Fundamentals of Distributed Systems I

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Categories of computer systems

Primary issue: data accessing and generation

Types:

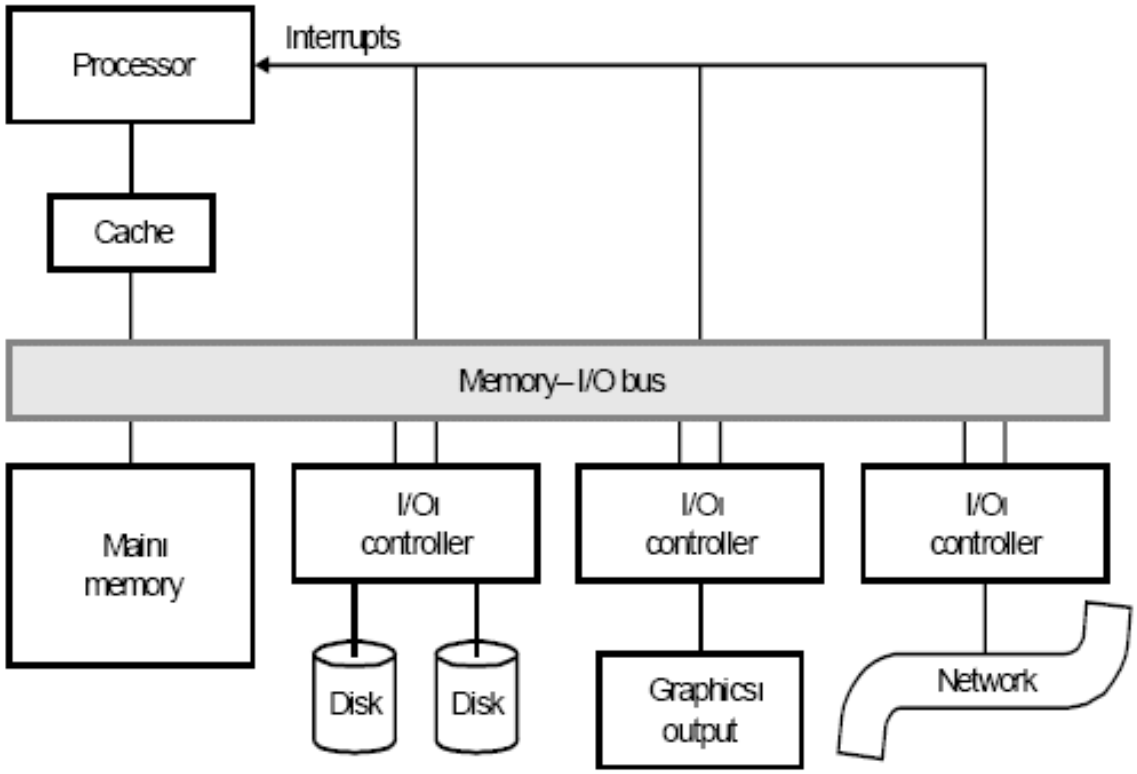
- Conventional sequential machines (mainframes, minicomputers + network of terminals) - multitasking, multiusers.

- Conventional systems with special purpose components (specialized processors) - single specialized task.

- Multiprocessor systems - single task allowing parallel computation.

- Distributed systems (computers connected by a network) - different task, shared data.

Conventional sequential machines



Conventional systems with special purpose components

(Master and slave architecture)

- A special purpose unit (e.g. math processor) attached to the main bus
- Back-end system (additional separate machine, e.g. graphic terminal)
- Example: iDBP
  - file operations: positioning and manipulating a cursor in a file
  - used to implement relational database systems
  - add-on board or back-end system

Multiprocessor systems

Multiprocessor systems:

- Multiple processors
- Shared memory (single address space) vs. multiple private memories
- Centralized memory vs. distributed memory

Categories of parallelism:

- Single instruction stream, single data stream (SISD)
- Single instruction stream, multiple data streams (SIMD)
- Multiple instruction streams, single data stream (MISD)
- Multiple instruction streams, multiple data streams (MIMD)

Distributed computer systems

Issues:

- data location and security
- load distribution
- process migration
- fault tolerance

Types:

