Polymorphism

Colorado State University

Department of Computer Science

Slides Originally Created by Marcia Moraes (marcia.moraes@colostate.edu)

Announcements

TODO Reminders:

Readings are due **before** lecture

- Reading 20 (zybooks) – you should have already done that ☺
- Lab 13
- Reading 21 (zyBooks)
- Lab 12
- Reading 22 (zybooks)
- RPA 10

Keep practicing your RPAs in a spaced and mixed manner ☺

"There is no magic to achievement.
It'sreally about hard work, choices, and persistence."

https://www.pinterest.com/pin/342062534189160703/

Help Desk

Day	**Time : Room**
Monday	12 PM - 2 PM : CSB 120
Tuesday	6 PM - 8 PM : Teams
Wednesday	3 PM - 5 PM : CSB 120
Thursday	6 PM - 8 PM : Teams
Friday	3 PM - 5 PM : CSB 120
Saturday	12 PM - 4 PM : Teams
Sunday	12 PM - 4 PM : Teams

Recall Activity

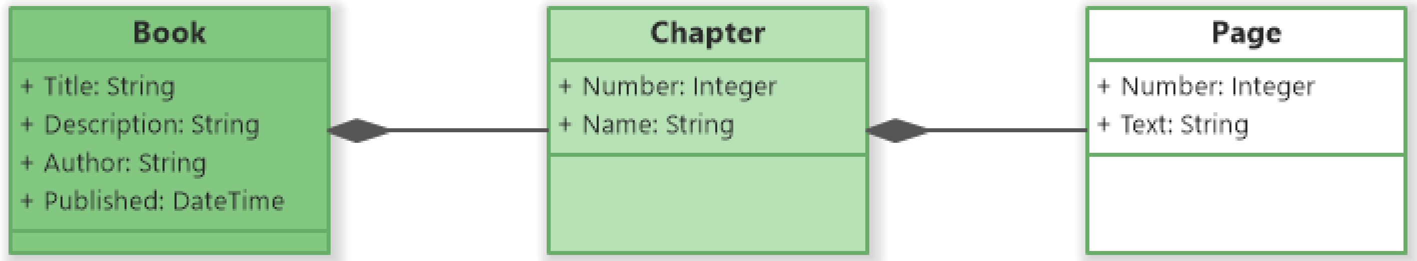
- Analyze the classes below. What type of relationship do we have: ‘has-a’ or ‘is-a’?
- Explain using your own words.

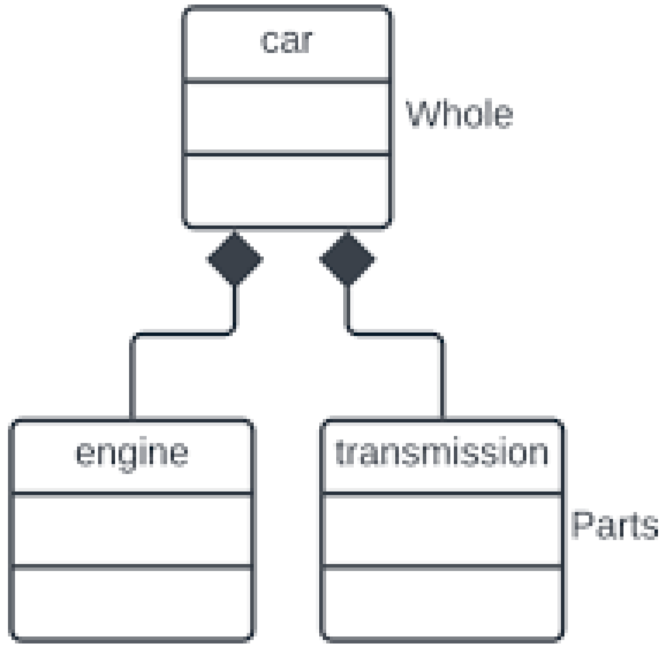
```
public class ChildInfo {
   public String firstName;
   public String birthDate;
   public String schoolName;

   ...
}

public class MotherInfo {
   public String firstName;
   public String birthDate;
   public String spouseName;
   public ArrayList<ChildInfo> childrenData;

   ...
}
```

Composition

- Has-a relationship

```
public class ChildInfo {
   public String firstName;
   public String birthDate;
   public String schoolName;

   ...
}

public class MotherInfo {
   public String firstName;
   public String birthDate;
   public String spouseName;
   public ArrayList<ChildInfo> childrenData;

   ...
}
```

