Software Architectures

From Design Patterns to Enterprise Architecture

Principles of software design

Last week on “Software Architectures”

- Principles
  - Low Coupling - High Cohesion
  - Liskov Substitution Principle
  - Open-Closed Principle
- Software Quality
  - Testing for Correctness
  - Tests for other quality criteria

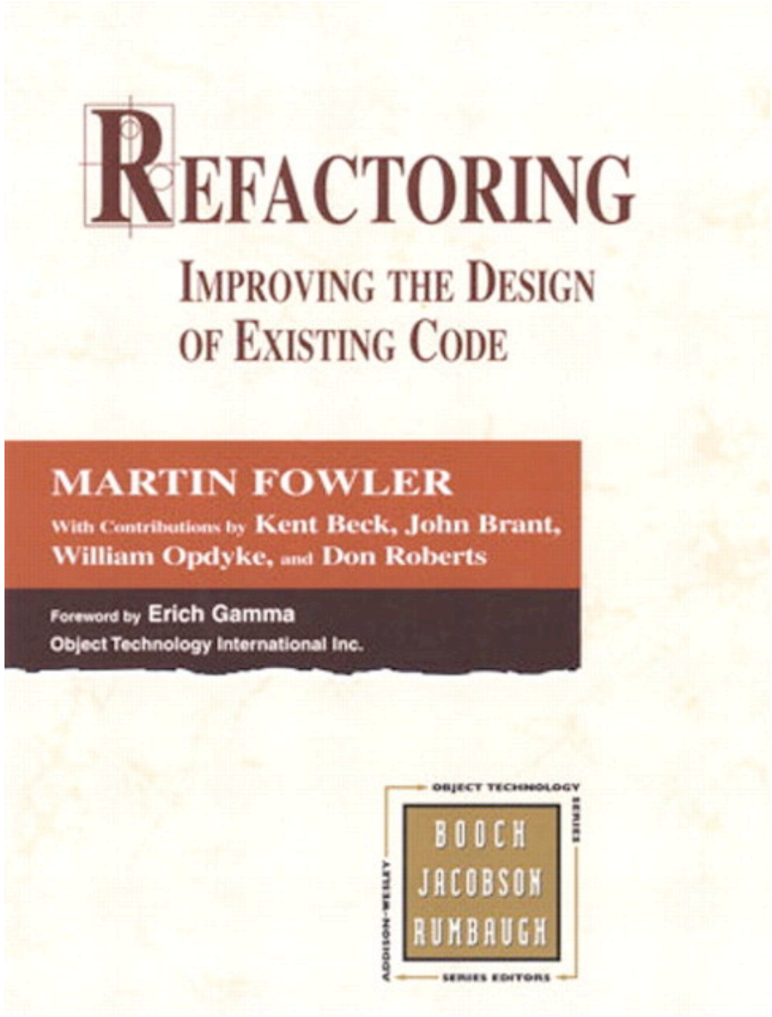
Testing for correctness

Unit tests

- We talked about unit tests, but we didn’t see them yet.
- So let’s write some.

But first…

- This code doesn’t look so good, now does it…
- So let’s do a little bit of refactoring
- Apply the learned principles to the code



REFACTORING

IMPROVING THE DESIGN OF EXISTING CODE

MARTIN FOWLER

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JUnit Tests

- Annotations: @Before,@After, @Test
- Assert Statements
- Test categories
- Test re-use

Further Principles

Think back to the refactoring we did

- Did everything really we did relate to the principles we learned already?
- To what is the separation of the multiply* methods related?

Responsibility

- UML says: “A contract or obligation of a classifier.”
- Robert Martin says: “Each responsibility is an axis of change. When the requirements change, a change will manifest through a change in responsibility amongst the classes. If a class has multiple responsibilities, it has multiple reasons to change.”
- Well what is valid here?
- Responsibility of DOING and KNOWING: What does a class do and what does a class know.

Evaluation

- Dimensions of Design
  - beautiful vs. ugly
  - good vs. poor
  - efficient vs. inefficient
  - understandable vs. mysterious
- What are your dimensions?
- How do you describe a system?
- Well, there are more formal methods out there.

