Object Oriented Concepts

OOP

- A principle of design and development of programs using modular approach
- A computer programming model that organizes software design around **data**, or **objects**, rather than functions and logic.
- well-suited for programs that are large, complex and actively updated or maintained.

Object

- Objects are basic building blocks for designing programs
- Has unique attributes and behavior
- A collection of data members and associated member functions that manipulate that data members
- An object is active, not passive; it does things
- An object is responsible for its own data
- But: it can expose that data to other objects

Class

- Objects can be made with the help of a class.
- A class is a collection of objects that have identical properties, common behavior and shared relationship
- Hold both data and methods

Classes and Objects

Class
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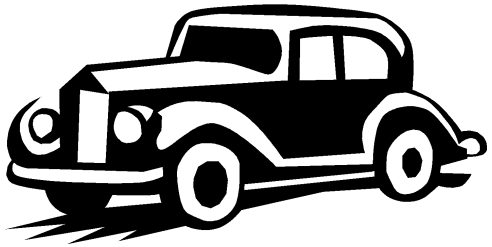


Example of a class

```
class Employee {
    // Fields
    private String name;     //Can get but not change
    private double salary;   // Cannot get or set
    // Constructor
    Employee(String n, double s) {
        name = n; salary = s;
    }
    // Methods
    void pay () {
        System.out.println("Pay to the order of " +
                                name + " $" + salary);
    }
    public String getName() { return name; } // getter
}
```

Concept: Objects must be created

- int n; does two things:
  - It declares that n is an integer variable
  - It allocates space to hold a value for n
  - For a primitive, this is all that is needed
- Employee secretary; also does two things
  - It declares that secretary is type Employee
  - It allocates space to hold a *reference* to an Employee
  - For an object, this is ***not*** all that is needed
- secretary = new Employee ( );
  - This allocate space to hold a *value* for the Employee
  - Until you do this, the Employee is null

Notation: How to declare and create objects

```
Employee secretary;   // declares secretary
secretary = new Employee (); // allocates space
Employee secretary = new Employee(); // does both
```

- But the secretary is still "blank" (null)

```
secretary.name = "Adele";   // dot notation
secretary.birthday ();   // sends a message
```

Notation: How to reference a field or method

- Inside a class, no dots are necessary

  ```
  class Person { … age = age + 1; …}
  ```

- Outside a class, you need to say which object you are talking to

  ```
  if (john.age < 75) john.birthday ();
  ```

- If you don't have an object, you cannot use its fields or methods!

Concept: this object

- Inside a class, no dots are necessary, because
  - you are working on this object
- If you wish, you can make it explicit:

  class Person { … this.age = this.age + 1; …}
- this is like an extra parameter to the method
- You usually don't need to use this

