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Object Oriented Design (OO != Real World)

Week 2-1

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Don’t try to understand with just OO concept.

- OO == (?)
  - “Technique to represent the real-world in Software as is”
- You would observe some inconsistencies between real-wold and soft-representation.
  - Design pattern, Framework, etc....hard to map them to the real-world

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Don’t try to understand with just OO concept.

- Just like OOT started in designing OOPL,
- don’t just learn OO concept...make sure do OOPL as well to see the implication on implementation.
  - some concepts might not directly translate to software objects/classes.

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Look OO (vs Real World)

- Class
- Polymorphism
- Inheritance

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Class == Kind
Instance == concrete object

- Class : The basic structure of OO
  - category of things
- Instance (object) :
  - an example or single occurrence of something

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Class vs. Instance (examples)

- Class : Instances.
  - country: Australia, China, USA, ...
  - OS: Windows, Linux, OS X, ...
  - academics: lecturer, Assis/Prof, Assoc/Prof, Prof
  - ...

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Class first

- In OOP, you first “define” a class.
- From the defined class, an instance (instances) are “created”
- Interaction between the instances achieves a task.
  - Ppl might say...”that’s why software objects in OO work just like real world objects (people, things)”.

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Example (Java)

```
    // define Brother
public class Brother {
    private String name;    // name

    Brother(String name) {  // constructor (executed at the time of instance creation)
        this.name = name;
    }

    String cry() {          // make him cry.
        return "*sob*";
    }

    public static void main(String[] args) {
        Brother john = new Brother("John");
        Brother jack = new Brother("Jack");

        // make them cry
        System.out.println(john.cry());
        System.out.println(jack.cry());

        return;
    }
}
```

Anything odd?

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Example (C++)

```
    #include <string>
#include <iostream>
using namespace std;

// define Brother
class Brother {
private:
    string name;        // name

public:
    Brother(string n) {  // constructor (executed at the time of instance creation)
        name = n;
    }

    string cry() {    // make him cry.
        return "*sob*";
    }
};

int main() {
    Brother john("John");
    Brother jack("Jack");

    // make them cry
    cout << john.cry() << endl;
    cout << jack.cry() << endl;

        return 0;
}
```

Anything odd?

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Polymorphism (common way of messaging)

- the occurrence of something in different forms
- a mechanism to use a common messaging
  - to objects of similar (slightly different) classes.
  - without being conscious about each classes.

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Example

- “Brother” class... you can make him cry.
- If you have “Dog” class, you can also make him cry.

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```
#include <string>
#include <iostream>
using namespace std;

class Animal {
private:
    string name;
public:
    Animal(string name):name(name) {}
    virtual string cry() {}
};

// define Brother
class Brother : public Animal {
public:
    Brother(string n): Animal(n) {}  // constructor (executed at the time of instance creation)
    string cry() {    // make him cry.
        return "*sob*";
    }
};

// define Dog
class Dog : public Animal {
public:
    Dog(string n): Animal(n) {}  // constructor (executed at the time of instance creation)
    string cry() {    // make him cry.
        return "bowwow";
    }
};

int main() {
    Brother john("John");
    Dog jack("Jack");

    // make them cry
    cout << john.cry() << endl;
    cout << jack.cry() << endl;

    return 0;
}
```

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```
   class Trainer {
public:
    void train(Animal animal) {
      cout << animal.cry();
      return;
    }
};

int main() {
    Brother john("John");
    Dog jack("Jack");

    Trainer trainer;

    // make them cry
    trainer.train(john);
    trainer.train(jack);

   return 0;
}
```

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Inheritance

- systematically organize common/different features
  - From “Superclass” to “Subclass”
  - Subclass inherits from its Superclass.