- homogeneous systems
- heterogeneous systems

Distributed file systems:

- Apollo DOMAIN (efficient data sharing)
- NFS (UNIX, DOS, system independence)
- AFS (scalability, cache at the file level)
- CFS (mobile systems)

Fault-tolerant networks:

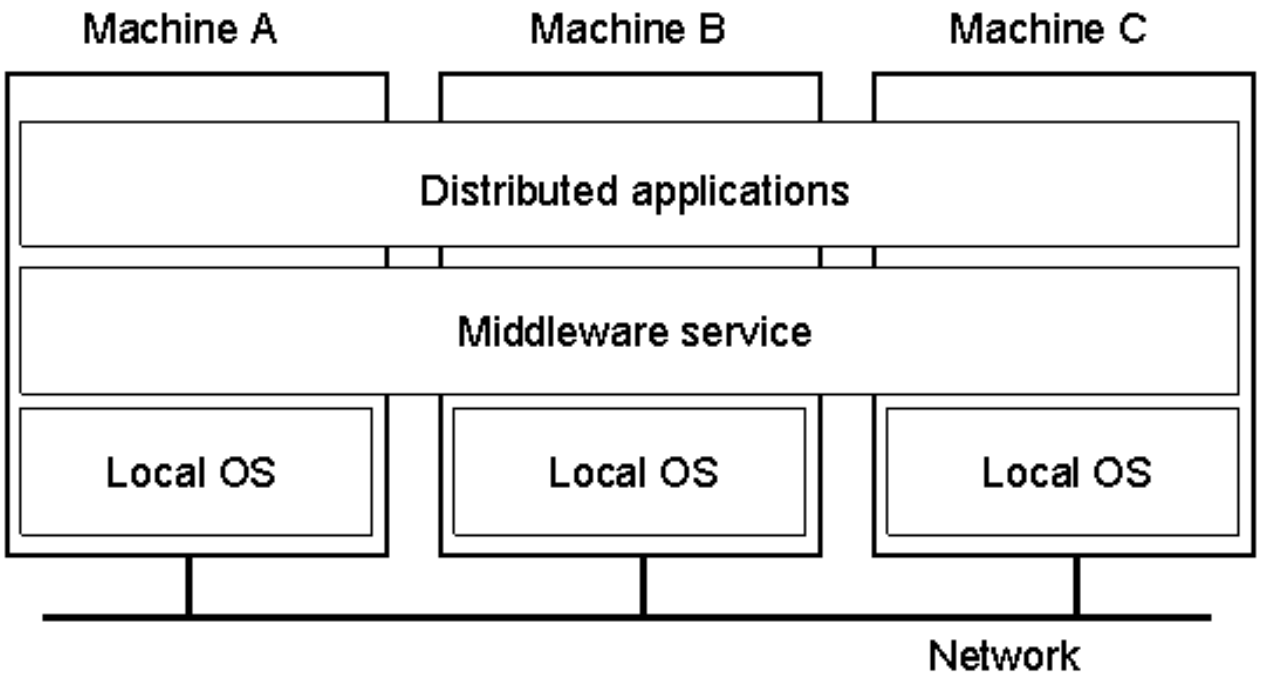
- redundancy (static, dynamic)
- consistency (string, weak)
- self-stabilizing networks

Definition of a Distributed System (1)

- A distributed system is:

A collection of independent computers that appears to its users as a single coherent system.

Definition of a Distributed System (2)



