面向对象软件方法学

张波

Textbook and Reference

- Mark Priestley, 2000, Practical object-oriented design with UML (面向对象设计的UML实践), Tsinghua University Press, Reprint. Originally published: McGraw-Hill, 2000. ISBN 7302040982.
- Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, 2002, Design Patterns: Elements of Reusable Object-Oriented Software, 机械工业出版社.
- 张波，Qt中的C++技术，2012年, 机械工业出版社

Outline of this lecture

Chapter 1 Introduction

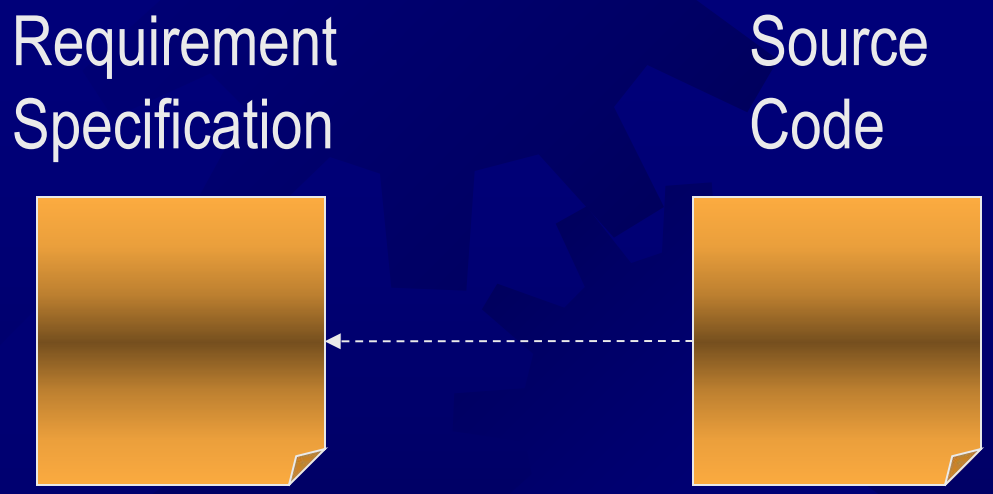
- Why do we need modeling?
- What kinds of modeling methods available?
- Why do we need UML?
- Fundamental elements of UML
  - Views
  - Diagrams

Chapter 2 Modeling with Objects

- Properties, Navigibility, Message Passing,
- Strength of OOP

Introduction to UML

- Software development
  Wide sense / narrow sense
- The process of software development



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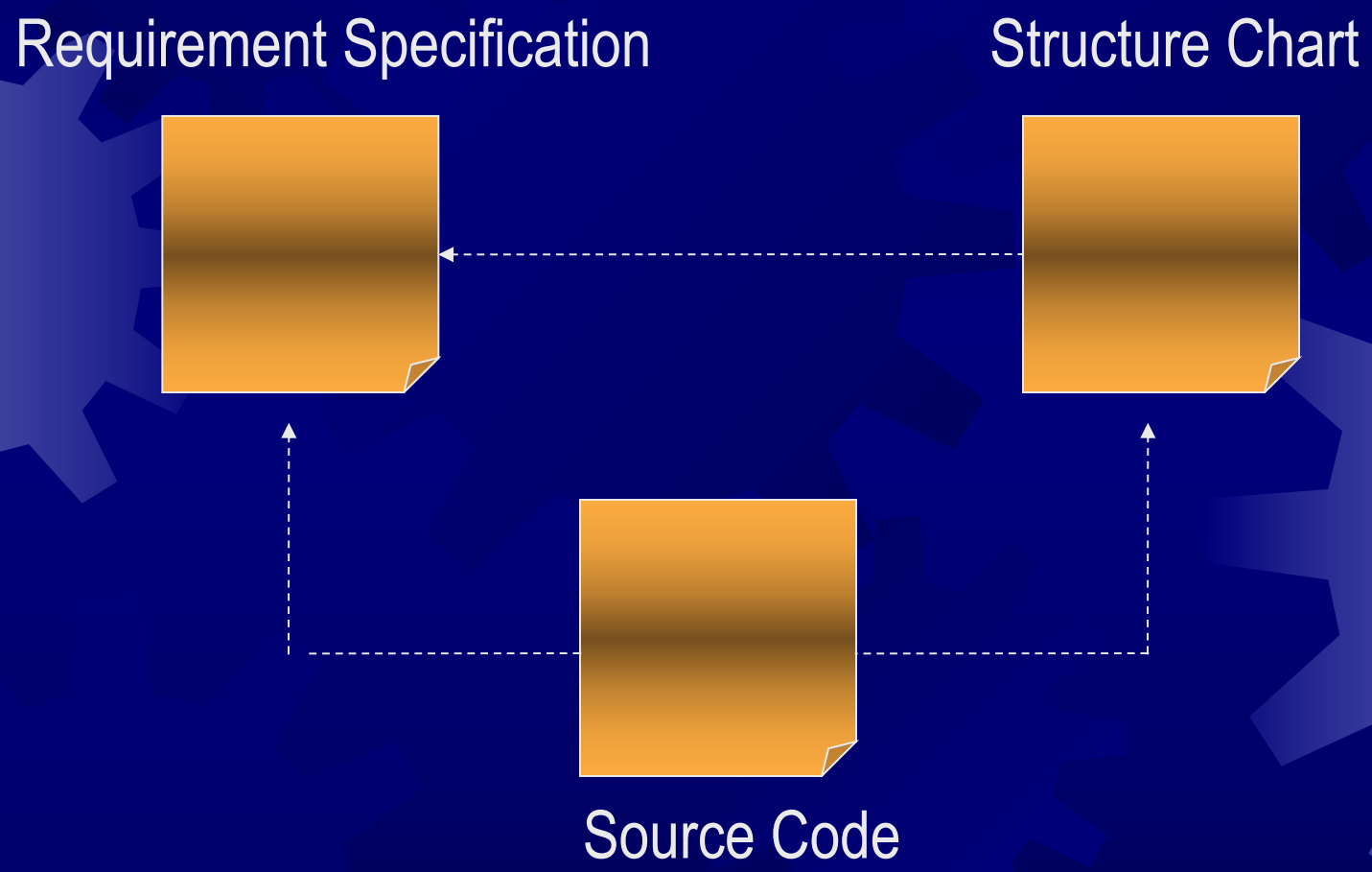
A more complex process



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Model

- Definition: the intermediate descriptions (documents) produced in the process.
- Features:
  - Abstract view of a system.
  - Easy to understand.
  - A valuable means for communication.

