# Design Defects and Restructuring

LECTURE 14

SAT, DEC 19, 2020

## Stability

The classic definition of the word stability is “Not easily moved”

Stability is not a measure of the likelihood that a module will change; rather it is a measure of the difficulty in changing a module

Modules that are more difficult to change, are going to be less volatile

The harder the module is to change, the more stable it is, the less volatile it will be

Classes that are heavily depended upon are called “Responsible”

Responsible classes tend to be stable because any change has a large impact

The most stable classes of all are classes that are both Independent and Responsible

Such classes have no reason to change, and lots of reasons not to change

## The Acyclic Dependency Principle (ADP)

Allow no cycle in the package dependency graph

Morning-after syndrome

The weekly build – Partitioning the development environment into releasable packages

Breaking the cycle

- Apply DIP
- Create a new package, move the classes that they both depend on into that new package

Top-Down design

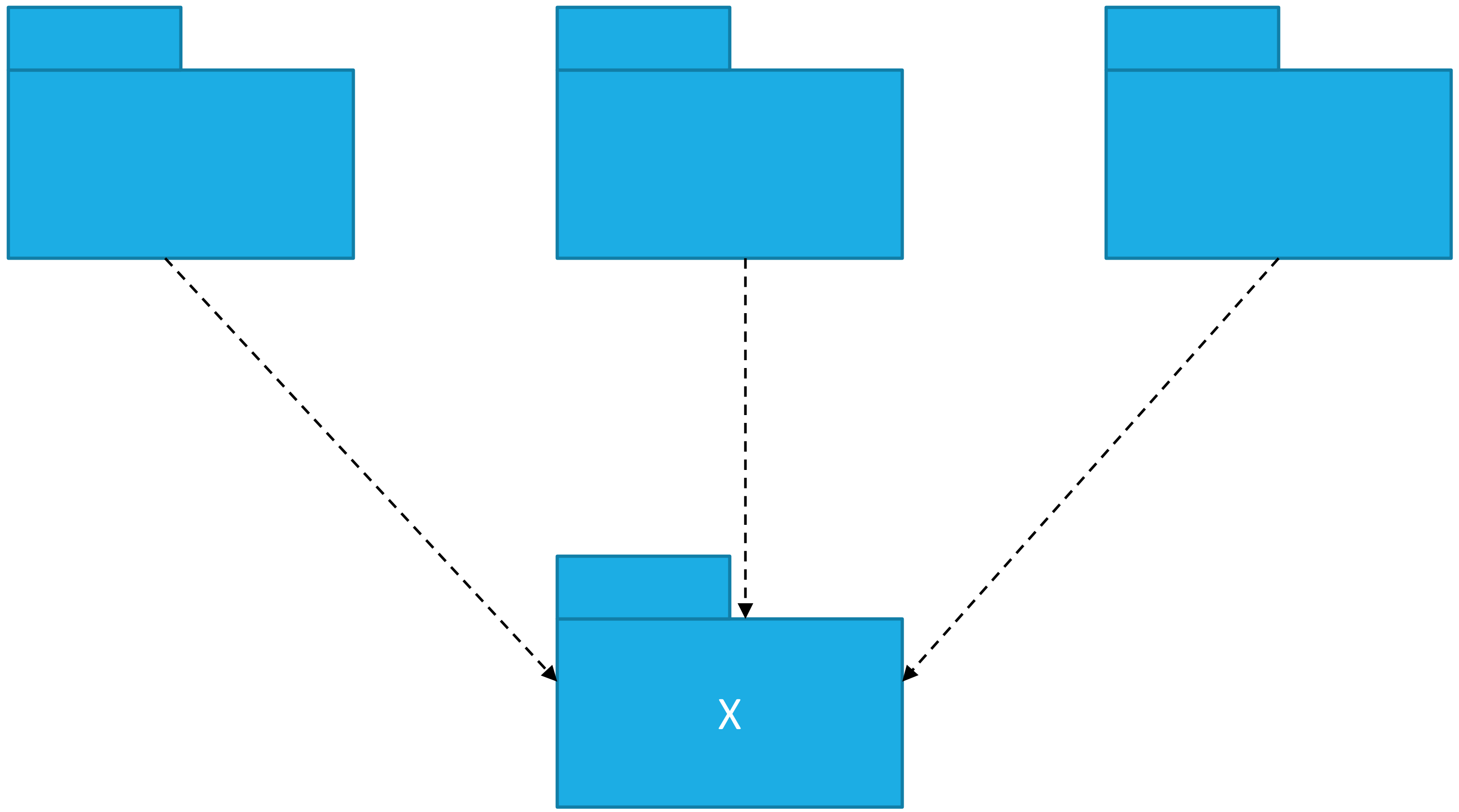
## The Stable Dependency Principle (SDP)

Depends in the direction of stability

Any package that we expect to be volatile should not be depended on by a package that is difficult to change, otherwise the volatile package will also be difficult to change

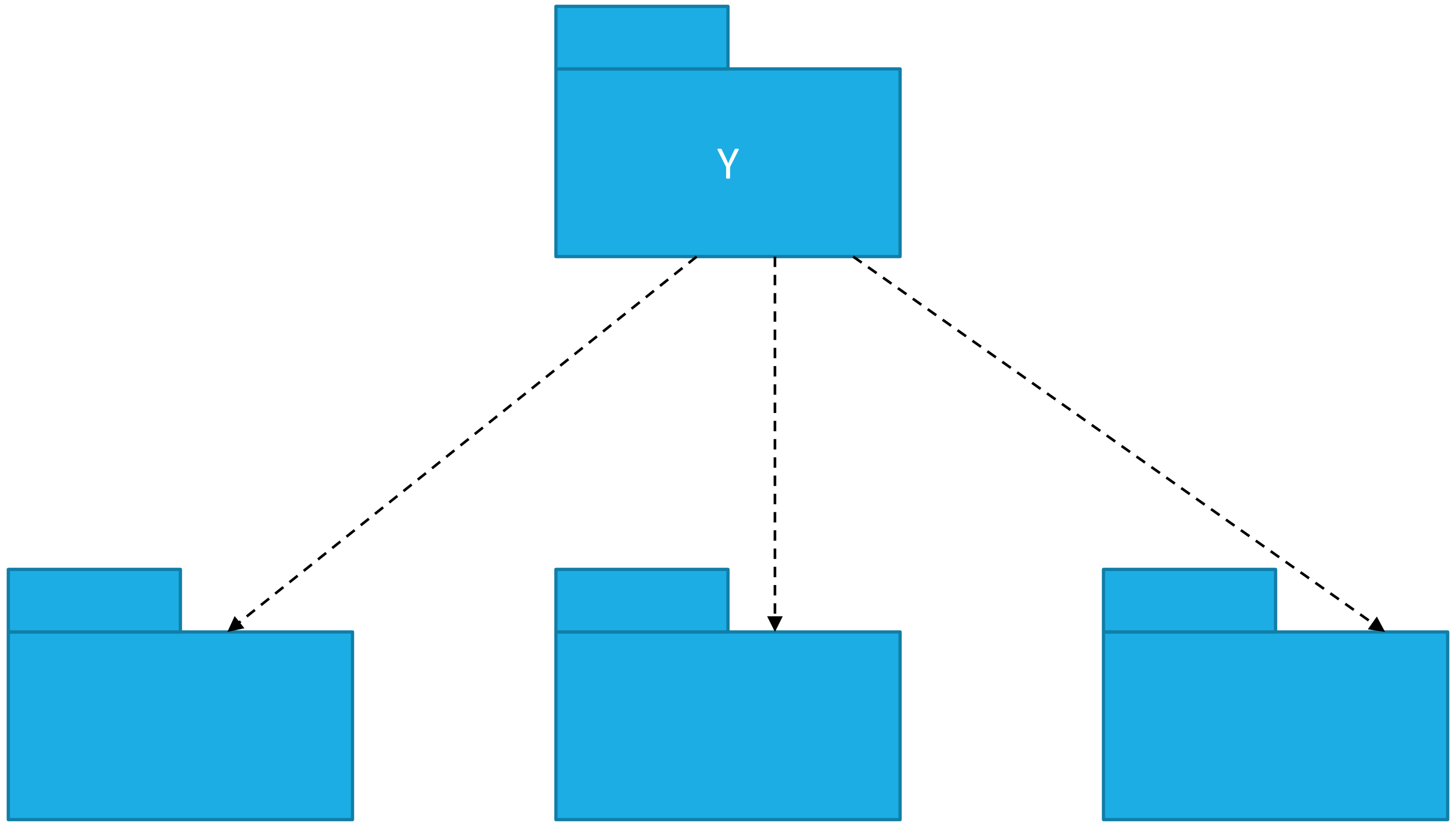
Stability : amount of work required to make a change

