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# **Basic Concepts to Represent the World**

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# Basic Concepts for Representation and Description

- Objects and their Interaction
- Object and Link
- Class
- Attribute
- Association
- Aggregation and Composition
- Operation and Method
- Polymorphism

# A Lazy Lodger (Scene 1)

- One night in some apartment house, the “hungry boy” is alone in his room. He looks for “something to eat” Unfortunately, There is nothing to eat in the room. There is a “convenience store” across the street. He knows the convenience store sells “something to eat”. He needs money to buy “something sold”. He checks the amount of money in his “purse” and gets out of his room to buy something to eat. There are one “thousand-yen bill”, six “100-yen coins” and three “10-yen coins”.

**Ochimizu, Higashida, "Object Modeling", Addison-Wesley Publishers Japan**

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## Scene 2

- A car passes through in front of him when he wants to across the street to go to the convenience store. He looks at it and thinks: Color of the body is white; A tire is a radial tire; How much is the displacement of the engine.

**Ochimizu, Higashida, "Object Modeling", Addison-Wesley Publishers Japan**

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## Scene 3

- This is the convenience store. It sells many something to eat. There are “apples”, “big red ones” and “blue small ones”, and many “instant-noodles”, soybean-paste-tasted ones, salt-tasted ones, and soy-sauce-tasted ones. There are bottles of juice next to them. Everything seems to be delicious. He takes a “big red apple”, fresh one, and a bag of soy-sauce-tasted noodle. He buys a bottle of orange juice because he knows he will be thirsty after eating them. He pays 520 yen at the checkout counter, feeling it is too expensive. He thinks this convenience store is not good because the goods sold in this store are too expensive. He decides to go to another convenience store 30 meters far from here next time when he leaves the store.

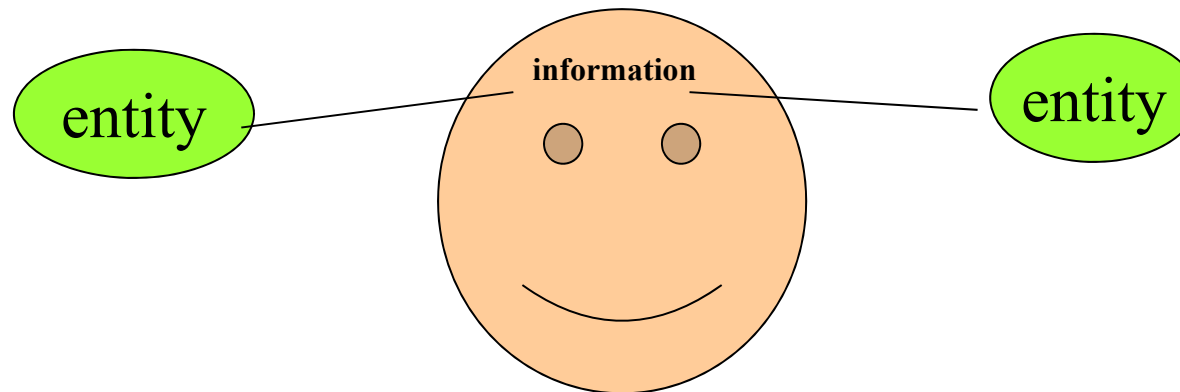
## Scene 4

- Next night, he is dull this time. He goes to a convenience store again to buy a magazine. He goes to the same store because he thinks price of a magazine is the same at every convenience store, He hesitates over to buy a paper book or a cartoon. He finally buys a paper book and a bottle of Coca-Cola. He thinks he must go to the bank and withdraw money tomorrow because the amount of money in his purse is not enough to buy anything.

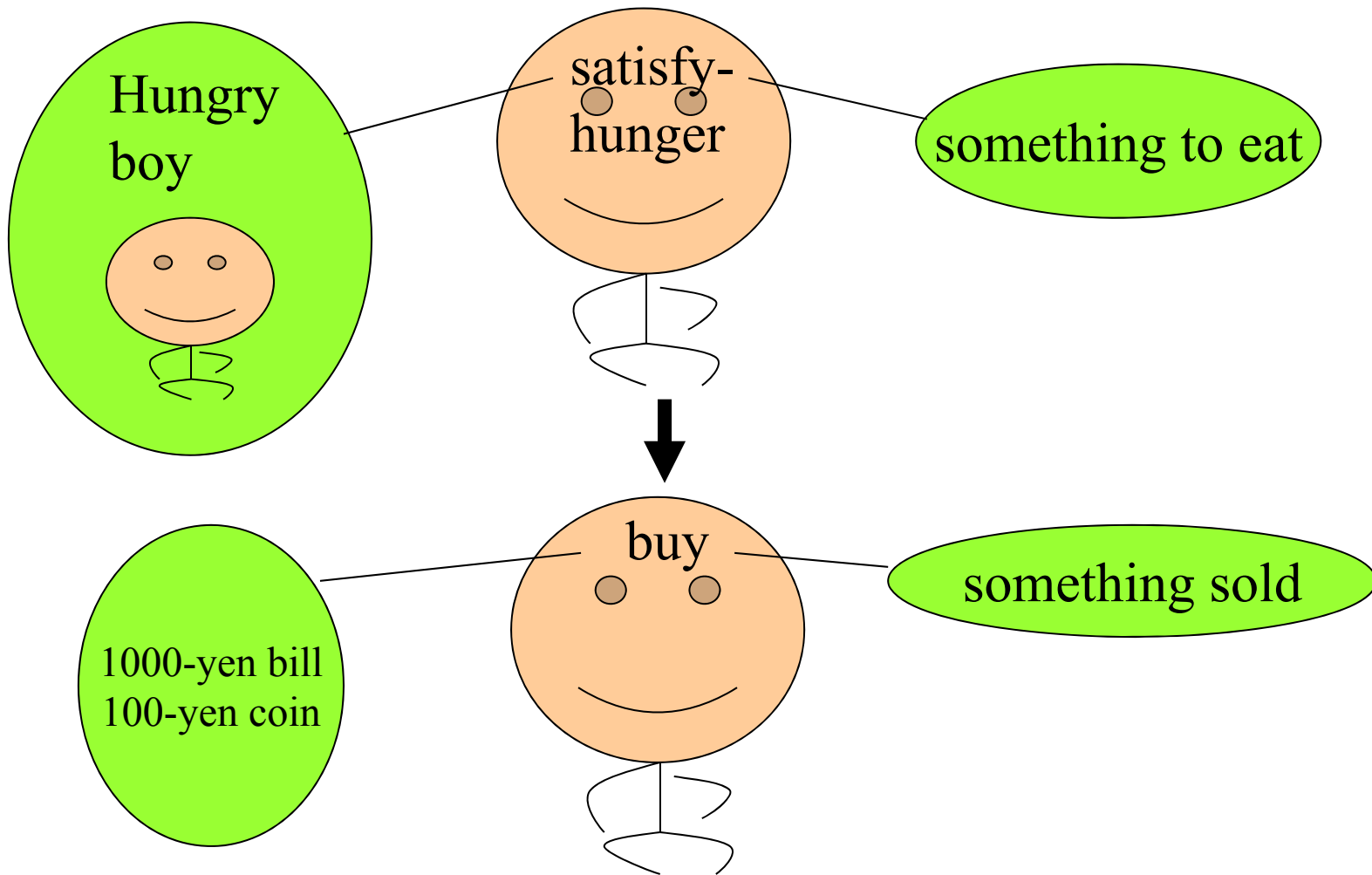
# What is information ?

- Information is created when two entities are linked together. The view and role of each entity is decided by the link.

(W.Kent, "Data and Reality")



