

# Polymorphism

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The purpose of this exercise is to practice writing code that uses the Object-Oriented Programming principle of polymorphism.

## Learning objectives

After completing this exercise, students will be able to:

- Explain the concept of polymorphism and how it's useful
- Demonstrate an understanding of where inheritance can assist in writing polymorphic code
- State the purpose of interfaces and how they're used
- Use polymorphism through inheritance using IS-A relationships
- Use polymorphism through interfaces using CAN-DO relationships
- Give examples of interfaces from the Java/C# standard library (Collections)

## Evaluation criteria and functional requirements

- The project must not have any build errors.
- Code is presented in a clean, organized format.
- Code is appropriately encapsulated.
- Polymorphism is used appropriately to avoid code duplication.
- The code meets the specifications defined below.

## Bank customer application

### Notes for all classes and interfaces

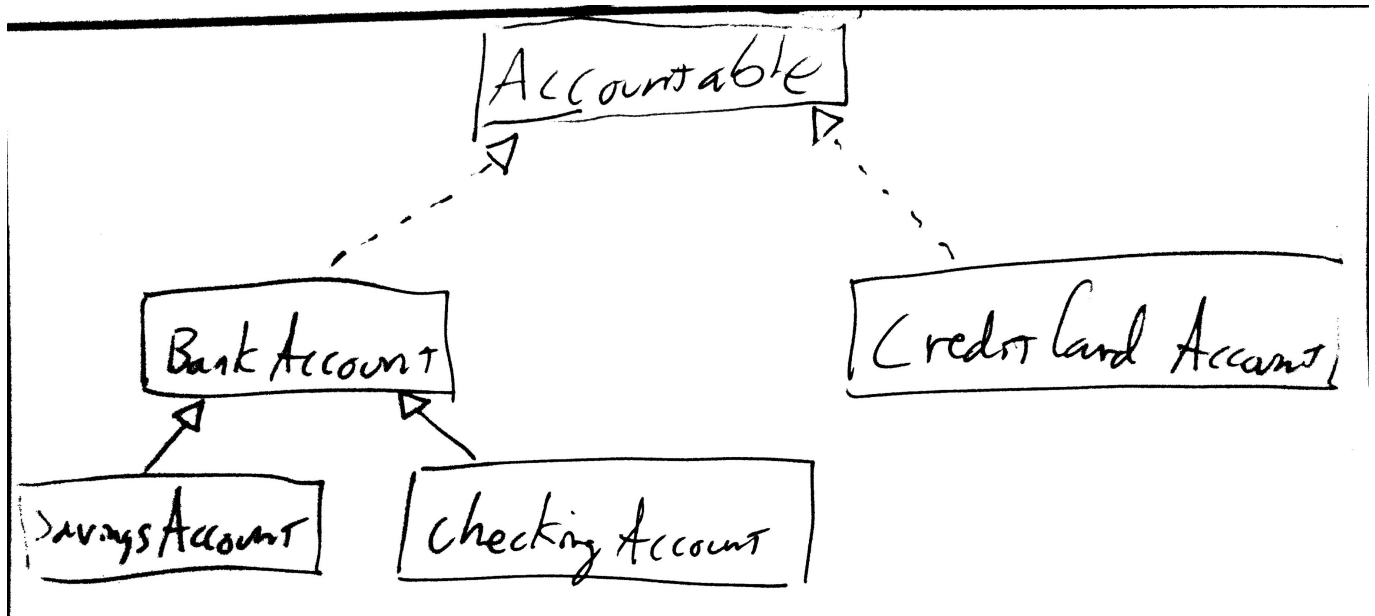
- X in the set column indicates it **must have a Setter**.
- Nothing in the set column indicates the attribute is derived.
- Readonly attributes don't require a Setter.

### Instructions

This code is from the Inheritance day. The bank account classes work well, but now the bank needs to calculate a customer's total assets to assign them VIP status if they have over \$25,000 in assets at the bank.

The bank is also introducing credit cards. Since credit cards aren't strictly bank accounts where money is stored, they don't inherit from the `BankAccount` class. However, they must still be accounted for in the VIP calculation.

For this exercise, you'll add new features to the code to create a `Customer` class that has multiple accounts. You'll also create a new type of account: a credit card account. A credit card account isn't a `BankAccount`, but it needs to be stored with the customer as one of their accounts. To do this, you need to create a new interface that specifies that an object is `Accountable` and has a `getBalance()` method.