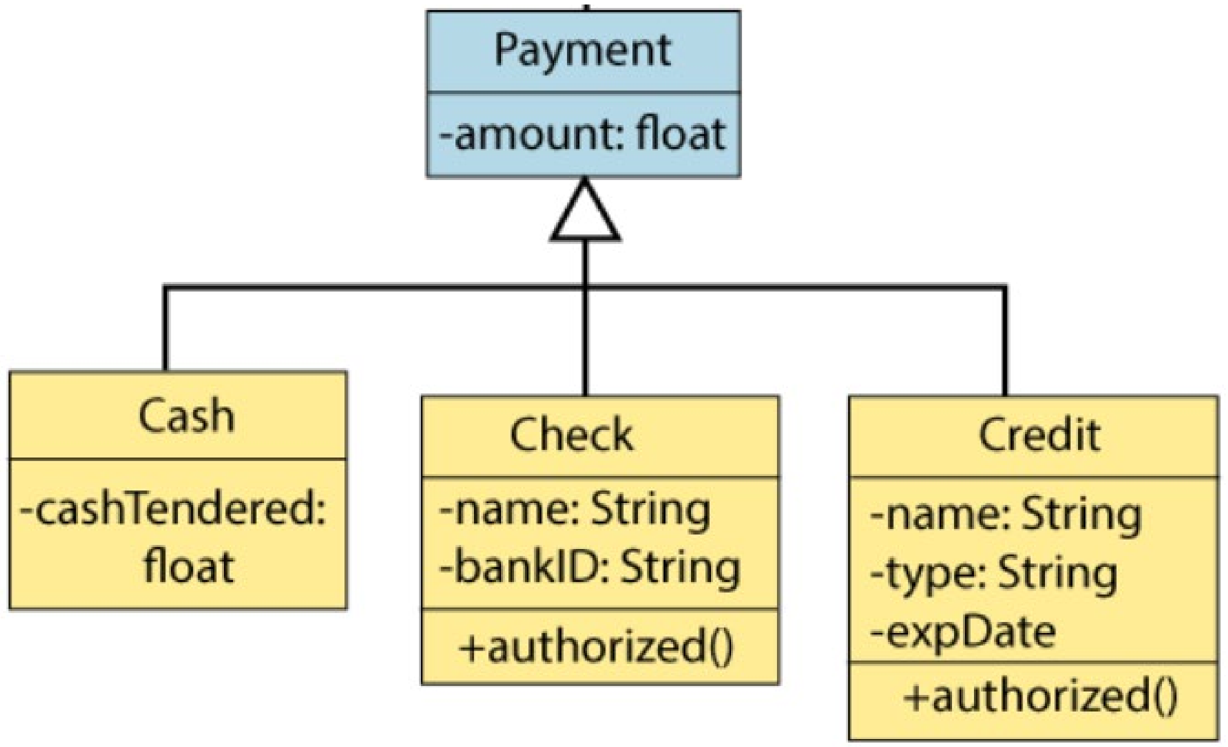


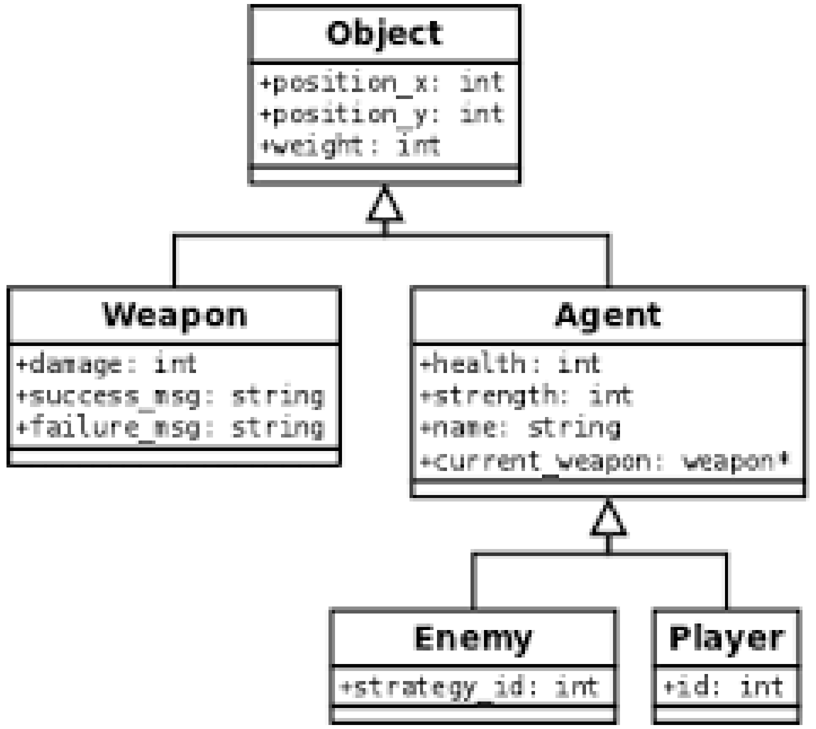


Inheritance

- Is-a relationship

```java
public class PersonInfo {
   public String firstName;
   public String birthdate;

   ...
}

public class ChildInfo extends PersonInfo {
   public String schoolName;

   ...
}

public class MotherInfo extends PersonInfo {
   public String spousename;
   public ArrayList<ChildInfo> childrenData;
  ...
}
```





