Purpose	1. Use an *abstract superclass* to implement common behavior and eliminate duplicate code. 2. See how one interface can extend another. 3. Practice refactoring in Eclipse. 4. Revise the design to include a currency for money.
What to Submit	Commit your code to your "coinpurse" project on Bitbucket. 1. Before committing your work, create an annotated tag named "LAB3" for your Lab3 coin purse. 2. Commit your work to the same project. 3. Add an annotated tag "LAB4" to indicate this revision.

In a previous lab, you wrote an interface for *Valuable* objects to enable polymorphism, and defined several kinds of valuable objects that can be put in a Purse.

This makes the Purse a lot more flexible, but results in some duplicate code.

For example, equals() and getValue() are the same in most or all the classes implementing Valuable.

1. Create an Abstract Superclass for Valuables

To eliminate duplicate code, create an *Abstract Superclass* named **`AbstractValuable`**.

Note: If you are using Eclipse, then you can do 1.1 - 1.3 using *Refactoring* . *See below for how.*

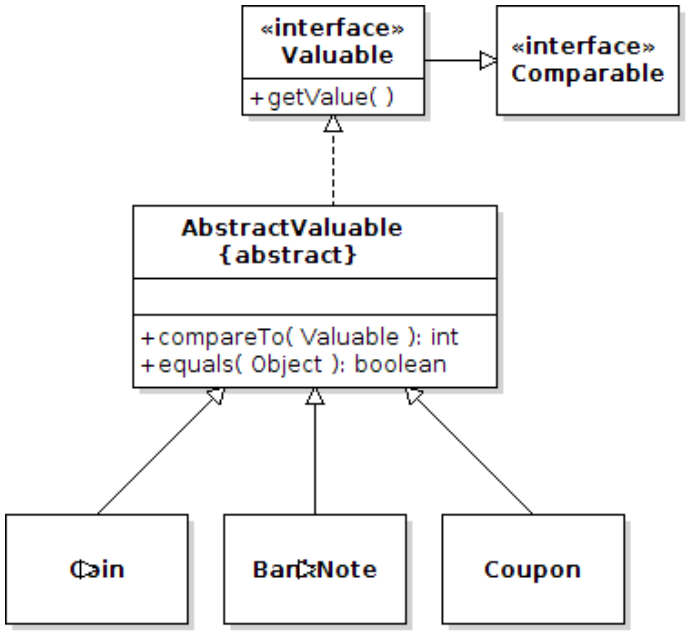
1.1 Declare the AbstractValuable class to be **`abstract`**.

1.2 Declare that Coin, BankNote, and Coupon are subclasses of AbstractValuable.

1.3 Move identical code for **`equals( )`** to the superclass. If you are using Eclipse, use *Refactoring* to extract the methods.

Verify that **`equals( )`** in AbstractValuable works correctly for each subclass. To achieve this, for testing that two objects belong to the same class use:

if (this.getClass() == obj.getClass()) ...



Note: in the `equals` and `compareTo` of AbstractValuable, you should use `getValue()` to get the value of objects, so that each object is free to determine its value any way it wants. *Don't* try to directly access the `value` attribute.

Why? A subclass may want to redefine how its value is computed. Using `getValue()` obeys the principle "*Program to an interface, not to an implementation.*"

2. Modify Valuable to *extend* Comparable

Every Valuable class *must* be comparable by value: a 10-Baht coin is worth less than a 50-Baht BankNote, which is worth less than a Red coupon. So it makes sense that *Valuable* itself should be *Comparable*.

2.1 Modify *Valuable* to declare it is also *Comparable*.

2.2 Delete "... `implements Valuable`" from Coin, BankNote, and Coupon.

2.3 Be careful how you do the comparison. We may have some kinds of *Valuable* with very small value (0.000001) or very large value (1,000,000,000).

3. What about the `value` attribute?

What about the `value` attribute in Coin, BankNote, and (maybe) Coupon?

Can you move `value` to the superclass? What should you do with getValue()?

4. Redesign to add Currency

The value of money is not just a number. "150" is not money. Money has a *currency*, too.

How would you redesign the Purse to handle different currencies?

Characteristics of a good solution are:

- *convenience* - its easy to specify currency
- *uniqueness* - currency is implemented in only one place. No duplicate code.
- *backwards compatible* - we can still write "new Coin(5)" to create a coin using the "default" currency.

4.1 Create a design for how to add currency on paper, as a UML class diagram.

4.2 Explain your design to TA or instructor.

4.3 Implement it! Your existing user interface should still work (using the default currency), and display currency as "THB" or "Thai Baht", but it should also be possible to change to another currency.

4.4 **`equals`** should test currency, too. Two objects must have same currency to be equal.

Note: if your code thinks 5 THB equals 5 USD, then I want to exchange 5 Baht for US dollars.

Thought Questions

1. Coin, BankNote, and Coupon clearly depend on AbstractValuable. Does any other part of the code know about AbstractValuable? The Purse? The user interface?
2. Does adding an *abstract superclass* make the code less complex? More complex?