# Buy to satisfy hungry

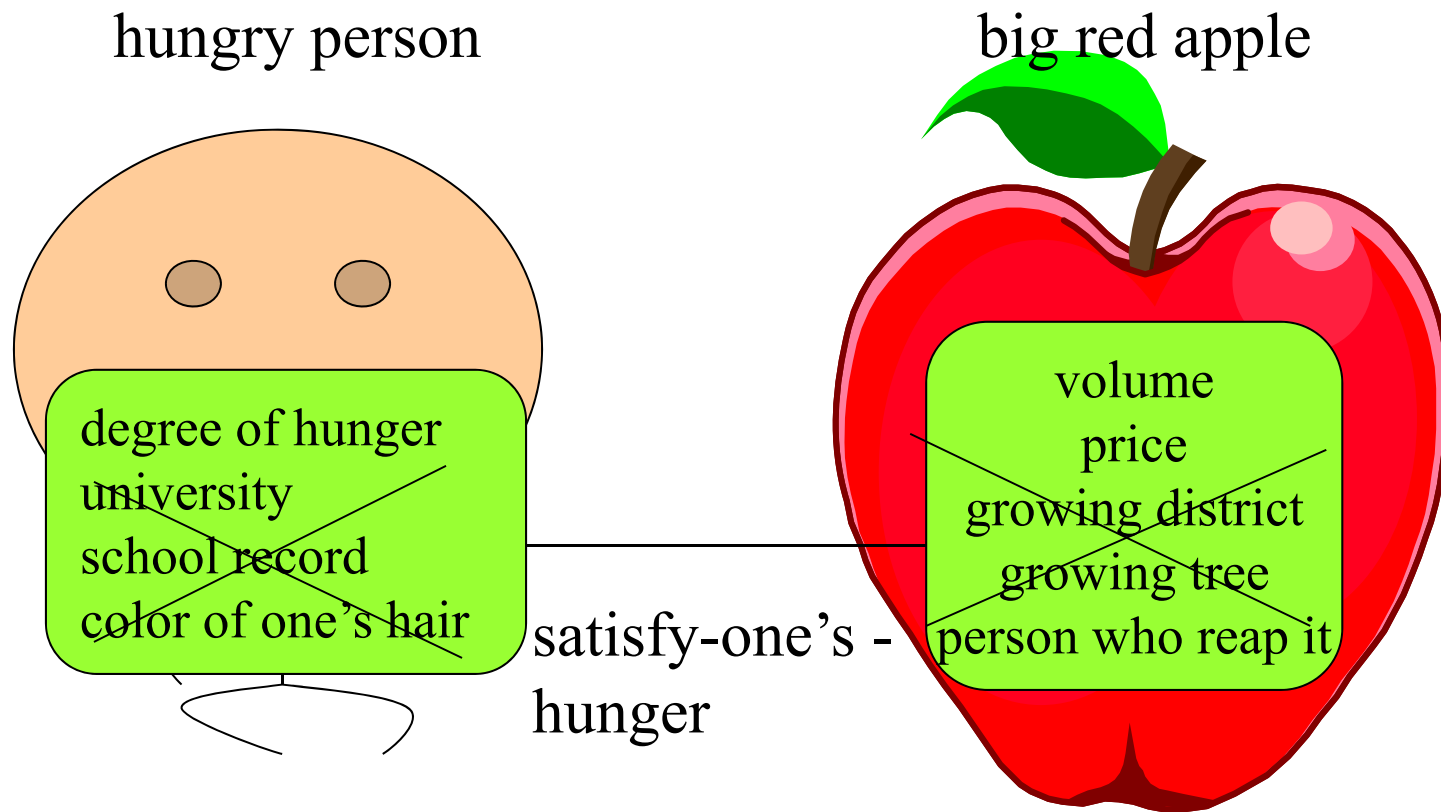


# **Object and Message passing** **(Notations for representing** **and describing the world)**

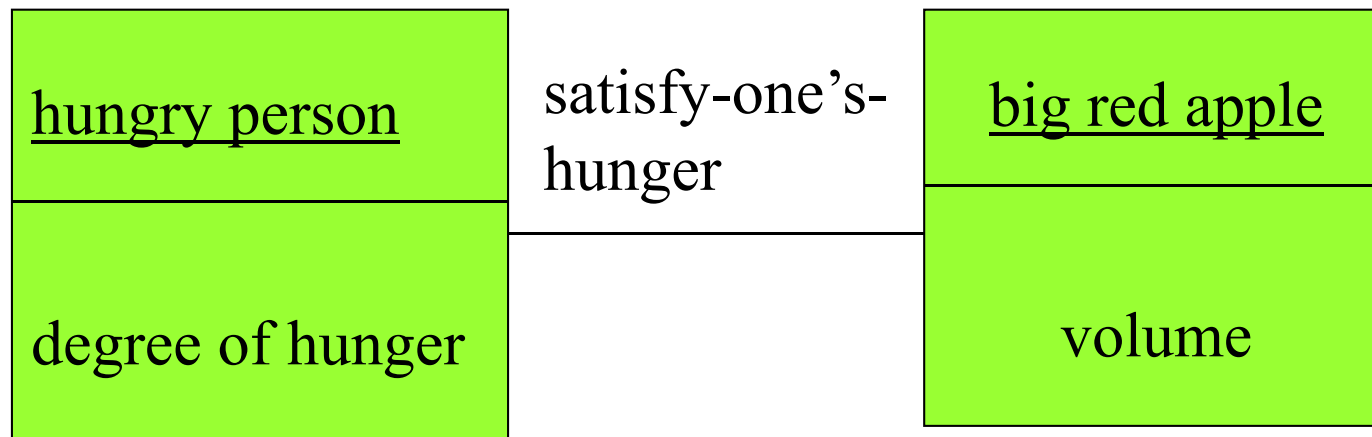
object, class, association

# What is an Object ?

An **Object** is an abstraction of an **Entity** from some information processing point of view

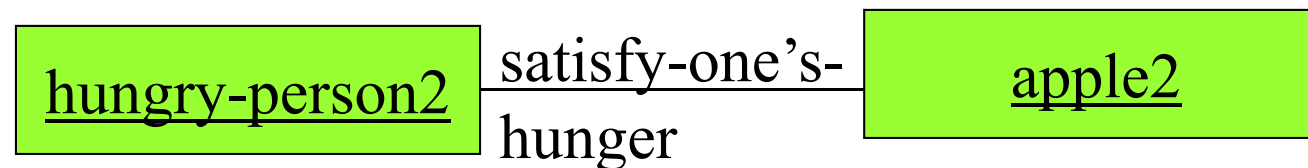
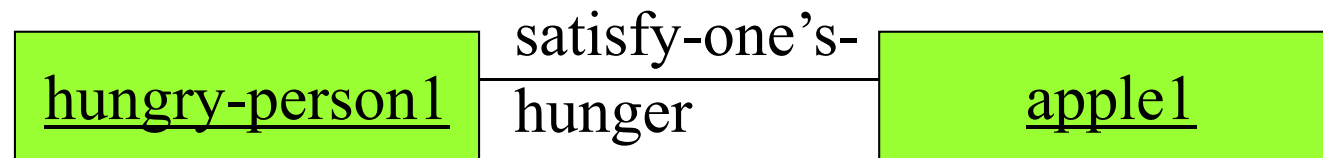


# UML Representation



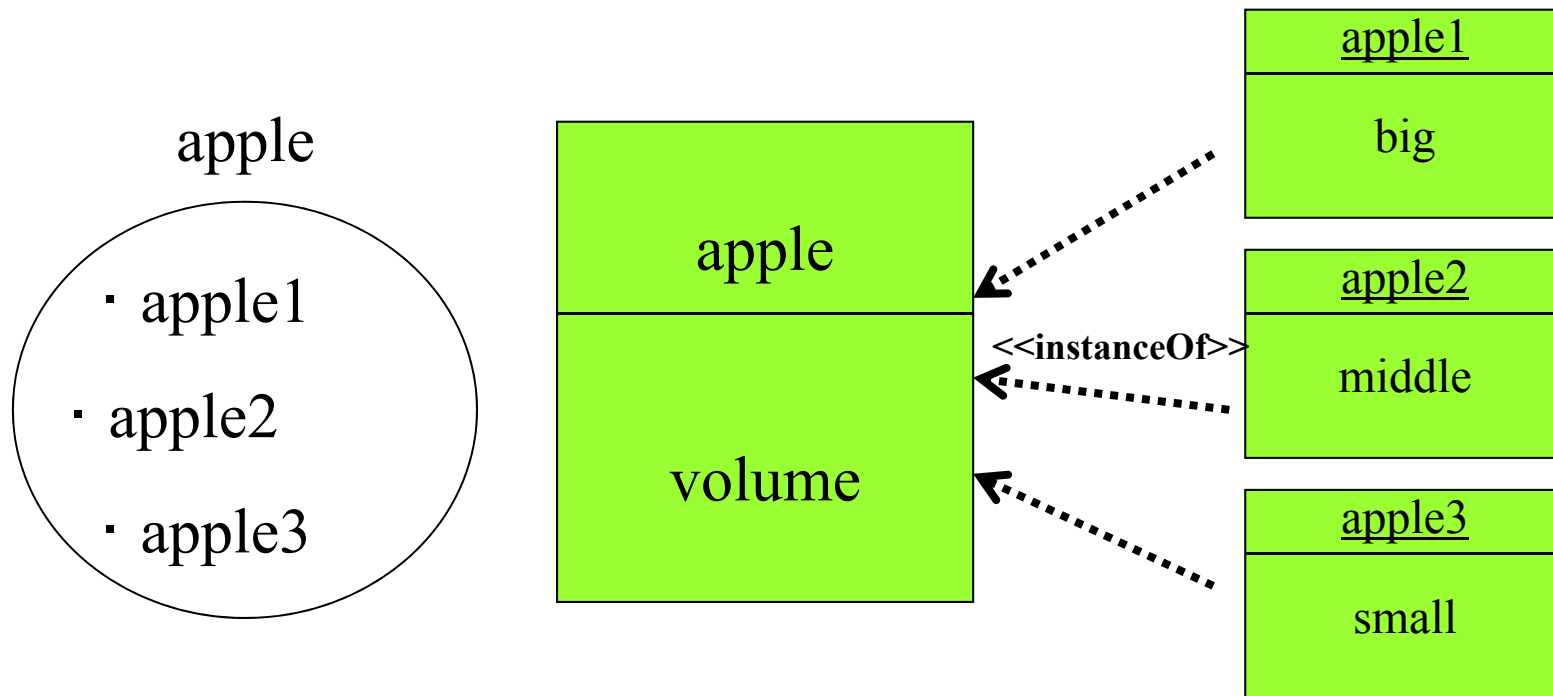
# Object and Link

- Objects and a link can represent the fact happened in the world.



