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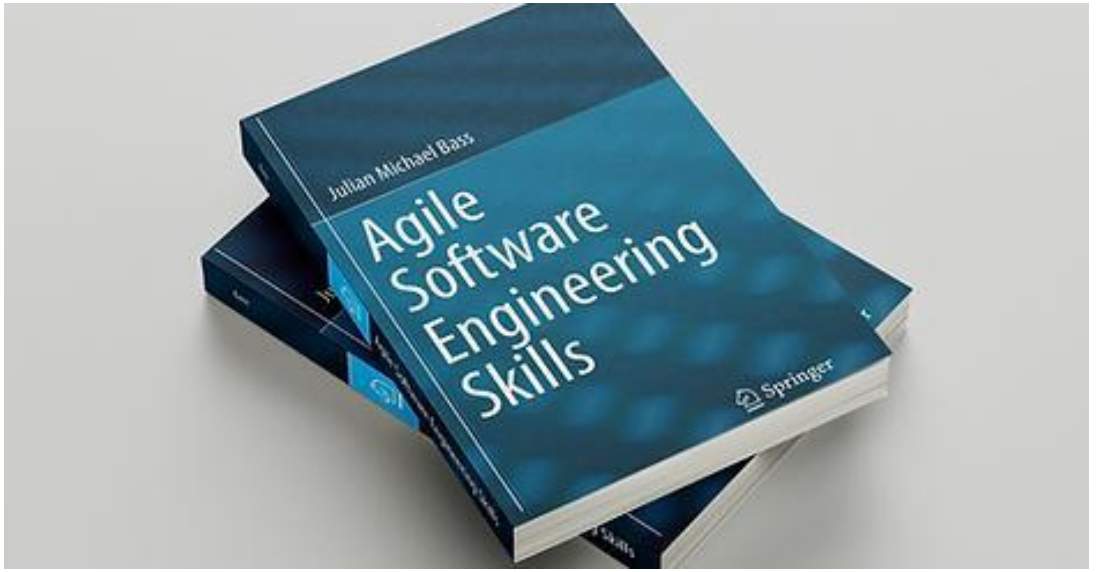
Agile Software Engineering Skills

Design

Chapter 9

Julian M. Bass



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Introduction

- We've established requirements
  - What our system must do (Chapter 7)
- We've created a high-level structure
  - Adopted an architectural style and created a reference architecture (Chapter 8)
- Now we can design specific features

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Introduction

- We will create class diagrams and object sequence diagrams to understand
  - How our software will be structured
  - How the moving parts interact during run-time
- Implement design patterns to solve recurring problems

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Contents

- Feature Driven Development
- System Modelling
- Class Diagrams
- Object Sequence Diagrams
- Technology Stack Selection
- Model-driven Engineering

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Feature Driven Development

- Features are independent pieces of functionality
- Provide end-to-end services to external actors
- Features provide value to customers
- End-to-end fulfilment of a user need
  - Client, business logic and persistence
- Incremental development consists of implementing features, one after another

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Feature Driven Development

- Features comprise working code
- We create acceptance tests for features
- We can demonstrate features and get feedback
  - Clients or users should be able to understand the goal

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System Modelling

- Develop visual representations of the system
- Models use graphical notations
  - Often based on one of the Unified Modelling Languages (UML)
- Models stimulate discussion, and ultimately consensus
  - On what something does or how something works
- Models record decisions about design

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System Modelling

- Two main types of model: static and dynamic
- Static models depict unchanging internal structure
- Dynamic models depict run-time behaviour
- Models of the world as it exists
  - Before our system is implemented.
  - ***As Is*** or ***domain*** models
- Models that describe the proposed new system
  - ***To Be*** models

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Class Diagrams

- Structural models
  - Current environment
  - Organisation of a system
- Components that make up a system
  - Their relationships with each other

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Class Diagrams

- Deriving Class Diagrams
  - Noun and Noun Phrases that describe a person, place, thing, quality or idea
    - Implemented in software as data items (attributes), data structures or classes
  - Verb and Verb Phrases describe actions
    - Implemented as methods or operations

