent Read exclusive write is a constraint that same memory location but are not allowed to write into the same memory location at the same time.

(3) ERCW:- also called exclusive read concurrent write is a constraint that allows all the processors to write the same memory location but are not allowed to read the same memory location at the same time.

(4) CRCW:- also called concurrent Read concurrent write is a constraint that allows all the processors to read from and write to the same memory location parallelly.

Programming using the message-passing paradigm.

Numerous programming language and libraries have been developed for explicit parallel programming. These differ in their view of the address space that they make available to the programmer, the degree of synchronization imposed on concurrent activities and the multiplicity of programs.
The message-passing programming paradigm is one of the oldest and most widely used approaches for programming parallel computers. Its roots can be traced back in the early days of parallel processing and its wide-spread adoption can be attributed to the fact that it imposes minimal requirement on the underlying hardware.

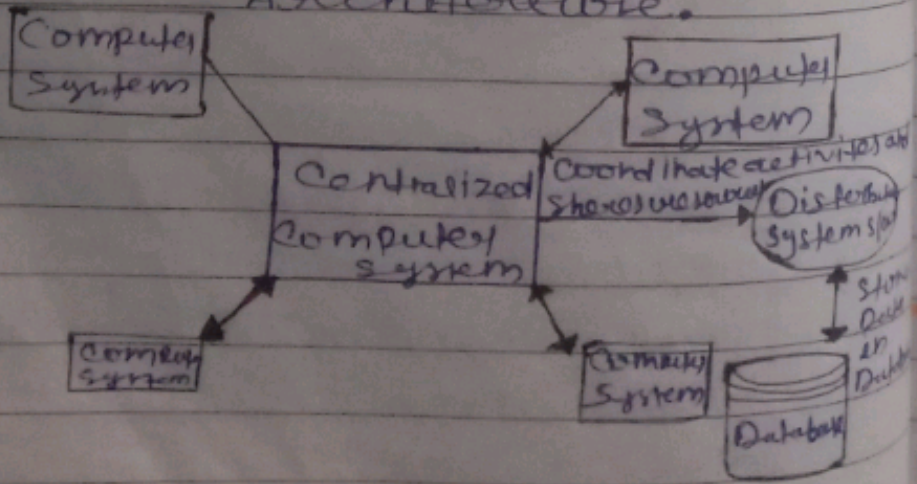
DISTRIBUTING SYSTEM

- Distributed system is a collection of autonomous computer system that are physically separated but are connected by a centralized computer network that is equipped with distributed system s/w.
- the autonomous computers will communicate among each system by sharing resources and files and performing the tasks assigned to them.

Example

An social media can have its centralized computer network as its headquaters and computer system that can be accessed by any user and using their services will be the Autonomous system in th Distributed system

Architecture.



- Distributed system s/w:- this s/w enables computers to coordinate their activities and to share the resources such as H/w, s/w, Data, etc.

- Database:- it is used to store the processed data that are processed by each node / system of the Distributed system that are connected to the centralized network.

⊙ Characteristics of Destributed system

- Resource sharing ✓
- openness ✓
- Concurrency ✓
- Scalability ✓
- fault tolerance ✓
- transparency
- Heterogeneity

(1) Resource:- it is ability to use any h/w, s/w or data anywhere in the system.

(2) openness:- it is concerned with Extensions and improvements in the system.

(3) Concurrency:- It is naturally present in Distributed System.

(4) Scalability:- it increases the scale of the system as a number as a number of processcommun with more user by accommodating to improve the responsiveness of the system.

(5) Fault tolerance:- It cares about the reliability of the system if there is failure in h/w or s/w the system continues to operate properly without degrading the performance the system.

(6) Transparency:- It hides the complexity of the distributed sys to the user and application program as there should be privacy in every system.

(7) Heterogeneity:- Networks, Computer hardware os system programming languages, and developer implementation each all very and differ among dispersed system components.

* ADVANTAGE

1) Applications in Distributed system are Inherently Distributed application.