Polymorphism

- Refers to determining which program behavior to execute depending on data types

- Polymorphism of methods – methods overloading
  - **compile-time polymorphism**
  - compiler determines which of several identically-named methods to call based on the method's arguments

- Polymorphism of variables – involves derived classes (inheritance)
  - **runtime polymorphism**
  - compiler cannot make the determination but instead the determination is made while the program is running

Polymorphism of variable

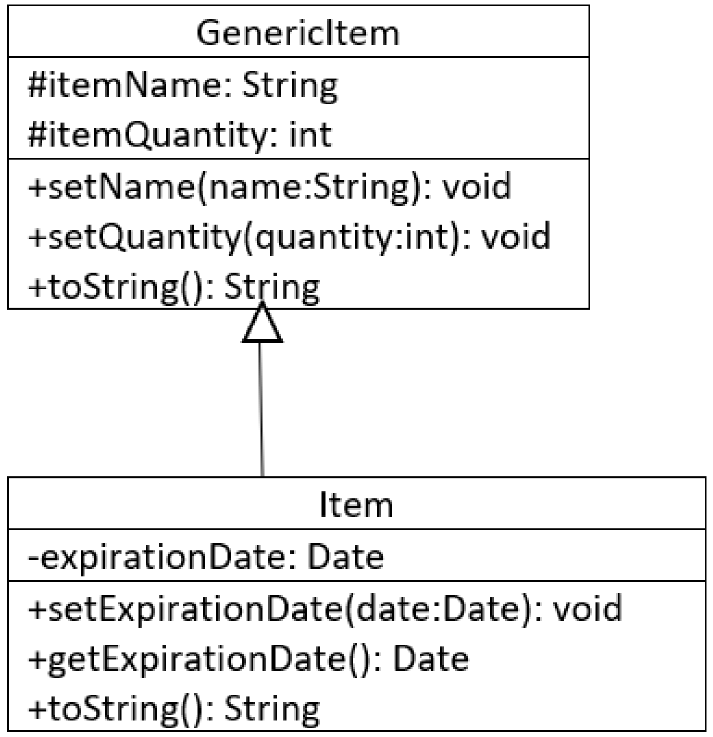
- **Substitution principle** - you can always use a subclass object when a superclass object is expected
- Super class variable can store super class types and sub class types as well
- Sub class variable can only store sub class types

```
GenericItem g1 = new GenericItem();
```
Correct!

```
GenericItem g2 = new Item();
```
Correct!

```
Item g3 = new Item();
```
Correct!

```
Item g4 = new GenericItem();
```
Incorrect!



GenericItem
#itemName: String
#itemQuantity: int
+setName(name:String): void
+setQuantity(quantity:int): void
+toString(): String
Item
-expirationDate: Date
+setExpirationDate(date:Date): void
+getExpirationDate(): Date
+toString(): String

Member Access

- private
protected
+ public

ArrayList of Objects

- Store a collection of objects of various class types

```
java.lang.Object@4517d9a3
12
3.14
Hello!
ACME -- 5 Main St
```

```java
public class Business {
   protected String name;
   protected String address;

   public Business() {}

   public Business(String busName, String busAddress) {
      name = busName;
      address = busAddress;
   }

   @Override
   public String toString() {
      return name + " -- " + address;
   }
}
```

```java
import java.util.ArrayList;

public class ArrayListPrinter {

   // Method prints an ArrayList of Objects
   public static void printArrayList(ArrayList<Object> objList) {
      int i;

      for (i = 0; i < objList.size(); ++i) {
         System.out.println(objList.get(i));
      }
   }

   public static void main(String[] args) {
      ArrayList<Object> objList = new ArrayList<Object>();

      // Add new instances of various classes to objList
      objList.add(new Object());
      objList.add(12);
      objList.add(3.14);
      objList.add(new String("Hello!"));
      objList.add(new Business("ACME", "5 Main St"));

      // Print list of Objects
      printArrayList(objList);
   }
```

instanceof

- Rewrite the class Pet to have its constructors properly overloaded.

```
public static void printArrayListV2(ArrayList<Object> objList) {
    int i;
    for (i = 0; i < objList.size(); ++i) {
        Object obj = objList.get(i);
        if(obj instanceof String)
            System.out.println("String:" + objList.get(i));
        else if(obj instanceof Integer)
            System.out.println("Integer:" + objList.get(i));
        else if(obj instanceof Double)
            System.out.println("Double:" + objList.get(i));
        else if(obj instanceof Business)
            System.out.println("Business:" + objList.get(i));
    }
}
```

Worksheet

- Complete the Polymorphism worksheet

- Codes from this lecture and worksheet - https://github.com/CSU-CompSci-CS163-4/Handouts/tree/main/ClassExamples/10Polymorphism