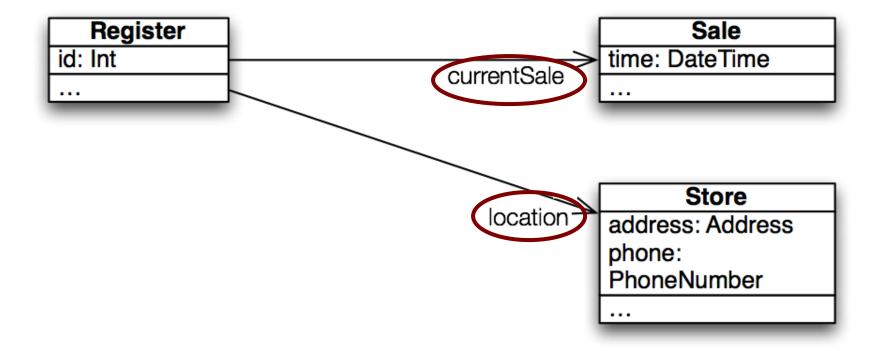
CSSE 220

Object & Polymorphism

UML Class Diagram Review

Inheritance, Associations, and Dependencies

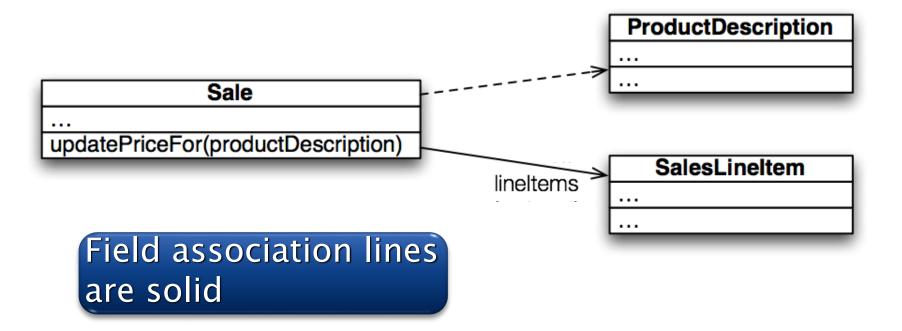
Recall UML: Associations



Solid line, open arrowhead = "has-a"

Recall UML: Dependencies

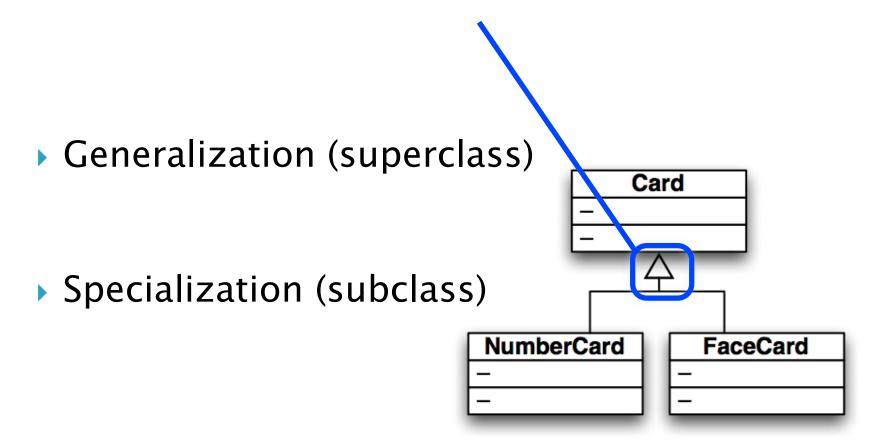
Dependency lines are dashed



Use association lines only when an item is stored as a field.

Two types of open arrowheads

Recall UML: Inheritance



Closed arrowhead = "is-a".

Two types: solid line= inherits, dotted line = implements

I, Object

The superest class in Java

Object

Every class in Java inherits from Object

- Directly and explicitly:
 - public class String extends Object {...}
- Directly and implicitly:
 - o class BankAccount {...}
- Indirectly:
 - class SavingsAccount extends BankAccount {...}

Object Provides Several Methods

String toString() Often overridden boolean equals(Object otherObject) Class getClass() Sometimes useful > Object clone() Often dangerous!