# The Stable Dependency Principle (SDP)



X: A Stable Package

## The Stable Dependency Principle (SDP)



Y: An Unstable Package

## The Stable Dependency Principle (SDP)

Stability Metrics

- Afferent Couplings ($C_a$): The number of classes outside this package that depends on classes within this package
- Efferent Couplings ($C_e$): The number of classes inside this package that depend on classes outside this package
- Instability (I) : $I = \frac{C_e}{C_a + C_e}$

Range = [0,1]

I = 0: Maximum Stability

I = 1: Maximum Instable Package

## The Stable Abstraction Principle (SAP)

The package should be as abstract as it is stable

This principle sets up the relationship between stability and abstractness

Stable package should also be abstract so that its stability does not prevent it from being extended

Instable package should also be concrete since its instability allows the concrete code within it to be easily changed

# The Stable Abstraction Principle (SAP)

Abstraction Metrics

- $N_c$ – The number of classes in the package
- $N_a$ – The number of abstract classes in the package
- Abstractness (A) :

$$A = \frac{N_a}{N_c}$$

Range = [0,1]

A = 0: Package has no Abstract classes

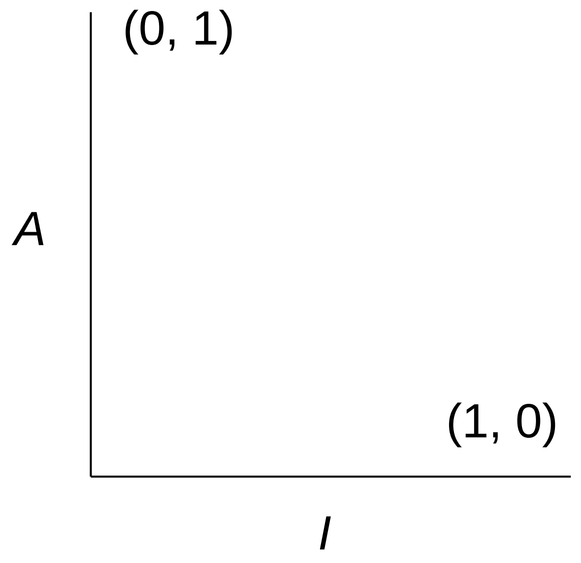
A = 1: Package contains nothing but the abstract classes

## The Main Sequence

A – I Graph

Maximally stable and abstract (0, 1)

Maximally instable and concrete (1, 0)



## The Main Sequence

(0, 0) : Highly stable and concrete package

It cannot be extended because it is not abstract

It is very difficult to change because of its stability

Example 1 : Database Schemas

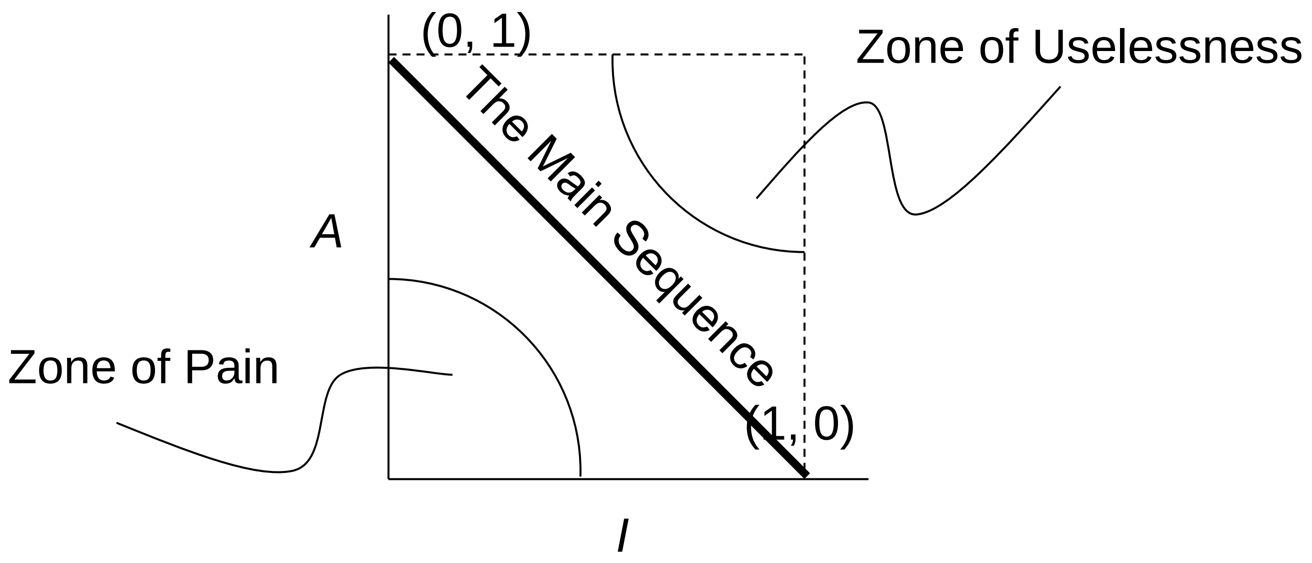
Example 2 : Concrete Utility Library

Zone of Pain

## The Main Sequence

(1, 1) : Maximally abstract and no dependents

Zone of Uselessness



# Distance from the Main Sequence

Distance Formula

Range [0, ~ 0.707]

$$D = \frac{|A + I - 1|}{\sqrt{2}}$$

Normalized Distance D’

