
Architectural Patterns

Pipes and filters
Observer network
Client-server
Layers
Active Object-Model

Architecture

How system is divided into components
How components are connected
How components communicate
Constraints and patterns

Software Architecture by Mary Shaw and David Garlan

Pattern Oriented Software Architecture by Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, and Michael Stal

Pipes and Filters architectural style

Components are filters

Filters transform input to output

Filters don't

- share state
- know identity of input or output

Example: Streams

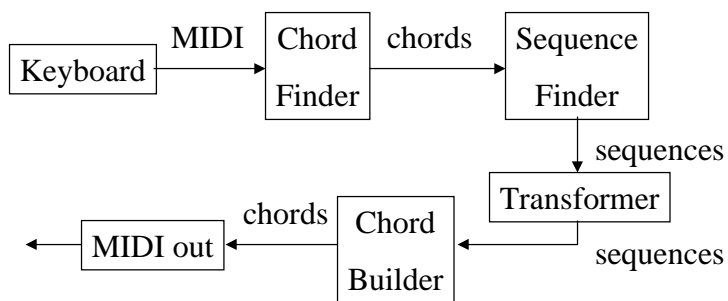
Advantages of Pipes and Filters

- Easy to understand
- Easy to change
- Easy to maintain
- Components are reusable
- Handle parallelism well

Disadvantages of Pipes and Filters

- Not good for interactive processing
- Doesn't handle separate but related streams very well.
- Doesn't model state very well.

Music Improvisor



Object-oriented Programming and Design - Copyright 1998 by Ralph E. Johnson

7

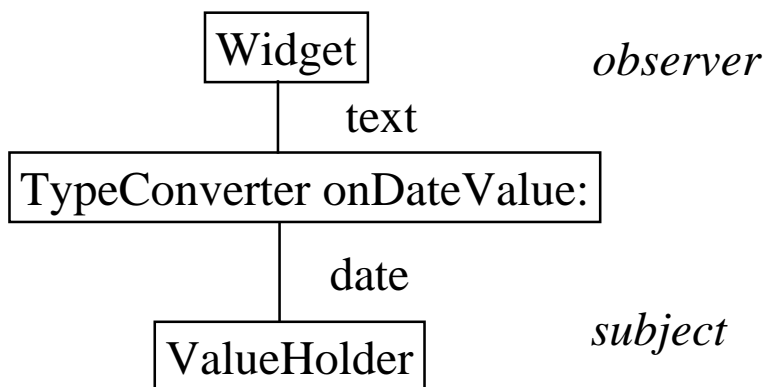
Observer architectural style

Components are observers and subjects
 State of observer is function of state of its
 subjects

Object-oriented Programming and Design - Copyright 1998 by Ralph E. Johnson

8

Reusable components



Object-oriented Programming and Design - Copyright 1998 by Ralph E. Johnson

9

Reusable components

ValueModel (value, value:, update:)

 ComputedValue

 PluggableAdaptor

 TypeConverter

 ProtocolAdaptor

 RangeAdaptor

 ValueHolder

Object-oriented Programming and Design - Copyright 1998 by Ralph E. Johnson

10

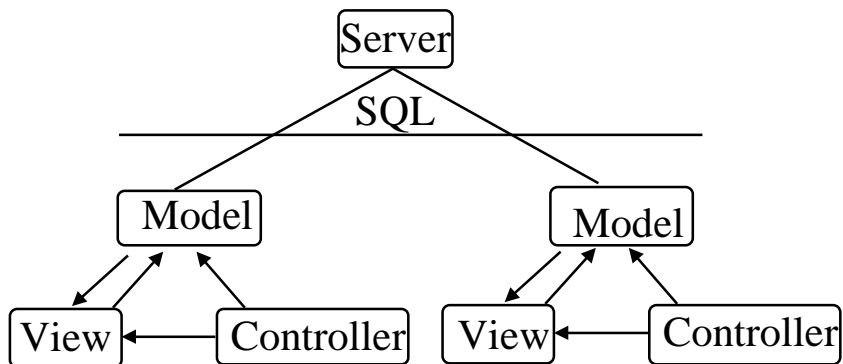
Advantages

- Reusable components
- Easy to change
- Handles parallelism well
- Handles interaction well