Refactoring in Eclipse

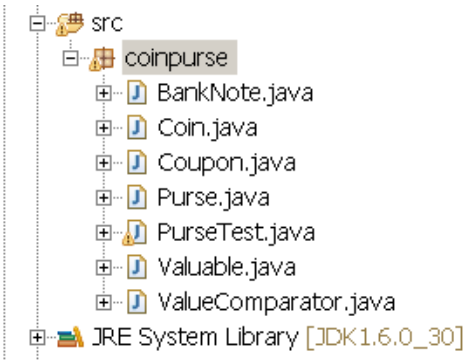
"*Refactoring*" means to restructure your source code. Eclipse and NetBeans have many refactoring operations to save time & reduce errors. The "Extract Superclass" refactoring creates a superclass and can move methods to the superclass.

We want to create an abstract superclass for BankNote, Coin, and Coupon.

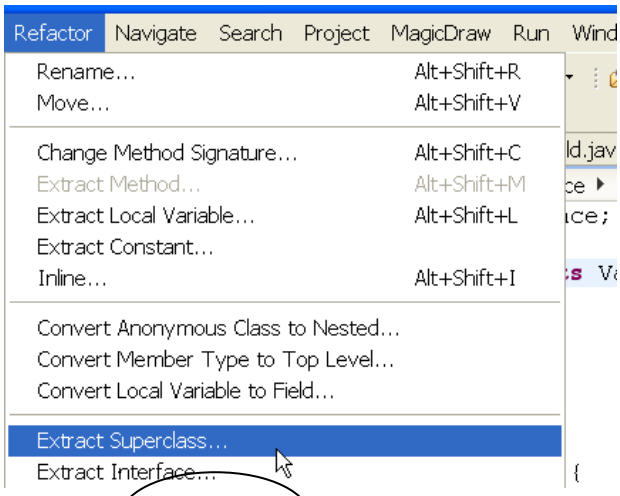
Eclipse can create an AbstractValuable superclass for you. Follow these steps:

1. Open one of the classes in the Eclipse editor.

Double-click on Coin to edit it.



2. From the Refactor menu select Extract Superclass...

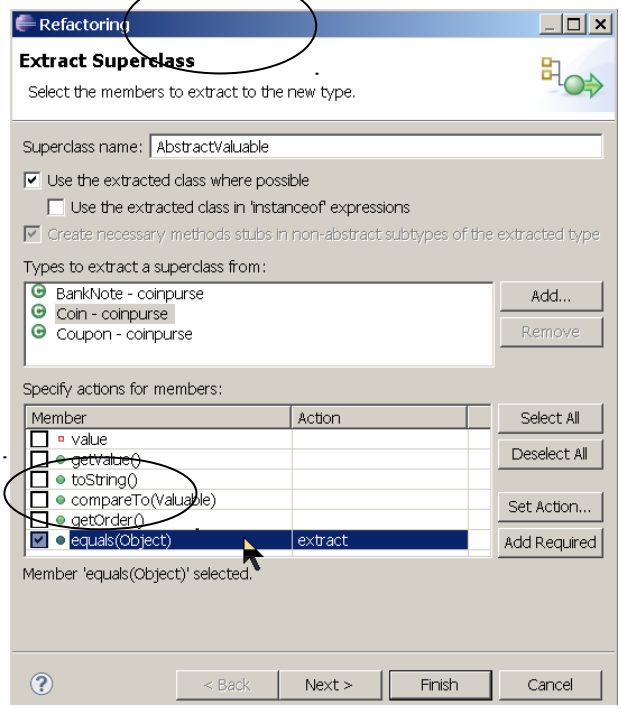


3. In the Extract Superclass dialog, enter `AbstractValuable` as the Superclass name.

4. Click Add... and add other classes you want to refactor (BankNote and Coupon).

5. Select equals(Object) as the method to extract to the superclass.

Click the Next> Button.

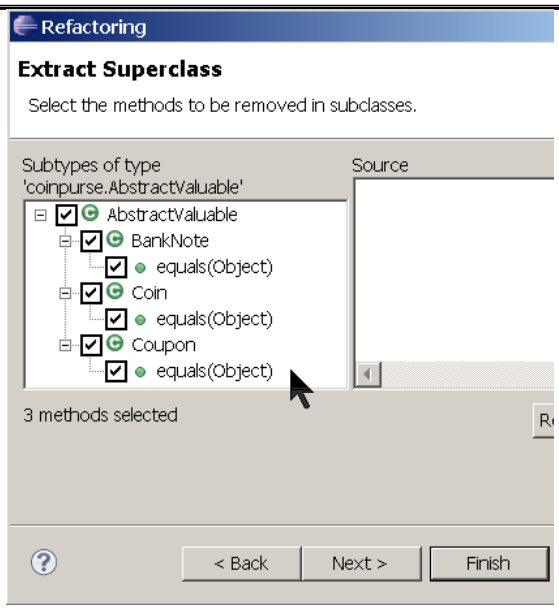


6. This dialog shows which classes will be subclasses and what methods will be extracted to AbstractValuable.

Check equals method for all 3 subclasses.

Click Finish.

You can ignore warning message about problems. You can fix these problems after refactoring.



How to Extract More Methods to Superclass

You can move other methods from a subclasses to a superclass . In the Refactor menu choose "Pull Up".

Undo Refactoring

If you make a mistake, you can Undo refactoring (Edit -> Undo or Refactor -> History).