

# System Design & Software Architecture

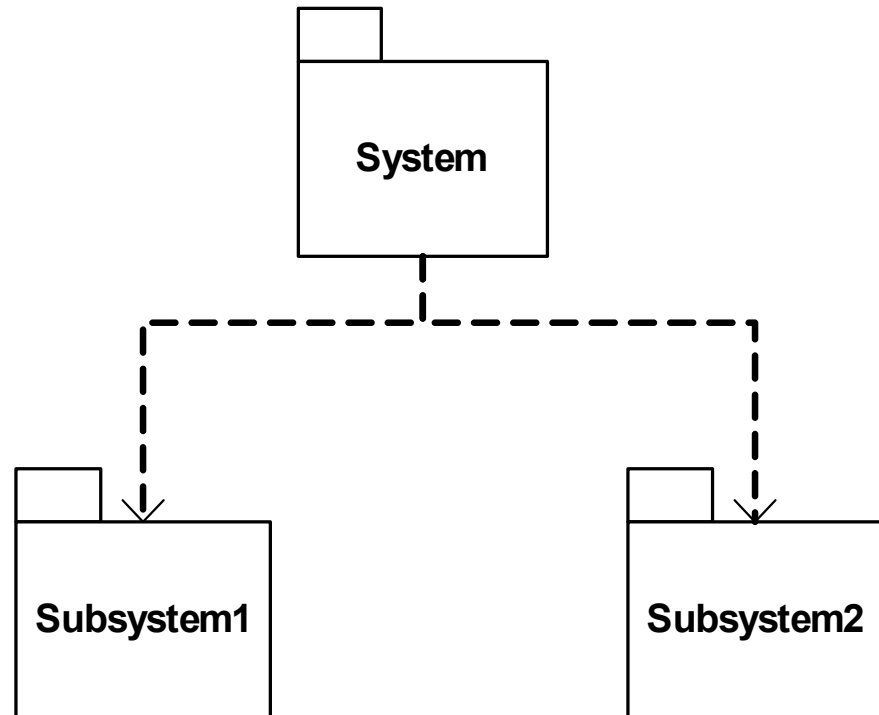
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# System Design