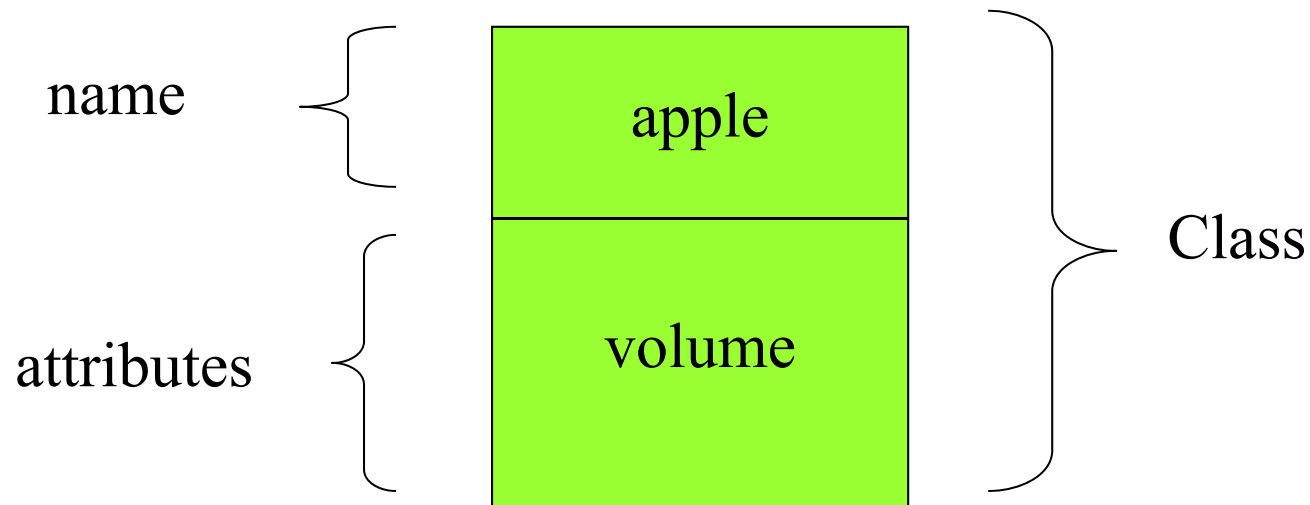
# What is a Class ? (temporary)

- A class is a definition of properties common to a group of objects.



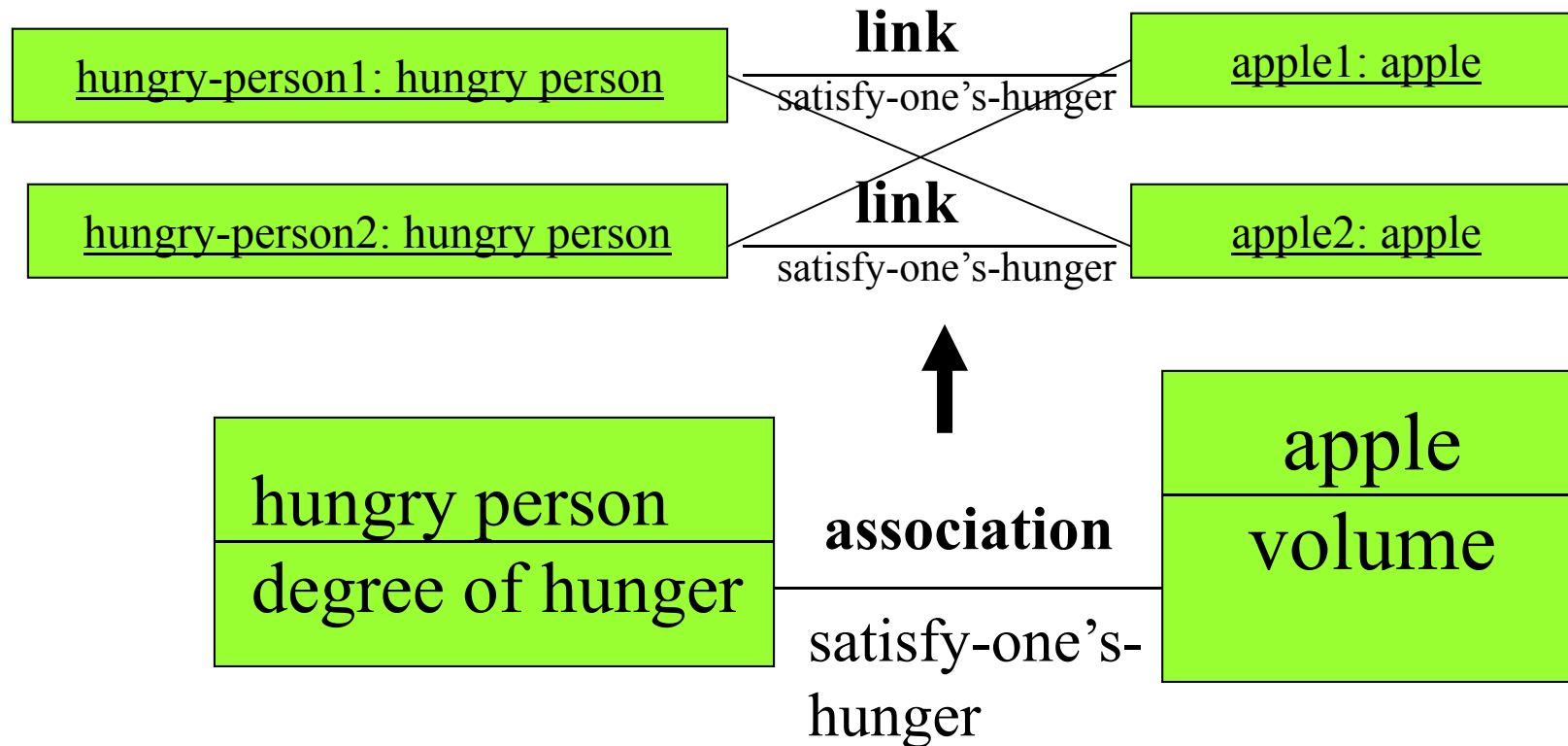
# What is an attribute ?

- Attributes are data that characterize a class. Attributes are obtained by abstracting an entity from the information processing point of view.