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Classes of methodologies

- Structured methods
  - Models
    a collection of data +
    functions external to the data
  - Notations: data flow diagrams
- Object-oriented methods
  - Models: see the following example
  - Notations
    Unified Modeling Language (UML)

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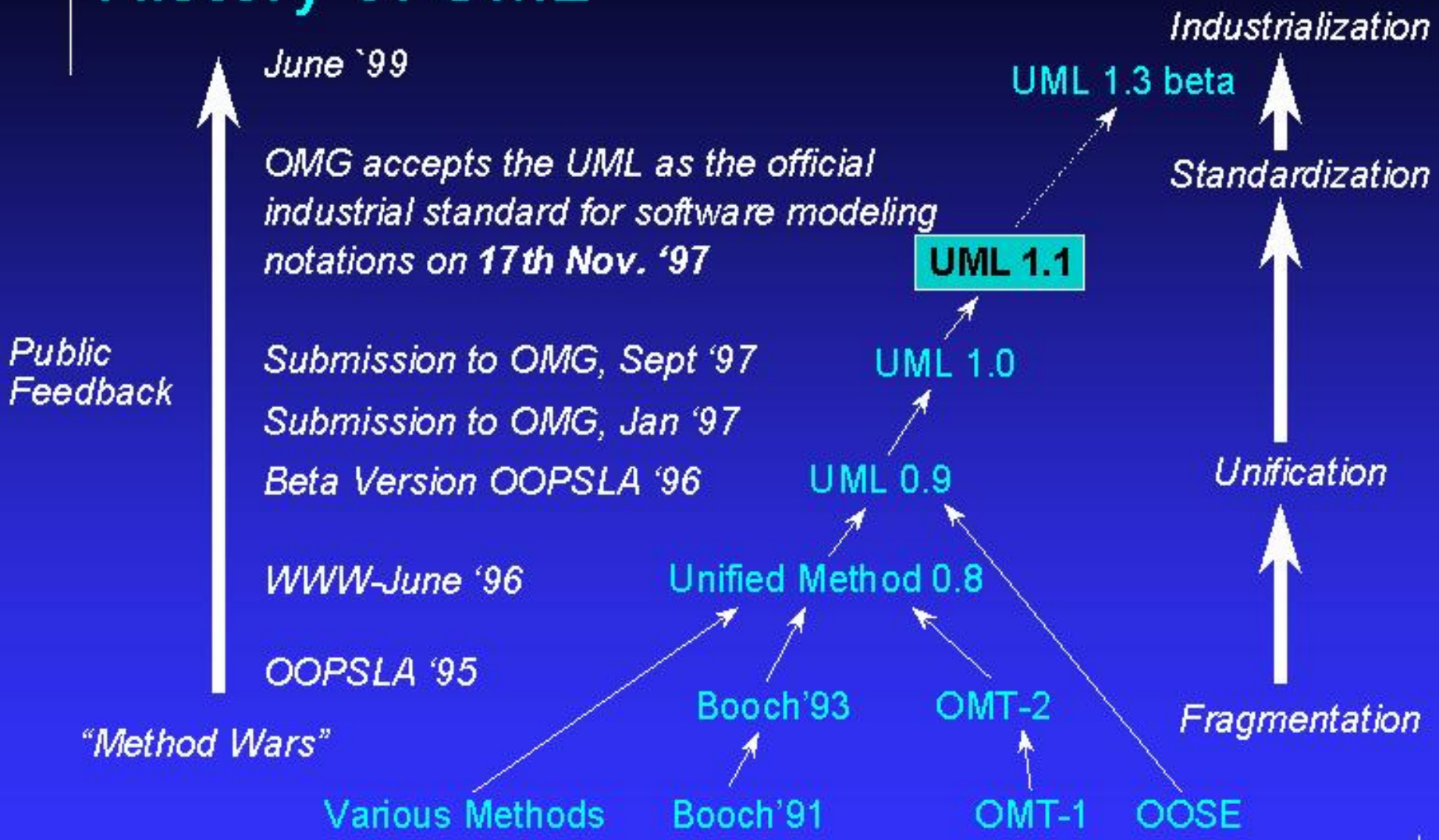
History of UML



Taken from http://ias.uni-klu.ac.at/projects/uml/OTG99/sld006.htm

A brief Introduction to UML

- The dominant language in OO modeling
- It can be used with a wide range of software processes
- Views
- Models/Diagrams

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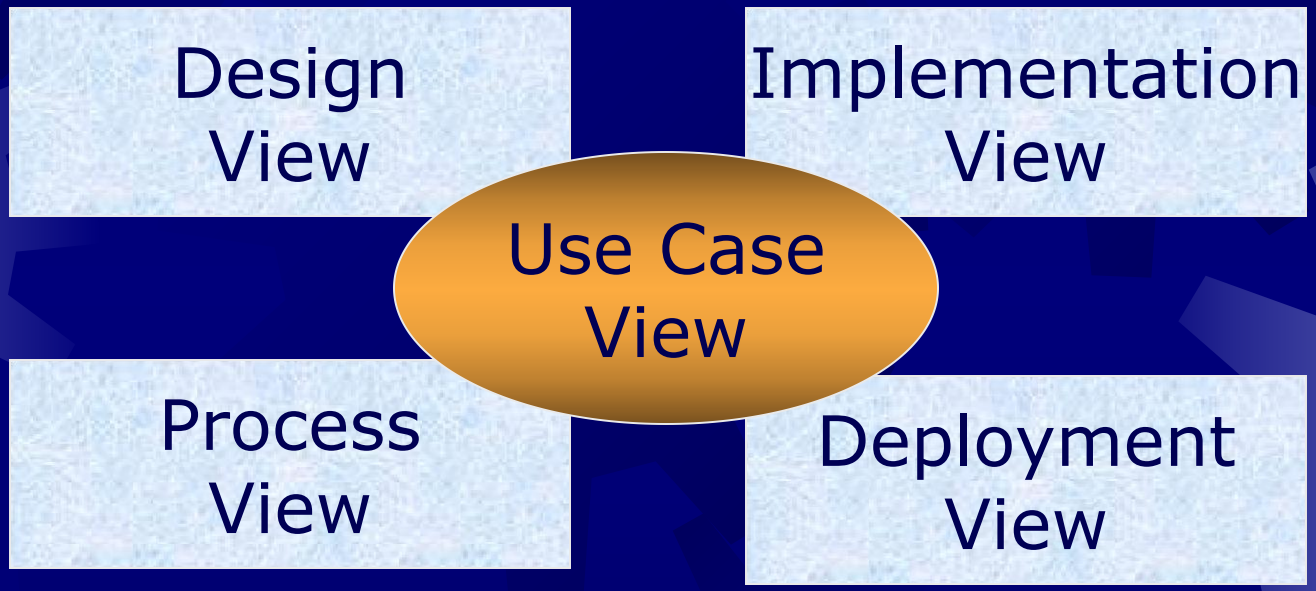
Views