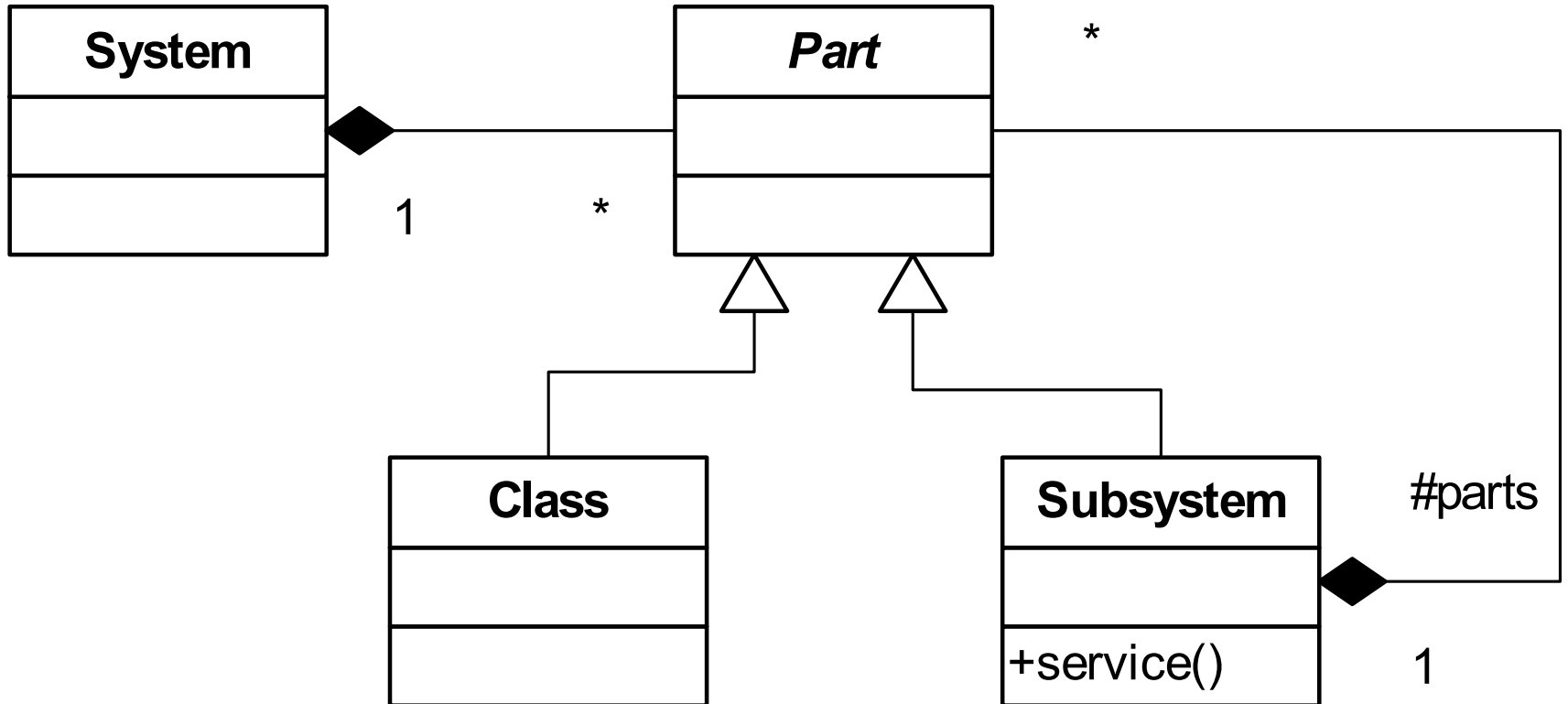
A system is decomposed in to subsystems



# System Decomposition

- A *subsystem* provides a set of *services* to the system.
- A set of related operations that share a common purpose
- The set of services available to other systems form the subsystem interface
- Application Programmer Interface (API) includes name of operations, parameters/types, and return types
- System design focuses on defining services

# (sub) System Model



# Software Architecture

- Shaw & Garlan '96
- The use of standard patterns and styles of design is pervasive in many engineering disciplines
- What standard style are used in software at the architectural level?

# Architectural Style

- An *architectural style* defines a family of systems in terms of a pattern of structural organization
  - Components (e.g., client, server, DB)
  - Connectors (e.g., procedure call, pipe, event broadcast)
- Vocabulary of components and connectors
- Constraints on how they are combined

# Common Architectural Styles

- Dataflow systems
  - Pipe and filter
  - Batch Sequential
- Virtual machines
  - Rule based systems
  - Interpreters
- Repository
  - Databases
  - Hypertext systems
  - Blackboards
- Independent components
  - Peer-to-Peer
  - Client Sever
  - Model / View / Controller
  - Event systems
- Call and return systems
  - Main program and subroutine
  - Layered Systems
  - Object oriented systems

# Pipe and Filter Architecture

- Subsystems are called filters and associations between the filters are called pipes
- Filters only know the content and format of data being received and produced – nothing about the other filters in the system
- Filters are executed concurrently and synchronization is done via pipes
- Very reconfigurable
- Transformational systems, Info. Mang. Sys.



# Pipe and Filter Example

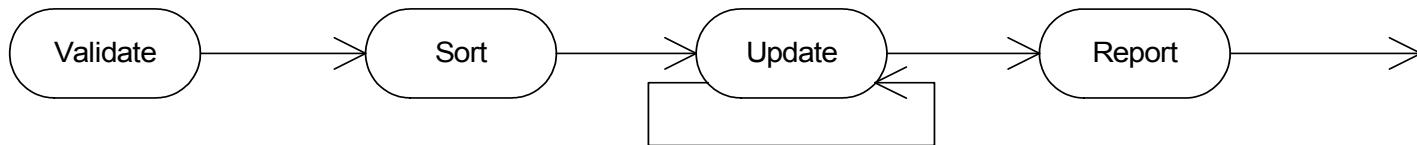
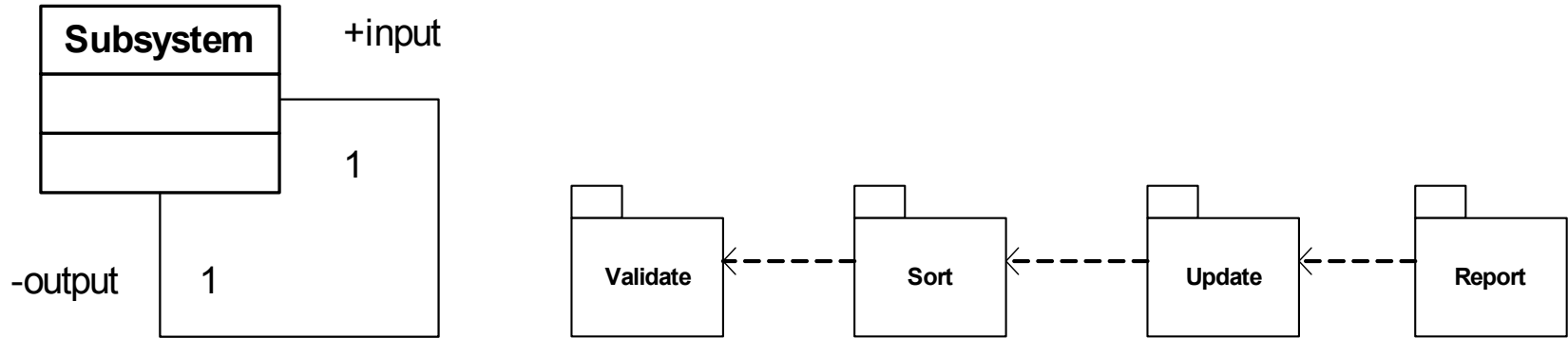
- Unix shell
- `ps auxwww | grep maletic | sort | more`