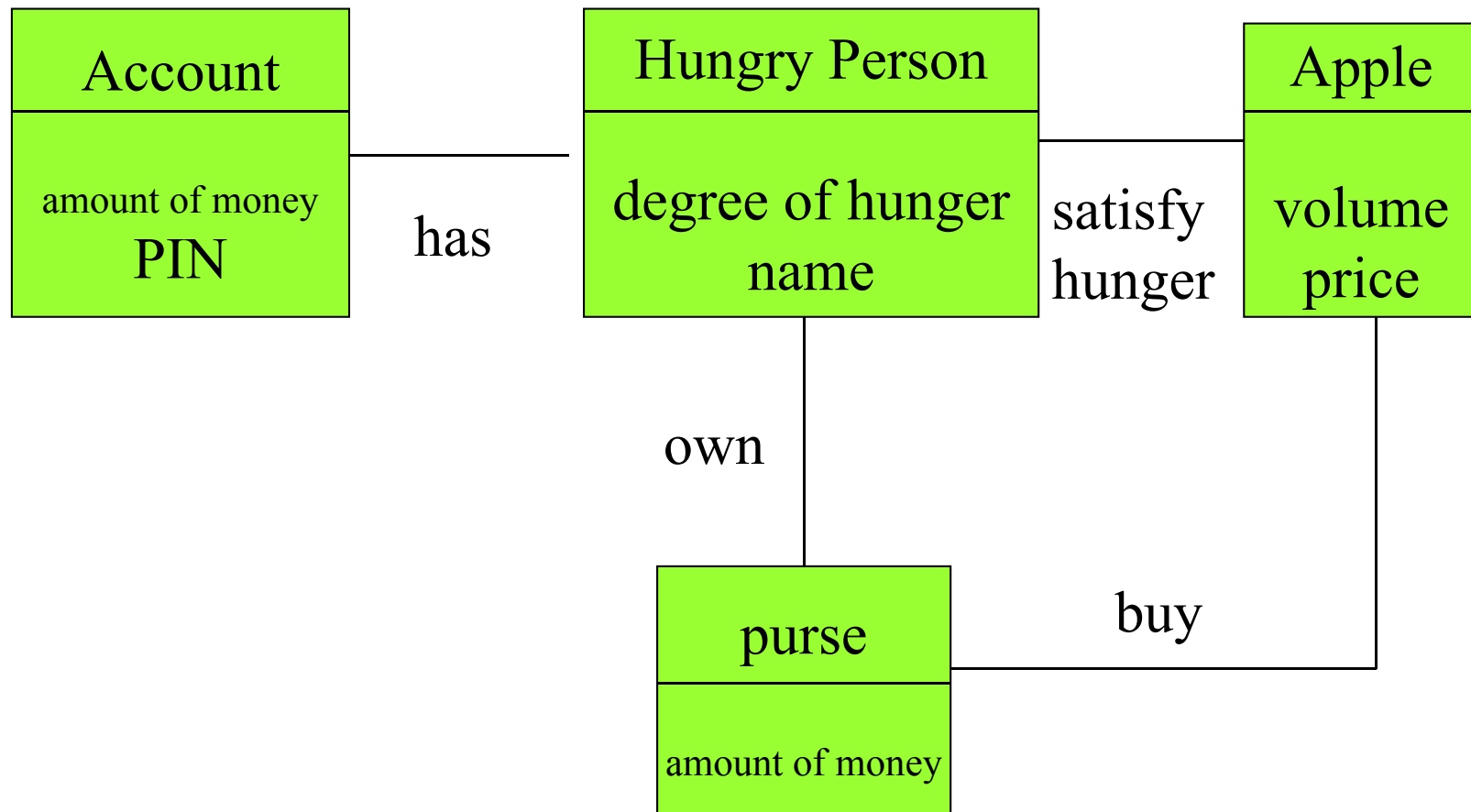


# What is an association ?

- An association represents a possibility for being able to make links between objects.

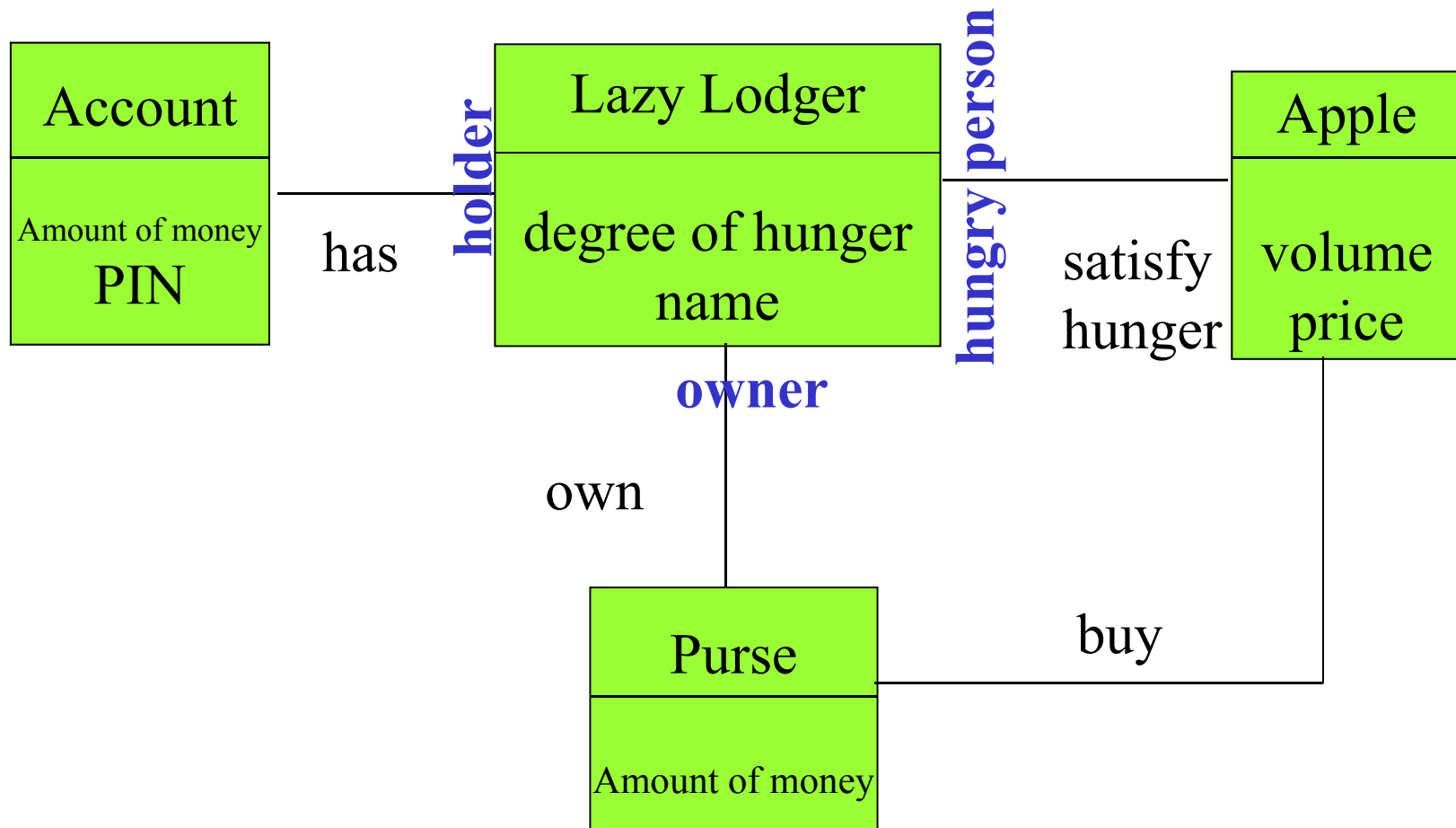


# Information Structure (Object Model) that control Mr. Poor's Daily Life



Ochimizu, Higashida, "Object Modeling", Addison-Wesley Publishers Japan

# Revised One



# Usage of Association

- An association represents the structural relation between classes **or** a route of message passing between classes.
- An association is a foundation to represent constraints existing in the domain.
- We can define the information structure of the domain at some specific abstraction level by using associations and classes

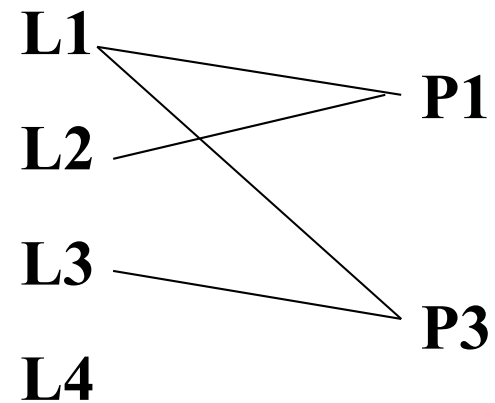
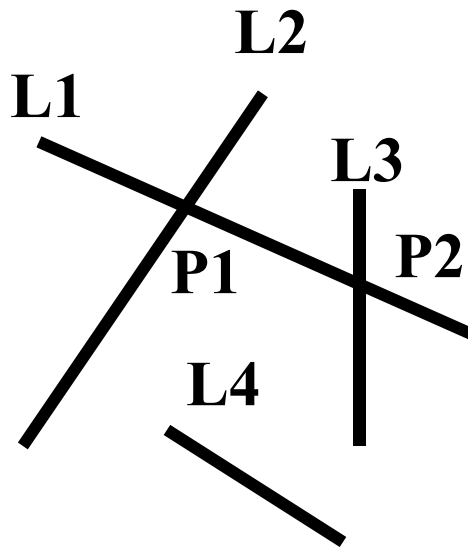
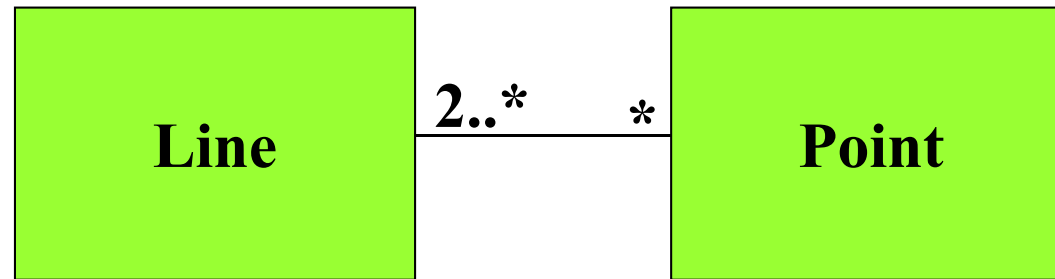
# Example of a Structural Relation

- There are several line segments on a plane. Draw the class diagram that can represent the following facts. “point is formed by the intersection of two or more line segments. Each line segment has zero or more intersection points