Design View
Implementation View
Use Case View
Process View
Deployment View

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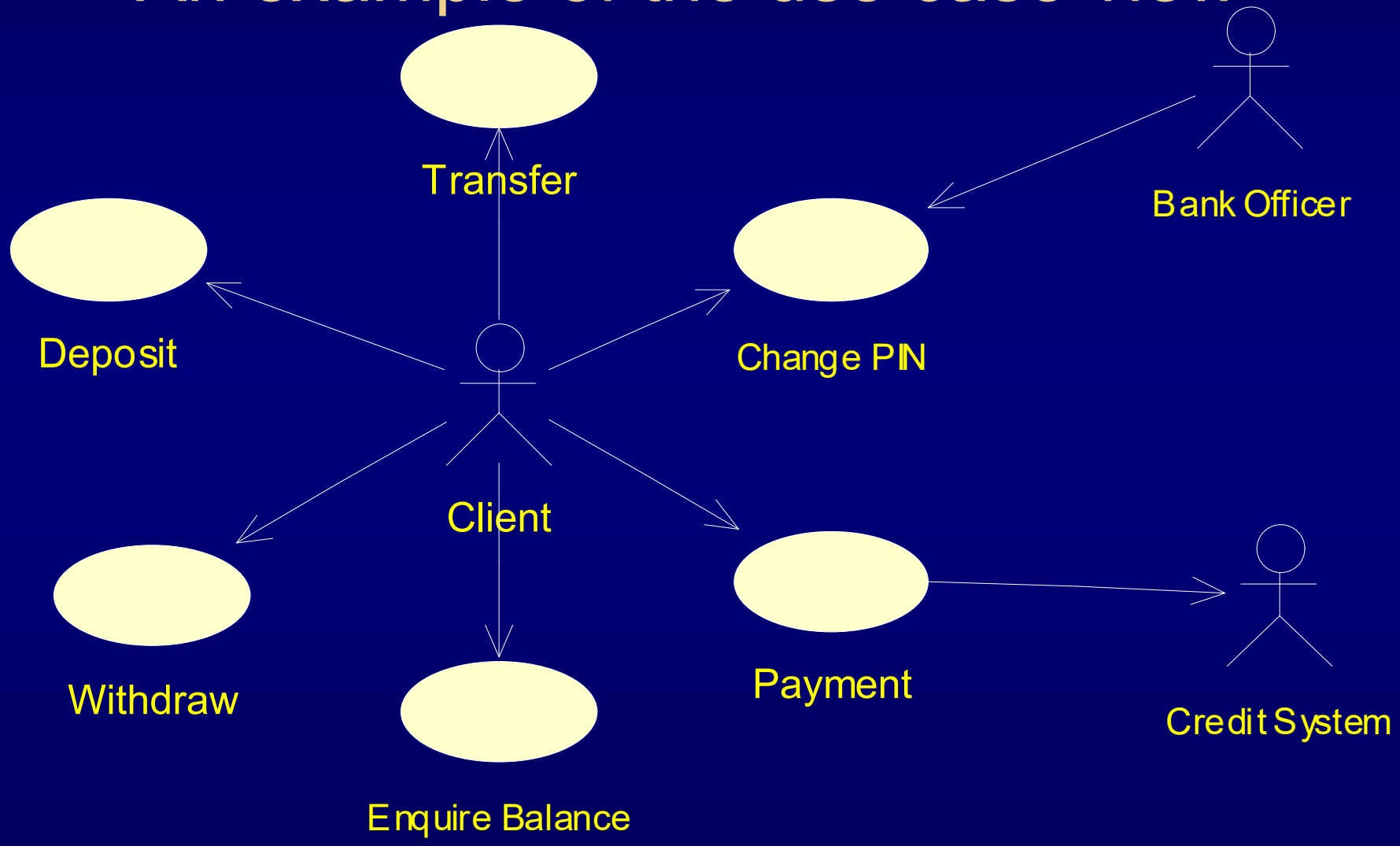
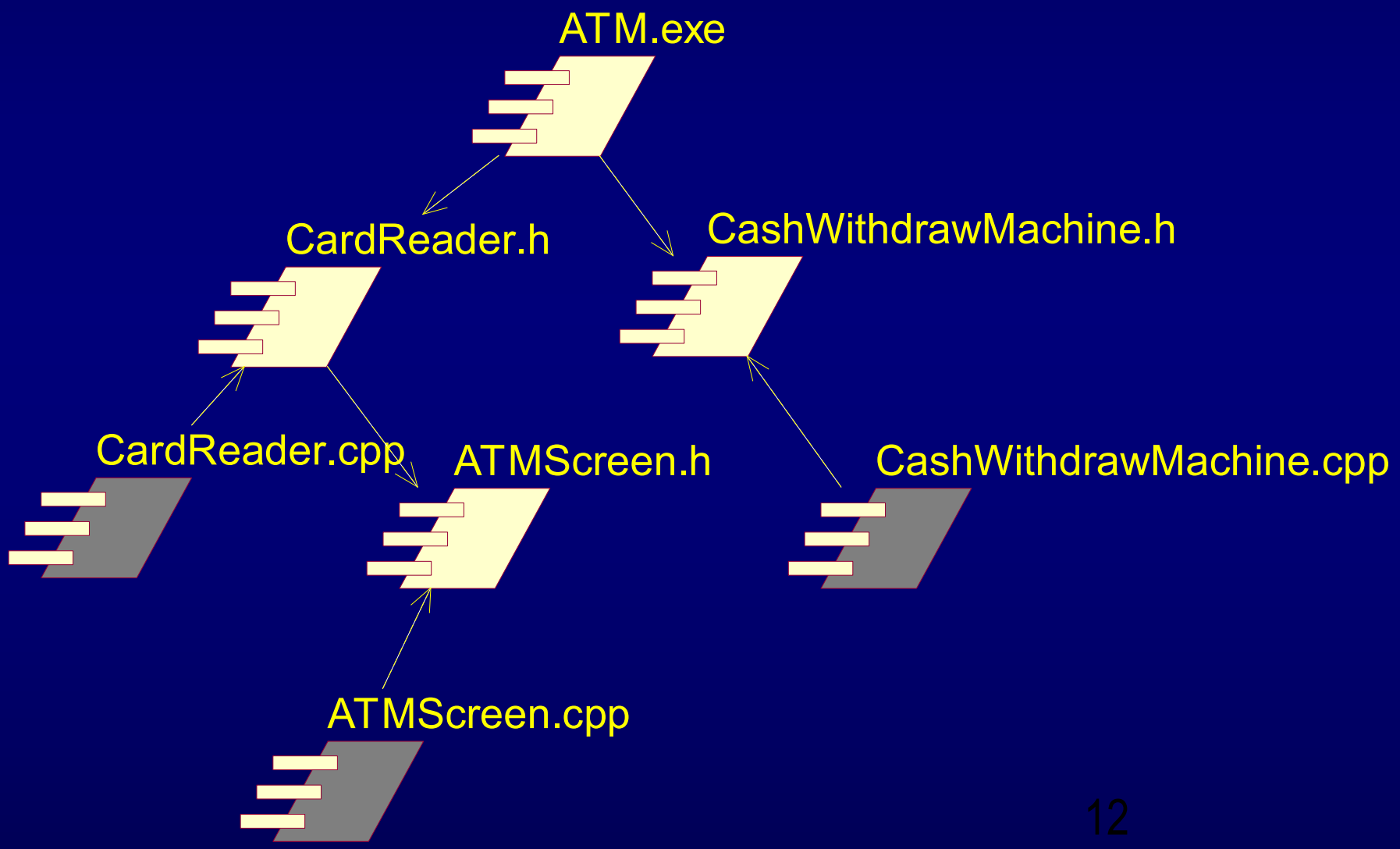
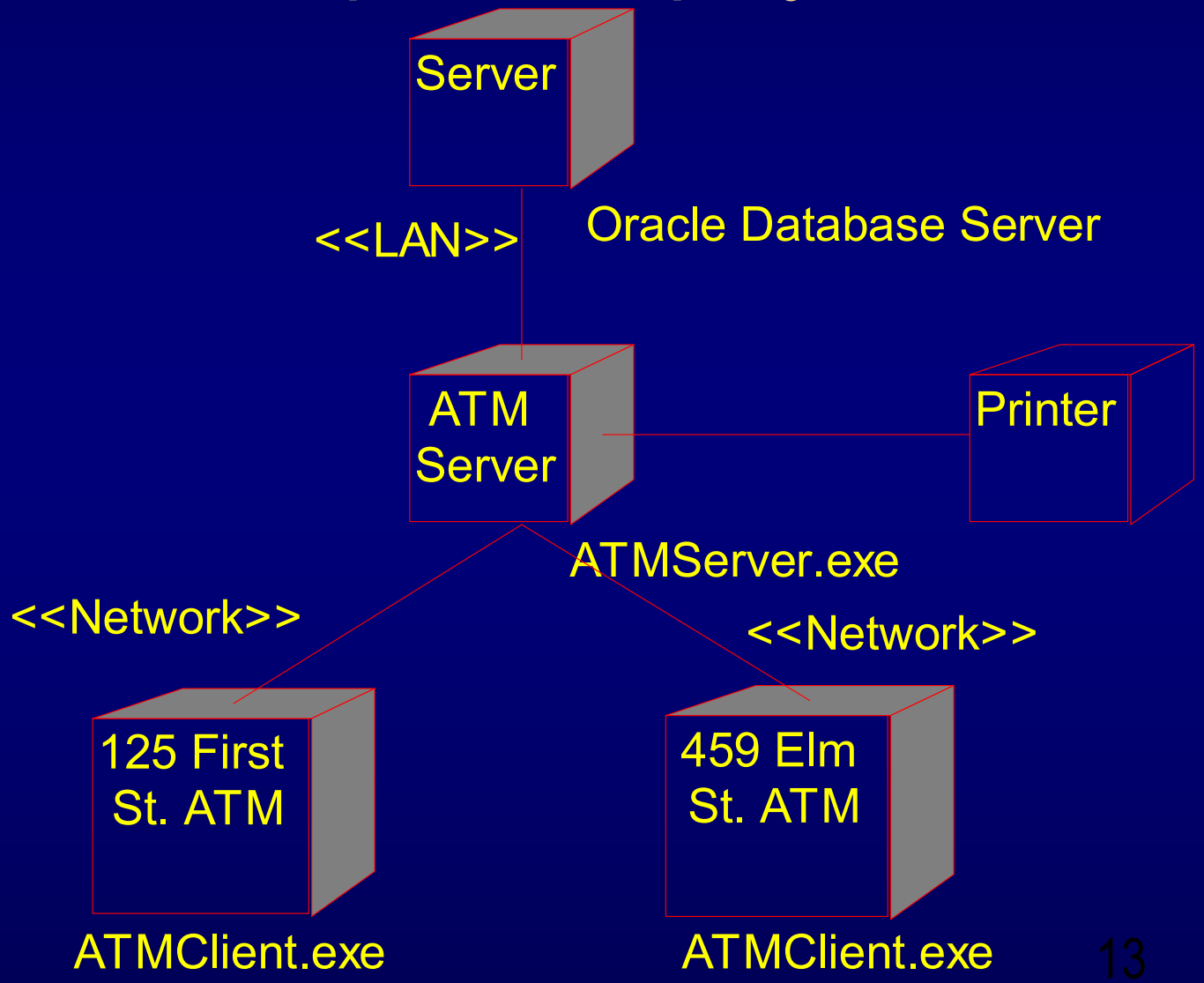
An example of the use case view