# Batch Sequential Architecture

- Small number of large stand alone subsystems
- Must be executed in a fixed sequential ordering (batch)
- Typically work on large flat files, transforming the file into a new format or ordering so the next subsystem can work on the data
- Subsystems are tightly coupled through the shared file
- No real time feedback, no concurrency

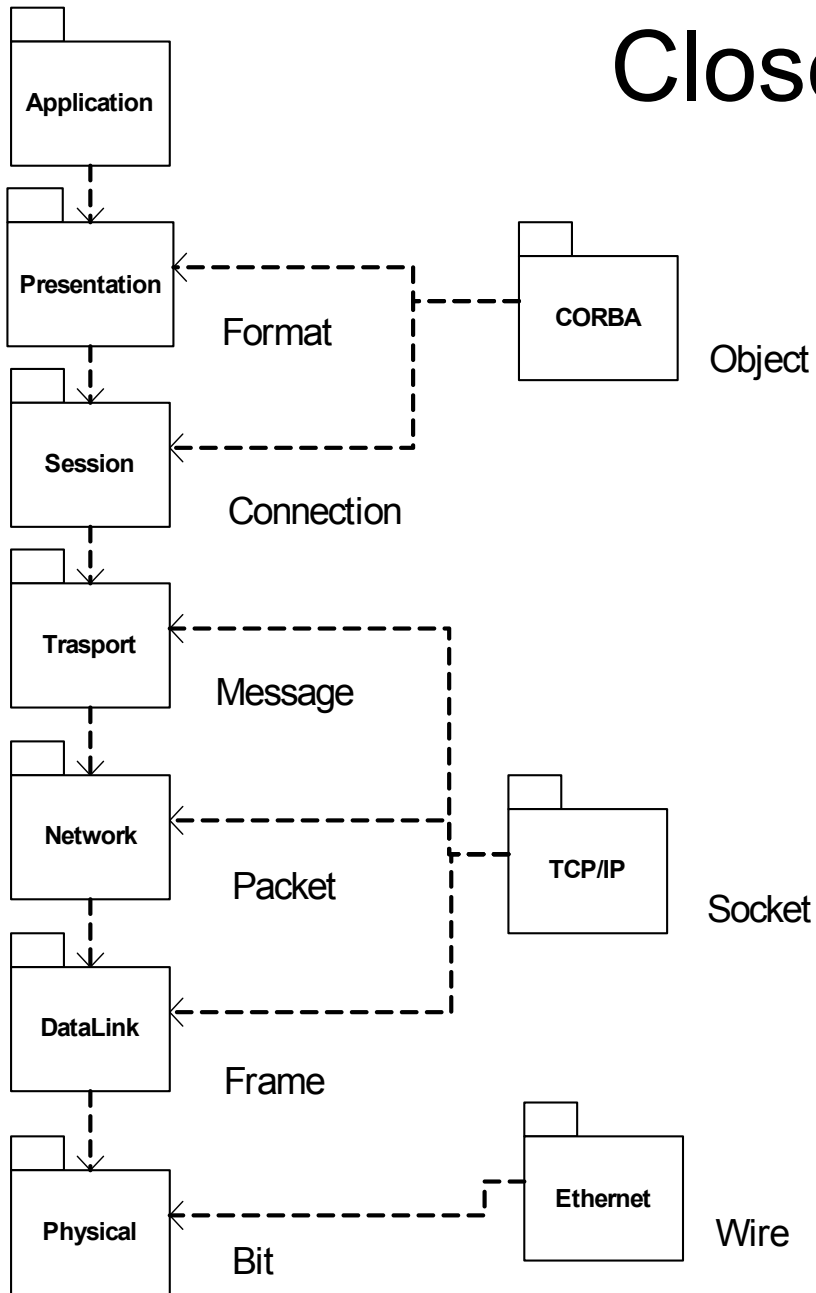