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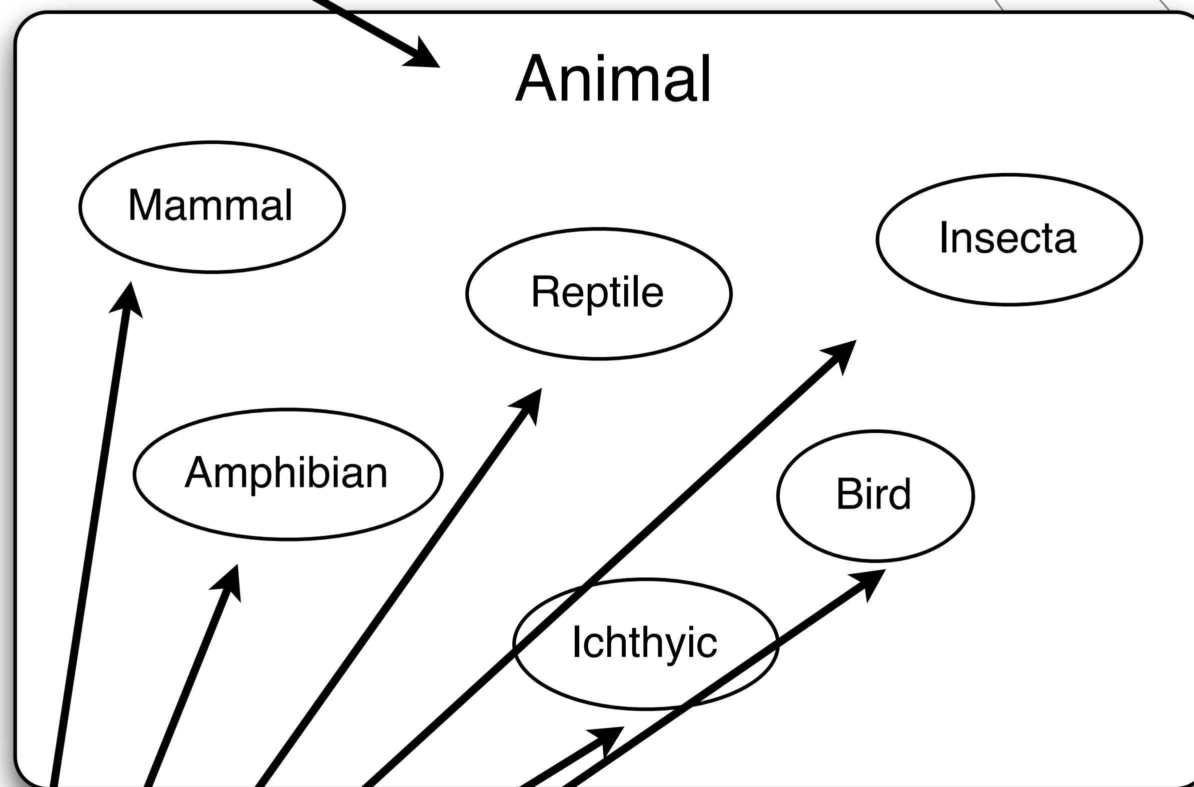
Superclass



Subclass

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```
   class Animal {
private:
   string name;
public:
   Animal(string name):name(name) {};
   virtual void move() {};
    virtual string cry() {};
};

class Mammal : public Animal {
   virtual void bear() {};
};

class Bird : public Animal {
   virtual void fly() {};
};
```

- Is anything odd?

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Don’t be afraid to question.

- Typical OO teaching..
  - Difficult terms...with abstract explanation
  - use of metaphor(s)
  - sample code based on the metaphor
  - but! you still need to support conventional technologies...

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Class vs. Instance

- Abstract Concept:
  - Class == Kind, Instance == concrete object
- metaphor/example:
  - Animal, Mammal, Bird
- So far, sounds good....

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```
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    string cry() {    // make him cry.
        return "*sob*";
    }
};

// define Dog
class Dog : public Animal {
public:
    Dog(string n): Animal(n) {}  // constructor (executed at the time of instance creation)
    string cry() {    // make him cry.
        return "bowwow";
    }
};

int main() {
    Brother john("John");
    Dog jack("Jack");

    // make them cry
    cout << john.cry() << endl;
    cout << jack.cry() << endl;

     return 0;
}
```

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Class/Instance which one is first?