An example of the implementation view



An example of deployment view



Diagrams

- A diagram presents certain aspect of the underlying system model. Diagrams are just like programs, but more abstract (object structure).
- Do not be overwhelmed by the details of the diagrams.
- Some types of diagrams can be used in both use case and design views

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UML's diagram types

Diagram	View
1 Use case diagram	Use case view
2 Object diagram	Use case & design view
3 Sequence diagram	Use case & design view
4 Collaboration diagram	Use case & design view
5 Class diagram	Design view
6 Statechart diagram	Design view
7 Activity diagram	Design view
8 Component diagram	Implementation view
9 Deployment diagram	Deployment view

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The software development process

- Linear or waterfall model

Analysis → Designing → Development → Testing → Deployment

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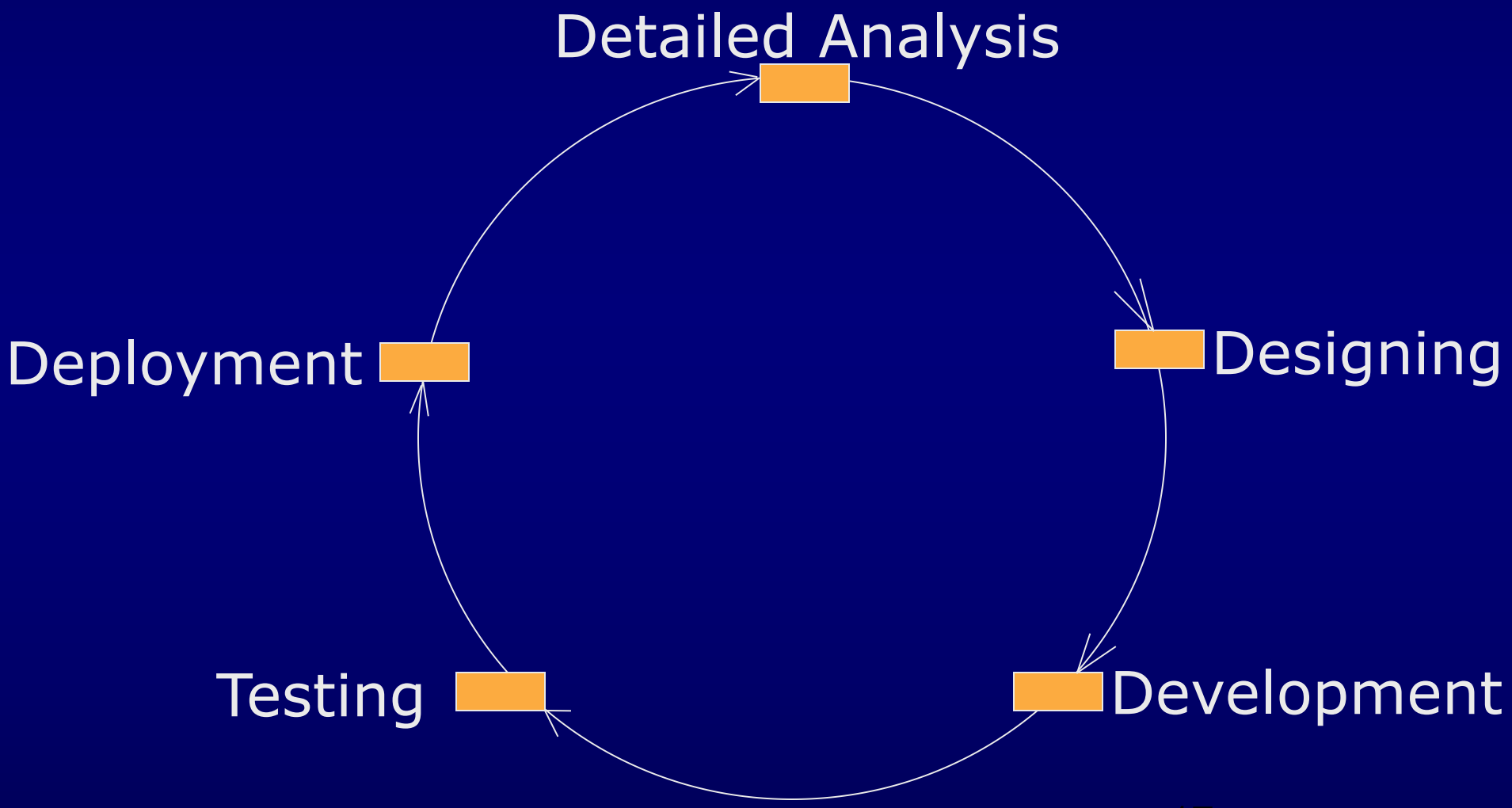
Iterative model



Chapter 2: Modeling with Objects

- The object model
  - Data + Operations
  - Execution of a program: a dynamic network of intercommunicating objects.
    Nodes (object) + links (sending messages)
  - The semantic foundation for UML's design models
- The stock control example

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Objects

- Design: how to split up a system's data and overall functionality.
- A frequently used rule: real-world objects

myScrew:Part
name="screw" number=28834 cost=0.02

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Object Properties

- State: the aggregate of the data values contained in an object's attributes
- Behavior

  shown in the class diagram
- Identity: address in memory
- Object names: a convenient alias for its identity.
  - Sometimes these corresponds to object names in program source, but not always, such as objects in a vector.