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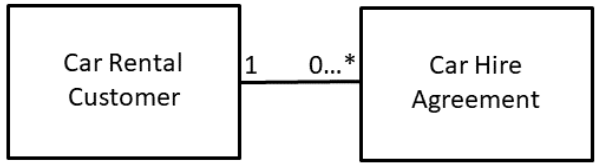
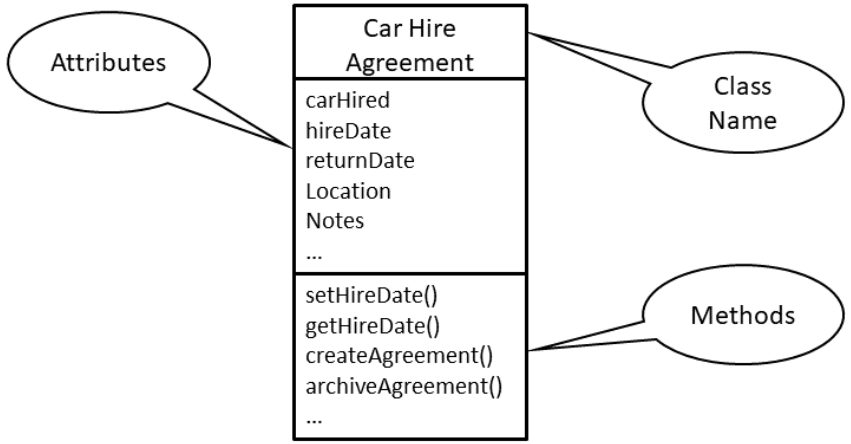
Class Diagrams

A) Simple classes and an association



B) Car hire agreement class (incomplete)



J. M. Bass, Agile Software Engineering Skills,
https://doi.org/10.1007/978-3-031-05469-3_9

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Class Diagrams

- Domain models
  - As Is models of system context
- High-level design models
  - Outline diagrams of classes and their relationships and attributes
- Detailed design models
  - Include method signatures and attribute data types

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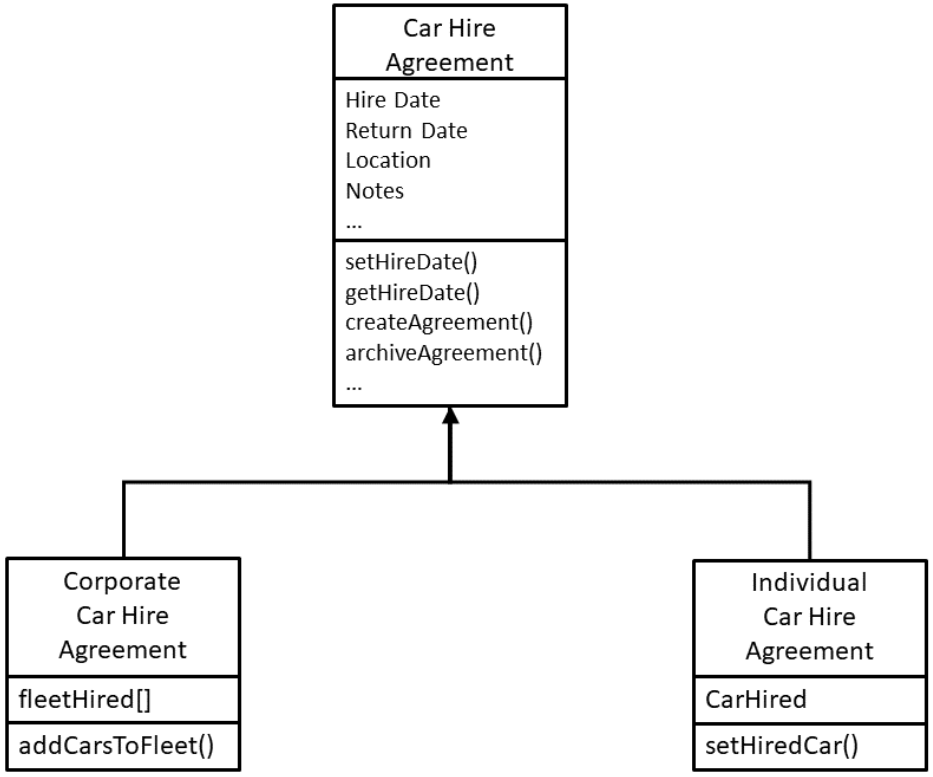
Class Diagrams