# Batch Sequential Example



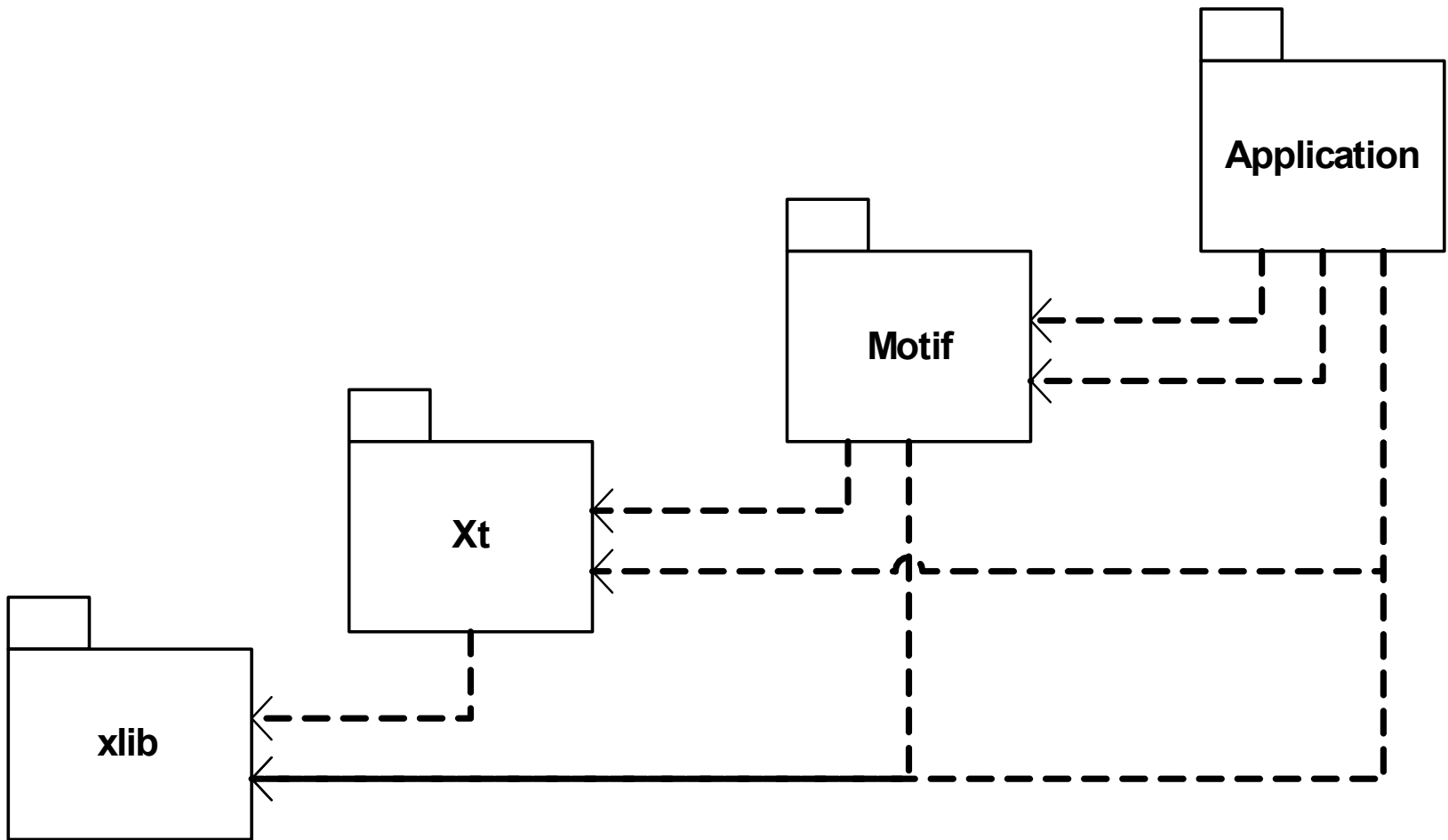
# Layered Architecture

- A hierarchical decomposition of a system into subsystems (layers) with each providing a higher level of services provided from lower level subsystems
- Closed architecture – each layer can only depend on the layer(s) immediately below
- Open architecture – each layer can access any layer below