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Avoiding data replication

- Data in the previous object model is replicated
  - Waste storage
  - Difficult to consistently update all objects
- Links

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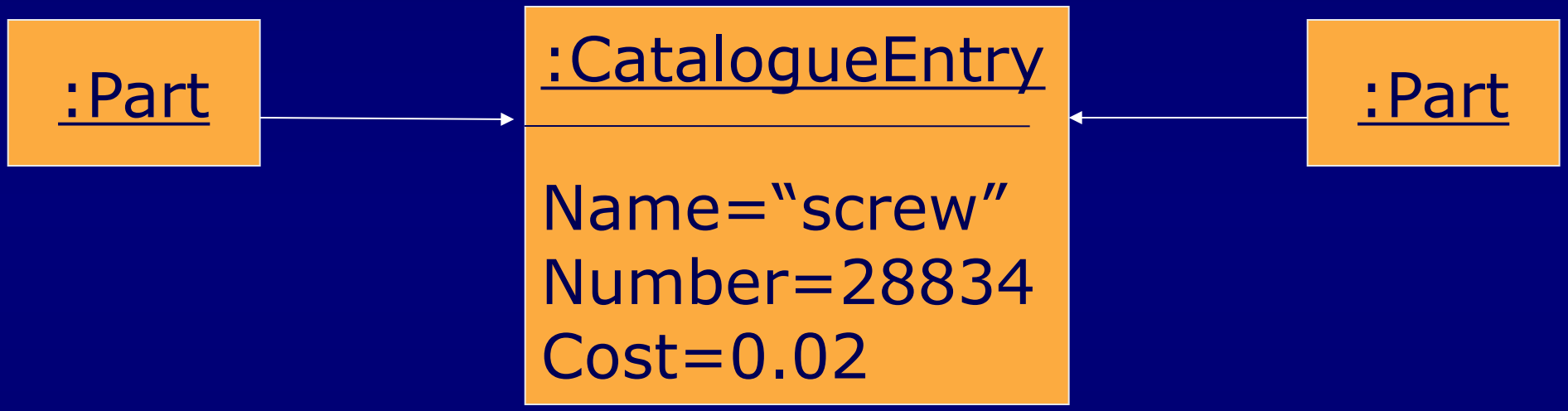

Information: attributes & links

```
#include <iostream>
using namespace std;
class CatalogueEntry {
public:
   CatalogueEntry(string p_name, long
   p_number, double p_cost){
        name   = p_name  ;
        number = p_number;
        cost   = p_cost  ;
   }
   string getName()   { return name;};
   long   getNumber() { return number; };
   double getCost()   { return cost;};
```


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```
private:
    string name;
    long number;
    double cost;
};

class Part {
public:
    Part(CatalogueEntry * e){
        entry = e;
    }
private:
    CatalogueEntry * entry;
}
```


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```
int main()
{
   CatalogueEntry *screw = new
         CatalogueEntry("screw",28834,0.02);
   Part * screw1 = new Part(screw);
}
```


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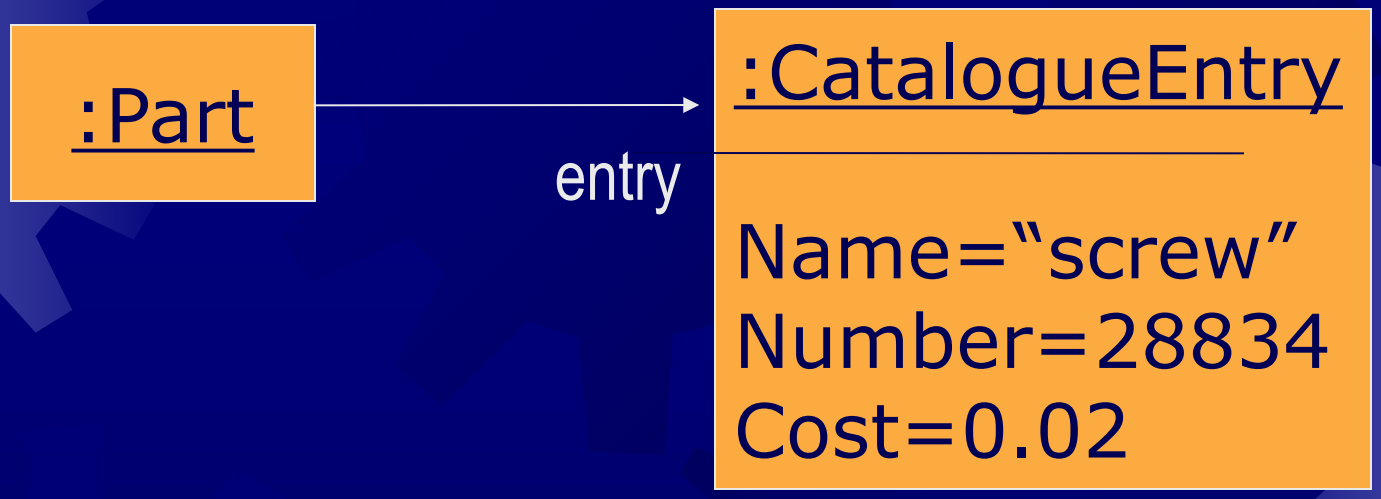
Navigability