**J. Rumbaugh, “Object-Oriented Modeling and Design”, Prentice Hall, 1991.**

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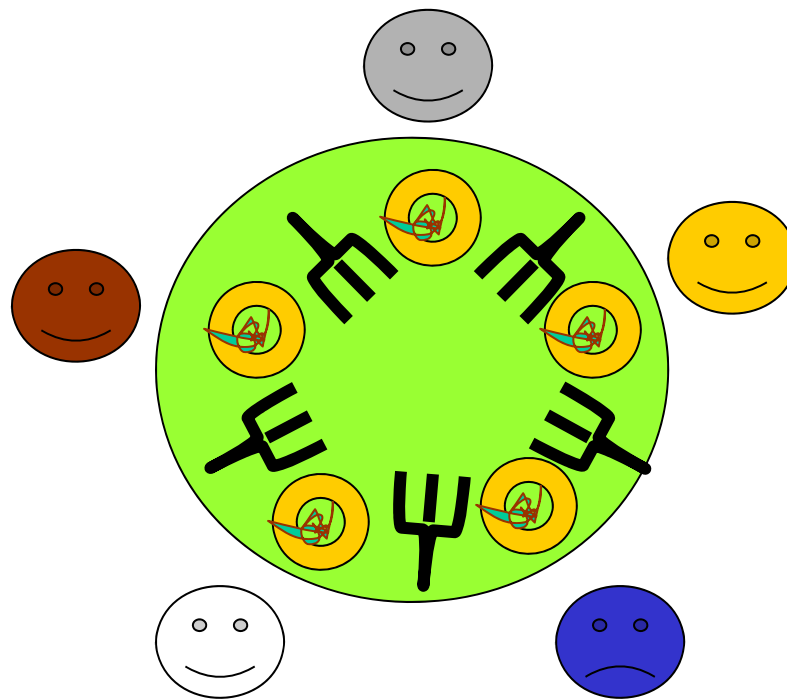
# Answer



# An Association is a foundation to represent Constraints

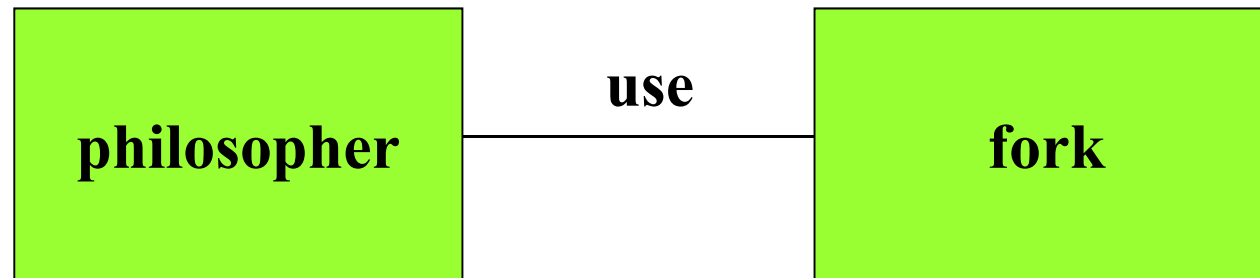
## Dining Philosophers

1. thinking  $\rightarrow$  eating  $\rightarrow$  thinking  $\rightarrow$ ...
2. Each philosopher needs two forks to eat
3. They must use right next fork and left next one not used



Ochimizu, Higashida, "Object Modeling", Addison-Wesley Publishers Japan

# Definition of the characters (classes) and stage setting (associations)



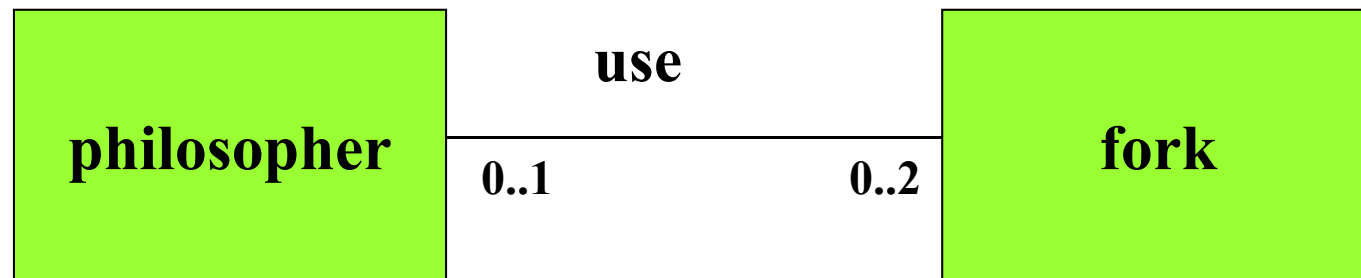
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# **Representing the Constraints by Multiplicity**

- 1. Each philosopher uses at most two forks**
- 2. Each fork is used by at most one philosopher**
- 3. Philosophers and forks form a circle by turn**

# First two Constraints

1. Each philosopher uses at most two forks
2. Each fork is used by at most one philosopher

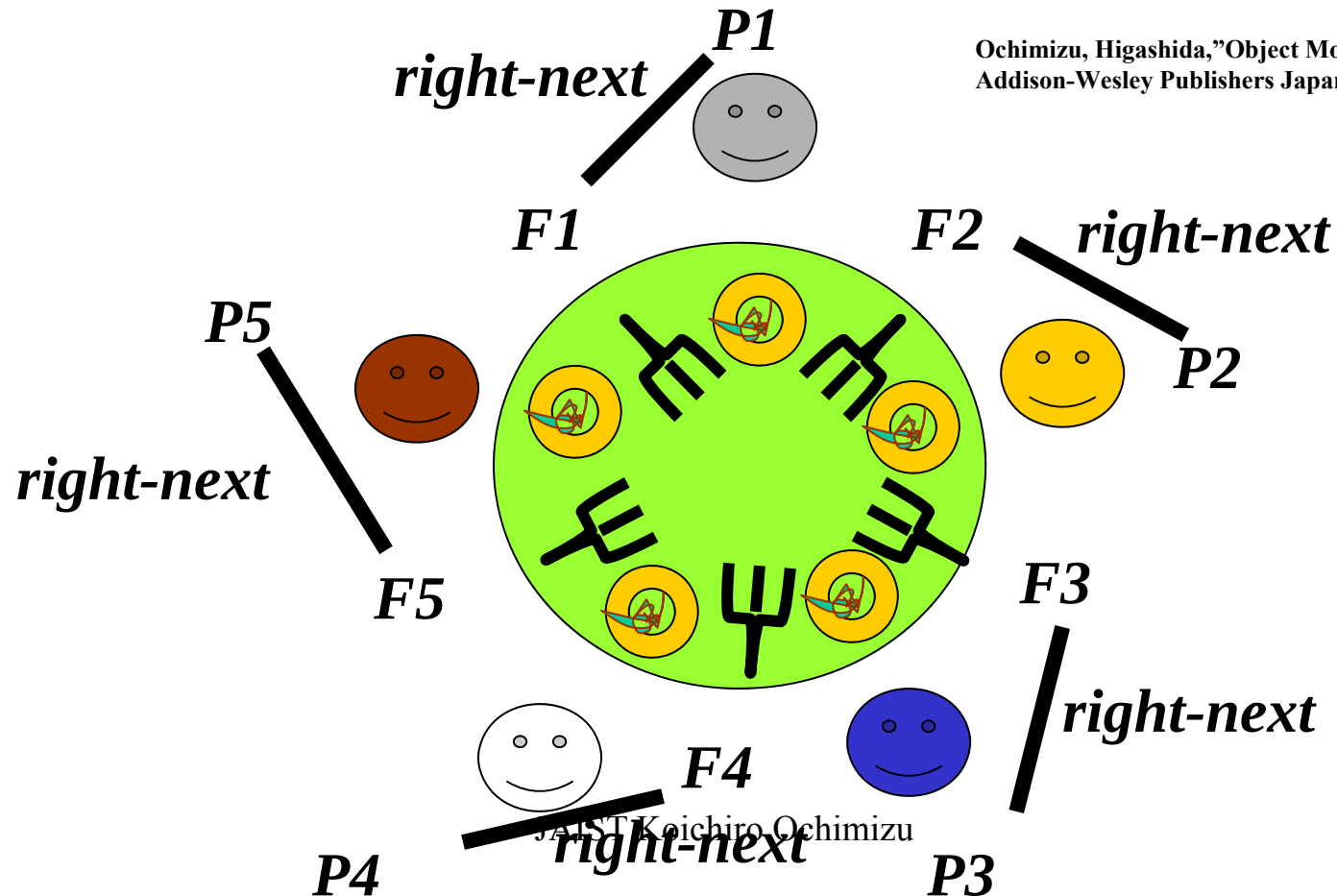


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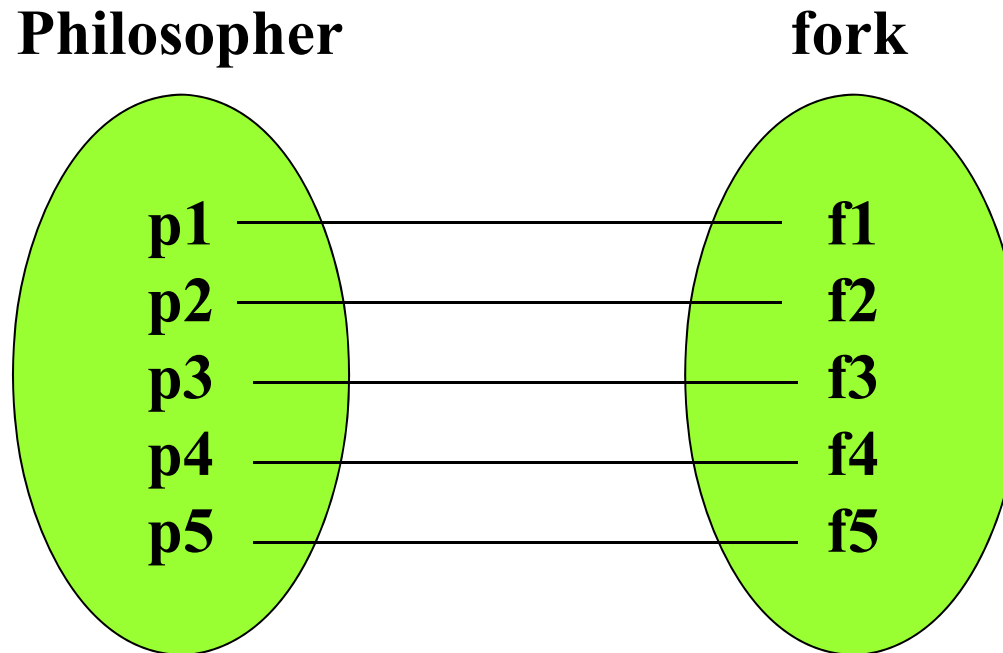
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# Right Next