# Closed Architecture OSI Network Model

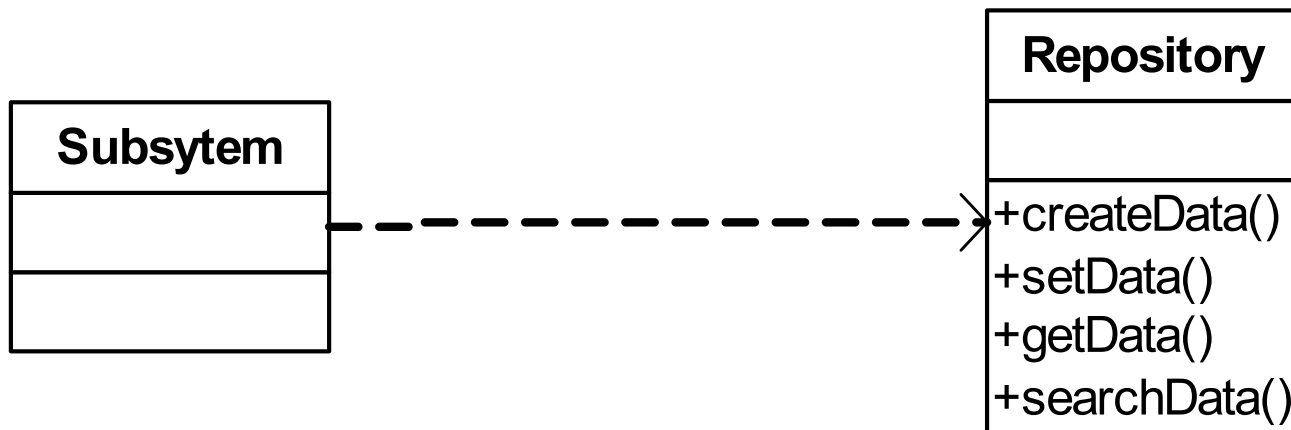


# Open Architecture: Motif Library

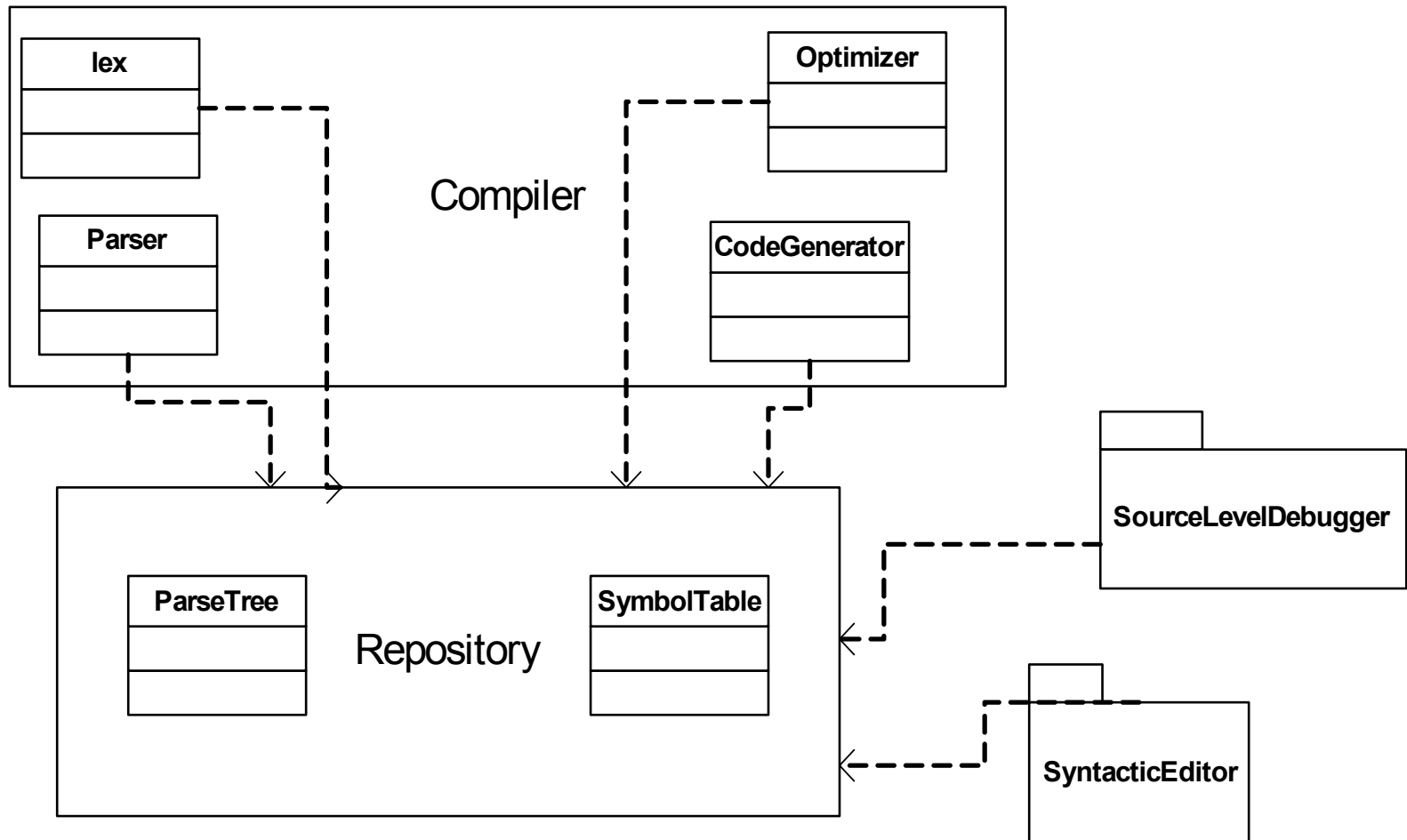


# Repository Architecture

- Subsystems are independent and interact by a central repository
- Examples: Payroll or banking system, Modern IDE/Compiler, Blackboard