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Object Sequence Diagrams

- Interactions between actors and system objects
- Usually correspond to a specific use case
- Model dynamic (run-time) interactions between components

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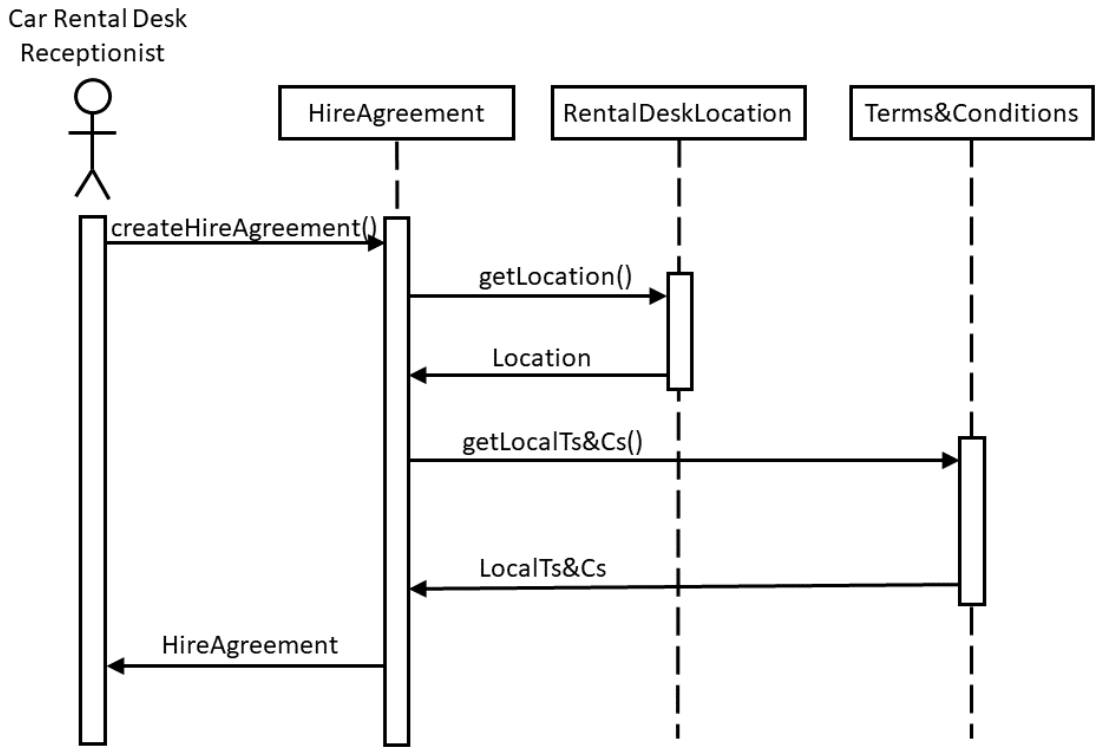
Object Sequence Diagrams



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Design Patterns

- Reusable descriptions of abstract design fragments
- Solve problems that re-occur in applications
- Provide best practice solutions
- Comprises description of problem and essence of solution
- Patterns enable design reuse

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Design Patterns

- Singleton Pattern
  - Ensures only one instance of the class is created
  - To instantiate…

```
SingletonObject so = SingletonObject.getInstance();
System.out.println( so.showMessage() );
```

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Design Patterns

```
public class SingletonObject {
                            /* Make the instance private and static */
                            private static SingletonObject instance = new SingletonObject();

                            /* Make the constructor private  */
                            private SingletonObject() {
                            }

                            /* Use this method to return the instantiated object */
                            public static SingletonObject getInstance() {
                                return instance;
                            }

                            public String showMessage() {
                                return "This is from the singleton";
                            }
                        }
```

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Design Patterns

- Model View Controller
  - Manage data (model) separately from the display (view) of information
  - Controller class manages interaction between views and model
  - Good separation of concerns
    - Can change underlying persistence implementation (model) without affecting rest of system
    - Can implement various client (views) without affecting model

