The meaning of OO, part 2?

Comp-304 : The meaning of OO, part 2
Lecture 6

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Changes to Assignment 1

- Task 2
  - Fix any bug I might have inserted in the code. These bugs are typos, usually involving one or two characters. If a method does something mathematically impossible (division by zero, for example), it should throw a ArithmeticError exception. You will need to add those checks and test for them.
- Task 3
  - Implement the following functions in the Vector class : dotProduct, unit. Also, implement the equals function in the Force and Mass classes. You can use the unit tests from Task 1 to help you implement these functions (as done in XP Programming).You don't need to implement the crossProduct method in the Vector class.

Assignment 1 : Force Object

v1 = vector(2,2)
f1 = force(v1, 5, 10)

f1.getMagnitudeAtTime(0) -> (0,0)
f1.getMagnitudeAtTime(1) -> (0,0)
f1.getMagnitudeAtTime(4) -> (0,0)
f1.getMagnitudeAtTime(5) -> (2,2)
f1.getMagnitudeAtTime(6) -> (2,2)
f1.getMagnitudeAtTime(9) -> (2,2)
f1.getMagnitudeAtTime(10) -> (2,2)
f1.getMagnitudeAtTime(11) -> (0,0)

Assignment 1 : Force Object

v1 = vector(2,2)
v2 = vector(1,1)
f1 = force(v1, 5, 10).add(force(v2, 1, 6))

f1.getMagnitudeAtTime(0) -> (0,0)
f1.getMagnitudeAtTime(1) -> (1,1)
f1.getMagnitudeAtTime(4) -> (1,1)
f1.getMagnitudeAtTime(5) -> (3,3)
f1.getMagnitudeAtTime(6) -> (3,3)
f1.getMagnitudeAtTime(7) -> (2,2)
f1.getMagnitudeAtTime(9) -> (2,2)
f1.getMagnitudeAtTime(10) -> (2,2)
f1.getMagnitudeAtTime(11) -> (0,0)

Recap

1) Encapsulated
2) State Retention
3) Implementation / Information Hiding
4) Object Identity
5) Messages
6) Classes
7) Inheritance
8) Polymorphism
9) Generacity

Horizontal vs Vertical Packaging

	Replication Strategy	Interest Management
Zone-based	Zone-based Replication Strategy	Zone-based Interest Management
Tile-based	Tile-based Replication Strategy	Tile-based Interest Management

Info. / Implementation hiding

- When observing an encapsulation, we can have two point of view:
  - From the outside (public view)
  - From the inside (private view)
- The advantages of a good encapsulation is the separation of the private and public views.
- To access elements in the private view, users must go through the public interface.
  - Use of encapsulation to restrict internal workings of software from external user view

Information vs Implementation

Information Hiding

- We restrict user from seeing information
  - variables, attributes, data, etc.
- To access information, users must use a set of public methods.

Implementation Hiding

- We restrict user from seeing implementation
  - code, operations, methods, etc.
- Users can use the method without knowledge of their working.

Why should we do this?

- Designer and user must agree on some interface, and nothing else. They are independent. They do not need to speak the same language
- Software evolution is easier. Suppose user knows about implementation and relies on it. Later, if the designer changes the implementation, the software will break
- Code re-use is high
- Abstraction from user is high, user need not worry about how it works!

Get / Set Rule

- Never allow other class to directly access your attribute.
- Once an attribute is public, it can never be changed.
  - Ex: img.pixeldData
- Make your attributes available using get/set methods.
  - ~~this.connectionStatus~~ Bad!
  - this.getConnectionStatus() Good!

Point

```
public interface Point {
    public set(int x, int y);
    public int getX();
    public int getY();
}
```

- Inside, point could be using Cartesian or Polar coordinates.
  - Cartesian coordinates are more efficient when dealing with lots of translations.
  - Polar coordinates are more efficient when dealing with lots of rotatitions.