# Repository Example

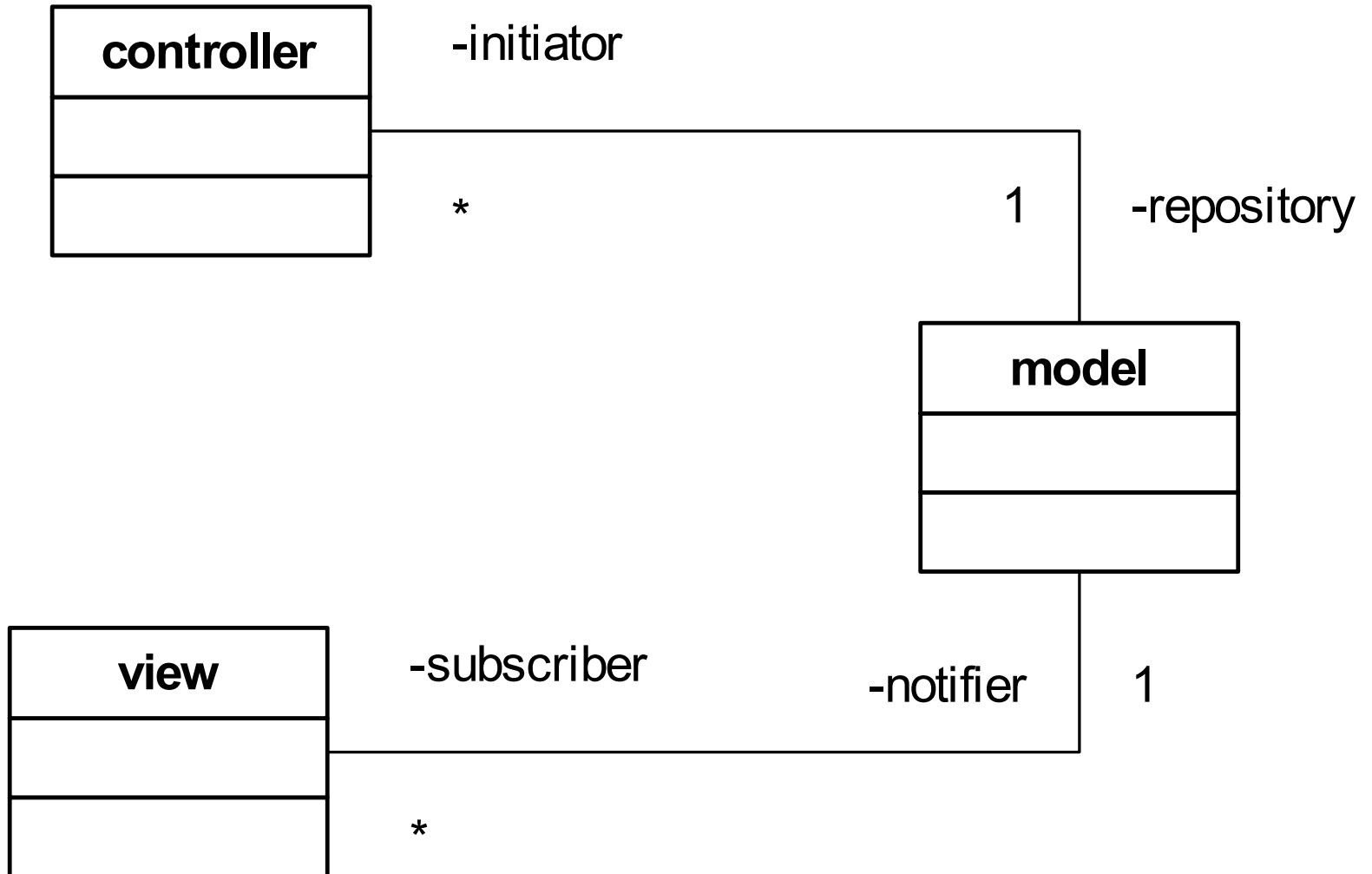




# Model / View / Controller

- Subsystems
  - Model subsystems are responsible for maintaining domain knowledge
  - View subsystems are for displaying knowledge to the user
  - Controller subsystems manage the interactions with the user
- Model subsystems do not depend on view or controllers.
- Changes in model state is propagated via a subscribe notify protocol
- Examples: File system, database

