TNG TECHNOLOGY CONSULTING

OOP is dead – long live Object Orientation!

Franz Thoma

3/14/2025

BobKonf 2025, Berlin

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About me

- Principal Consultant @ TNG
- github.com/fmthoma
- linkedin.com/in/fmthoma
- Organizer of MuniHac
  - Save the date: 12.–14.9.2025

Franz Thoma
Principal Consultant
franz.thoma@tngtech.com

My first Java `Hello World`

```java
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello World");
    }
}
```

Java

My first Java `Hello World`

```java
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello World");
    }
}
```

Very classy!

- A class around `main`
- Objects (`out`)
- Method calls
  (`out.println`)

My first Java `Hello World`

```java
public class HelloWorld {

    public static void main(String[] args) {

        System.out.println("Hello World");
    }
}
```

Very classy?

- Static methods
- Public properties
  (`System.out`)
- Classes are nothing more
  than namespaces

What's the definition for OOP?

- Polymorphism

- Inheritance

- Encapsulation

What's the definition for OOP?

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- **Subtyping** Polymorphism
- Inheritance
- Encapsulation

Polymorphism

- **Ad-hoc polymorphism** (Overloading)
- **Parametric polymorphism** (Generics)
- **Subtyping polymorphism**
- **Row polymorphism**

What's the definition for OOP?

- **Subtyping** Polymorphism
- Inheritance
- **Class** Encapsulation ← ignored?

Encapsulation

- Module encapsulation
- Library encapsulation
- Class encapsulation
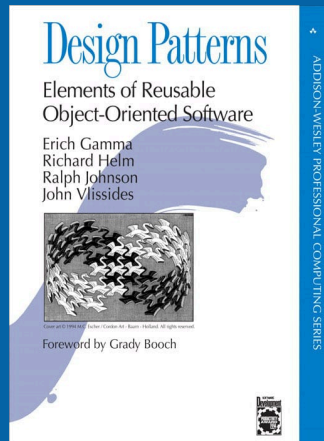- Abstract data types

Getters and Setters

```
class Box {
  private Object thing;

  public Object getThing() { return thing; }
  public void setThing(Object newThing) { this.thing = newThing; }
}
```

What's the definition for OOP?

- **Subtyping** Polymorphism
- ~~**Inheritance**~~ ← deprecated?
- **Class** Encapsulation ← ignored?

Inheritance

Design Patterns
Elements of Reusable
Object-Oriented Software

Erich Gamma
Richard Helm
Ralph Johnson
John Vlissides

ADDISON-WESLEY PROFESSIONAL COMPUTING SERIES

Foreword by Grady Booch

[...] our second principle of object-oriented design: *Favor object composition over class inheritance.*

Design Patterns, 1994, Chapter 1

What's the definition for OOP?

- **Subtyping** Polymorphism

- ~~Inheritance~~ ← deprecated?

- **Class** Encapsulation ← ignored?

Table of Contents

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1 | Problems with Inheritance & Subtyping

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```java
class InternalFrameInternalFrameTitlePaneInternalFrameTitlePaneMaximizeButtonWindowNotFocusedState extends State {
    InternalFrameInternalFrameTitlePaneInternalFrameTitlePaneMaximizeButtonWindowNotFocusedState() {
        super("WindowNotFocused");
    }

    @Override protected boolean isInState(JComponent c) {
        Component parent = c;
        while (parent.getParent() ≠ null) {
            if (parent instanceof JInternalFrame) {
                break;
            }
            parent = parent.getParent();
        }
        if (parent instanceof JInternalFrame) {
            return !(((JInternalFrame)parent).isSelected());
        }
        return false;
```
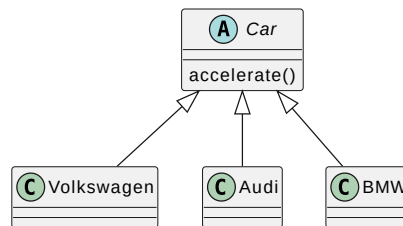
Inheritance

Code re-use you should not use

- Breaks encapsulation

- Tight coupling between parent and child

- Non-locality

- Overriding vs. Shadowing

Inheritance

Favor object composition over class inheritance.

Design Patterns, 1994, Chapter 1

Subtyping Polymorphism

The Casting Conundrum