- According to the program,
  - Class is first defined, and
  - Instances are created from it.
- If OO is for representing the real world, does this make sense?

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- In the real world,
  - there are many concrete objecs.
  - depending on how one would see them, one would categolize them based on some criteria.

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Inconsistency

- Me
  - At Uni : Professor
  - With Clients: Consultant
  - At Home: Dad / Husband
  - At Street: ?

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Object’s life doesn’t change

- Objects are generated from a Class,
  - Object’s class does not change.
  - example: Baby.
    - Once you create the instance of baby, this baby never become an instance of Adult.
- This problem also apply to “Inheritance”

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How about Polymorphism?

- A mechanism to provide a common messaging to instances of similar classes ✓
- example of Animal.cry().

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int main() {
    Brother john("John");
    Dog jack("Jack");

    // make them cry
    cout << john.cry() << endl;
    cout << jack.cry() << endl;

     return 0;
}
```

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- Unless your brother is big enough to understand you...
- Unless your dog is one of those appear on YouTube as “Amazing Dog”...
  - They would not under stand the message “Cry” in the real world

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- How about if there were more messages:
  - Wait
  - Eat / Stop eating
  - Clean-up your room/kennel
  - Go toilet, etc.
- Will they do as you say?

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- In OO world, all behaviours are pre-defined.
- It is understood that all objects faithfully execute the command.

- Polymorphism is based on this basic.
- Hence, message-passing and polymorphism are not for representing the real world as is.

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- Class, Polymorphism, Inheritance
  - mechanisms for Programming
  - not necessarily for “representing the real world as is”.

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Simple OO Modelling/Design

- OO : Describe a system with objects and their interaction.
- Analyse the "real objects" and categorize in abstracted manner. (design "Class")
- UML (Unified Modelling Language)
  - became standard in 1997
  - common language

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You need OOD "training"

- Theory: What is OO, Design Pattern, etc in Textbooks
- Practice: Build a real system
- You need "Training" in between.

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Design (Modelling (Analysis))

- To do good design,
- you need good modelling
- you need good analysis

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Training Process

1. Pick an ordinary item/thing around you,
2. Discern the essence of the item/thing
3. Describe it as an abstracted item/thing

- As a training, spend decent amount of time on #2.
- If you reached #3 from #1,
  - list out how you modelled
  - evaluate your model.

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Example

- Model Ice Cream

images from Google Image search

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Step 1

- Understand the overall picture.