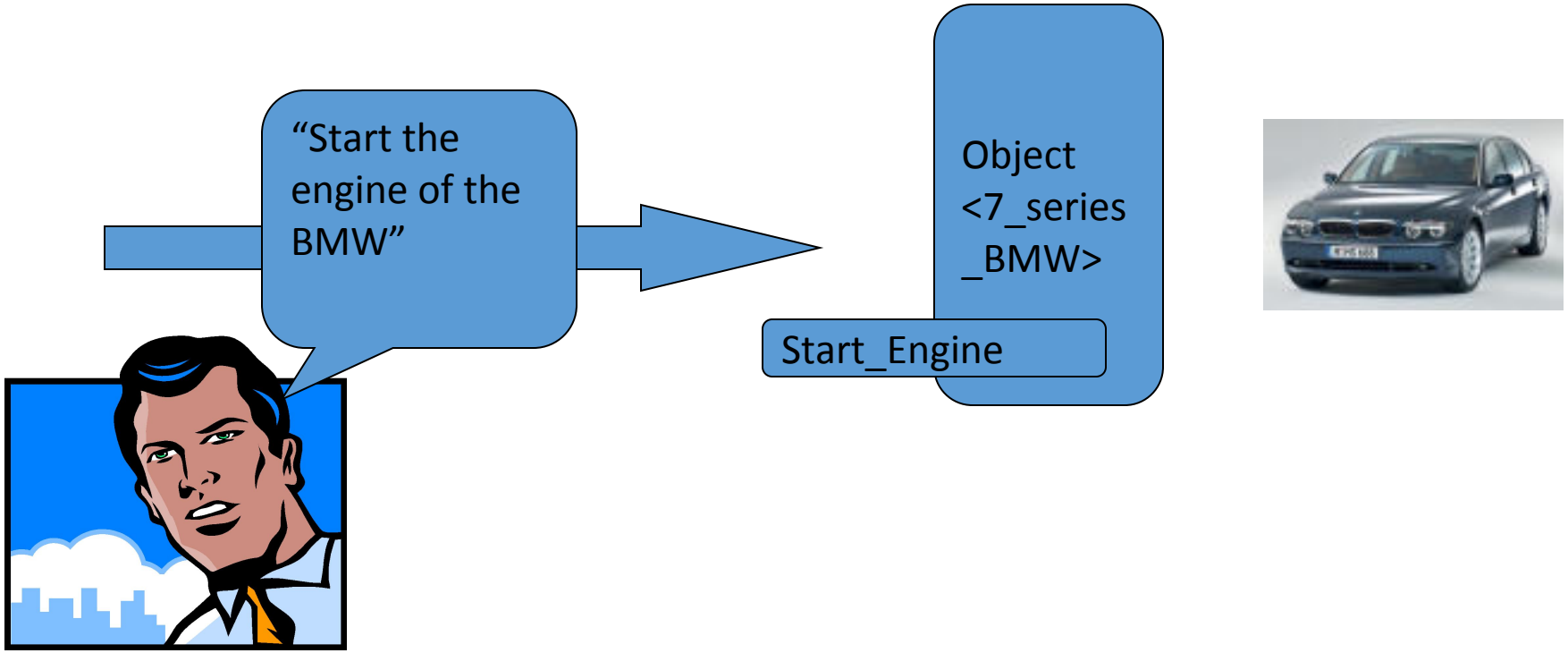
Classes and Objects

Object <7_series _BMW>

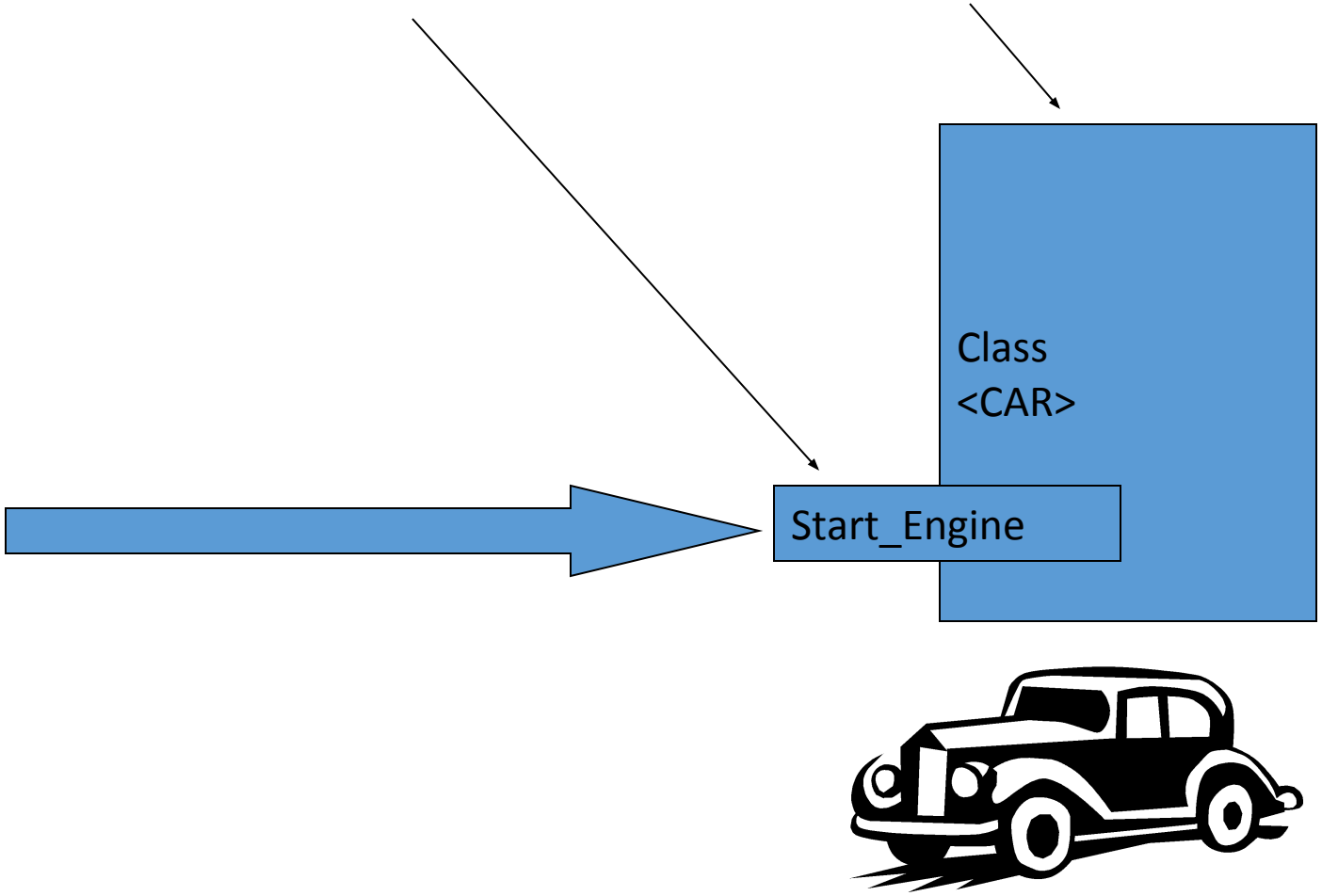
Object <VW_Beetle>

Object <Ford_Mustang>

Messages to Objects



Method of a Class



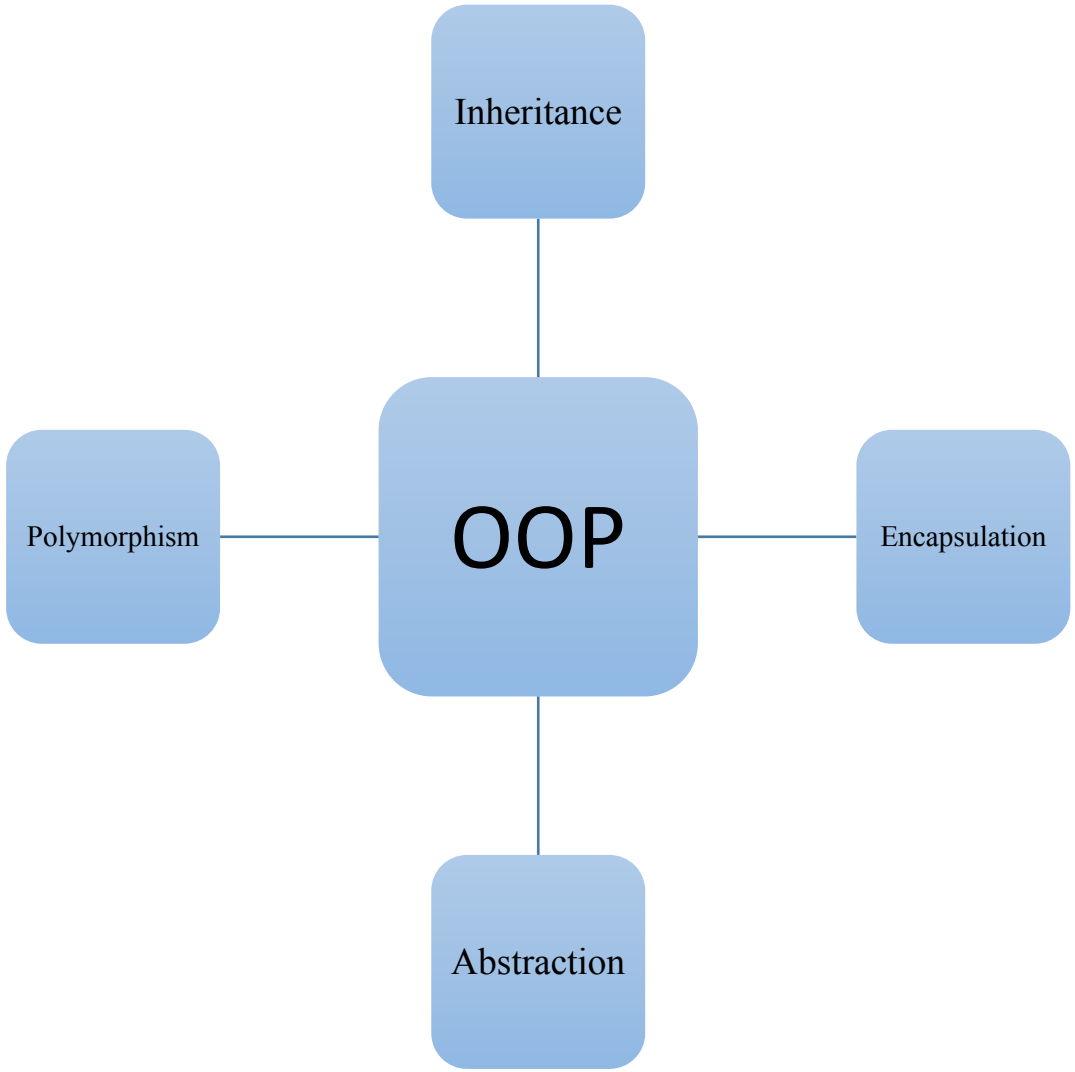
Types of Methods

- There are 4 basic types of methods:
  - Modifier (sometimes called a mutator)
    - Changes the value associated with an attribute of the object
    - E.g. A method like ***Change_Car_Color***
  - Accessor
    - Returns the value associated with an attribute of the object
    - E.g. A method like ***Price_of_Car***
  - Constructor
    - Called once when the object is created (before any other method will be invoked)
    - E.g. ***Car(Mustang)***
