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M3 (b) – Object State

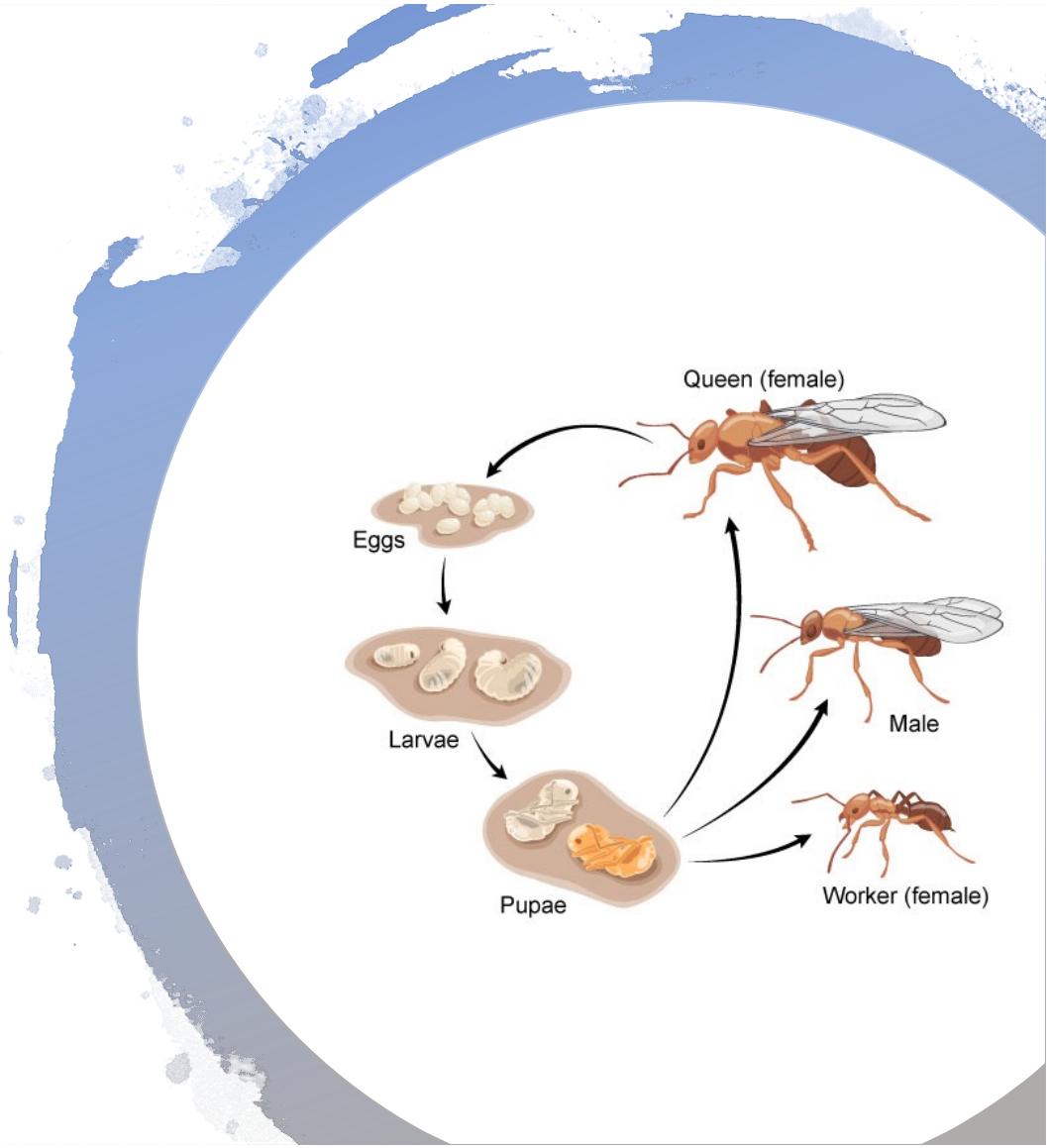


Image Source: https://askabiologist.asu.edu/individual-life-cycle

Recap - Objective

- Programming mechanism:

Null references, optional types

- Concepts and Principles:

Object life cycle, object identity and equality

- Design techniques:

State Diagram

Objective

- Concepts and Principles:

Object uniqueness

- Design Patterns and Antipatterns:

FLYWEIGHT, SINGLETON, NULL OBJECT

Object Uniqueness

Do we even need to have more than one object to represent the cards with the same rank and suit?