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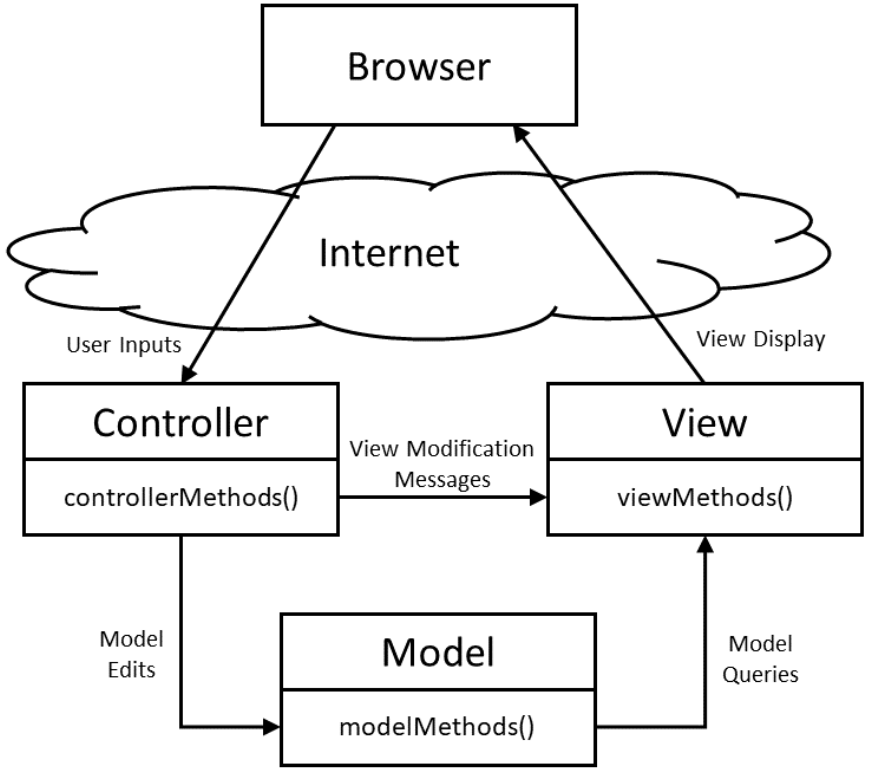
Design Patterns



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Design Patterns

- Factory Pattern
  - Creates and returns objects of a particular type
  - Single point in the system for instantiating a family of similar objects
    - Simplifies maintenance in sophisticated systems
  - Simple example
    - Bass, J. (2022). *Julianbass/CarFactory* [Java]. https://github.com/julianbass/CarFactory (Original work published 2021)

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Technology Stack Selection

- Selecting project implementation technologies
  - Programming languages, frameworks, libraries, development environments and deployment environments
- In commercial sector, joining an existing project
  - You probably won't get much say
- In an academic, HackCamp or Hackathon environment,
  - Choosing the technology stack important decision

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Technology Stack Selection

- Consider how candidate technologies
  - Impact your chosen delivery model
    - installable desktop application, web app, cloud-hosted service etc.
  - Impact your functional and non-functional requirements
  - Contribute to achieving your architectural goals
  - Impact your product/project goals
- Identify the team member skill set
- Collect evidence and assess the Pros/Cons of the technologies your team members know

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Model-driven Engineering

- Automatically generate a complete or partial system from our system models
- Integrated development environments can generate skeleton classes and certain methods
  - Accessor and mutator methods
  - Constructor method skeletons
- Commercially available database design tools
  - Draw diagrams which are then automatically implemented as database tables

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Exercises

- Exercises 9.1 and 9.7 encourage creation of a learning journal
- Exercises 9.2 – 9.5 Cover class diagrams
- Exercise 9.6 Covers factory pattern implementation

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Summary

- Architecture in Agile
  - Avoid ***Big Design Up Front***
  - Refactoring to refine architecture as product matures
- Design Styles
  - Client-Server
  - Repository Architecture
  - Pipe and Filter
  - Layered Architecture