**GENERAL TEST INFO**

* #1 Read Design Pattern QN + UML Dump for the question as soon as you start
* #2 Start from Q2
* LEAVE SPACE FOR JAVADOC + WRITE CODE OUT FIRST (except for Q2 – Programming by Contract)
* COME BACK TO UML DIAGRAMS Q1 Q4 AT THE END
* COME BACK TO JAVADOC FOR Q2 Q3 Q4 AT THE END.
* For UMLs: Draw boxes and lines first, leave arrows until last

**Programming by Contract**

**Programming by Contract** is a concept which creates a contract between the software developer and the software user.

Every method starts with a **Pre-condition** that must be satisfied by the user of the feature.

* They don’t have to be handled by the developer
* If they hold, error checking is redundant

Every method ends with a **Post-condition** which the developer guarantees to be true (IFF pre-conditions were met when the method is called).

* The developer guarantees expected behaviour for the end user

**/\*  
 \* Method to deposit money into a bank account  
 \* @param amount is the amount to be deposited  
 \* @pre amount > 0  
 \* @post balance = balance + amount  
 \*/  
Public void deposit(float amount) { code inside method }**

Each class has an **Invariant** which is a logical condition that must be satisfied after any changes are made to the object represented by the class. It guarantees that the object is in a valid state.

* The condition is true after the constructor has completed execution (guarantees no invalid objects are created)
* The condition is true before and after a method call, but it can be temporarily violated during execution of a method.

**/\*   
 \* Bank Account handles the deposit and withdrawal of funds  
 \* @invariant balance >= 0  
 \*/  
Public class BankAccount() { variables and methods inside class }**

Other notes

* Getters don’t really need @pre @post as no state is being changed in the object. The user is simply viewing the object.
* **Calendar.getInstance()** returns a calendar object whose fields have been initialised with the current date and time.
* **currDate.get(Calendar.DATE)** returns the DATE field from the Calendar object.

**Generic Types / Polymorphism**

**Generics** allow you to customise a “generic” method or class to whatever type you’re working with.

Set<E>, List<E>, Map<E>, Graph<E> are interfaces. You can implement it using any underlying structure you want. It just has to support the standard interface methods + distinct element property.

Interfaces

|  |  |
| --- | --- |
| **Set<E>**  NO DUPLICATES  UN-ORDERED | **void add(E e)**  **void remove(E e)**  **boolean contains(E e)**  **Set<E> union(Set<E> other)**  **Set<E> intersection(Set<E> other)**  **boolean isSubset(Set<E> other)**  **boolean equals(Object o)** |
| **List<E>**  DUPLICATES  ORDERED | **void add(E e)** 🡪 adds to end of list **void add(int index, E e)** 🡪 adds to specified index in list  **void remove(E e)** 🡪 removes element  **void remove(int index)** 🡪 removes at specified index  **List<E> subList(int from, int to)** 🡪 returns view of sublist (from = inclusive, to = exclusive)  **E get(int index)** 🡪 returns element  **boolean contains(E e)** 🡪 T/F check for element  **boolean isEmpty()** 🡪 T/F check for empty  **boolean equals(Object o)** |
| **Map<K,V>** | **void put(V val)** 🡪 put value into map  **void remove(K key)** 🡪 remove value from map  **void replace(K key, V value)** 🡪 replace an entry of a specified key with the specified value  **V get(K key)** 🡪 get value from map  **boolean containsKey(K key)** 🡪 T/F check for key  **boolean containsValue(V vak)** 🡪 T/F check for value  **boolean isEmpty()** 🡪 T/F check for empty  **boolean equals(Object o)** |