```java
@Override protected boolean isInState(JComponent c) {
    Component parent = c;
    while (parent.getParent() ≠ null) {
        if (parent instanceof JInternalFrame) {
            break;
        }
        parent = parent.getParent();
    }
    if (parent instanceof JInternalFrame) {
        return !(((JInternalFrame)parent).isSelected());
    }
    return false;
}
```

Subtyping Polymorphism

The Casting Conundrum

Subtyping:

- Taxonomy that corresponds to real life
- Handle objects as generically as possible

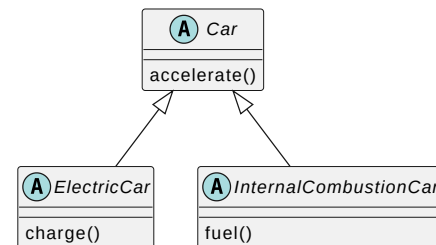# Subtyping Polymorphism

The Casting Conundrum

Subtyping:

- Taxonomy that corresponds to real life

- Handle objects as generically as possible

However:

- Real-life: Rarely hierarchical

  - Diamond problem!

- We often care about the specific sub-type

- Information loss when passing a specific thing to generic code

Subtyping Polymorphism

The Casting Conundrum

```java
interface Garage {
  Ticket park(Car car);
  Car retrieve(Ticket ticket);
}
```

```java
ElectricCar eTron = …;
Ticket ticket = garage.park(eTron);
```
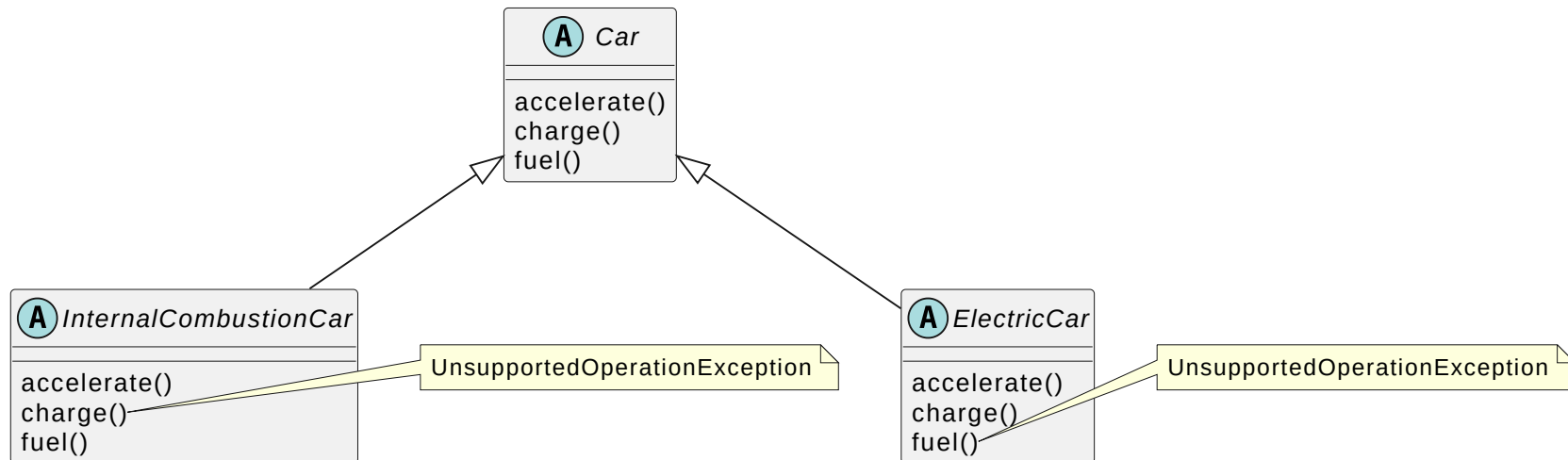
```java
Car eTron = garage.retrieve(ticket);
eTron.charge(); // ← Type error!
```

```java
ElectricCar eTron = (ElectricCar) garage.retrieve(ticket);
eTron.charge();
```

Subtyping Polymorphism
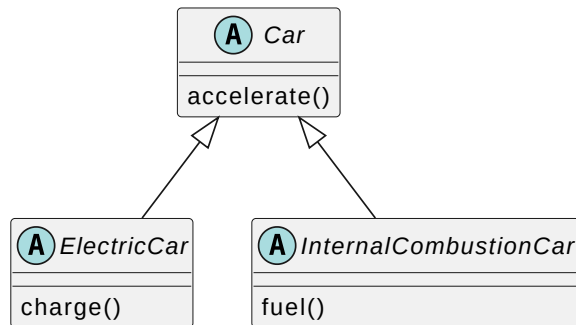
Whenever you cast, you've already given up on type safety.

Subtyping Polymorphism

To Liskov or not to Liskov?

Subtyping Polymorphism

To Liskov or not to Liskov?