Network Engine Example

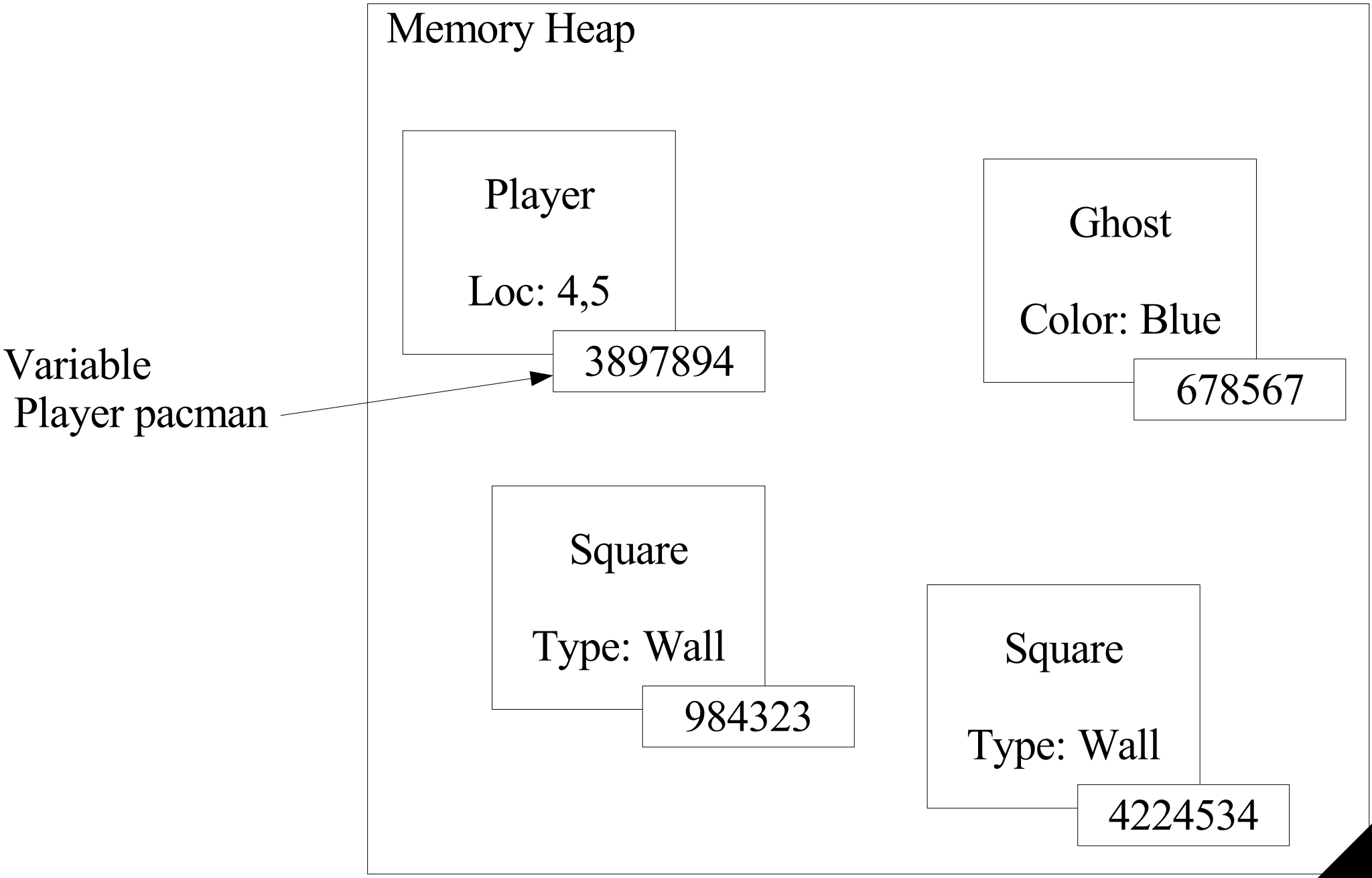
```
public interface NetworkClient {
    public connect(String address);
    public void send(Object obj);
    public Object receive();
    public void close();
}
```

- This kind of network interface can be implemented using multiple protocol.
- The user doesn't even need to know which underlying protocol is used.

Object Identity

- Each object can be identified and treated as a distinct entity.
- Use **unique** names, labels, handles, references and / or object identifiers to distinguish objects. This unique identifier remains with the object for it's **whole life.**
- We cannot use objects' states to distinguish objects, since two distinct objects may have the same state (i.e. same attribute values).

Distinct Identity



Mutable vs Immutable Objects

- An Immutable object is an object that is created once and is never changed.
  - String, Long, etc.
  - Two Immutable objects are considered the same if they have the same state.
- A Mutable object is an object who's state can change.
  - Vector, Array, etc.
  - Two different Mutable objects are never considered the same (different identity).

Messages (Calls)

- *Sender* object (o1) uses messages to demand *target* object (o2) to apply one of o2's methods
- For o1 to send a meaningful message to o2, it must adhere to some *message structure*
  - *o1 must know o2's unique identifier*
  - o1 must know name of o2's method it wants to call
  - o1 must supply any arguments to o2 so that the method may execute properly
- i.e. in Java, we write o2.method(args)

Messages (Calls) (cont.)

- In “pre-OO” language, we might have written method(o2, args). Why is this not good?
- This doesn't allow polymorphism!
- For o1's message to properly execute o2's method, o1 must
  - know the signature of o2's method
  - pass the proper arguments (inputs)
  - know if the method will return any values (outputs) and be ready to store them accordingly

Types of Messages

- Three types of messages:
  - Informative: supplies target object with information to update it's attribute(s) [i.e. o2.setx(5)]
  - Interrogative: asks target object to supply information about it's attribute(s) [i.e. o2.getx()]
  - Imperative: tells target object to do some action [i.e. o2.moveNorth()]

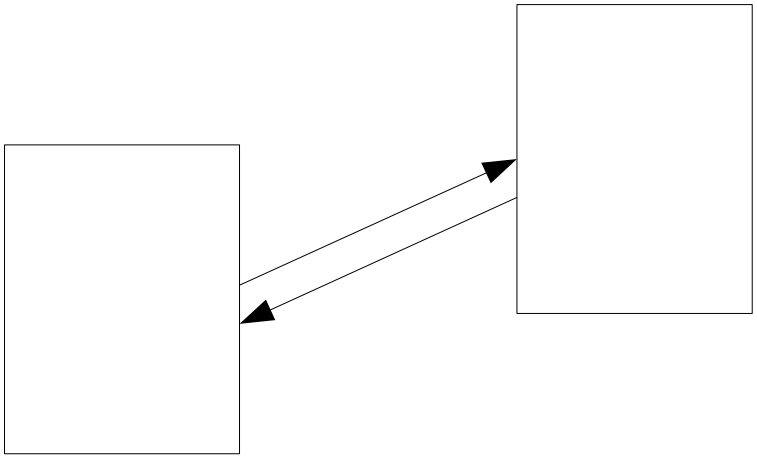
Informative, Interrogative or Imperative ?

- ghost.up() ?
- grid.insertPlayer(pacman, square)
- square.isWall() ?
- pacman.collectPellet()
- ghost.isScared() ?
- square.addItem(pellet)

Synchronous vs Asynchronous

Synchronous Messaging

- An object receiving a request executes it immediately and returns the result.



Asynchronous Messaging

- A object receiving a request acknowledges it.
- The request is executed latter and the return value is eventually returned (often through the use of a call-back method)