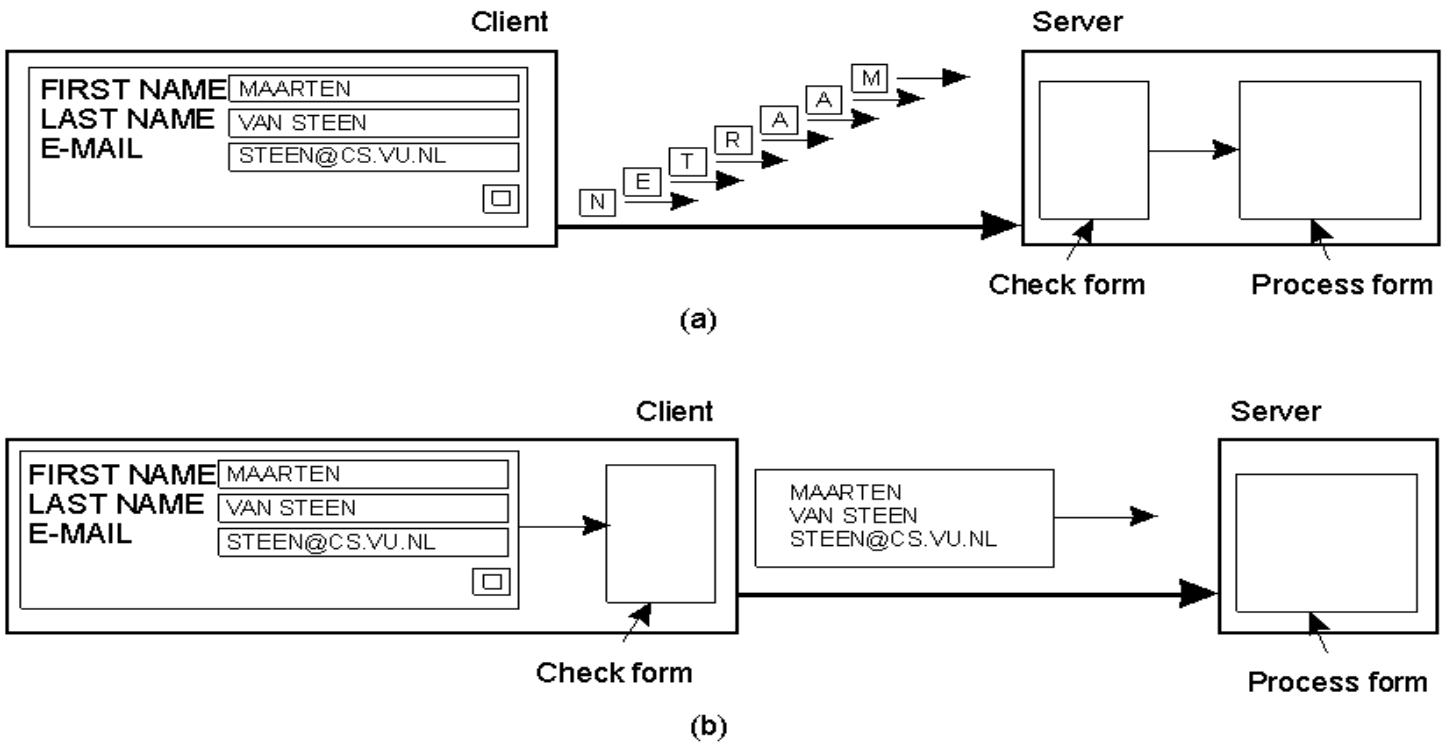
A distributed system organized as middleware.
Note that the middleware layer extends over multiple machines.

Transparency in a Distributed System

Transparency	Description
Access	Hide differences in data representation and how a resource is accessed
Location	Hide where a resource is located
Migration	Hide that a resource may move to another location
Relocation	Hide that a resource may be moved to another location while in use
Replication	Hide that a resource may be shared by several competitive users
Concurrency	Hide that a resource may be shared by several competitive users
Failure	Hide the failure and recovery of a resource
Persistence	Hide whether a (software) resource is in memory or on disk

Different forms of transparency in a distributed system.

Scaling Techniques (1)