Card immutable – then it's safe to share the same object across the system

Object Uniqueness

- Objects of one class cannot be equal - all unique
- Immutable objects are safe to shared

Objective

- Concepts and Principles:

Object uniqueness

- Design Patterns and Antipatterns:

FLYWEIGHT, SINGLETON, NULL OBJECT

Flyweight Design Pattern

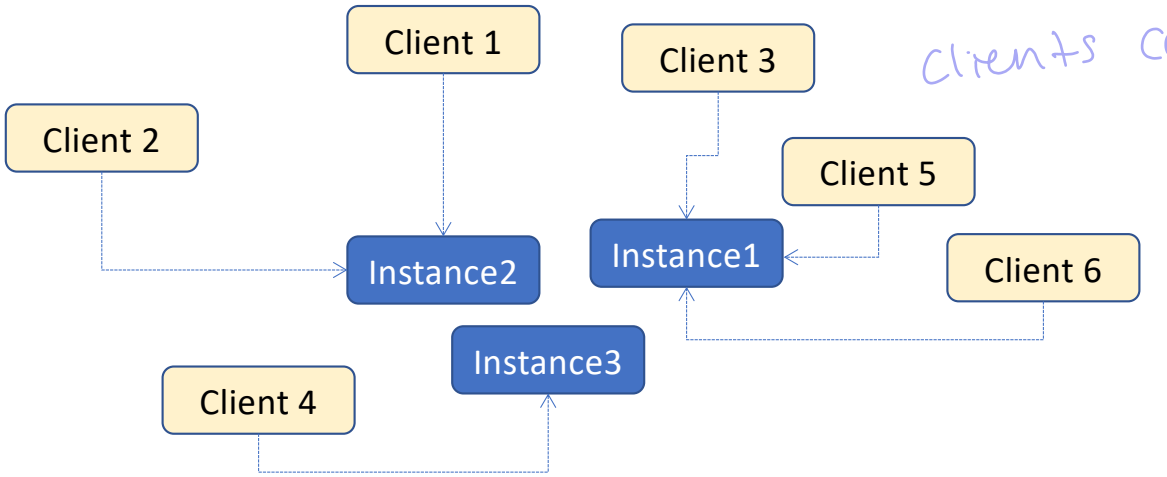
Application uses a large number of objects;

Storage of those objects is high; - dont want to create duplicates

Objects are immutable; - safe to share

Application doesn't depend on the object identity.

Flyweight Design Pattern



Clients can't change the state, so they can all use it

Flyweight Design Pattern

How to control the creation of instances?	Change access to constructor
How to store the flyweight instances?	Choose a data structure and its location
How to supply the flyweight instances?	Use a static factory method

```
public class CardFactory
{
   private static final Card[][] CARDS
      = new Card[Card.Suit.values().length][];
   static
   {
      for (Card.Suit suit : Card.Suit.values())
      {
         CARDS[suit.ordinal()] = new
         Card[Card.Rank.values().length];
         for (Card.Rank rank : Card.Rank.values())
         {
            CARDS[suit.ordinal()][rank.ordinal()]
               = new Card(rank, suit);
         }
      }
   }
}
```

```
public class CardFactory
{
```

could put in Card file to make Card constructor private

```
   ......

   public static Card getCard(Card.Rank rank, Card.Suit suit) {
      assert rank!=null && suit!=null;
      return CARDS[suit.ordinal()][rank.ordinal()];
   }

}
```

Clients use getCard from factory array instead of the constructor

Flyweight in Java

public so clients choose to use or make their own

- java.lang.Integer#valueOf(int)

Returns an Integer instance representing the specified int value.

If a new Integer instance is not required, this method should generally be used in preference to the constructor Integer(int), as this method is likely to yield significantly better space and time performance by caching frequently requested values.

This method will always cache values in the range -128 to 127, inclusive, and may cache other values outside of this range.

```
public static Integer valueOf(int i) {
     if (i >= IntegerCache.low && i <= IntegerCache.high)
         return IntegerCache.cache[i + (-IntegerCache.low)];
     return new Integer(i);
 }

private static class IntegerCache {
    static final int low = -128;
    static final int high;
    static final Integer cache[];

    static {
       /* … initialize cache … */
    }

    private IntegerCache() {}
}
```

Flyweight that enables sharing,
but does not enforce it.

Flyweight in Java

- java.lang.Integer#valueOf(int)