```java
package java.util;

public abstract class AbstractList<E> extends AbstractCollection<E> implements List<E> {

    public void add(int index, E element) {
        throw new UnsupportedOperationException();
    }

      public void remove(int index) {
        throw new UnsupportedOperationException();
    }
}
```
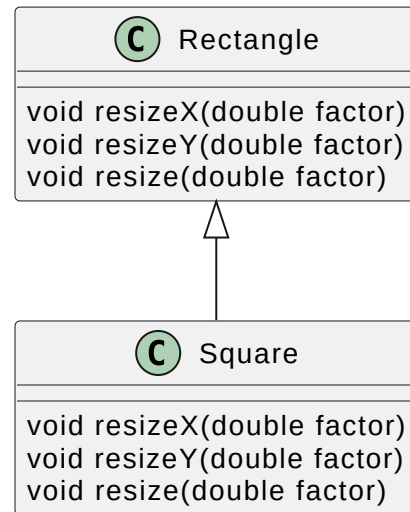
Subtyping Polymorphism

Liskov Substitution Principle

If `A` extends or implements `B`, then:

- Preconditions of `B` should be weaker,

- Postconditions of `B` should be stronger,

- and invariants of `B` should be the same as for `A`.

Subtyping Polymorphism

To Liskov or not to Liskov?

```java
package java.util;

public interface Collection<E> extends Iterable<E> {

    /**
     * […]
     *
     * @param e element whose presence in this collection is to be ensured
     * @return {@code true} if this collection changed as a result of the call
     * @throws UnsupportedOperationException if the {@code add} operation is not supported by this collection
     *
     * […]
     */
    boolean add(E e);
```

Subtyping Polymorphism

`instanceof`

```java
Car car = garage.retrieve(ticket);
if (car instanceof ElectricCar eTron) {
  eTron.charge();
}
```

Subtyping Polymorphism

`instanceof`

- Objects are abstract (Encapsulation!)
  - Execution is driven from inside the objects, not from the outside
  - ⇒ Class of an object does not matter, only behaviour
- Unlike Functional Programming
  - In FP, execution is driven by Pattern Matching
  - ⇒ Identity of a constructor is the driving factor in FP

`instanceof`

- Decision making based on an object's class

```java
interface Shape {
  double getArea();
}


class Square implements Shape {
  double getArea() {
    return Math.pow(a, 2);
  }
}


class Circle implements Shape {
  double getArea() {
    return Math.PI * Math.pow(r, 2);
  }
}
```

```haskell
area :: Shape → Double
area (Square a) = a^2
area (Circle r) = pi * r^2
```

Whenever you're using `instanceof`, you've already given up on OOP.

Whenever you're using `instanceof`, you've already given up on OOP.

You've bought into a poor man's version of Pattern Matching.

Design Patterns

Design Patterns

OOP:	FP:
Visitor Pattern	Pattern Matching
Interpreter Pattern	Functions & Pattern Matching
Strategy Pattern	Higher-Order Functions
Command Pattern	Functions as values
Memento Pattern	Immutability

Design Patterns
Elements of Reusable
Object-Oriented Software

Erich Gamma
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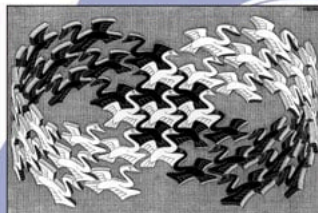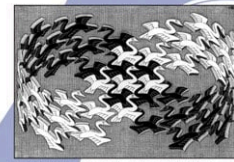
Cover art © 1994 M.C. Escher / Cordon Art - Baarn - Holland. All rights reserved.

Foreword by Grady Booch

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2 | A better definition for Object-Orientation

- **Subtyping** Polymorphism

- ~~**Inheritance**~~ ← deprecated?

- **Class** Encapsulation ← ignored?

Dr. *Alan Kay* on the meaning of "object-oriented programming"

Dr. *Alan Kay* was so kind as to answer my questions about the term "object-oriented programming".

(To link to this page, please use the above *PURL-URI* only, because any other *URI* is only temporary.)

Clarification of "object-oriented" [E-Mail]