  - Destructor
    - Called when the object is destroyed
    - E.g.***~Car( )***

Access

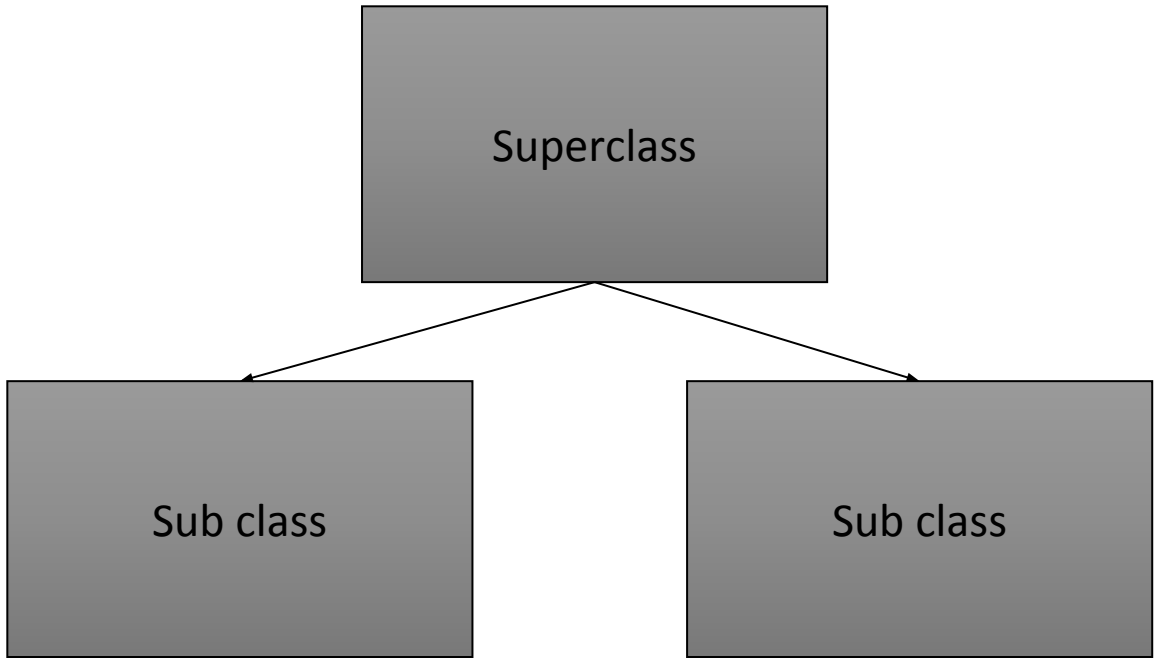
- Most classes provide three levels of access to their members (state and behavior):
  - Public
    - The part of the class of the class that is visible to all clients of the class
  - Protected
    - The part of the class that is only visible to subclasses of the class
  - Private
    - A part of the class that is not visible to any other classes

Components of OOP



Inheritance

Inheritance is a relationship where one class shares the structure or behavior defined in one class (single inheritance) or more (multiple inheritance)



Benefits of Inheritance

- One view of inheritance is that it provides a way to specify some properties/behaviors that all subclasses *must* exhibit
- Inheritance can be used to re-use code
- Inheritance also provides the ability to generalize
  - A method can be written to work with the super-class but subclasses can be passed as arguments

Example: Assignment of subclasses

```
class Dog { ... }
class Poodle extends Dog { ... }
Dog myDog;
Dog rover = new Dog ();
Poodle yourPoodle;
Poodle fifi = new Poodle ();

myDog = rover;                    // ok
yourPoodle = fifi;                // ok
myDog = fifi;                     //ok
yourPoodle = rover;               // illegal
yourPoodle = (Poodle) rover;      //runtime check
```