Range [0, 1]

$$D' = |A + I - 1|$$

## Enterprise Application Architecture Prerequisites

Layering

Organizing Domain Logic

Mapping to Relational Databases

Web Presentation

Concurrency

Session State

Distribution Strategies

# Layering

Benefits

- Understandability – Coherent, without knowing much about other layers
- Substitutability – With alternative implementation
- Minimal Dependency – Adaptation and Abstraction
- Standardization – Create your own standards for a layer
- High-level Service Use – Provide barrier to a layer below

Downsides

- Encapsulation
  - Not all elements are encapsulated
  - UI to Database?
- Too many Layers
  - Data transformation affects performance

## Layering

3 Principal Layers

- Presentation
  - Provision of services, display of information (e.g., in Windows or HTML, handling of user request (mouse clicks, keyboard hits), HTTP requests, command-line invocations, batch API)
- Domain
  - Logic that is the real point of the system
- Data Source
  - Communication with databases, messaging systems, transaction managers, other packages

## Organizing Domain Logic

Transaction Script

- Simple Logic

Domain Model

- Complex Logic

Table Module

- Moderate Logic and good API Tools around

Service Layer

- Provides API

# Mapping to Relational Databases

Architecture

- Mappings and Gateways

Behavioral Issues

- Data Reading
- Data Manipulation

Using Metadata

- Code Generation
- Reflective Programming

Database Connections

# Domain Logic Patterns

Transaction Script

Domain Model

Table Module

Service Layer

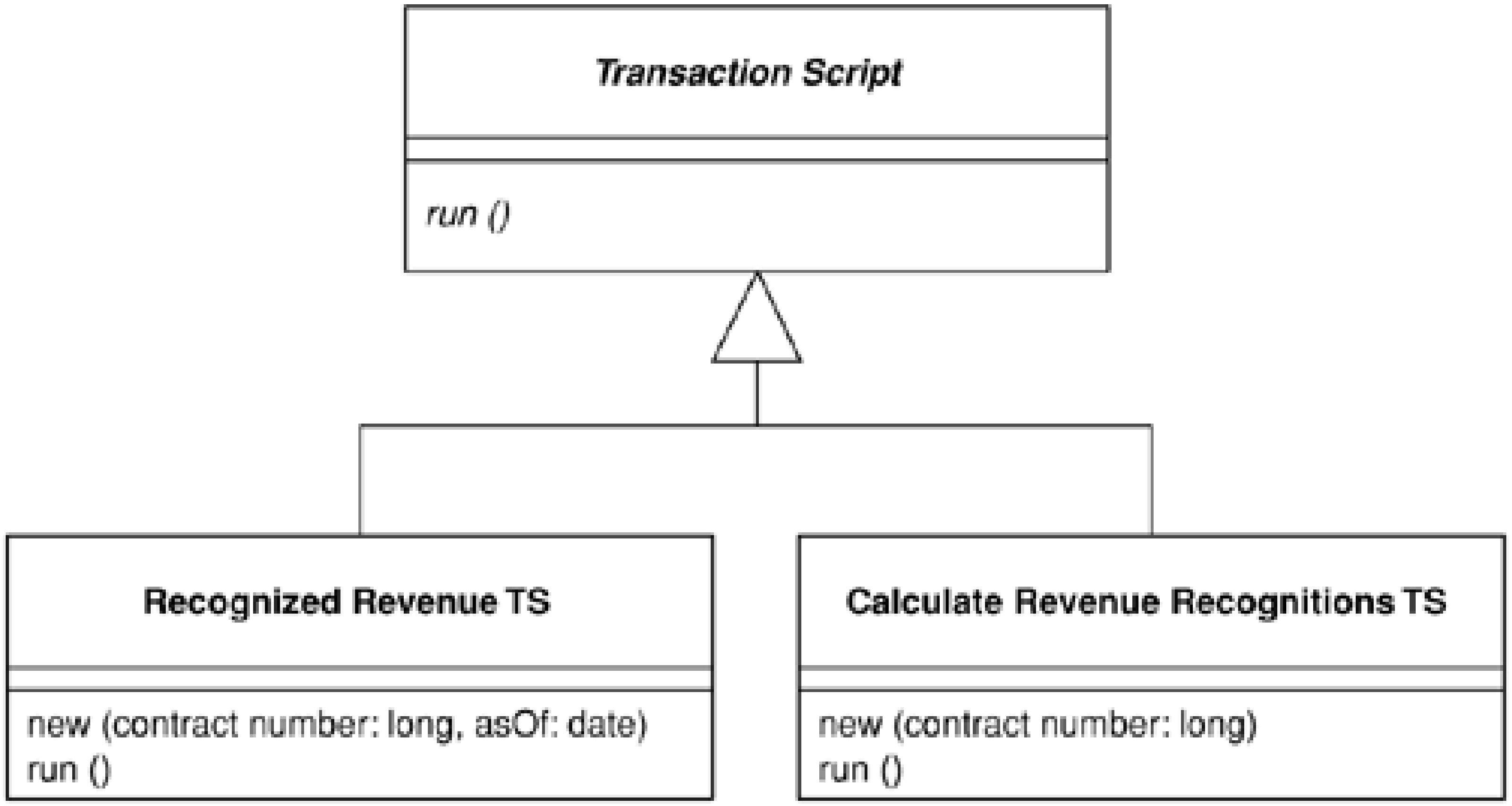
## Transaction Script

Organizes business logic by procedures where each procedure handles a single request from the presentation

When to use it

- Simplicity
- Smaller logic
- Beware of duplication

## Transaction Script


*Transaction Script*
*run ()*
Recognized Revenue TS
new (contract number: long, asOf: date)
run ()
Calculate Revenue Recognitions TS
new (contract number: long)
run ()