- We assume the world begins from the scene: all five philosopher are seated and prepared for thinking and eating



# Philosophers and forks form a circle by turn 1

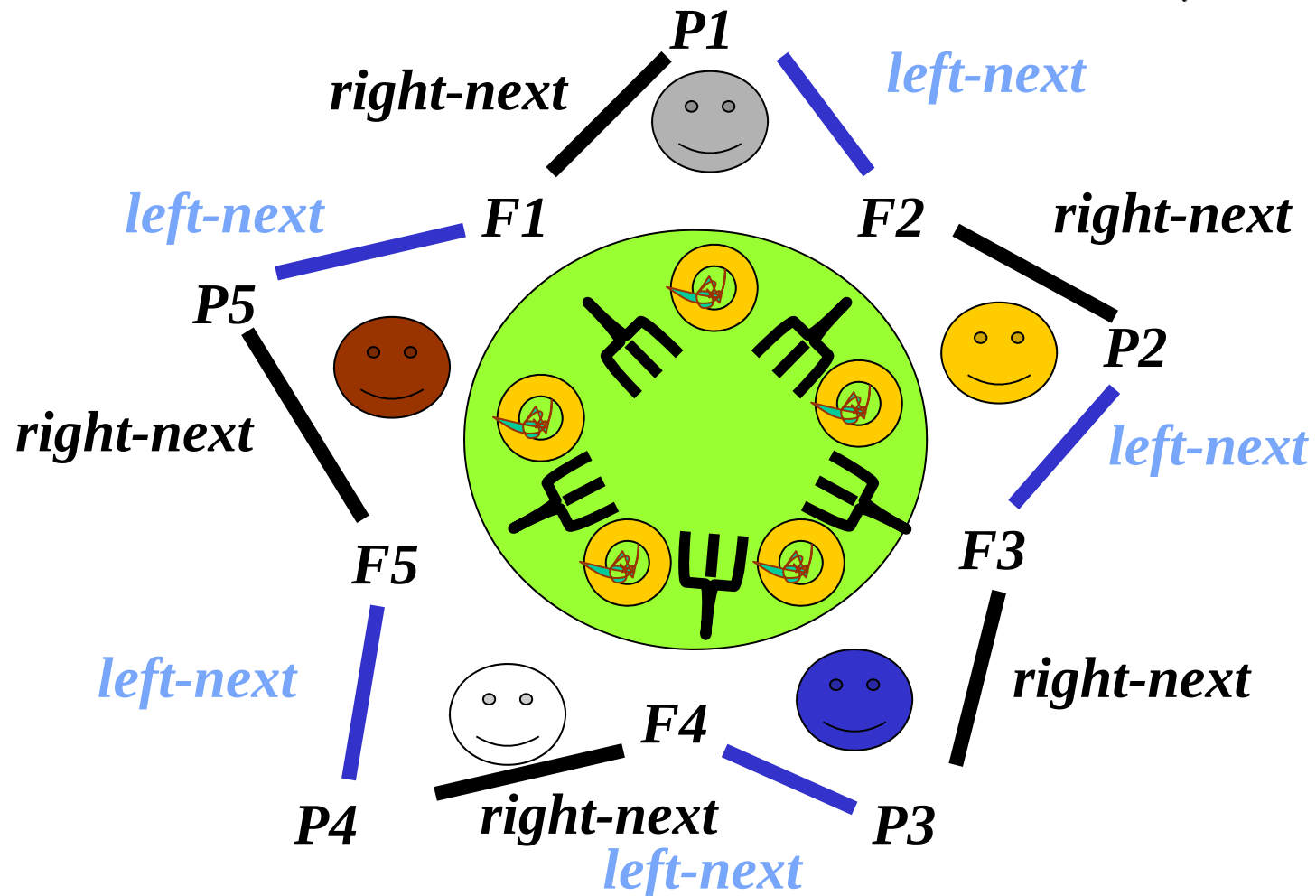


**One to one correspondence right-next**

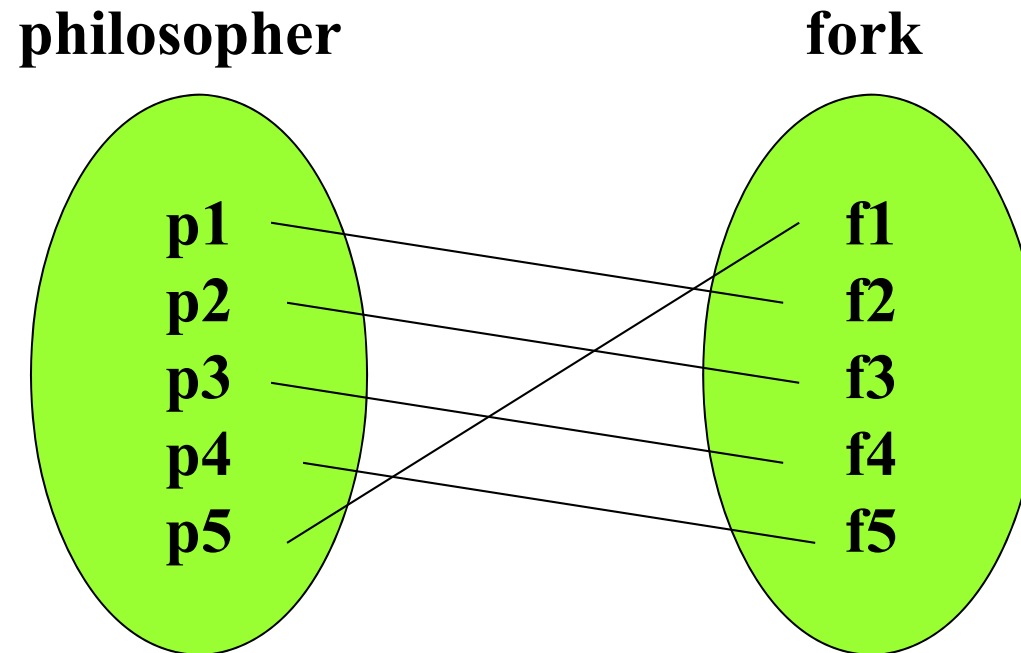
**Ochimizu, Higashida, "Object Modeling", Addison-Wesley Publishers Japan**  
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# Left-Next