For this exercise, you will:

1. Add a new method to allow customers to transfer money between `BankAccounts`.
2. Create a new interface called `Accountable`.
3. Make `BankAccount` implement `Accountable`.
4. Create a new class called `CreditCardAccount` that's also `Accountable`.
5. Create a `Customer` class that has many `Accountable` objects.
6. Add an `isVip()` method to `Customer`.

### Step One: Add a new `transferTo()` method to transfer money between `BankAccounts`

Add the following method to allow `BankAccounts` to transfer money to another `BankAccount`. Where would you add this method to make sure it works for all `BankAccounts`, including `SavingsAccount` and `CheckingAccount`?

Method Name	Return Type	Description
<code>transferTo(BankAccount destinationAccount, int transferAmount)</code>	<code>int</code>	Withdraws <code>transferAmount</code> from this account and deposits it into <code>destinationAccount</code> .

New unit tests have been added for this section. This section is complete when the `CheckingAccountTest`, `SavingsAccountTest`, and `BankAccountTest` unit tests all pass.

Note: Initially, the unit tests may show `transferTo()` as a **missing method error** rather than a failing test until you add the method. Once added, the `transferTo()` method may still fail. It won't be because it's missing.

### Step Two: Create the `Accountable` interface

The `Accountable` interface means that an object can be used in the accounting process for the customer.

Method Name	Return Type	Description
<code>getBalance()</code>	<code>int</code>	Returns the balance value of the account in dollars.

### Step Three: Make `BankAccount` accountable

Add the `Accountable` interface to `BankAccount`, making `BankAccount` and all the classes that inherit from `BankAccount` accountable classes.

### Step Four: Implement a new `CreditCardAccount` class

A `CreditCardAccount` isn't a `BankAccount` but "can-do" `Accountable`.

Constructor		Description		
<code>CreditCardAccount(String accountHolder, String accountNumber)</code>		A new credit card account requires an account holder name and account number. The debt defaults to a 0 dollar balance.		
Attribute Name	Data Type	Get	Set	Description
<code>accountHolder</code>	<code>String</code>	X		Returns the account holder name that the account belongs to.
<code>accountNumber</code>	<code>String</code>	X		Returns the account number that the account belongs to.
<code>debt</code>	<code>int</code>	X		Returns the amount the customer owes.
Method Name	Return Type	Description		
<code>pay(int amountToPay)</code>	<code>int</code>	Removes <code>amountToPay</code> from the amount owed and returns the new total amount owed.		
<code>charge(int amountToCharge)</code>	<code>int</code>	Adds <code>amountToCharge</code> to the amount owed, and returns the new total amount owed.		

Note: Be sure to implement the interface. The balance for the accounting should be the debt as a negative number.

Once the `CreditCardAccountTest` unit tests pass, this step is complete.

### Step Five: Implement a `BankCustomer`

Implement the `BankCustomer` class. A bank customer "has-a" list of `Accountables`.

Attribute Name	Data Type	Get	Set	Description
<code>name</code>	<code>String</code>	X	X	Returns the account holder name that the account belongs to.

Attribute Name	Data Type	Get	Set	Description
<code>address</code>	<code>String</code>	X	X	Returns the address of the customer.
<code>phoneNumber</code>	<code>String</code>	X	X	Returns the phone number of the customer.
<code>accounts</code>	<code>List&lt;Accountable&gt;</code>	X		Returns the customer's list of Accountables as an array.
Method Name		Return Type	Description	
<code>addAccount(Accountable newAccount)</code>		<code>void</code>	Adds <code>newAccount</code> to the customer's list of accounts.	

Note: Even though the `accounts` getter returns an array, you don't have to store the accounts in the `BankCustomer` as an array. Since you need to add accounts whenever the `addAccount()` method is called, you'll want to use a different data structure in the class to store the accounts that's like an array, but can be added to at any time.

#### Step Six: Add the `isVip()` method to `BankCustomer`

Customers whose combined account balances (credits minus debts) are at least \$25,000 are considered VIP customers and receive special privileges.

Add a method called `isVip` to the `BankCustomer` class that returns true if the sum of all accounts belonging to the customer is at least \$25,000 and false otherwise.

Once the `BankCustomerTests` unit test passes, this section is complete.