Example of inheritance

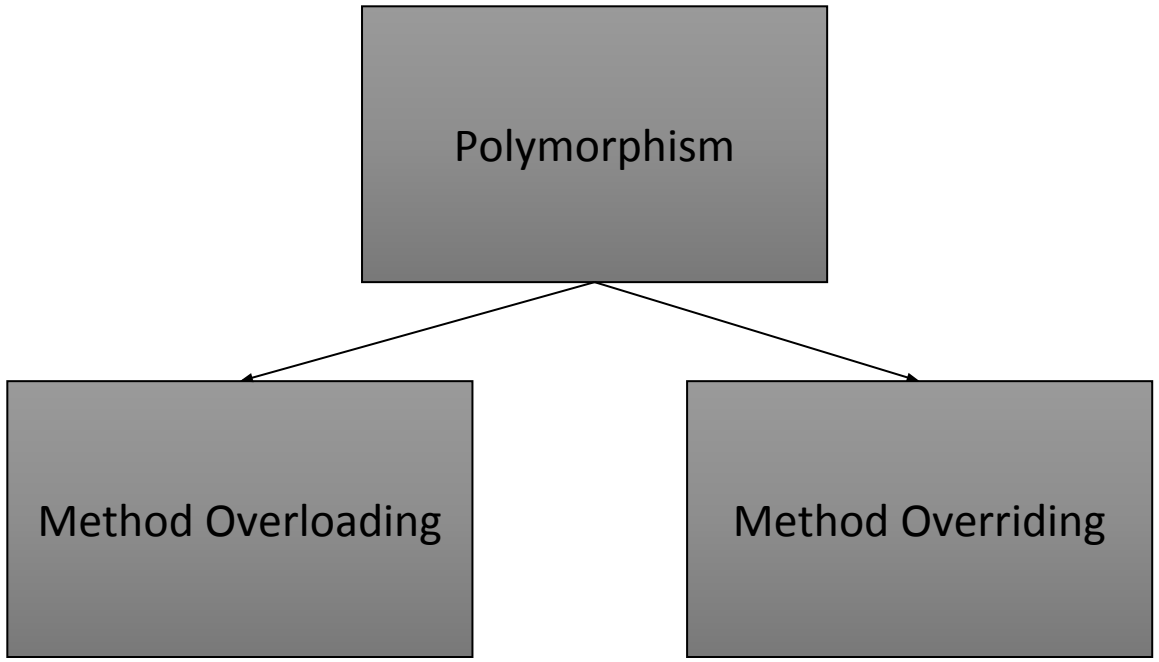
```
class Person {
   String name;
   int age;
   void birthday () {
      age = age + 1;
   }
}
```

```
class Employee
        extends Person {
   double salary;
   void pay () { ...}
}
```

Every Employee has name and age fields and birthday method *as well as* a salary field and a pay method.

Polymorphism

Ability of a function to take multiple forms



Methods can be overridden

```
class Bird extends Animal {
    void fly (String destination) {
        location = destination;
    }
}

class Penguin extends Bird {
    void fly (String whatever) { }
}
```

- So birds can fly. Except penguins.

How to use overridden methods

```
class FamilyMember extends Person {
   void birthday () { // override birthday() in Person
      super.birthday ();  // call overridden method
      givePresent ();     // and add your new stuff
   }
}
```

Overloading

Allows object to have different meaning depending upon context

- **Operator overloading:** when an existing operator operates on new data type is called operator overloading
- **Function overloading:** means two or more function have same name, but differ in the number of arguments or data type of arguments.

Without Method Overloading

```
int add2(int x, int y)
{
   return(x+y);
}
int add3(int x, int y,int z)
{
   return(x+y+z);
}
int add4(int w, int x,int y, int z)
{
   return(w+x+y+z);
}
```

With Method Overloading

```
int add(int x, int y)
{
   return(x+y);
}
int add(int x, int y,int z)
{
   return(x+y+z);
}
int add(int w, int x,int y, int z)
{
   return(w+x+y+z);
}
```

Encapsulation

```
class Employee extends Person {
   private double salary;
   private boolean male;
   public void setSalary (double newSalary) {
      salary = newSalary;
   }
   public double getSalary () { return salary; }
   public boolean isMale() { return male; }
}
```

- This way the object maintains control
- Setters and getters have conventional names: set***DataName***, get***DataName***, is***DataName*** (booleans only)

Abstraction and Interface