Discussion

System evaluation

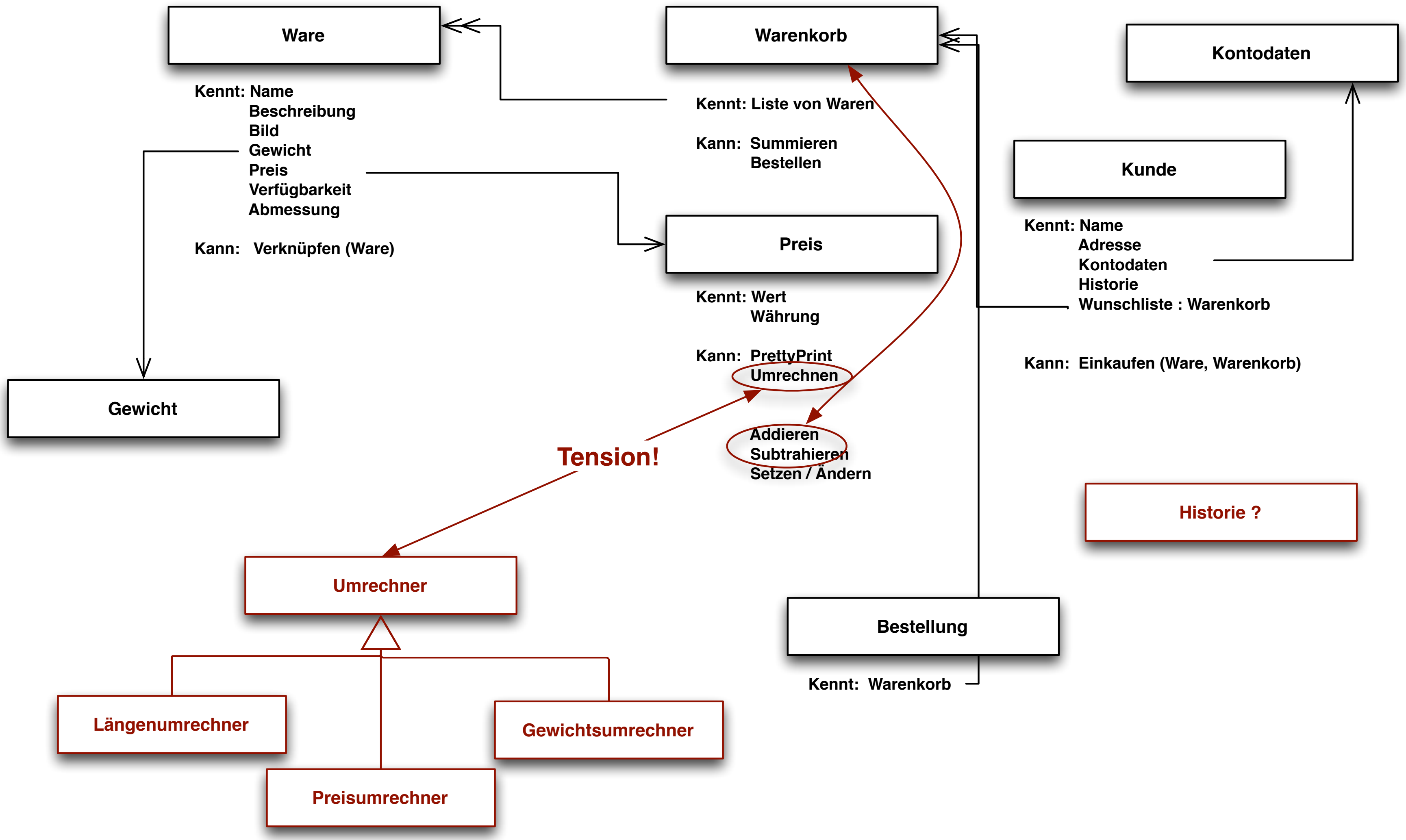
Single-Responsibility Principle

- Every class should have a single responsibility
- That responsibility should be entirely encapsulated by the class
- All its services should be tightly aligned with that responsibility
- What are typical violations?