Disadvantages

- Can be hard to understand
- Cycles are hard to handle
- Can be inefficient

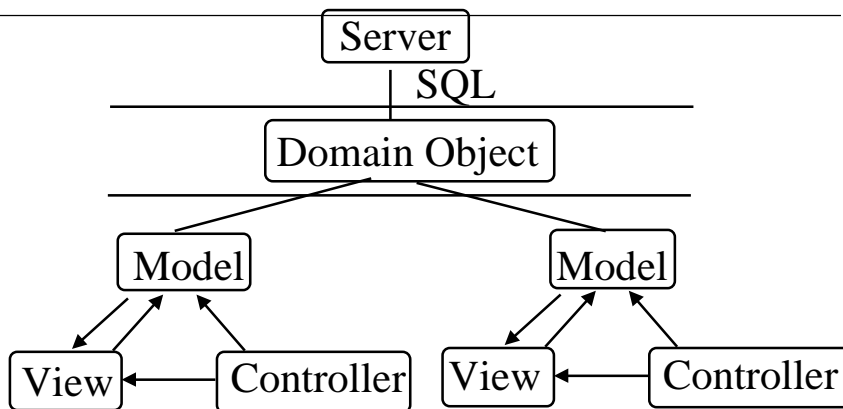
Client-Server



Object-oriented Programming and Design - Copyright 1998 by Ralph E. Johnson

13

Three-tiered Client-Server



Object-oriented Programming and Design - Copyright 1998 by Ralph E. Johnson

14

Advantages

Higher performance than single computer

- concurrent processing
- local processing

Higher reliability than single computer

Disadvantages

Distribution brings many new kinds of errors

Client/server systems are complex

Layer Systems

Organize software in layers
Each layer knows only layer below it.

Advantages

Each layer can be understood on it own.
Can change/replace layer.

Disadvantages

It can be hard to partition system into layers.

It can be more efficient for a layer to use layers far below it.

There can be many ways to divide a system into layers.

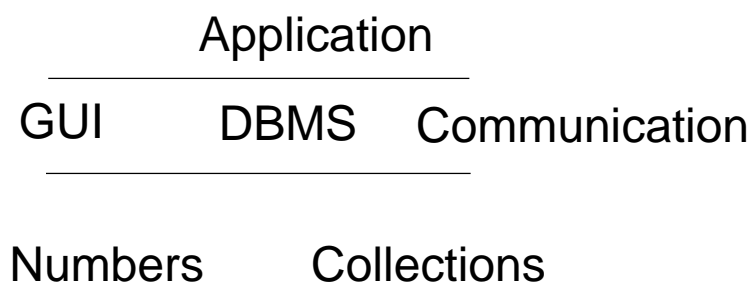
Layers in Smalltalk

User interface (Application Model)

Domain Model

Foundation (Numbers, Collections)

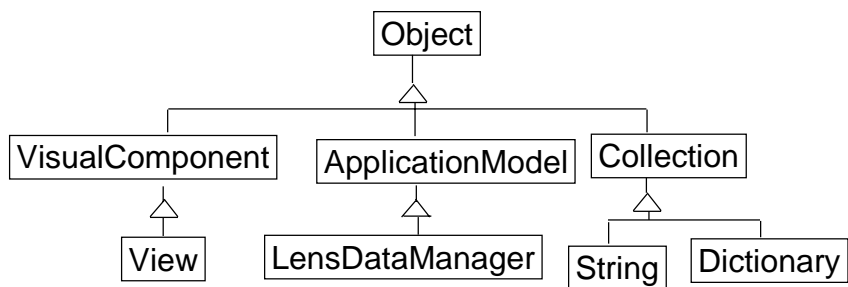
Alternate Layers in Smalltalk



Object-oriented Programming and Design - Copyright 1998 by Ralph E. Johnson

21

Inheritance: an Alternate Organization



Object-oriented Programming and Design - Copyright 1998 by Ralph E. Johnson

22

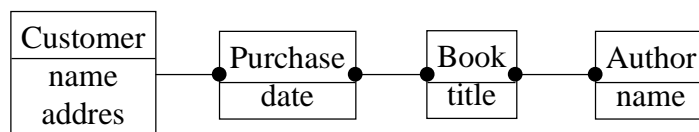
Conclusion

Multiple views are necessary.
Single system can use several different architectural styles.

Implementation patterns

Instance variable for each attribute and association.
1 to many association is implemented with a collection.
Many to many association is implemented with two collections.

Object model for Amazon



Customer has methods name, name:, address, address:, addPurchase: removePurchase:, and purchaseDo:

addPurchase: aPurchase
 purchases add: aPurchase.
 purchase customer: self

Other patterns

Analysis

GUI design

Distributed programming

Coding