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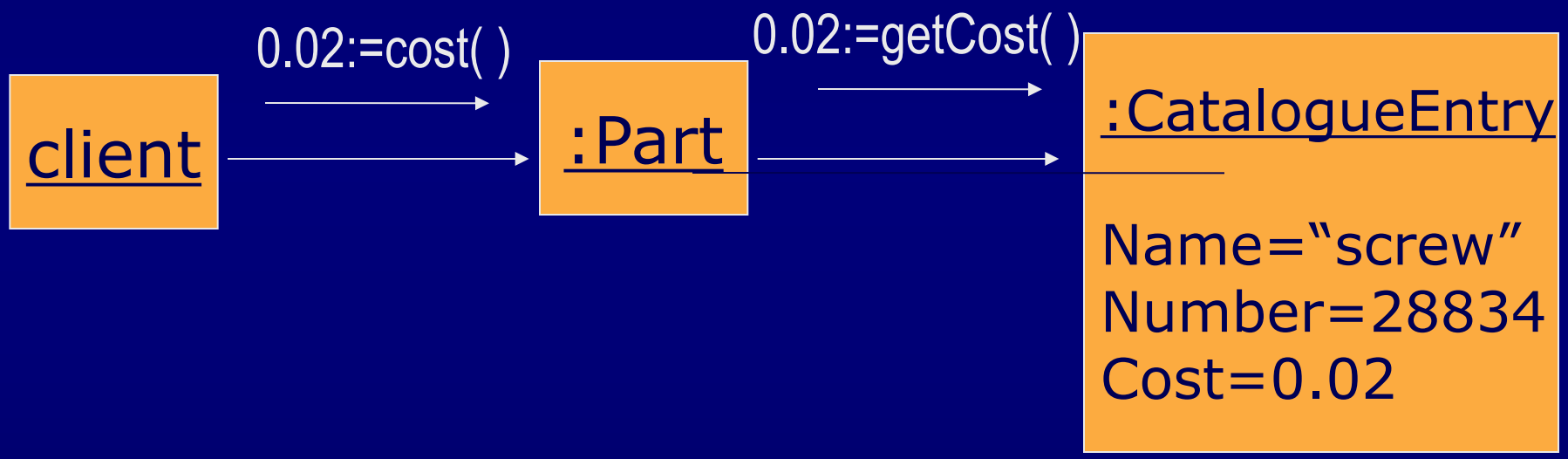
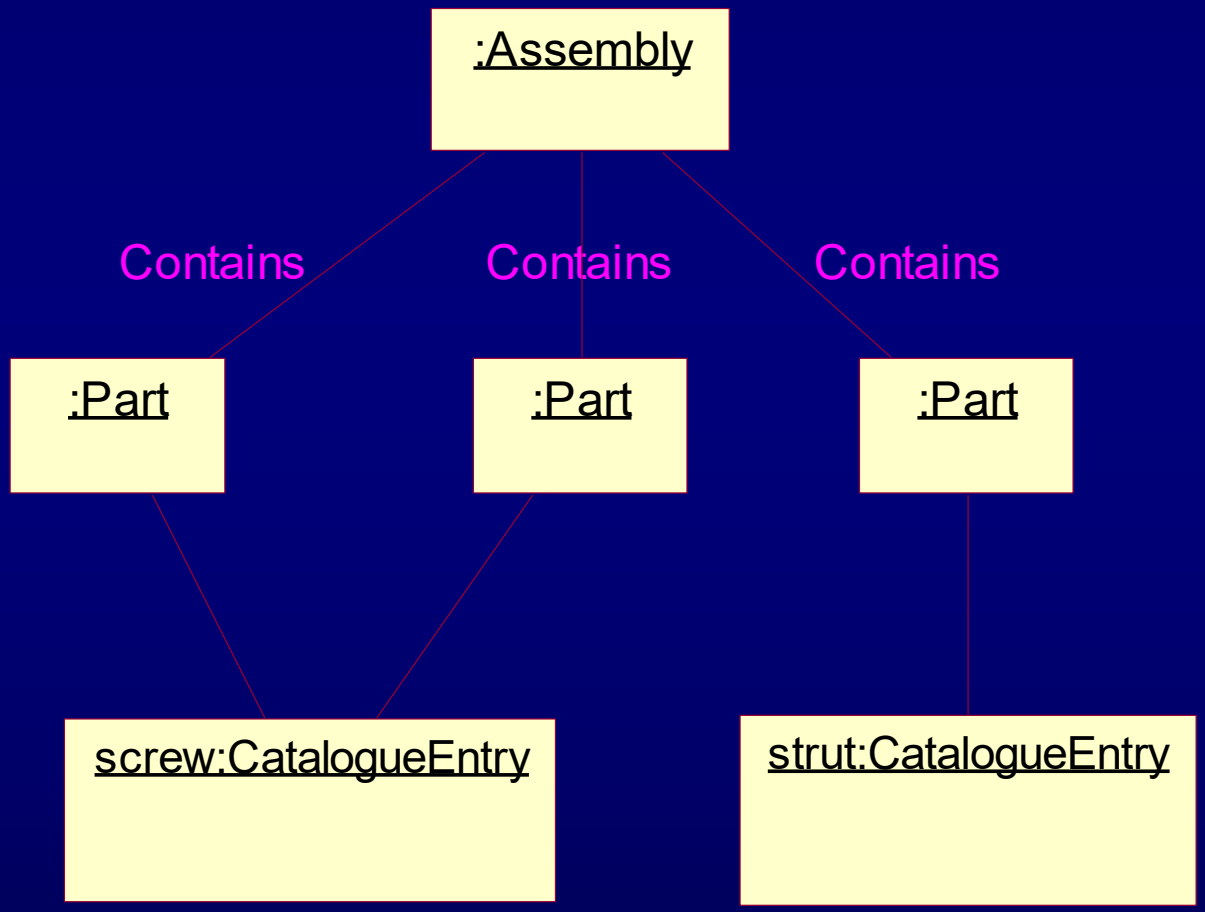
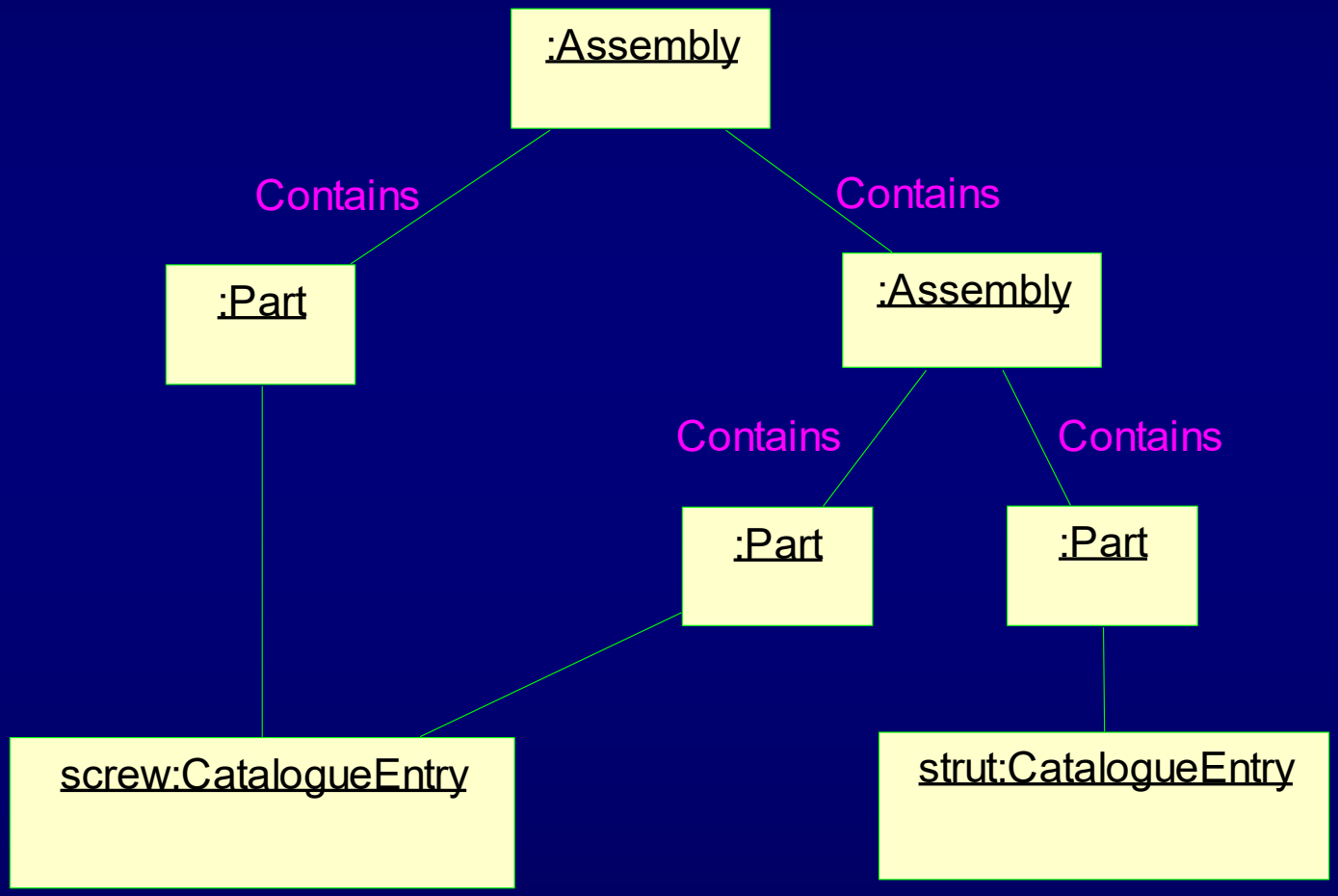
Message Passing