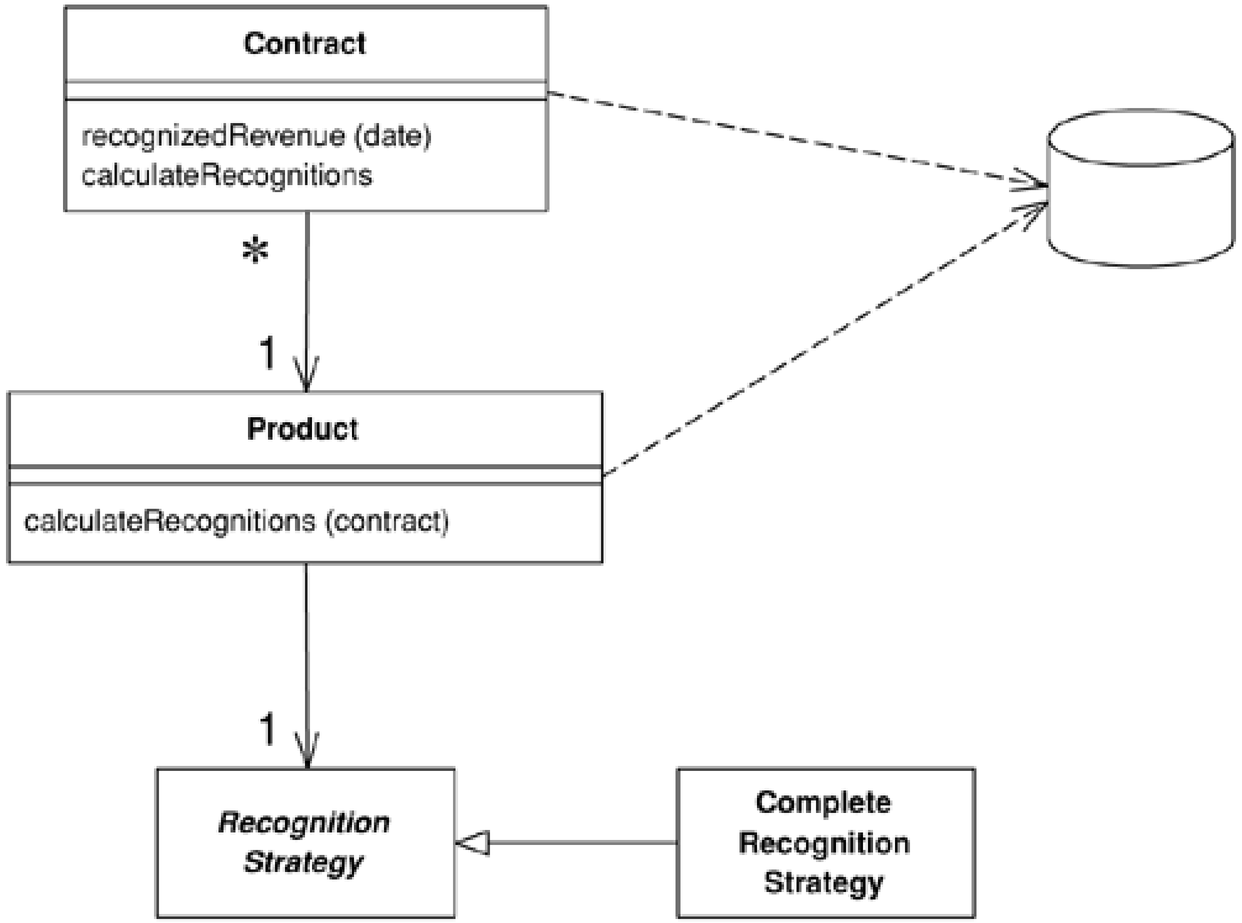
## Domain Model

An object model of the domain that incorporates both behavior and data

When to use it

- Complex logic
- Ever changing business rules
  - Involving validation, calculations, and derivations

## Domain Model



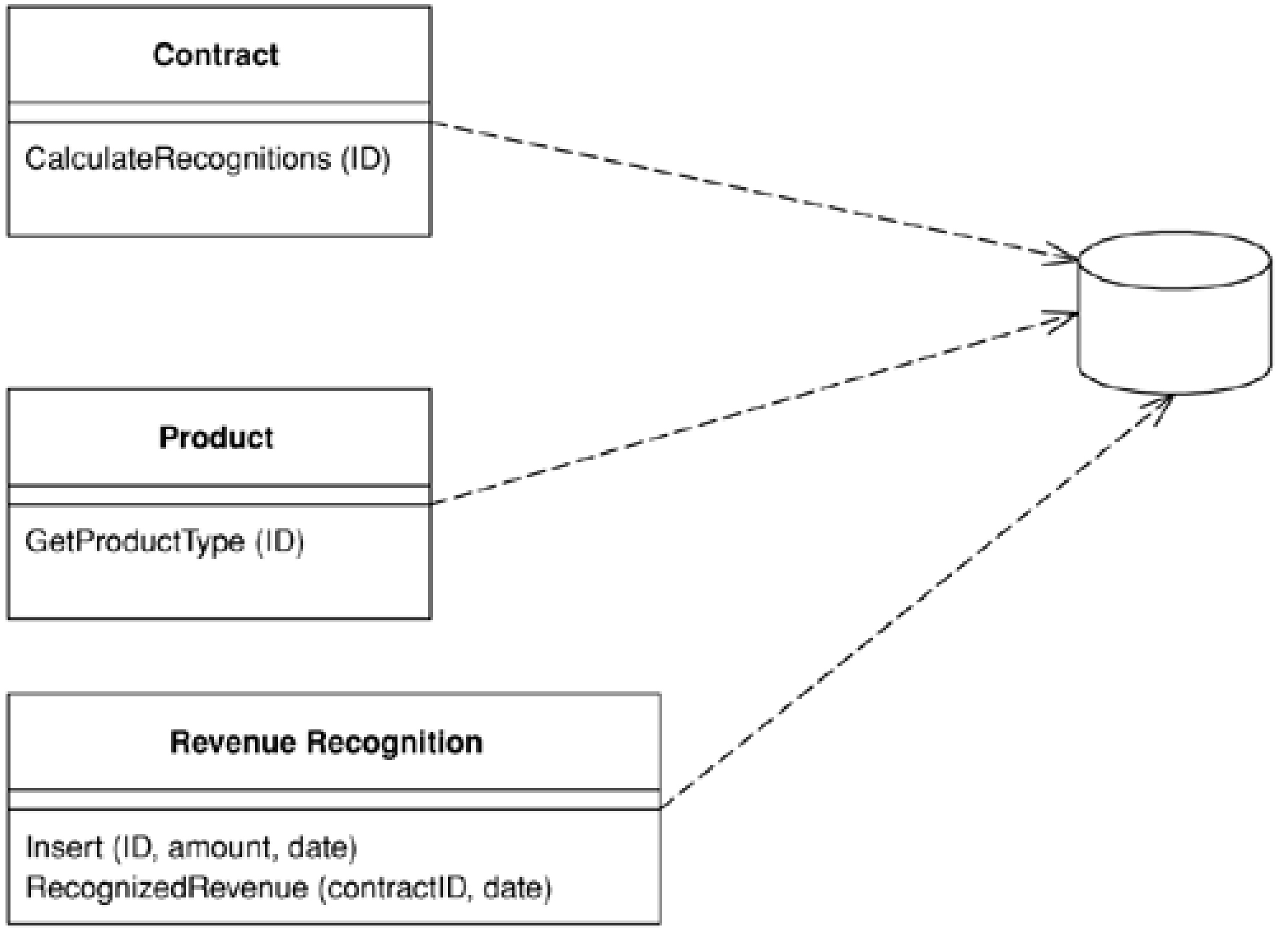
# Table Module

A single instance that handles the business logic for all rows in a database table or view

When to use it

- Based on table oriented data
  - Access using Record Set
- Data structure are fairly straightforward
- No direct instance-to-instance relationships

## Table Module


Contract
CalculateRecognitions (ID)
Product
GetProductType (ID)
Revenue Recognition
Insert (ID, amount, date)
RecognizedRevenue (contractID, date)

## Service Layer

Defines an application’s boundary with a layer of services that establishes a set of available operations and coordinates the application’s response in each operation

When to use it

- In an application with more than one kind of client of its business logic, and complex responses in its use cases involving multiple transactional resources, it makes a lot of sense to include a Service Layer with container-managed transactions