```
Date: Wed, 23 Jul 2003 09:33:31 -0800

To: Stefan Ram [removed for privacy]

From Alan Kay [removed for privacy]

Subject: Re: Clarification of "object-oriented"

[some header lines removed for privacy]

Content-Type: text/plain; charset="us-ascii" ; format="flowed"

Content-Length: 4965

Lines: 117
```

Inspiration for OOP

I thought of objects being like biological cells and/or individual computers on a network, only able to communicate with messages [...].

Alan Kay, in an email to Stefan Ram, 2003
http://www.purl.org/stefan_ram/pub/doc_kay_oop_de

On Polymorphism

- ~~Polymorphism~~
- Inheritance ← deprecated?
- **Class** Encapsulation ← ignored?

My math background made me realize that each object could have several algebras associated with it [...]. The term "polymorphism" was imposed much later (I think by Peter Wegner) and it isn't quite valid [...]. I made up a term "genericity" for dealing with generic behaviors in a quasi-algebraic form.

Alan Kay, in an email to Stefan Ram, 2003
http://www.purl.org/stefan_ram/pub/doc_kay_oop_de

On Inheritance

- ~~Polymorphism~~
- ~~Inheritance~~
- **Class** Encapsulation ← ignored?

I didn't like the way Simula I or Simula 67 did inheritance [...]. So I decided to leave out inheritance as a built-in feature until I understood it better.

Alan Kay, in an email to Stefan Ram, 2003
http://www.purl.org/stefan_ram/pub/doc_kay_oop_de

What's the definition for OOP?

- ~~Polymorphism~~
- ~~Inheritance~~
- Only Messaging
- Encapsulation
- Late Binding

OOP to me means only messaging, local retention and protection and hiding of state-process, and extreme late-binding of all things.

Alan Kay, in an email to Stefan Ram
http://www.purl.org/stefan_ram/pub/doc_kay_oop_de

What's the definition for OOP?

- Only messaging

- Encapsulation <small>local retention, protection and hiding</small>

- Late binding

What's the definition for OOP?

"Only messaging"

- Objects communicate with each other using messages

- cf. Actor models (Erlang, Akka)

- Not just method calls!

What's the definition for OOP?

"Local retention and protection and hiding of state-process"

- Objects keep their own local state
    - retention = they can have local state
    - protection = it's not accessible to the outside
    - hiding = it's not even visible to the outside, except for message passing
- cf. Encapsulation!

What's the definition for OOP?

"Extreme late-binding of all things"

- If one object stops functioning, messages are not consumed any more, but the rest still keeps running
- Individual objects can be exchanged/updated at runtime, without having to shut down the entire system
- cf. dynamic dispatch of object methods
- Downside: Runtime errors (`ClassNotFoundException`, `NoSuchMethodException`)

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3 | Putting OOP to good use

Putting OOP to good use

```
interface Garage {
  Ticket park(Car car);
  Car retrieve(Ticket ticket);
}
```

Putting OOP to good use