**public class Set<E> extends Iterable<E> {** /\* interface code \*/ **}**

* Extends = making a subclass

**public class ArraySet<E> implements Set<E> {** /\* class code \*/ **}**

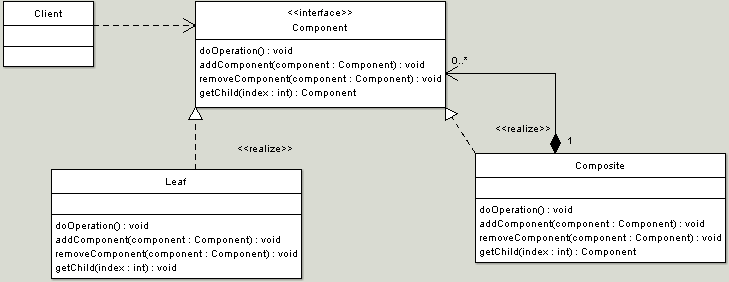
* Implements = implementing an interface 🡪 Animal implements AnimalInterface

**Overriding equals() method**

* **Default** equals() class **compares memory location and only** return true if two reference variable are pointing to same memory location i.e. essentially they are same object.
* For primitive types, using equals gives the correct result. This doesn’t work for Objects.
* Java recommends to **override equals** method if equality is going **to be defined by logical way or via some business logic.**

**Design Patterns**

**Composite Pattern** is used when creating a class that contains a group of its own objects. This class provides ways to modify its group of same objects. (A tree-like structure) E.g. A composite object COMPUTER 🡪 leaf object RAM, GRAPHICS CARD, PCU

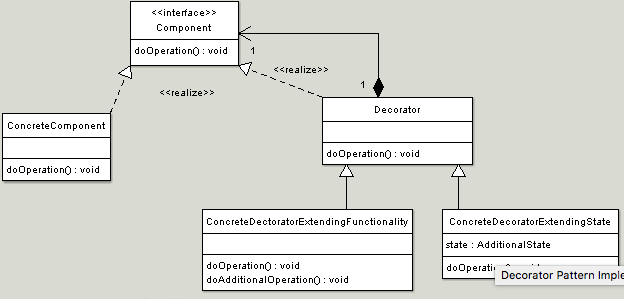


**Decorator Pattern** allows a user to add new functionality to an existing object without altering its structure.

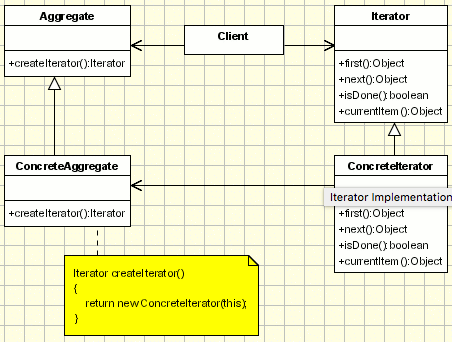
* Using the example above, you can include DISCOUNTED PRICES to both your composite / leaf objects.

**Super** is used to call a method or constructor defined in the super-class.

* E.g. if **DiscountComponent extends DecoratorComponent** , super = DecoratorComponent
* Calling super methods: **super.method();**
* Calling super constructor: **super(constructor arguments);**



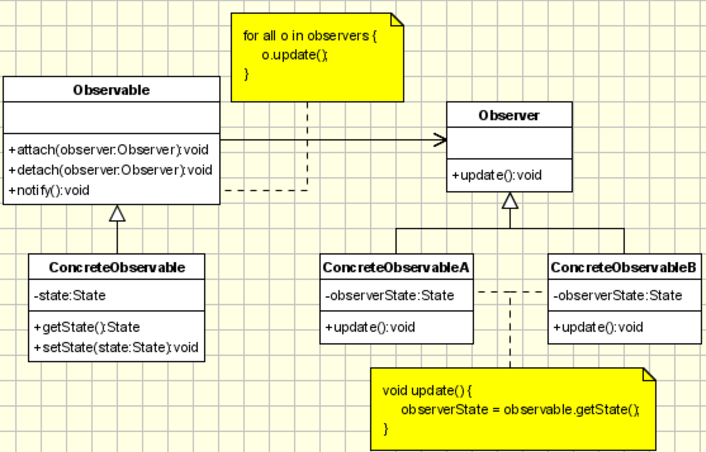
**Iterator Pattern** is used to access elements of a collection of objects in a sequential order, without need to know its underlying representation (i.e. list, set, map etc.)