## Data Source Architectural Patterns

Table Data Gateway

Row Data Gateway

Active Record

Data Mapper

## Table Data Gateway

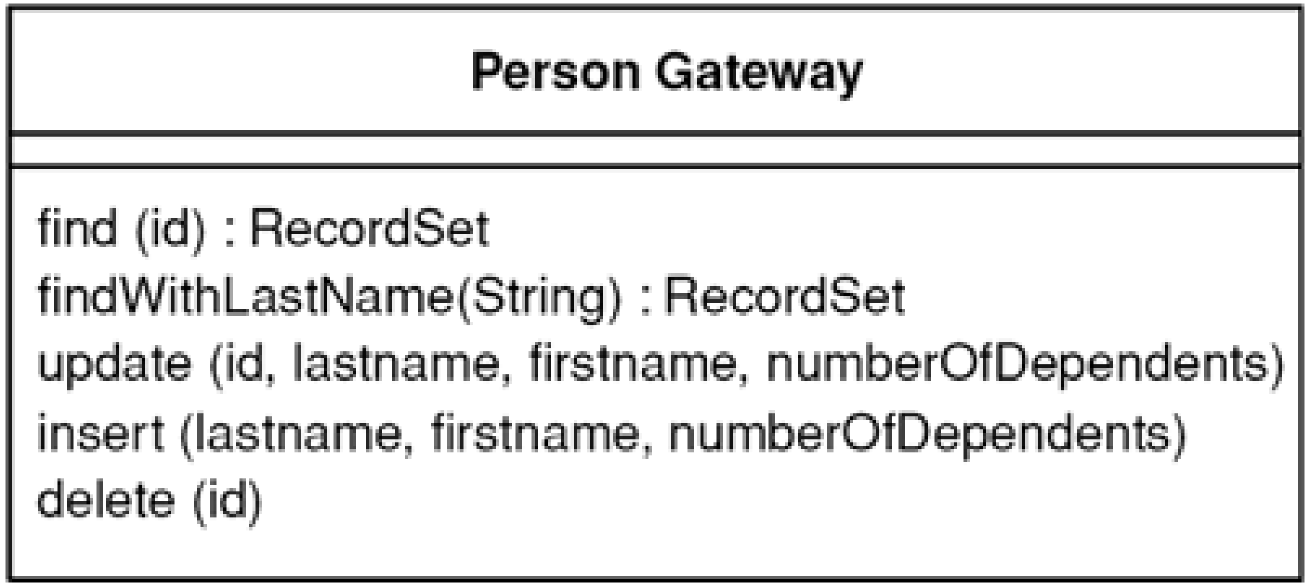
An object that acts as a Gateway to a database table

- One instance handles all the rows in the table

When to use it

- Work well with Table Module and Transaction Script
- Encapsulation of database access

# Table Data Gateway


Person Gateway
find (id) : RecordSet
findWithLastName(String) : RecordSet
update (id, lastname, firstname, numberOfDependents)
insert (lastname, firstname, numberOfDependents)
delete (id)

## Row Data Gateway

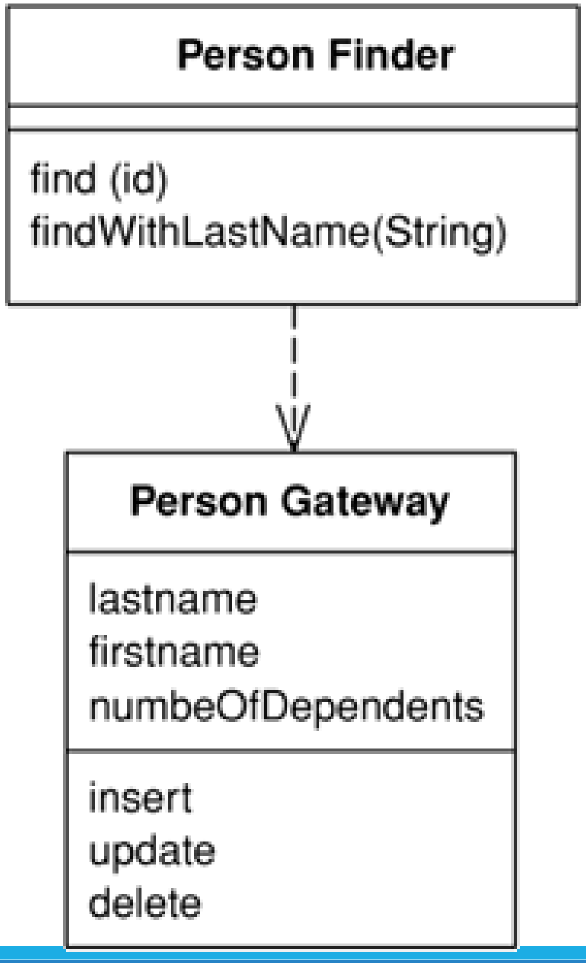
An object that acts as a Gateway to a single record in a data source

- There is one instance per row

When to use it

- Use it with Transaction Script

# Row Data Gateway



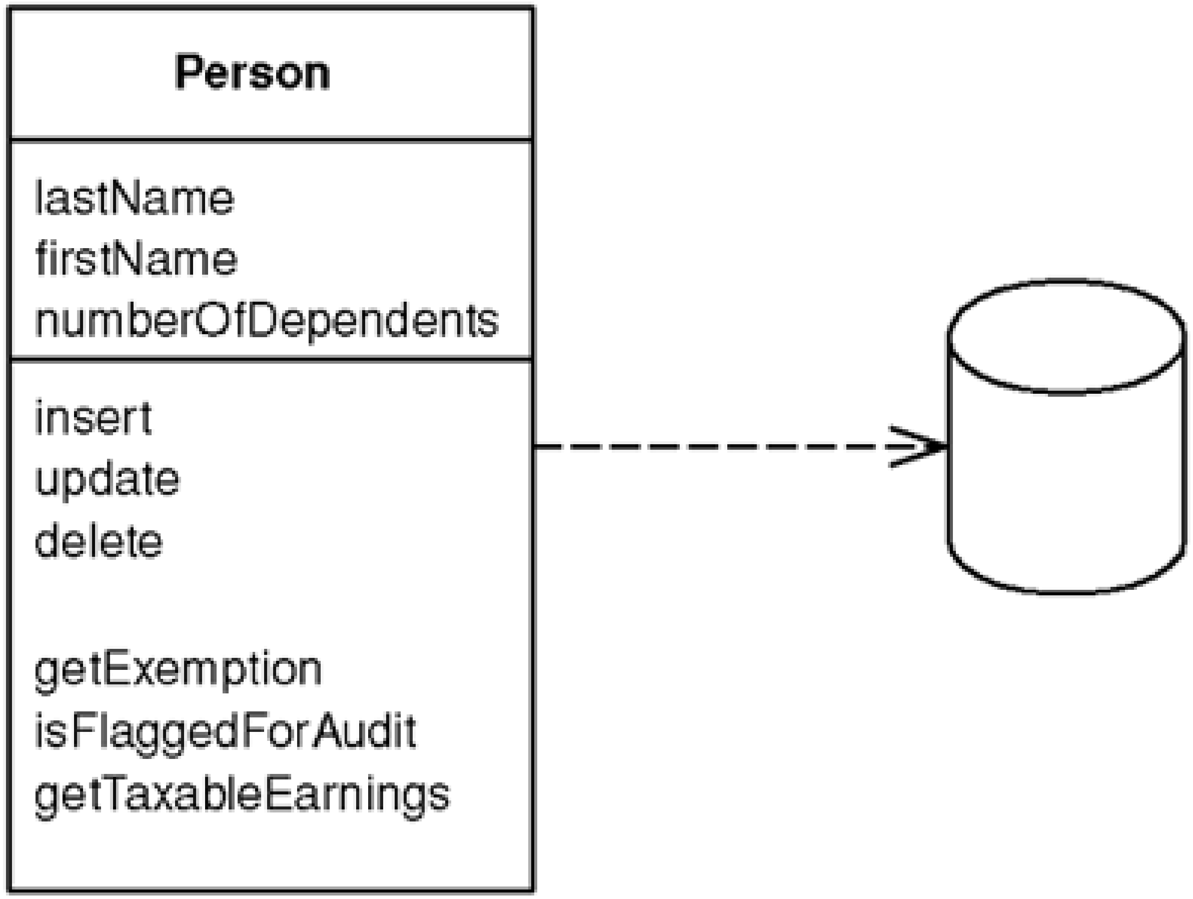
## Active Record

An object that wraps a row in a database table or view, encapsulates the database access, and adds domain logic on that data