2) Information in Distributed system is shared among graphically Distributed user.

3) It has a better price performance ratio and flexibility.

(4) It has shorter response time and higher throughput.

* Disadvantage

(1) Relevant s/w for Distributed system does not exist currently.

If every node in a distributed system tries to send data at once, the network may become overloaded.

Client Server Model

The client server model is a distributed application structure that partition task or workload between the providers of a resource or service, called servers, and service requesters called clients.
In the client server architecture, when the client computer sends a request for data to the server through the internet, the server accepts the requested process and delivers the data packets requested back to the client.
ex:- Email, www, etc.

- How the work?

In this article we are going to take a dive into the client server model and have a look at how the internet work via, web Browsers.
this article we have will help us in having a solid foundation of the web and help working with web technologies with

ease.

* How to browser interact with the servers?

- there are few steps to follow to interacts with the servers a client.

- User enter the URL (Uniform resource Locator) of the website or file. request the DNS (Domain name system) server.

- DNS server lookup for the address of the WEB server.

- DNS server responds with the IP address the web server.

- Browser send over an HTTP/ HTTPS request to the web server's IP (provided by DNS server).

- server send over the neccessary file of the website.

* Advantages:-

- centralized system with all data in a singee peace.
- cost efficeint requires less maintenance cost and data recovery is possibee.
- the capacity of the clientand server can be charged seperately.

* Disadvantages:-

- cleent are prone to viruses, trojans and worms if present in the server or uperaded into the server.
- server are prone to Denial of server attacks.

Qus:-1 Explain PRINCIPLE of message passing program.

Ans:- Message passing in Distributed system refers to the communication medium use by nodes to commute information and coordinate their action.

Msg passing is a flexible and scalable method for inter-node communication in distributed system.

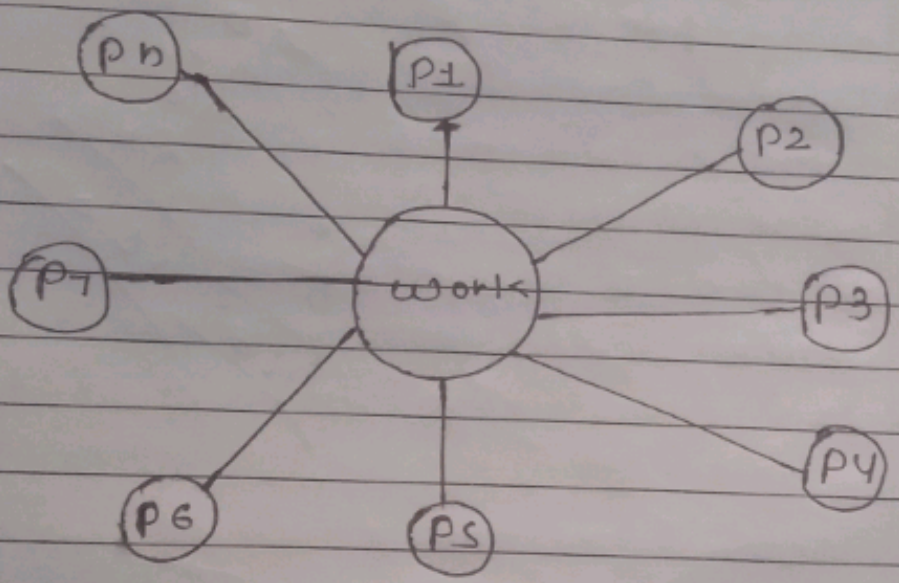
Type

1. Synchronous msg passing
2. Asynchronous msg passing
3. Hybrids

(3) Workpool model :- this model is used when the quantity of data associated with tasks is comparatively very smaller than computation associated with the tasks.

there is no desired pre-assigning of tasks onto the processes.

ex: Parallel tree search



(4) Hybrid Models :-

A hybrid algorithm model is required when more than one model may be needed to solve a problem.

A hybrid model may be composed of either multiple models applied