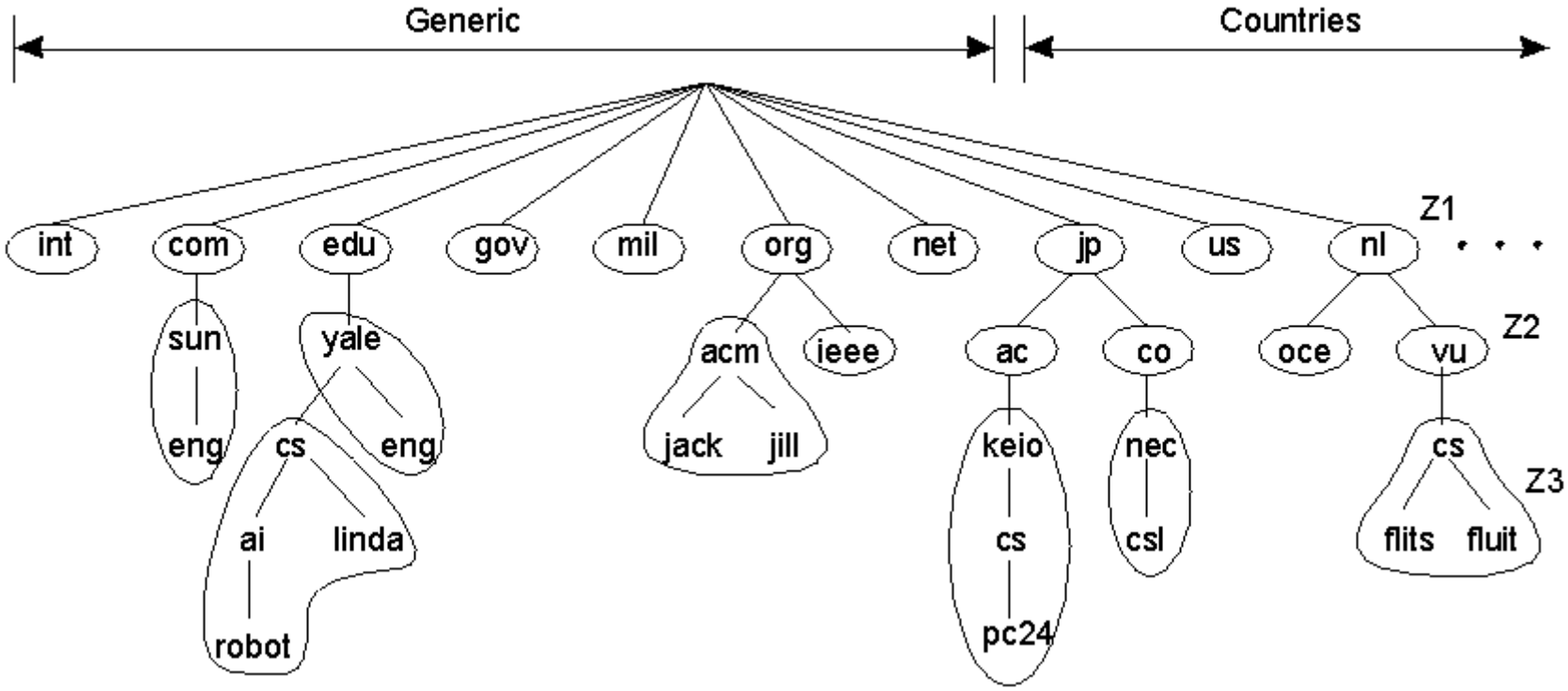


The difference between letting:

a) a server or

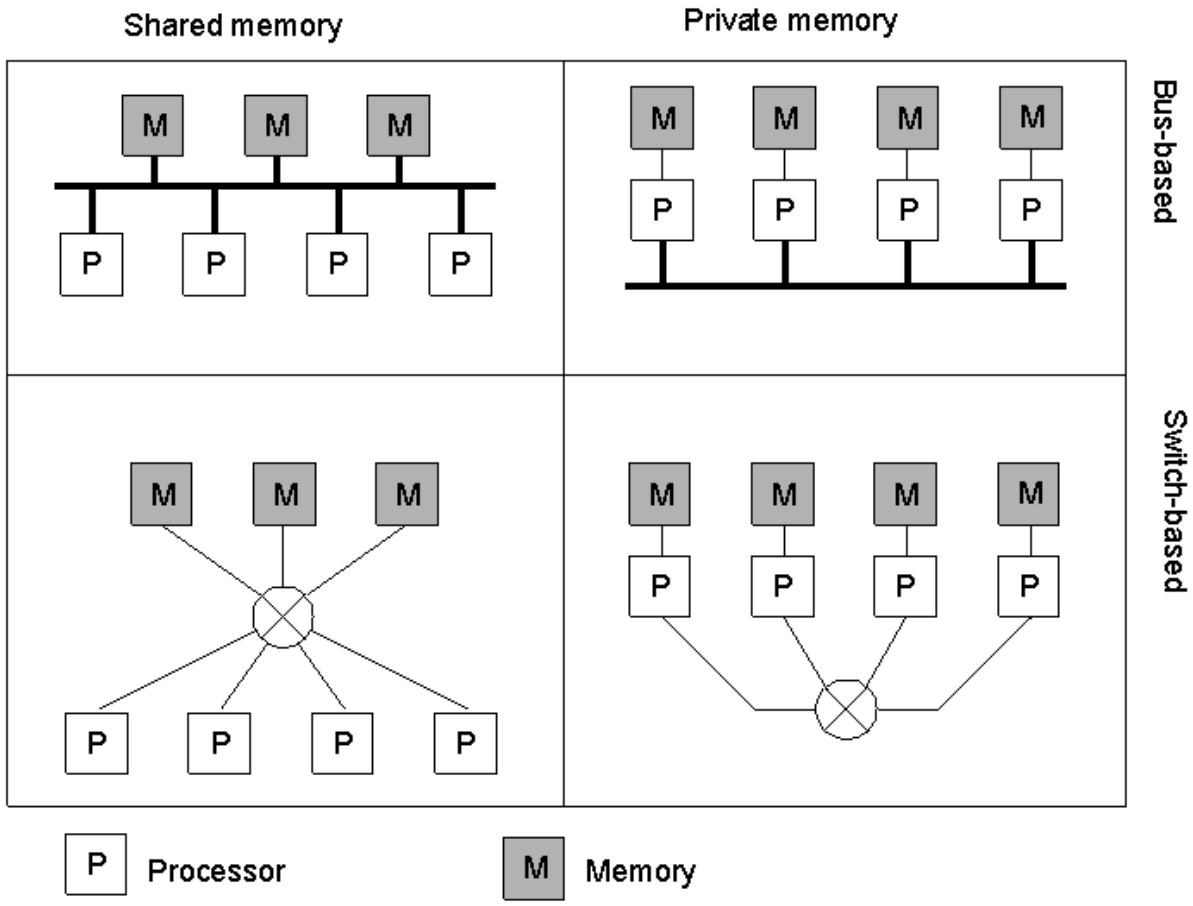
b) a client check forms as they are being filled

Scaling Techniques (2)



An example of dividing the DNS name space into zones.