Interface Segregation Principle

- No client should be forced to depend on methods it does not use
- Role interfaces
- Example: Split interfaces for reading and writing to a resource
- What are typical violations?

Group Exercise: Designing for Responsibility



Ware

Kennt: Name
Beschreibung
Bild
Gewicht
Preis
Verfügbarkeit
Abmessung

Kann: Verknüpfen (Ware)

Warenkorb

Kennt: Liste von Waren

Kann: Summieren
Bestellen

Kontodaten

Kunde

Kennt: Name
Adresse
Kontodaten
Historie
Wunschliste : Warenkorb

Kann: Einkaufen (Ware, Warenkorb)

Preis

Kennt: Wert
Währung

Kann: PrettyPrint
Umrechnen
Addieren
Subtrahieren
Setzen / Ändern

Gewicht

Tension!

Historie ?

Umrechner

Längenumrechner

Gewichtsumrechner

Preisumrechner

Bestellung

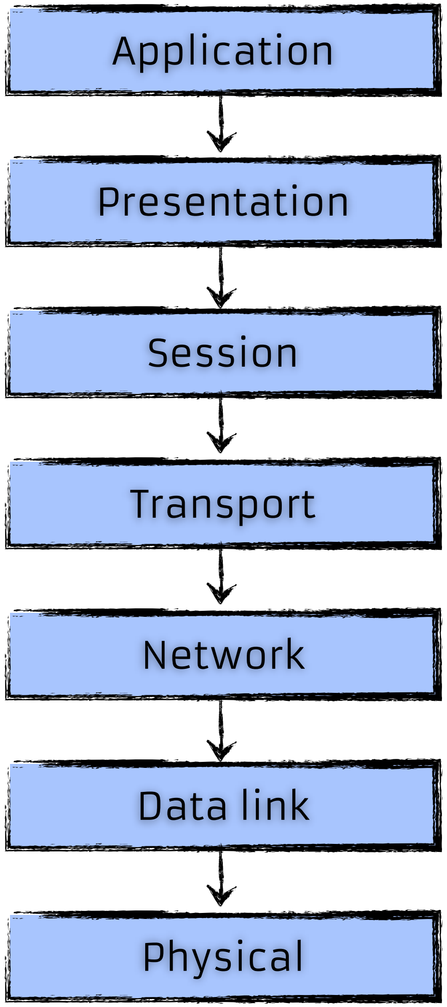
Kennt: Warenkorb

Super principle: Abstraction

- There is nothing that cannot be solved with another layer of abstraction
- There is also nothing that cannot be made more inefficient by another layer of abstraction

Layers and dependencies

- Benefit: Layers have strong responsibility and abstract lower layer away
- Downside: Strict, sometimes efficiency
- What another layered systems do you know?



Dependency Inversion Principle

- High level modules should not depend on concrete low-level modules, both should depend on abstractions
- Abstractions should not depend upon details. Details should depend upon abstractions
- What does such a design look like?

Command-Query Separation

- What is wrong with the upper example?
- Is the lower example well designed?
- Every method should be either a command or a query. Not both at the same time.
- Questions should not change the answer. Schrödinger be gone!

```
public class Counter {
   int i = 0;
   public int getValue() {
      return i++;
   }
}
```

```
public class Counter {
   int i = 0;
   public int getValue(){
      return i;
   }
   public void inc(){
      i++;
   }
}
```

Developing for robustness/reliance?

- Exception handling
  - Checked vs. Unchecked exceptions
  - What to catch?
- Exception throwing
  - Good principles also guide this activity!
- Checks
  - Trade-off between robustness and efficiency
- Assertions
  - Debug-time checks

Wrap up

- Testing for correctness: Unit tests
- Refactoring
- Notion of responsibility
- Architecture evaluation
- Single-Responsibility Principle
- Interface Segregation Principle
- Super principle: Abstractions!
- Dependency Segregation Principle
- Robustness and reliance