```
interface Garage {
  Ticket park(Car car);
  Car retrieve(Ticket ticket);
}
```

Garage API 1.0.0 OAS3

garage-api/garage-api.yml

Park a car

| POST | /garage/cars | Park a car in the garage |

Retrieve a car

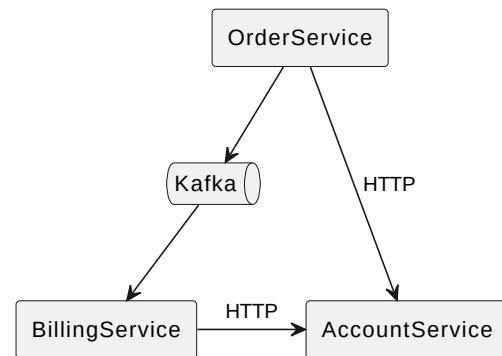| GET | /garage/cars/{ticket} | Look up a car |

| DELETE | /garage/cars/{ticket} | Retrieve a car from the garage, redeeming the ticket |

Schemas

car

# Putting OOP to good use

"Only messaging"

- Service communicate with each other using (actual!) messages
  - Synchronously (REST) or asynchronously (Kafka etc.)
- Not just method calls!

Putting OOP to good use

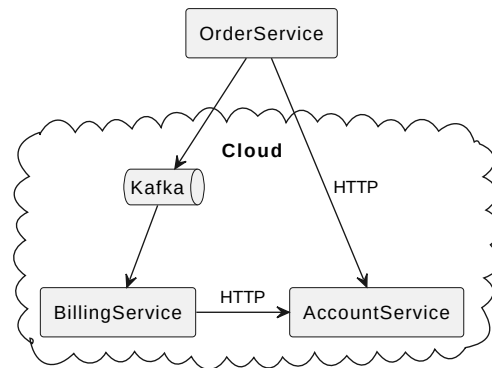"Local retention and protection and hiding of state-process"

- Services keep their own local state
  - retention = service (although stateless) has a database
  - protection = only this service is allowed to access it
  - hiding = outside does not need to know the data model, only the API
- cf. Encapsulation!
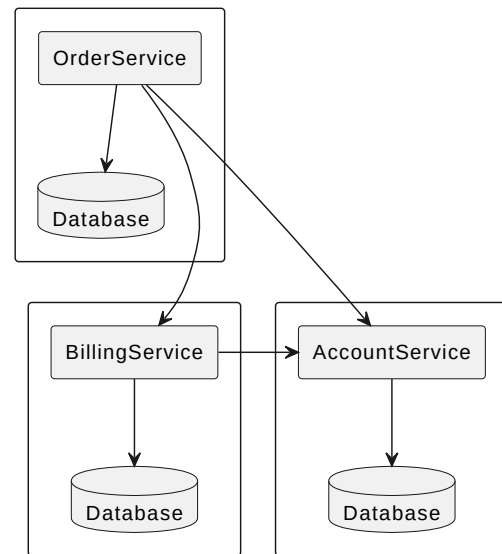
What's the definition for OOP?

"Extreme late-binding of all things"

- If one service stops functioning, messages are not consumed any more, but the rest still keeps running.
- Individual services can be exchanged/updated at runtime, independent from each other, without having to shut down the entire system
- Services can even be enabled/disabled depending on load (auto-scaling, serverless)

OrderService

Cloud

Kafka   HTTP

BillingService   HTTP→   AccountService

Programming vs. Architectural Paradigms

Programming paradigms

Architectural paradigms

- *Single team*

- *Code level*

- *Across teams*

- *Organizational level*

Programming vs. Architectural Paradigms

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Programming paradigms

- Static Predictability

- Cohesion

- Fault prevention

Architectural paradigms

- Runtime Flexibility

- Loose coupling

- Fault tolerance

On types

I'm not against types, but I don't know of any type systems that aren't a complete pain, so I still like dynamic typing.

Alan Kay, in an email to Stefan Ram, 2003
http://www.purl.org/stefan_ram/pub/doc_kay_oop_de

On types

Language	Polymorphism
TypeScript	**Structural Typing**, **Parametric**, Subtyping
Rust	**Parametric**, **Ad-hoc**
Golang	**Structural Typing**, Parametric

4 | Conclusion

Conclusion

1. The common definition of OOP in terms of "polymorphism, inheritance and encapsulation" misses the original point.

2. Polymorphism and inheritance are a disadvantage for programming paradigms.

3. "Biological cells that communicate via message passing" ↔ Microservice Architectures.

4. The principles of OOP are better suited for architectural than programming paradigms.
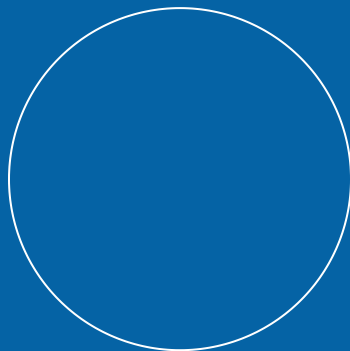
Thank you for your attention

Any questions?

Franz Thoma
Principal Consultant
franz.thoma@tngtech.com

TNG TECHNOLOGY CONSULTING

Franz Thoma

Principal Consultant

franz.thoma@tngtech.com