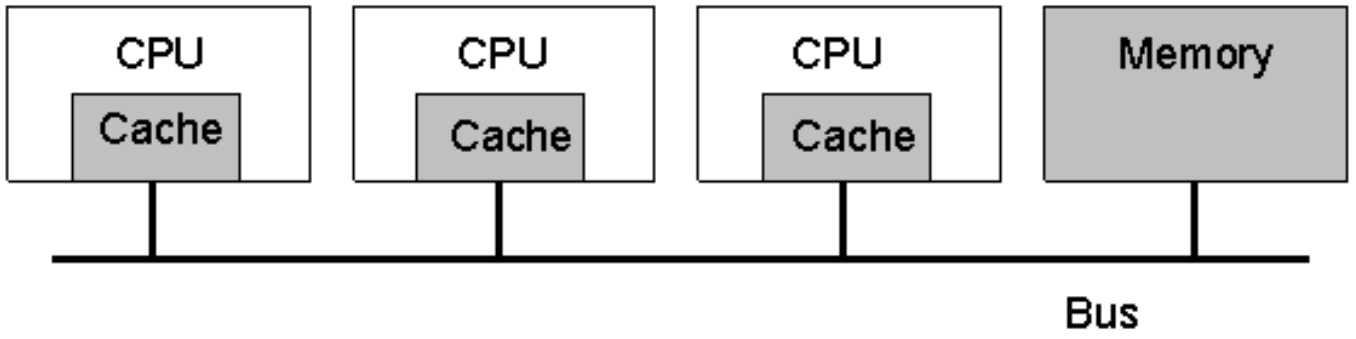
Hardware Concepts



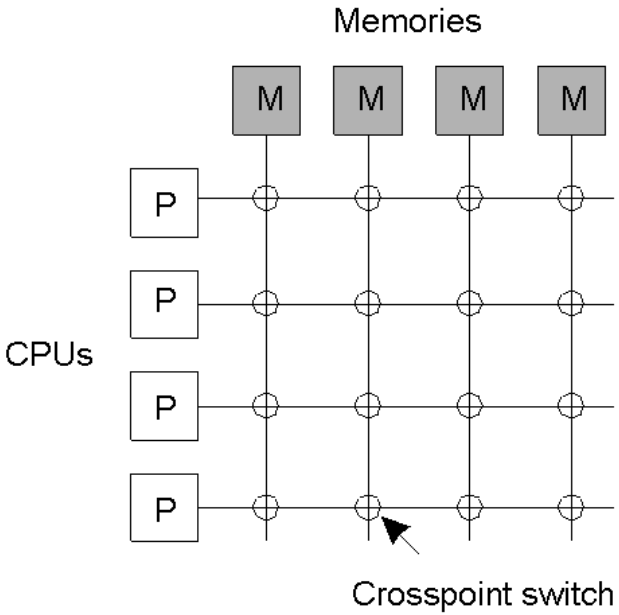
Different basic organizations and memories in distributed computer systems

Multiprocessors (1)

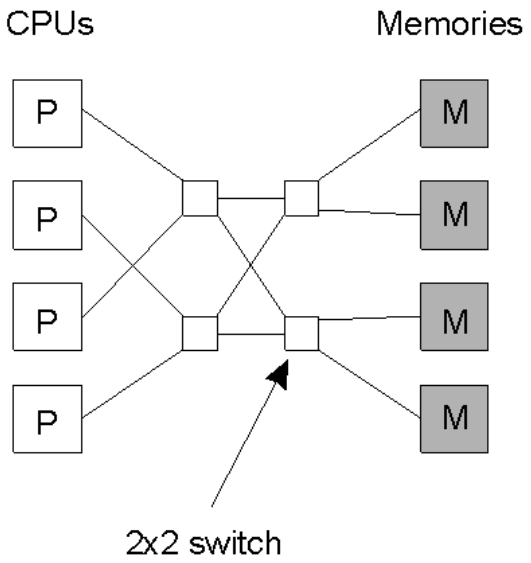
- A bus-based multiprocessor.



Multiprocessors (2)



(a)

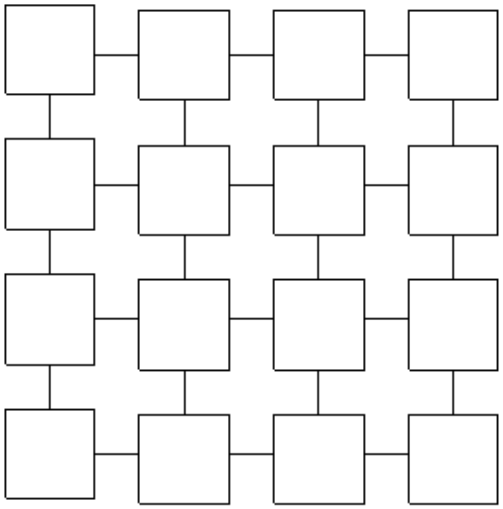


(b)

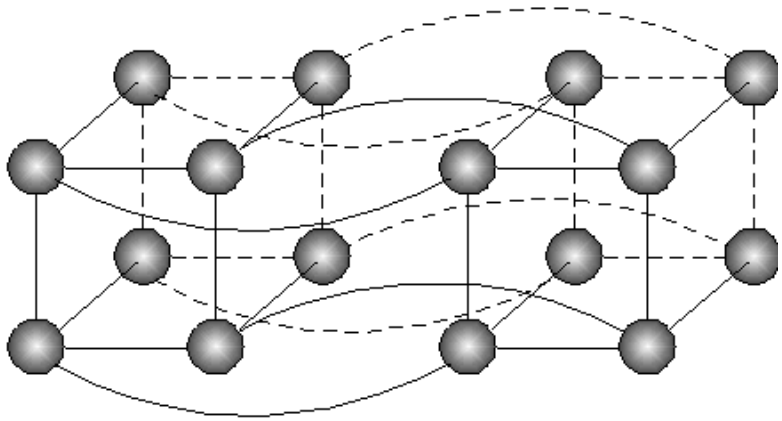
Homogeneous Multicomputer Systems

a) Grid

b) Hypercube



(a)



(b)