**ConcreteAggregate** implements **Aggregate**

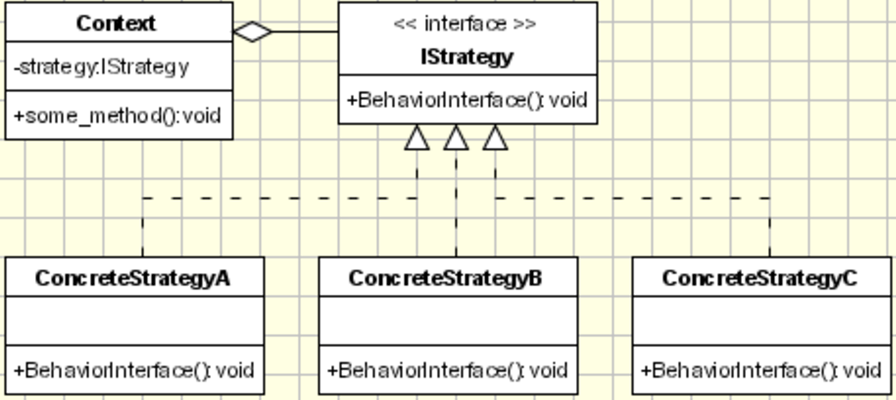
**ConcreteIterator** Implements **Iterator**

**Observer Pattern** is used when there is a one-to-many relationship between objects, such as when one is modified, its dependent objects are to be notified automatically.



**Strategy Pattern** is used when there are multiple possible algorithms / class behaviours to select from.

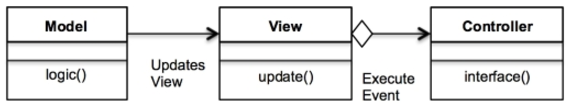
* Define a family of algorithms, encapsulate each one, make them interchangeable.
* Strategy lets the algorithm vary independently from clients that use it.



**Model View Controller (MVC) Pattern**

1. **Model** represents ONLY the data
2. **View** displays the model data and sends users actions (e.g. button clicks) to the controller.
3. **Controller** provides model data to the view, interprets user actions such as btn clicks.

Example: Address Book Program

* Model = Person objects / data
  + Name, picture, address
* View = GUI
  + Window that displayslist of people
  + Detect mouse hover over events
  + Detect mouse click events
  + Detect keyboard press events
* Controller = Handles actions
  + Delete person
  + Add person
  + Email person

**UML and CRC Cards**

|  |  |
| --- | --- |
| **Aggregation**   * A is made up of B * A has field types of B |  |
| **Generalisation**   * B is a subclass of A * B EXTENDS A |  |
| **Realisation**   * B realises the interface defined in A * B IMPLEMENTS A |  |

**Standard Class UML**

|  |
| --- |
| **ClassName** |
| - variableName: type + variableName:type |
| + <<constructor>**>** ClassName() + methodName(name: String): String |

**Interface Class UML**

|  |
| --- |
| <<interface>>  **ClassName** |
| + methodName(): type + methodName(num1: int, int: type): int + methodName(x: int, y: int): int |

**Example of CRC**

|  |  |
| --- | --- |
| **BOOK** | |
| Responsibilities | Collaborators |
| * Holds its current owner | * Customer * Library |

|  |  |
| --- | --- |
| **CUSTOMER** | |
| Responsibilities | Collaborators |
| * Manages individual book borrowing * Ensures return of books | * BorrowSystem * Book |

|  |  |
| --- | --- |
| **LIBRARY** | |
| Responsibilities | Collaborators |
| * Holds the collection of books | * Book * BorrowSystem * Customer |

|  |  |
| --- | --- |
| **BorrowSystem** | |
| Responsibilities | Collaborators |
| * Manages the customers * Manages the borrowing of books | * Customer * Book |