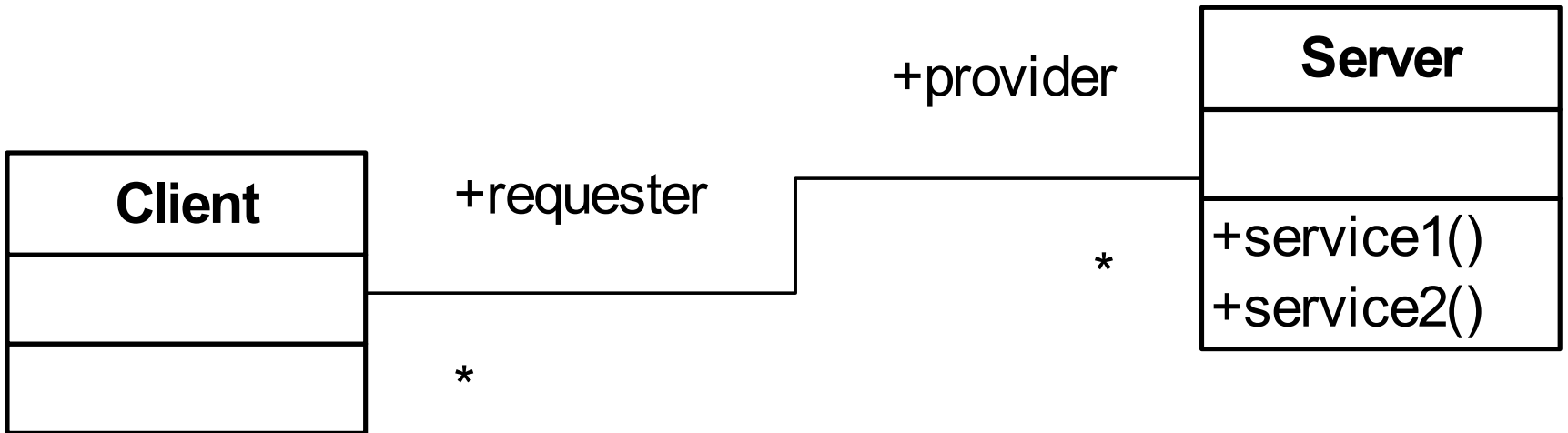
# MVC



# Client/Sever Architecture

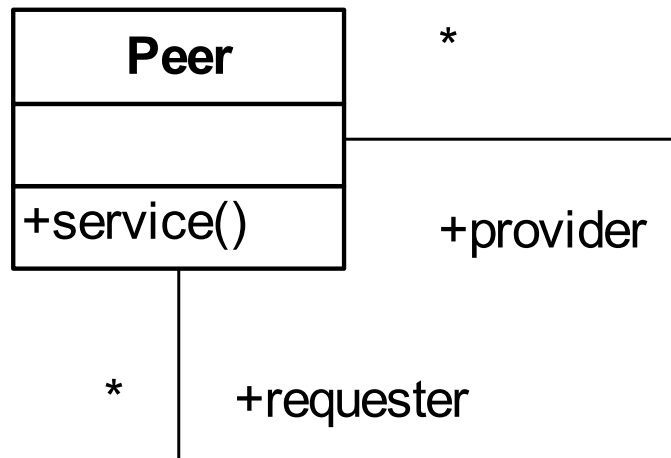
- Subsystems:
  - Server provides one or more services to instances of clients
  - Clients ask for services and clients interact with users
- Information system with a central DB is an example
- Web servers (multiple servers)