Ochimizu, Higashida, "Object Modeling",  
Addison-Wesley Publishers Japan



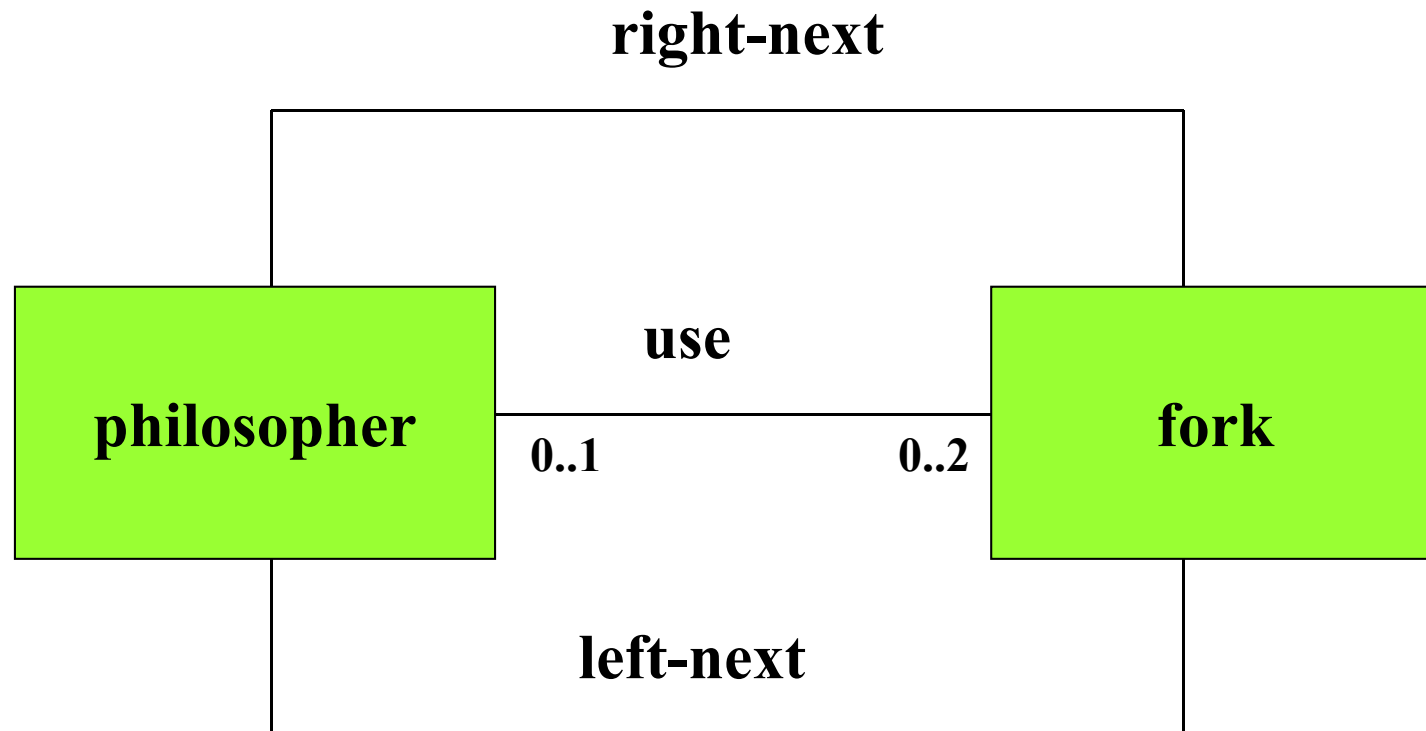
# Philosophers and forks form a circle by turn 2



one to one correspondence left-next

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# Object Model (completed one)

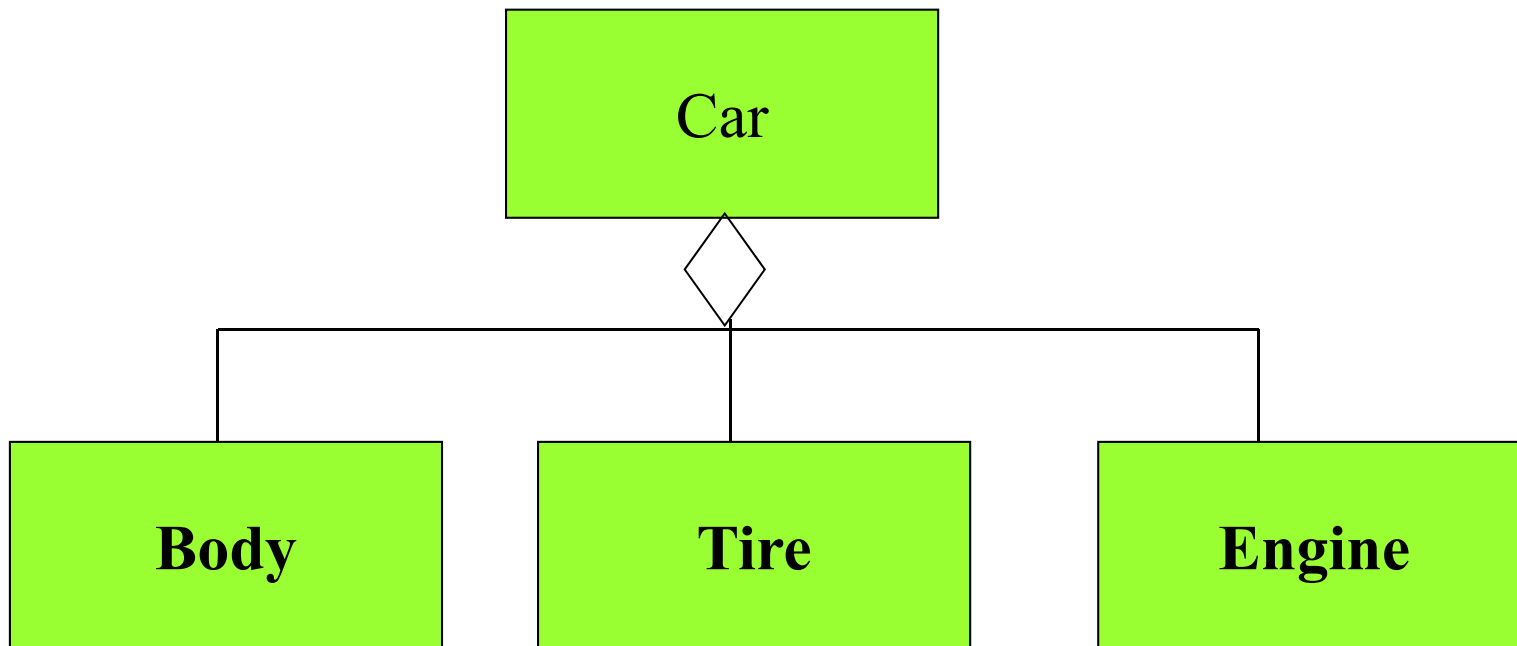


Each philosopher must use right next fork and left next one not used

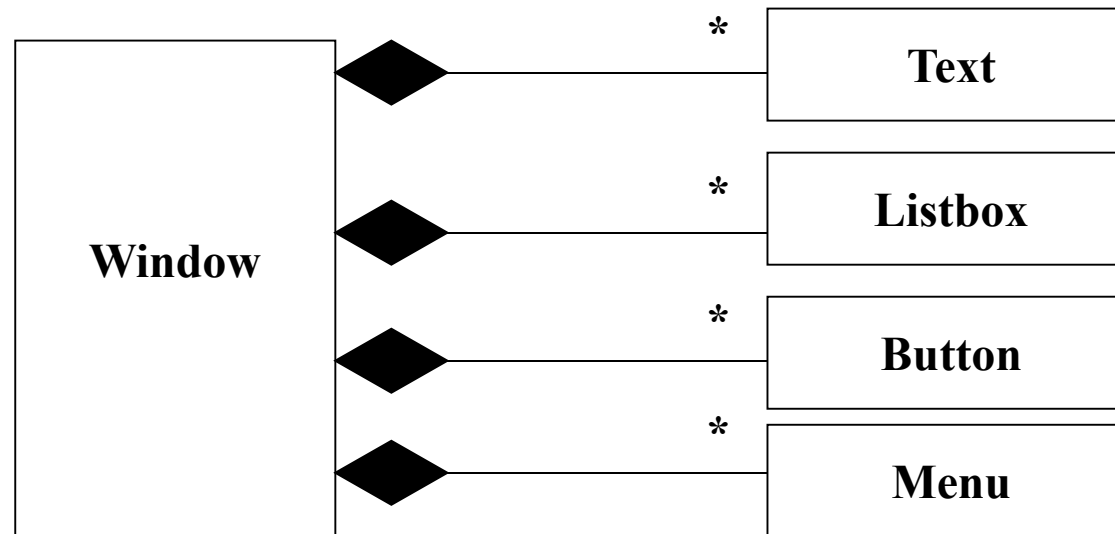
Ochimizu, Higashida, "Object Modeling", Addison-Wesley Publishers Japan

# Aggregation

- Special Association that represent whole-part ( is-part-of ) relationship



# Composition



If the whole object is deleted  
then the part objects are deleted

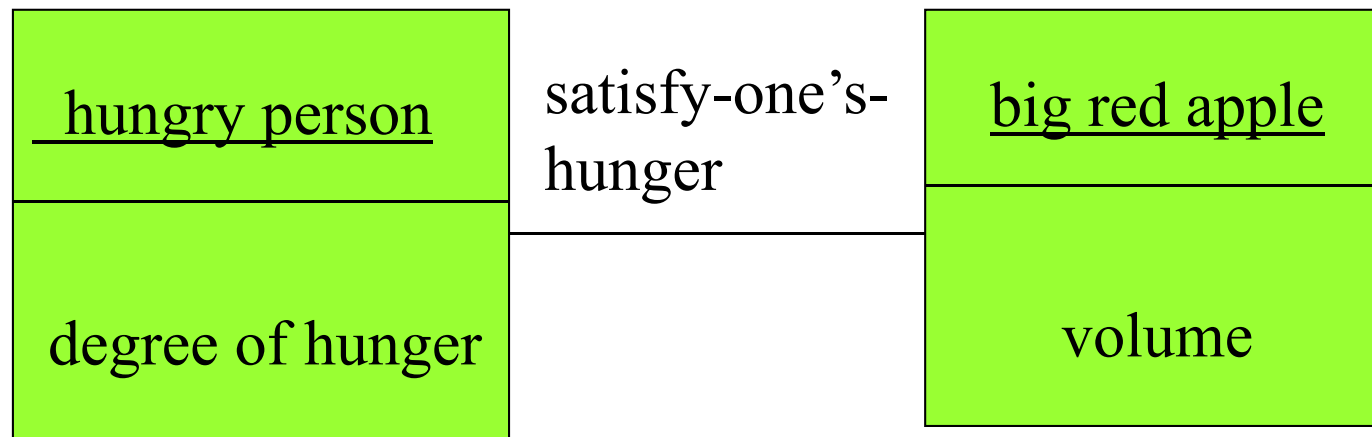
# **Object and Message passing**

## **(Notations for representing and describing the world)**

message passing, operation, method,  
polymorphism

# What is an interaction between objects ?

If the hungry-person munches the apple,  
the volume of the apple decreases and  
the degree of hungry of the person changes.