A simple structure

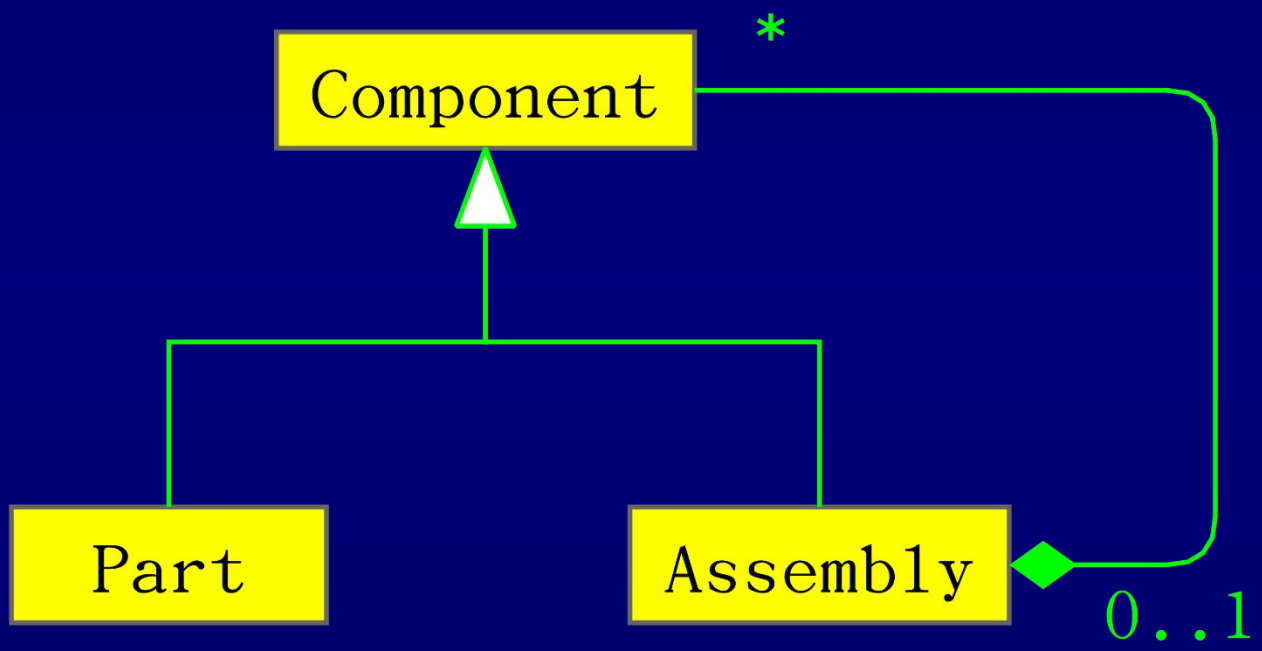


A more realistic structure



Impossible for implementation!

Use of abstract class



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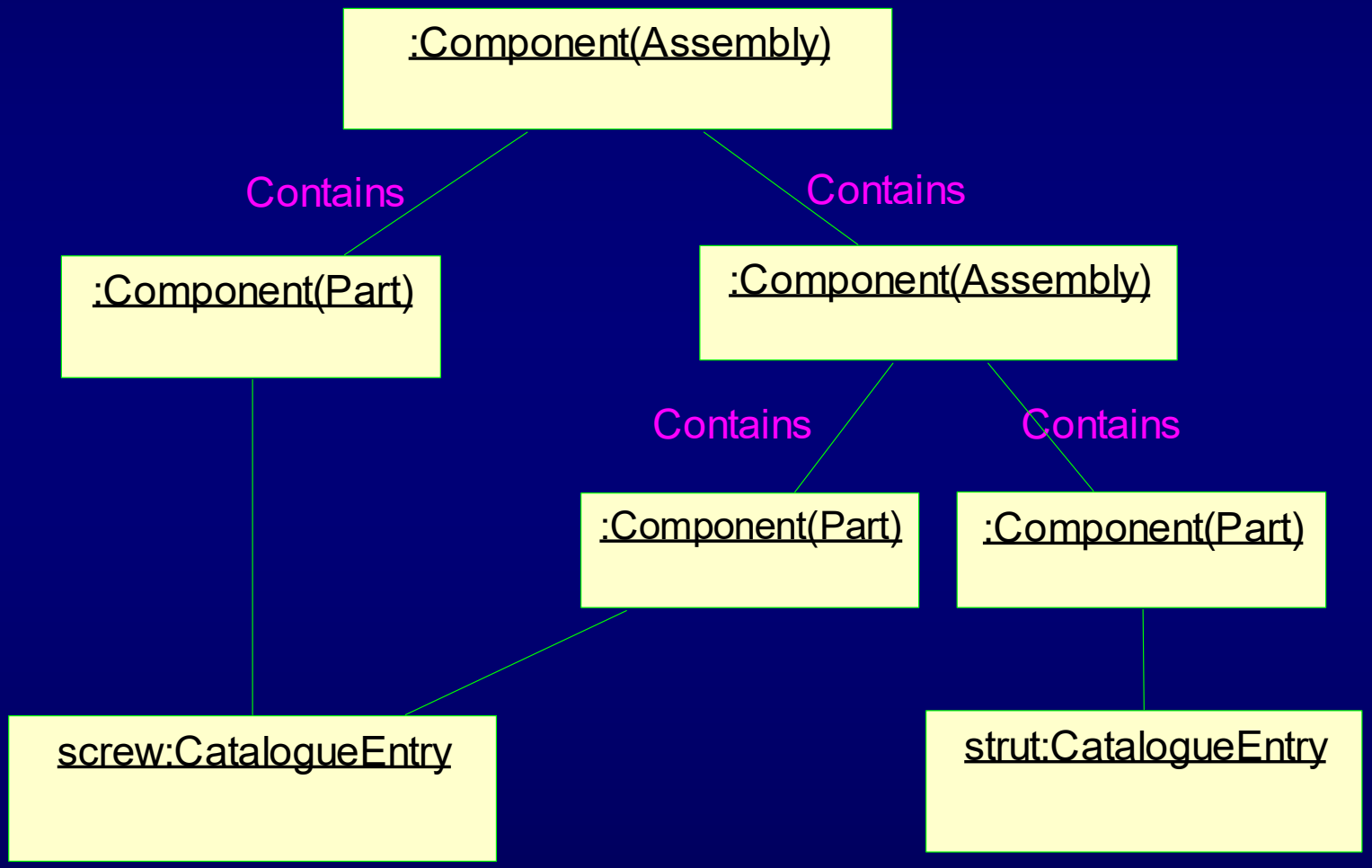
Object diagram