- Similarly on Boolean, Byte, Character, Short, Long and BigDecimal

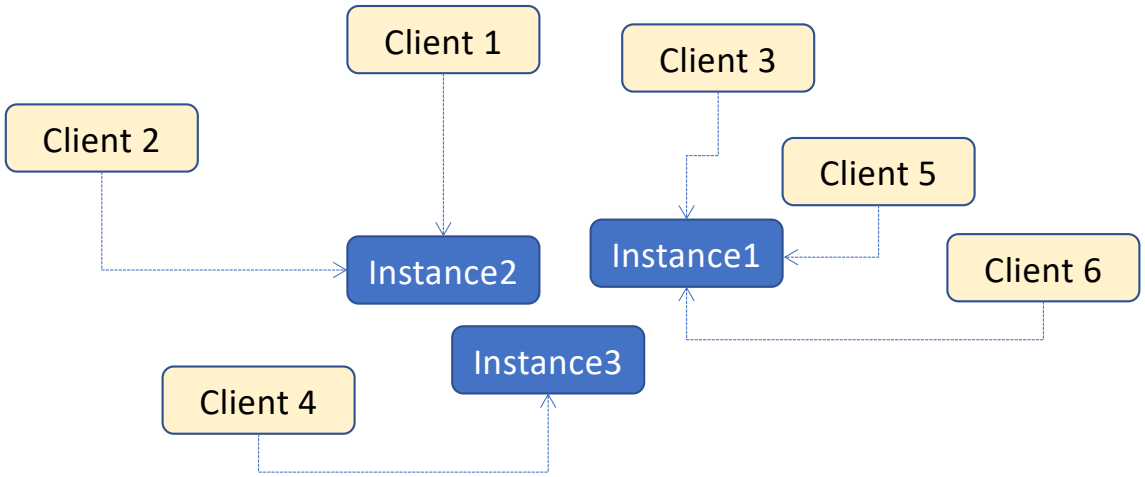
Flyweight Design Pattern

- When to instantiate flyweight object?
  - Pre-instantiate

    or
  - Create instance upon request and add to flyweight object

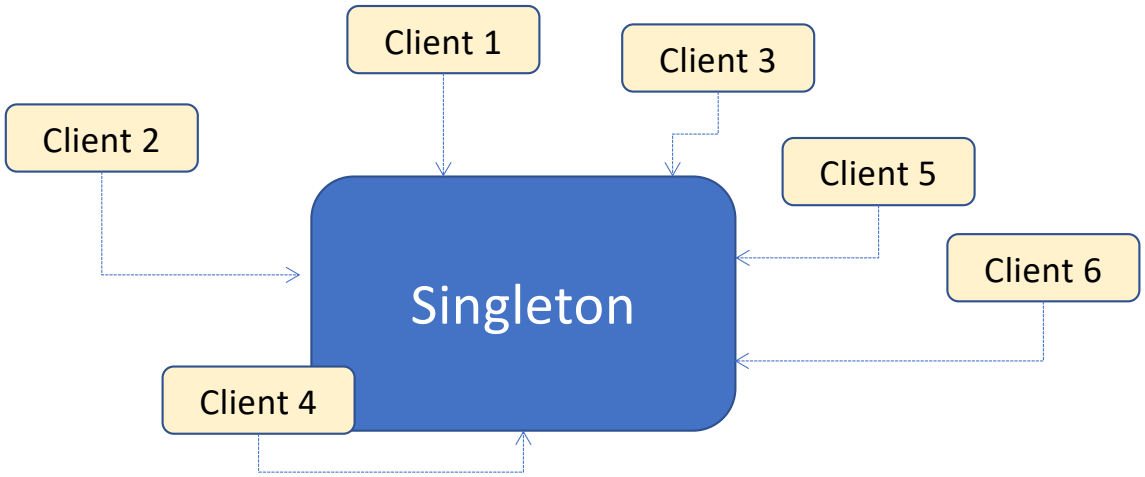
flyweight is good for memory

Flyweight Design Pattern



Singleton Design Pattern

- Guarantee there is *a single instance* of a class



Objective

- Concepts and Principles:

Object uniqueness

- Design Patterns and Antipatterns:

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Singleton Design Pattern

How to control the creation of instance? Change access to constructor

How to store the single instance? public A static final variable holding the reference to the instance

How to supply the single instances? public static method

static because it belongs to the class

Singleton in Java

- java.lang.Runtime

Every Java application has a single instance of class Runtime that allows the application to interface with the environment in which the application is running.

The current runtime can be obtained from the getRuntime method.

An application cannot create its own instance of this class.

```
public class Runtime {
    private static Runtime currentRuntime = new Runtime();


    /**
    * Returns the runtime object associated with the current Java application.
    * Most of the methods of class <code>Runtime</code> are instance
    * methods and must be invoked with respect to the current runtime object.
    *
    * @return  the <code>Runtime</code> object associated with the current
    *          Java application.
    */
    public static Runtime getRuntime() {
        return currentRuntime;
    }


    /** Don't let anyone else instantiate this class */
    private Runtime() {}
}
```

Code Exploration for Singleton

- `GameModel` in Solitaire
- `ApplicationReources` in JetUML

Objective

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`Null` Object Pattern

- Use polymorphism to handle absence
- Create a subtype to act as a null version of the class, make it singleton
- *Special Case* Pattern, representing absence, unknown, etc.

```
public interface CardSource extends Cloneable
{

   Card draw();

   boolean isEmpty();

   boolean isNull();

}
```

```
public interface CardSource extends Cloneable
{
   public static CardSource NULL = new CardSource() {
      @Override
      public Card draw() {
         assert isEmpty();
         return null;
      }

      @Override
      public boolean isEmpty() {
         return true;
      }
   };

   Card draw();

   boolean isEmpty();
}
```

Code demo on `NullComparator`