When to use it

- Logic is not complex

# Active Record



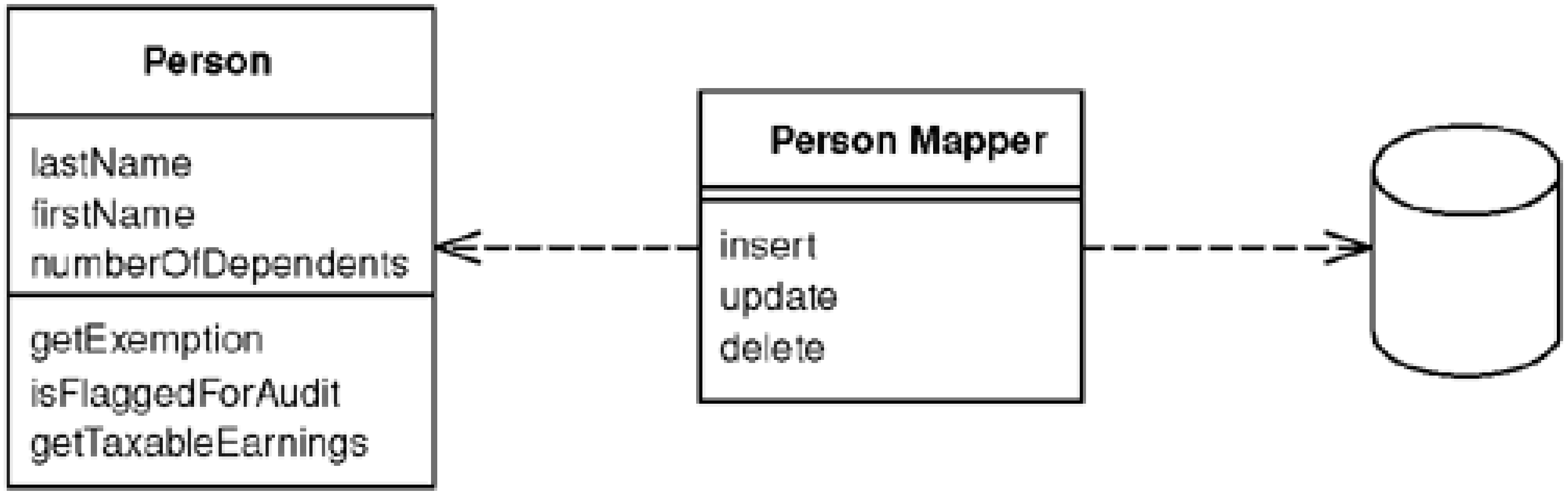
## Data Mapper

A layer of Mappers that moves data between objects and a database while keeping them independent of each other and the mapper itself

When to use it

- When you want the database schema and the object model to evolve independently
- When you are using Domain Model

## Data Mapper


Person
lastName
firstName
numberOfDependents
getExemption
isFlaggedForAudit
getTaxableEarnings
Person Mapper
insert
update
delete

## Object – Relational Behavioral Patterns

Unit of Work

Identity Map

Lazy Load

## Unit of Work

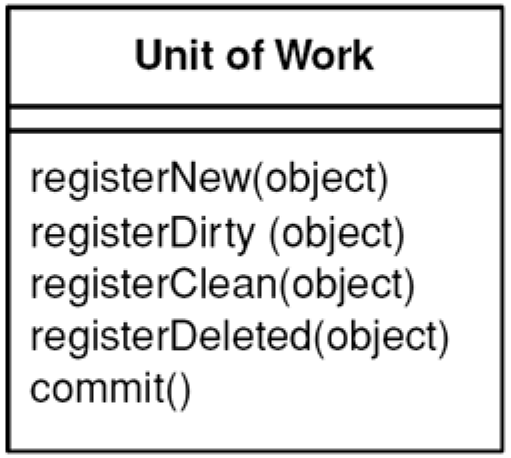
Maintains a list of objects affected by a business transaction and coordinates the writing out of changes and the resolution of concurrency problems