# Client/Server

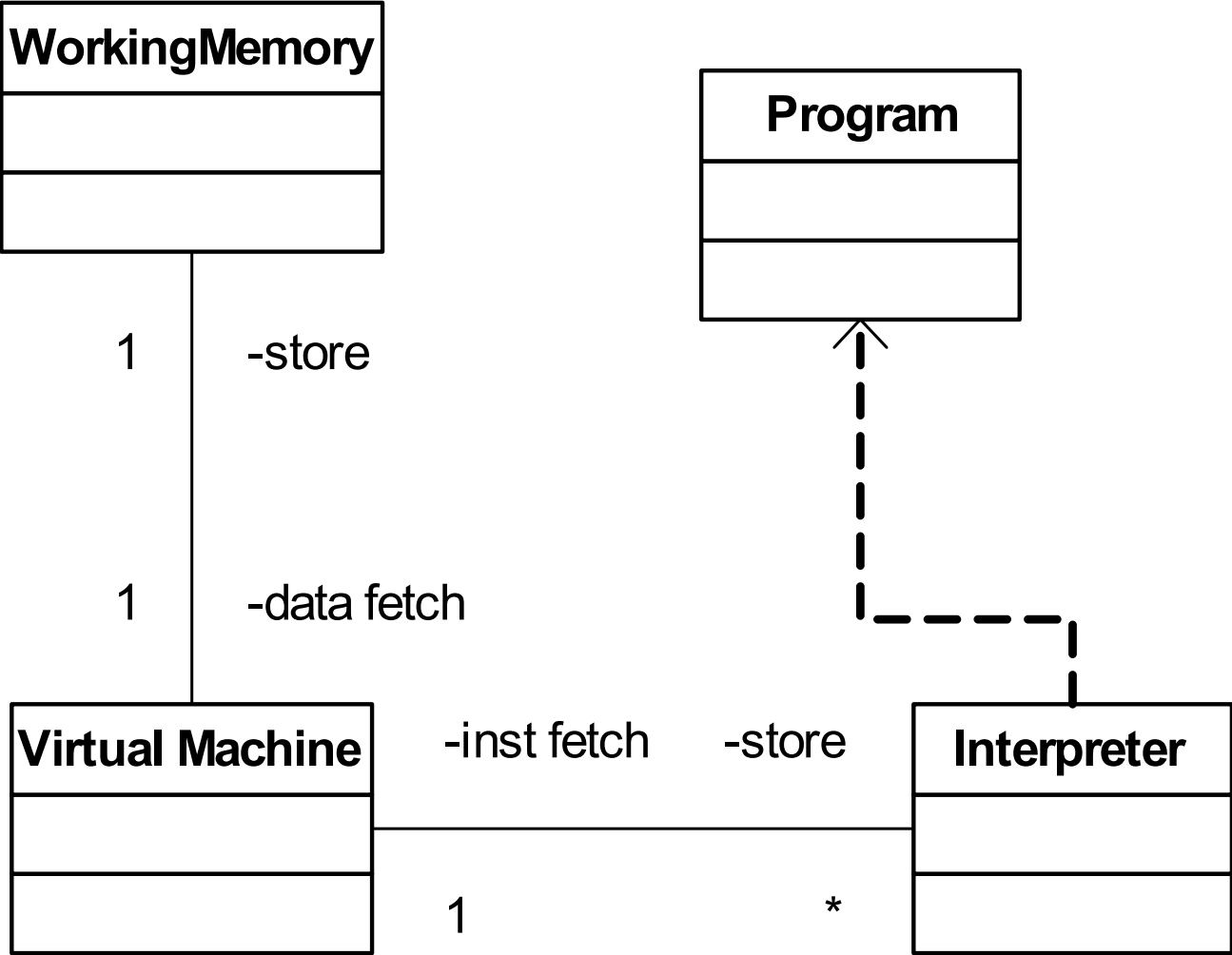


# Peer-to-Peer Architecture

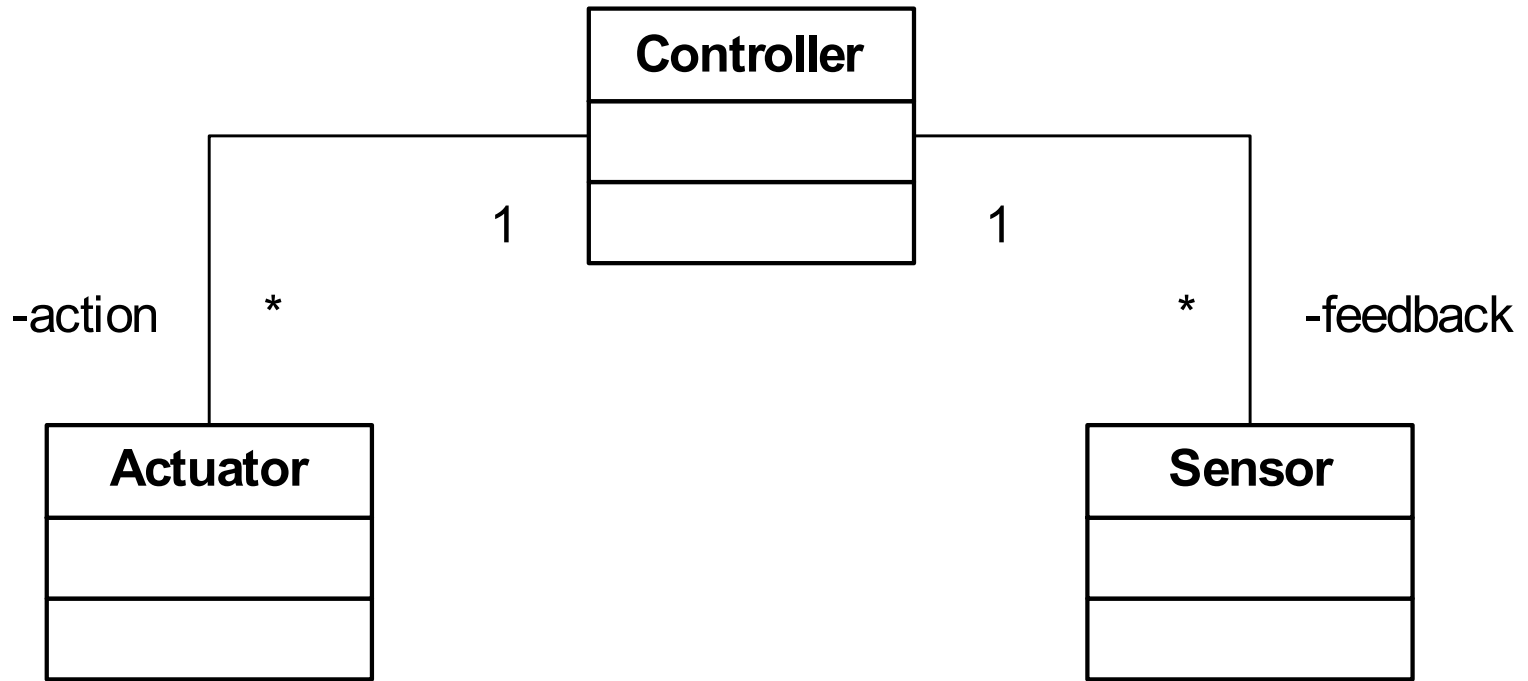
- Generalization of client/server, clients can be servers and vice versa
- The control flow of each subsystem is independent from others except for synchronization of requests.



# Virtual Machine Architecture



# Process Control Architecture



# Event-driven Architecture