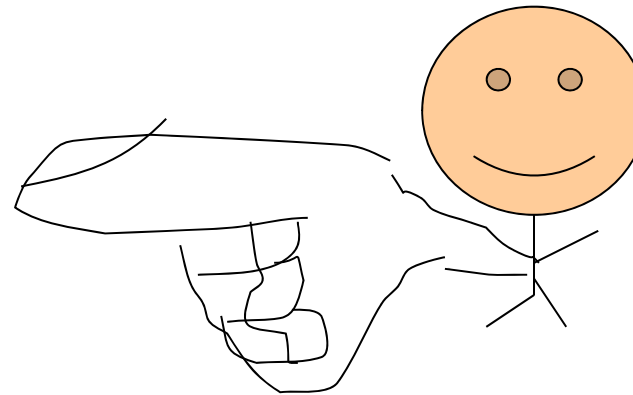
# How can objects interact?

- Objects can interact with each other by **Message Passing**.

**bankbook1 object**

|                                          |
|------------------------------------------|
| <u>bankbook1</u>                         |
| the balance<br>PIN                       |
| deposit<br>withdraw<br>check the balance |

**some-person object**



**bankbook1**

**how much is the balance?**

**receiver**

**selector**

**message**

# Operations and Methods

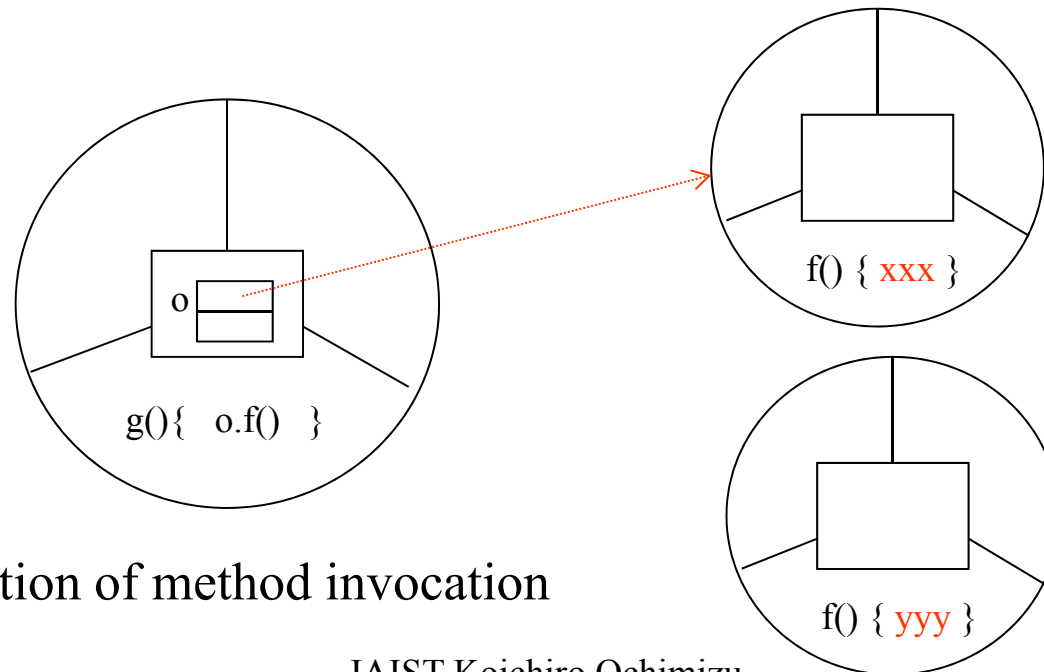
- An operation defines services to other object that supports us to ask the state of the object and to change the state of the object where the state of the object means value of the attributes.
- Operations are elements of a class.
- An method is an implementation of an operation.

**Ochimizu, Higashida,"Object Modeling", Addison-Wesley Publishers Japan**

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# Polymorphism

- Existence of numbers of objects that can respond to the same message
- Translation of axes by (x ,y). There are many geometric objects: a line, a line graph, a triangle.
- Dynamic Binding



Unification of method invocation

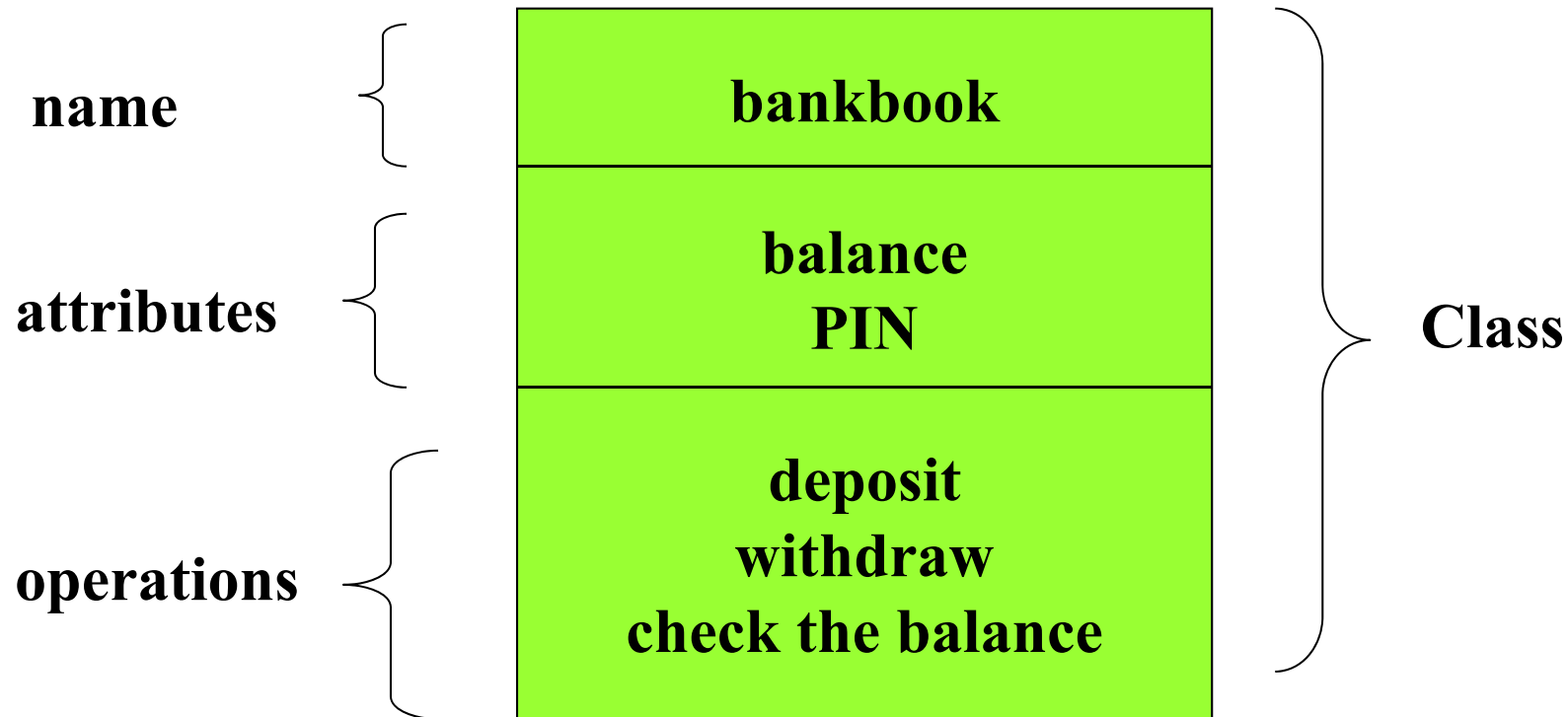
# **Object and Message passing**

## **(Notations for representing and describing the world)**

unit of thinking and representation

# What is a unit of modeling and programming in OOT ?

- Data(attributes) + Operations = Class



# Exercise

- **Review the content of my lecture by answering the following simple questions. Please describe the definition of each technical term.**
  - 1. What is an object?**
  - 2. What is a class?**
  - 3. What is an attribute?**
  - 4. What is an association?**
  - 5. What is an aggregation?**
  - 6. What is a composition?**
  - 7. What is an operation?**
  - 8. What is a signature?**
  - 9. What is a method?**
  - 10. What is a polymorphism?**
  - 11. What is a state of an object?**