- Caller Registration
- Object Registration
- Unit of Work Controller

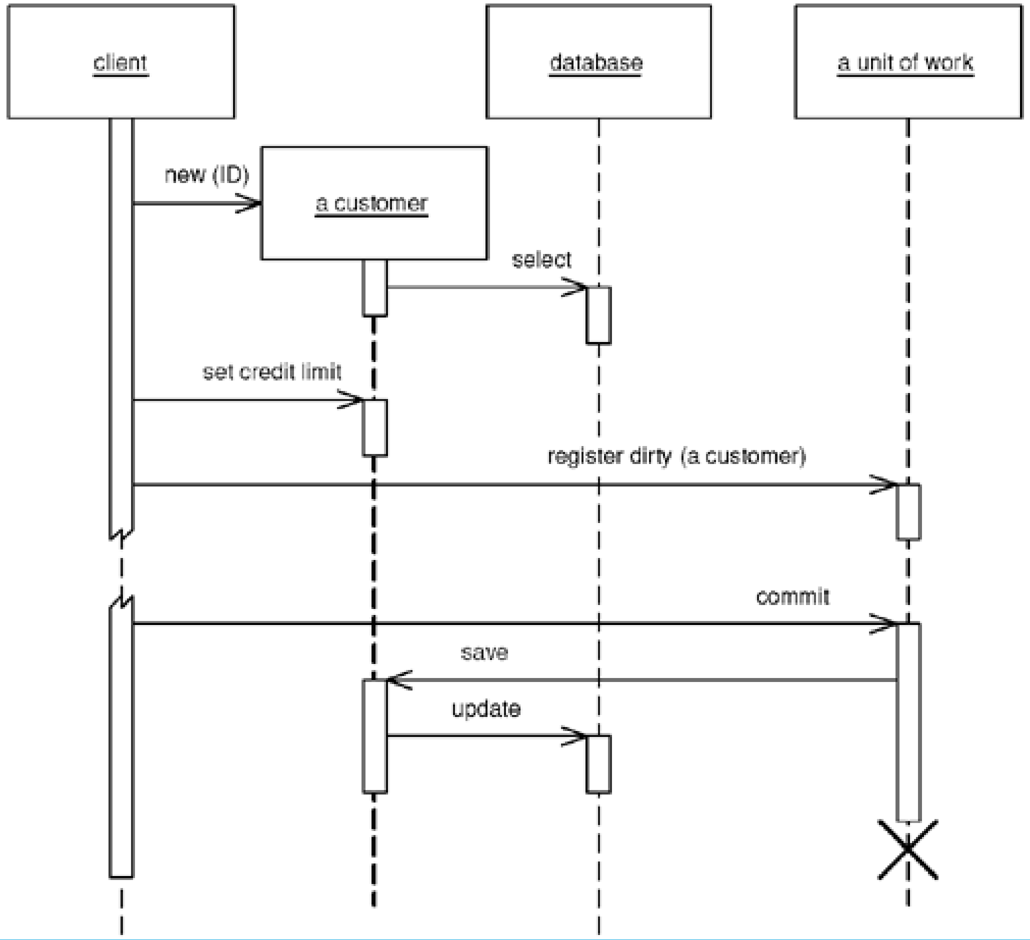
When to use it

- Keeping track of various objects
- Reducing database access

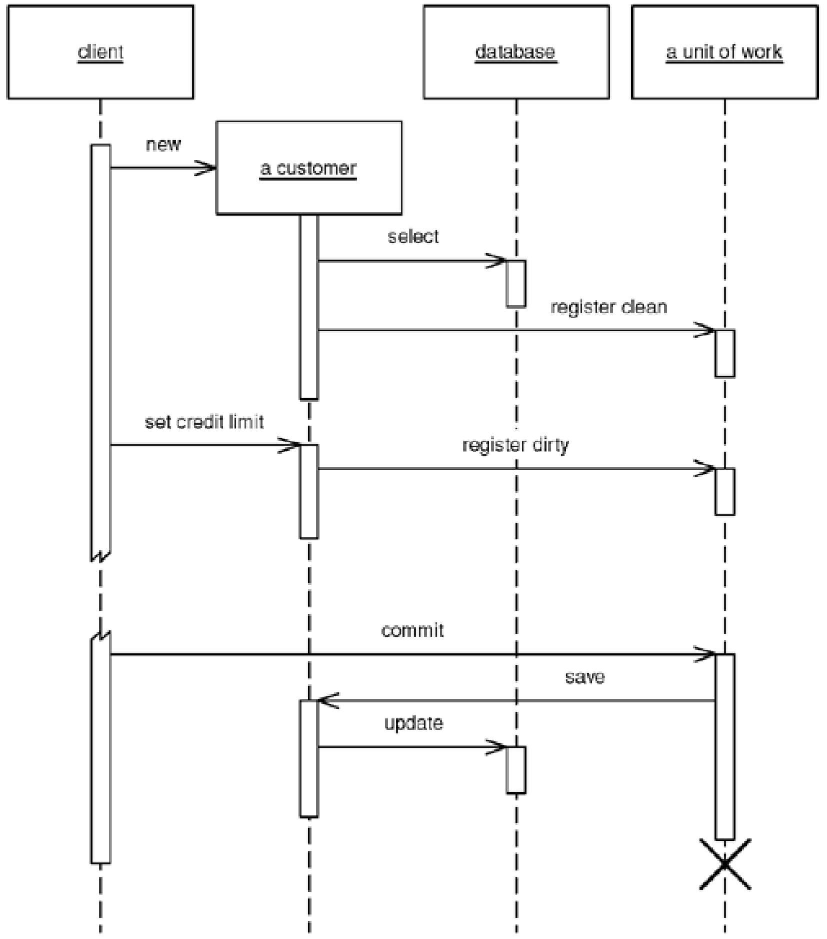
## Unit of Work


Unit of Work
registerNew(object)
registerDirty (object)
registerClean(object)
registerDeleted(object)
commit()