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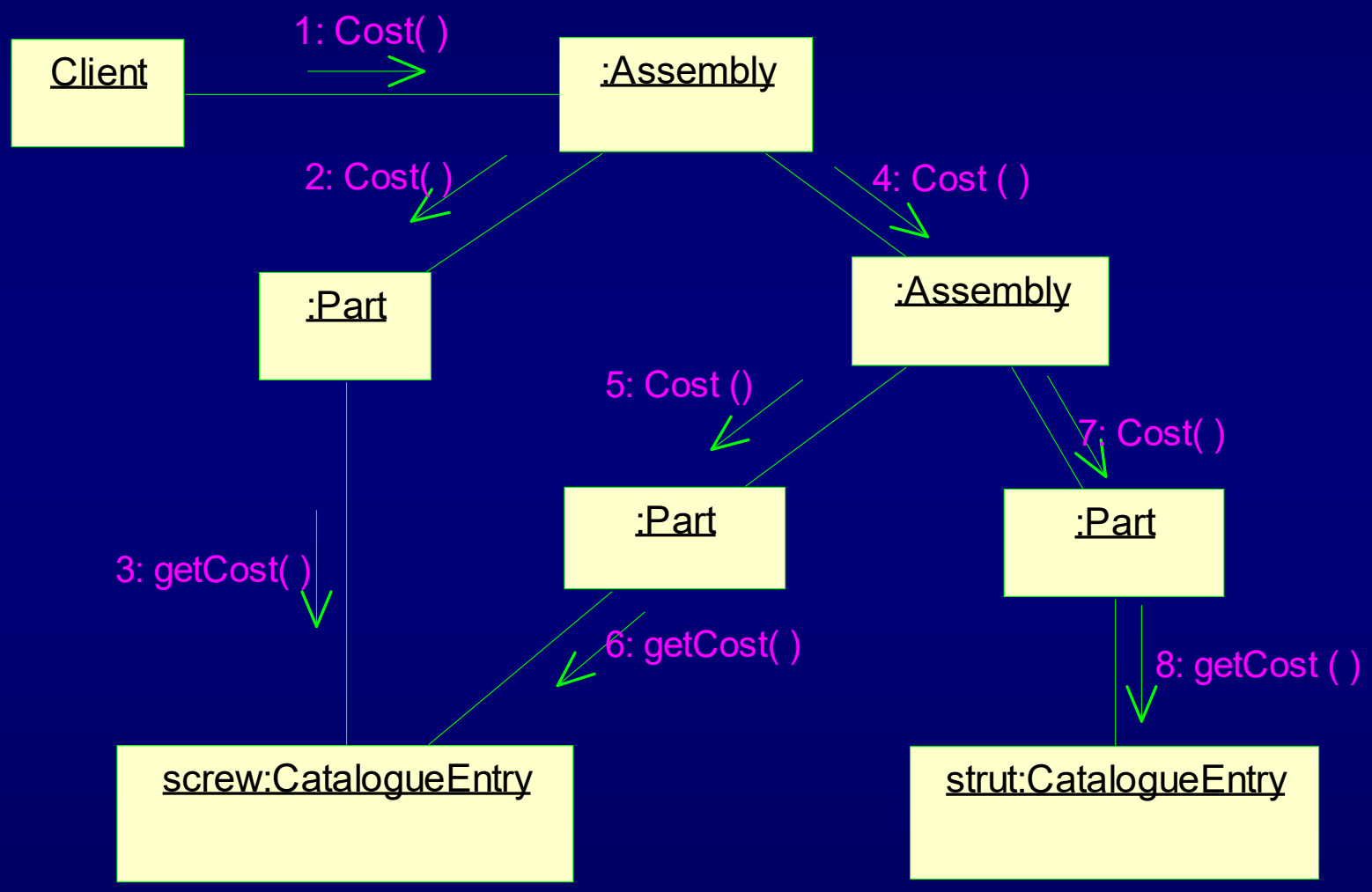
Late Binding & Polymorphism



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Class Diagrams

- Object diagrams: can only show a small subset of a program's possible states.
- We need to describe the software system in a more abstract level: class diagrams.
  - Similar to object diagram
  - Types of the attributes are shown
  - Association (linkage counter)
  - Inheritance

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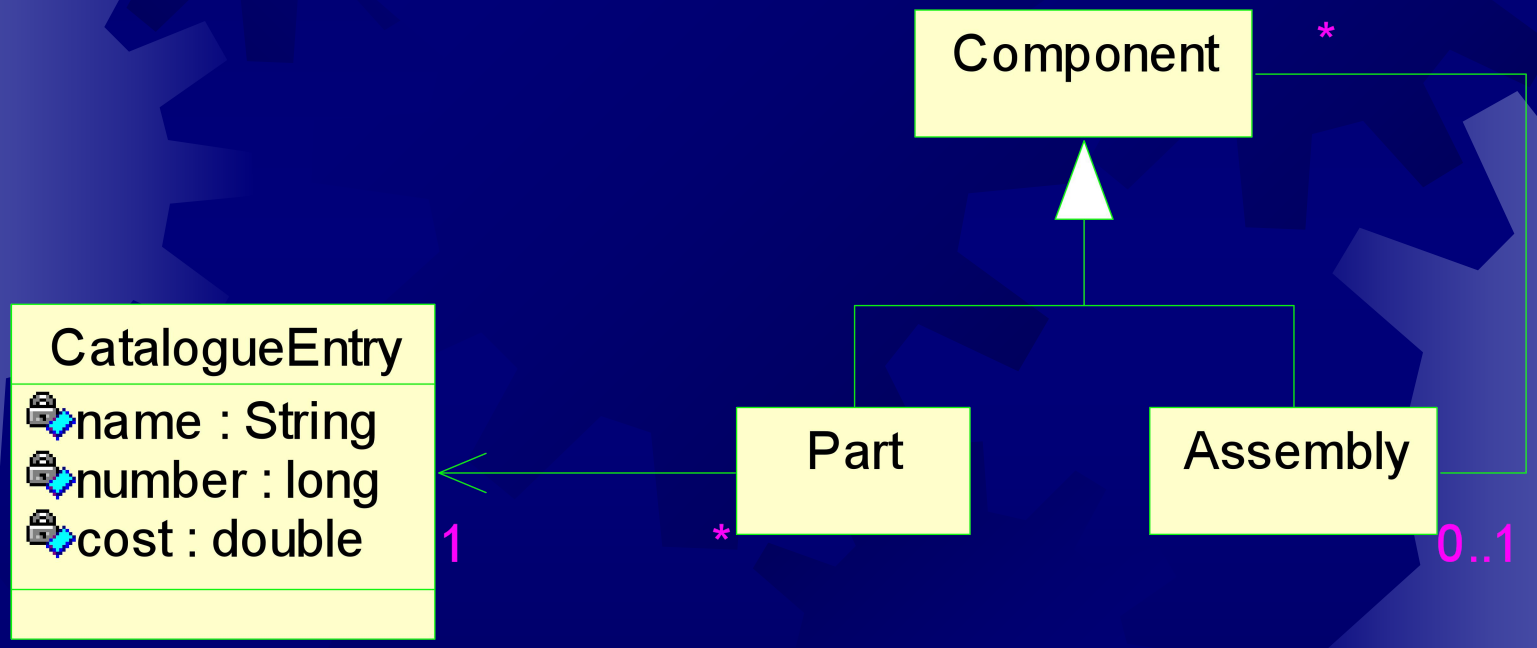
An example of class diagram



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The applicability of the object model

- Often: object (real world) object model
- Exceptions: the example above
- Message passing
  - Real world events are often treated as messages.
  - Objects + events Objects + messages
- Strength of OO
  - Localization of data and operations with objects
  - In most cases, the following mapping holds

    real world object object model

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