Overriding toString()

- Return a concise, human-readable summary of the object state
- Very useful because it's called automatically:
 - During string concatenation
 - For printing
 - In the debugger
- petClass().getName() OR
 getClass().getSimpleName() comes in
 handy here...

Overriding equals (Object o)

equals (Object foo) - should return true when comparing two objects of same type with same "meaning"

- How?
 - Must check types—use instanceof OR getClass().isAssignableFrom(foo.getClass())
 - Must compare state—use <u>cast</u>

Recall casting a variable: Taking an Object of one particular type and "turning it into" another Object type

Polymorphism



Recall: Polymorphism and Subclasses

- A subclass instance is a superclass instance
 - Polymorphism still works!

```
BankAccount ba = new SavingsAccount();
ba.deposit(100);
```

But not the other way around!

```
SavingsAccount sa = new BankAccount();
sa.addInterest();
```

Why not?



Another Example

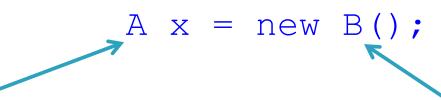
Can use:
 public void transfer(double amount, BankAccount o)
 {
 this.withdraw(amount);
 o.deposit(amount);
 }
 in BankAccount

To transfer between different accounts:

```
SavingsAccount sa = ...;
CheckingAccount ca = ...;
sa.transfer(100, ca);
```

Summary

▶ If B extends or implements A, we can write



Declared type tells which methods x can access.

Compile-time error if try to use method not in A.

The actual type tells which class' version of the method to use.

Can cast to recover methods from B:

Now we can access all of B's methods too.

If x isn't an instance of B, it gives a run-time error (class cast exception)

- Step 1: Identify the Declared/Casted Type
 - This is the item to the left of the variable name when the variable was declared:
 - BankAccount sa = new SavingsAccount();

Declared Type

- Declared Type may be changed due to a cast:
- ((SavingsAccount)sa).addInterest();

Casted Type

 If there is a casted type, record that, otherwise use the declared type.

- Step 2: Identify the Instantiation/Actual Type
 - This is the type on the right hand side of the equal sign the last time the variable was assigned to:
 - BankAccount sa = new SavingsAccount();

Instantiation Type

Record the instantiation type

Step 3: Check for Compilation Errors

Calling a method that is not available based on the declared or casted type of the object

```
BankAccount sa = new SavingsAccount();
sa.addInterest();
```

Compiler Error: BankAccount does not have addInterest

Incompatible type assignment

SavingsAccount x = new BankAccount();

Compiler Error: BankAccounts can not be stored in SavingAccount typed variables

Invalid cast: casting to a type that isn't in the tree below the declaration type.

```
BankAccount sa = new SavingsAccount();
((SafetyDepositBox)sa).depositItem();
```

SafetyDepositBox is not below BankAccount.

Cannot instantiate interfaces or abstract classes!

Step 4: Check for Runtime Errors

Runtime errors are caused by invalid casting.

An item may only be cast to a type IF:

- The instantiation type matches the casted type
- The casted type is between the declaration type and the instantiation type

```
BankAccount sa = new SavingsAccount();
((CheckingAccount)sa).deductFees();
Runtime Error: SavingsAccount is not a CheckingAccount
```

```
Account a = new CheckingAccount();
((BankAccount)a).deposit();
This is valid because a CheckingAccount is a BankAccount
```

- Step 5: Find Method to Run
 - Find the instantiation type in the hierarchy.
 - 1. If that type implements the given method, then use that implementation.
 - 2. Otherwise, move up to the parent type and see if there's an implementation there.
 - a. If there is an implementation, use that.
 - Otherwise, repeat step 2 until an implementation is found.

Exercise

- Do questions 5 through 7 from Quiz.
- Please hand them in when done and then start reading the BallWorlds specification on your schedule page.



BallWorlds Worktime