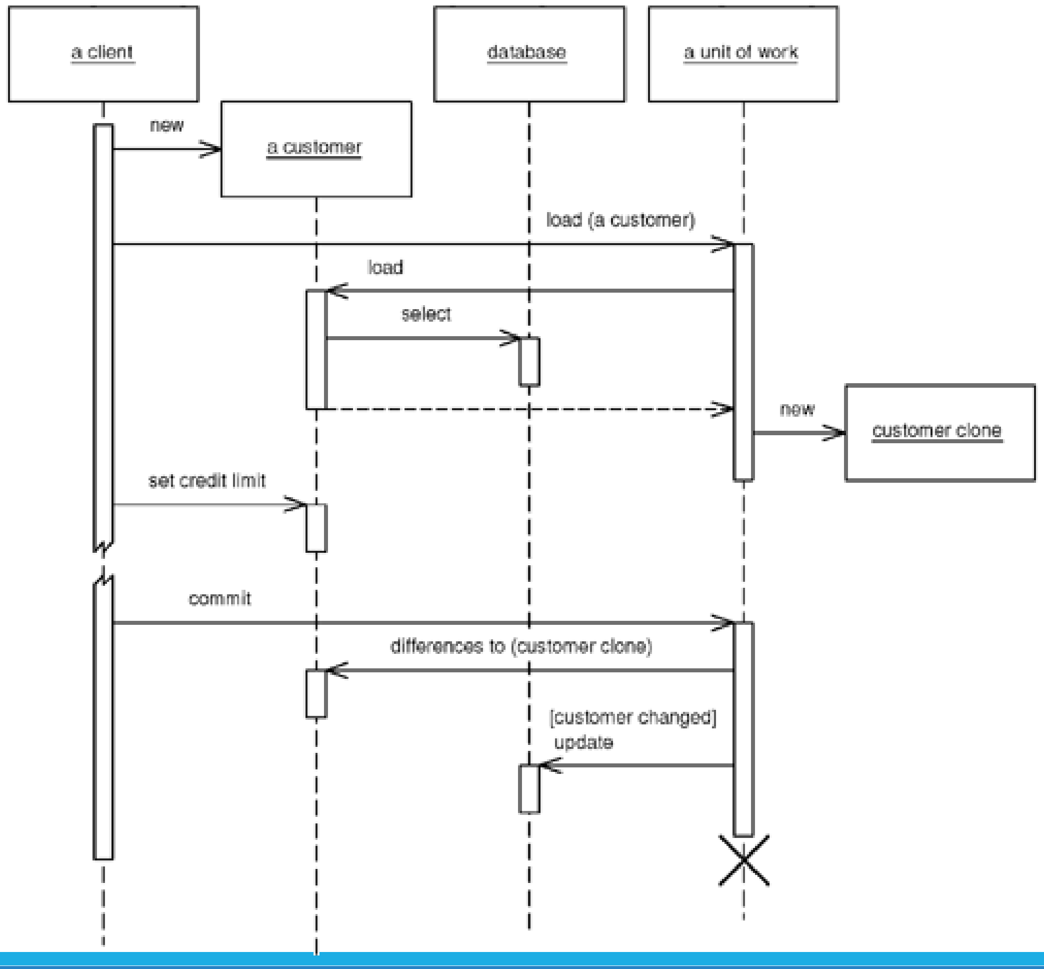
## Unit of Work – Caller Registration



# Unit of Work – Object Registration



# Unit of Work – Controller



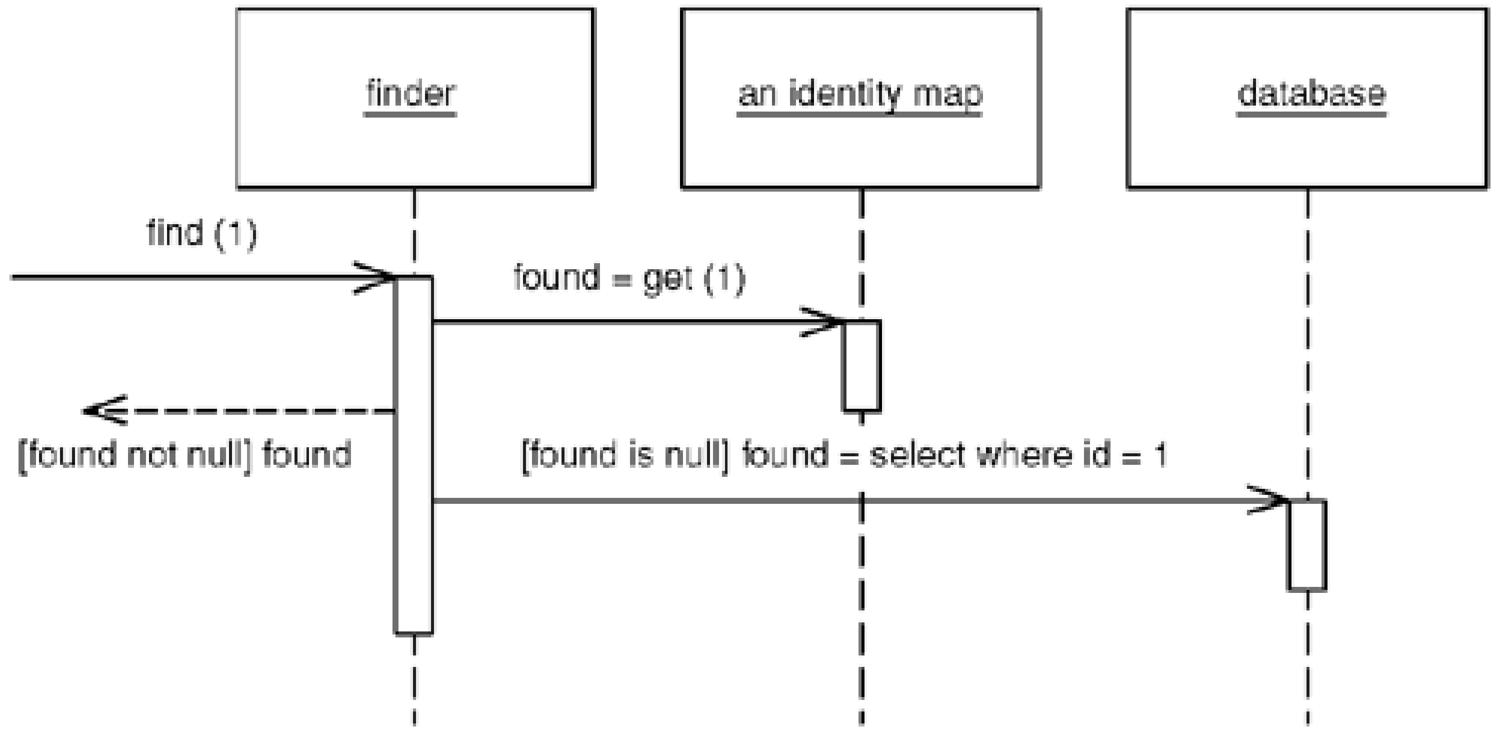
# Identity Map

Ensures that each object gets loaded only once by keeping every loaded object in a map. Looks up objects using the map when referring to them

When to use it

- Treat it as an in memory cache
- To remove in consistency
- Key field – Surrogate Key
- Explicit or Generic
- Mapper per Class or Mapper per Session

# Identity Map



## Lazy Load

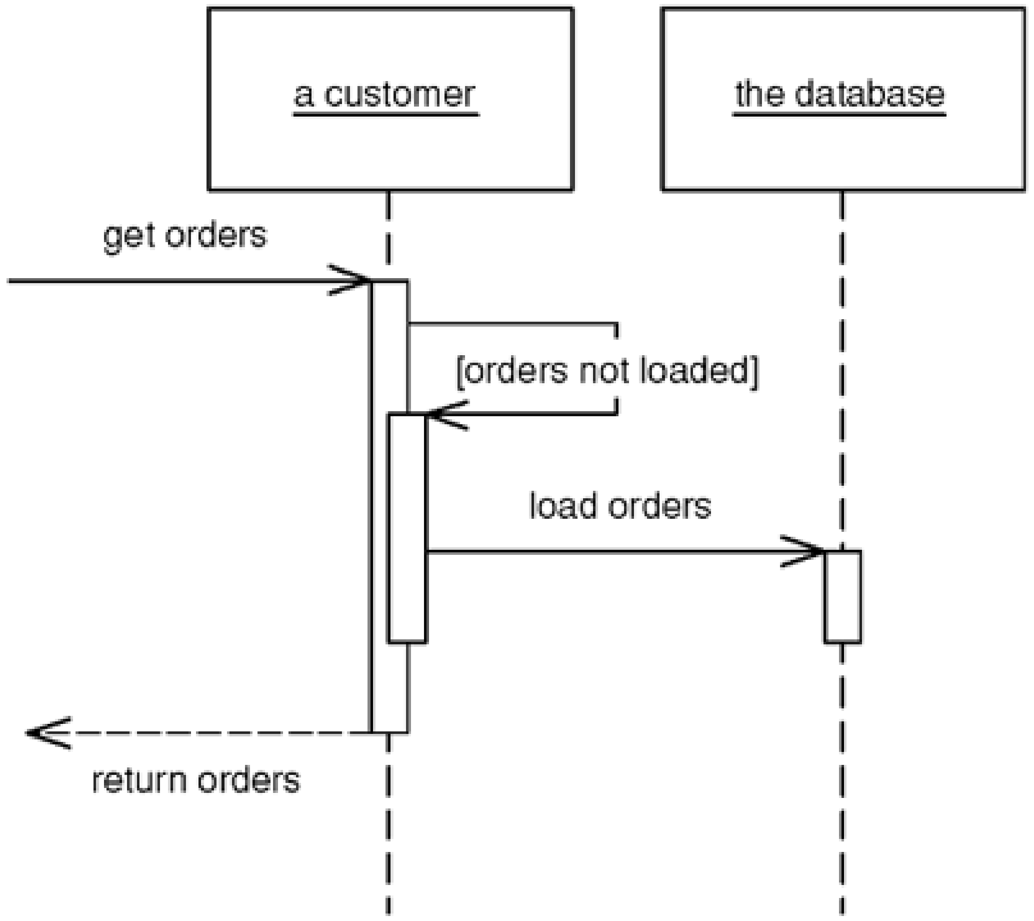
An object that does not contain all of the data you need but knows how to get it

- Lazy initialization
  - Gateways
  - Getter Method
- Virtual proxy
  - Mappers
  - Proxy pattern
- Value holder
  - Wraparound object
  - Single loading
- Ghost
  - Real object in partial state

When to use it

- Performance in reducing in memory objects

## Lazy Load


a customer
the database
get orders
[orders not loaded]
load orders
return orders