  - list out everything you can think of..
  - search literature

- understand facts and their relationships with concrete examples

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Ice cream ?

- kinds:
  - vanilla, choc, mint, etc.
  - waffle cone, cake cone, pretzel cone, kiddie cup.
- structure:
  - ice cream (ball) sitting on the cone
- nature:
  - It melts.

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Step 2

- Decide your view point.
- Decide what are the essence
- Decide how you would represent

- Conceptualisation

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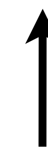
- Ice cream (ball)
- cone

Ice cream



placed on

cone

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- Ice cream (ball): different flavours
- cone : different types of cones

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- Ice cream cone is
  - different flavours of ice cream ball
  - is placed on
  - different types of cone.

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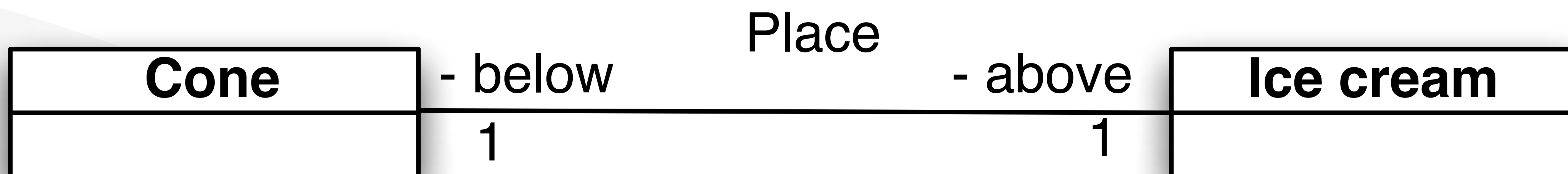
Step 3 (Modelling)

- Represent Structural relationship



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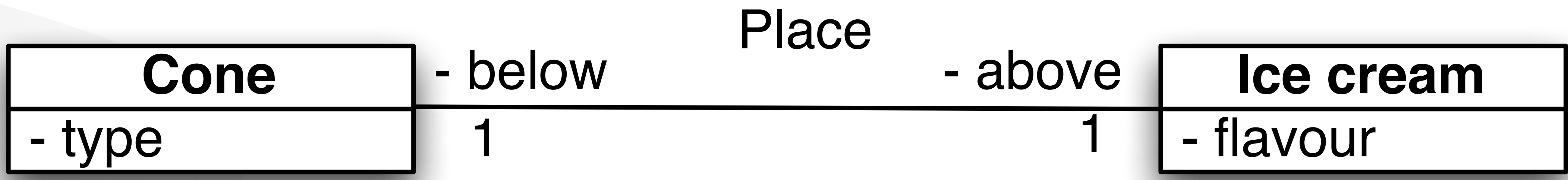
- Represent each internal features



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More modelling

- State of Ice cream

frozen

melted

not etable

etable

not etable

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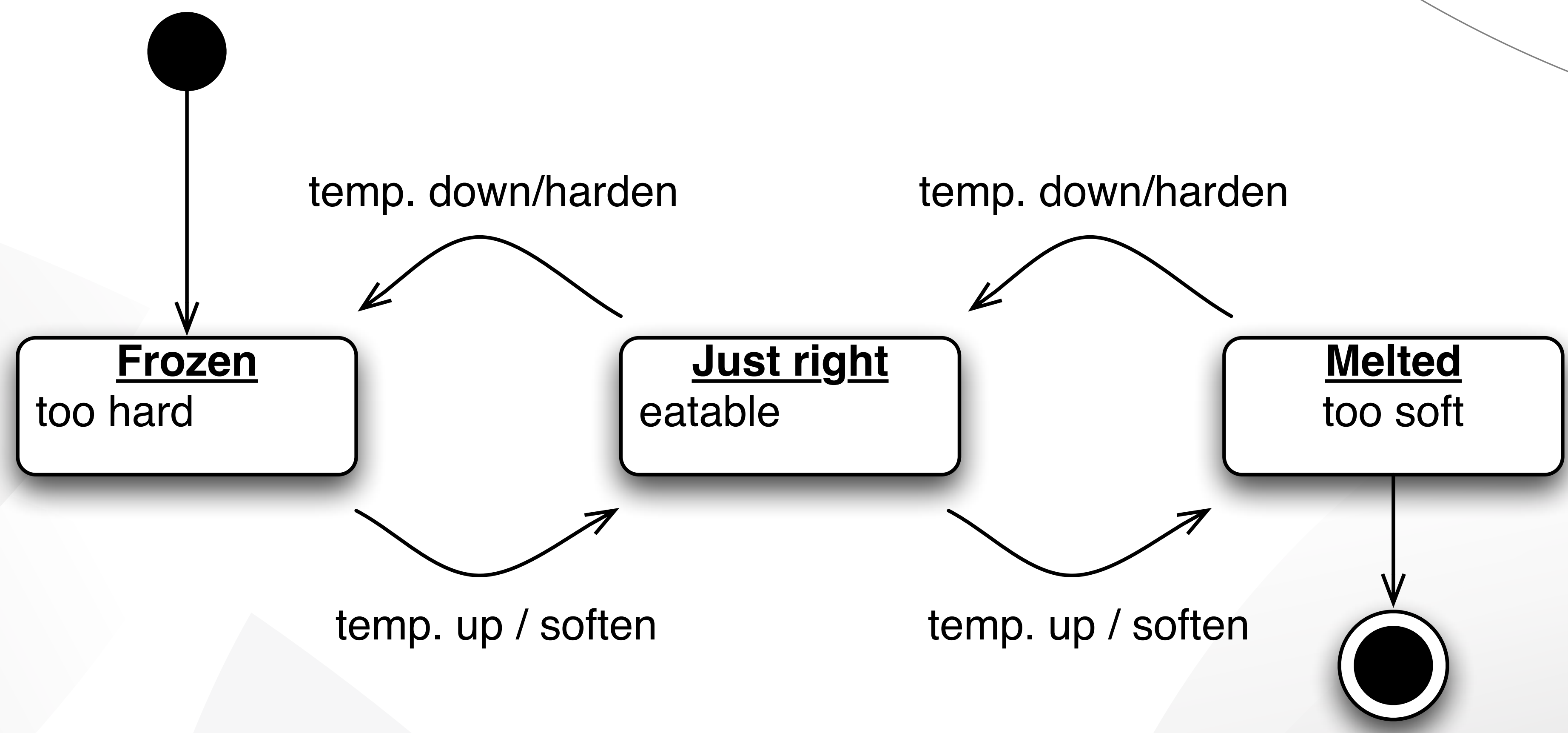

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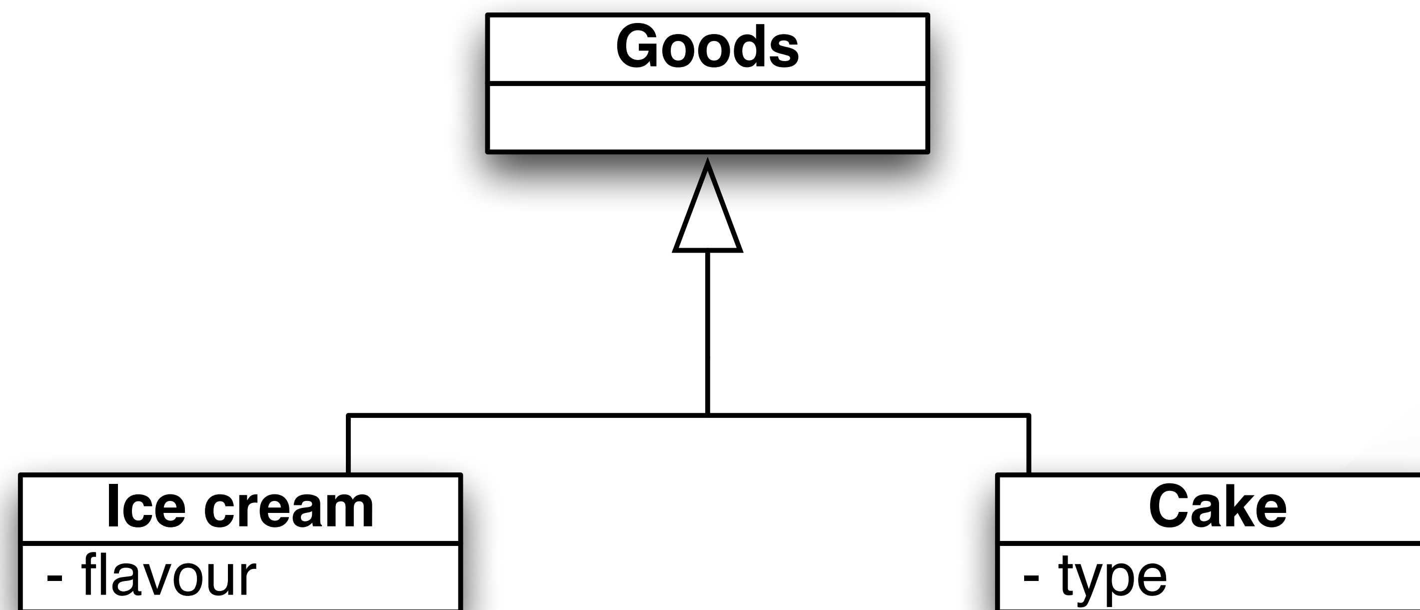
- If you change a view point, you would reach a different model.



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