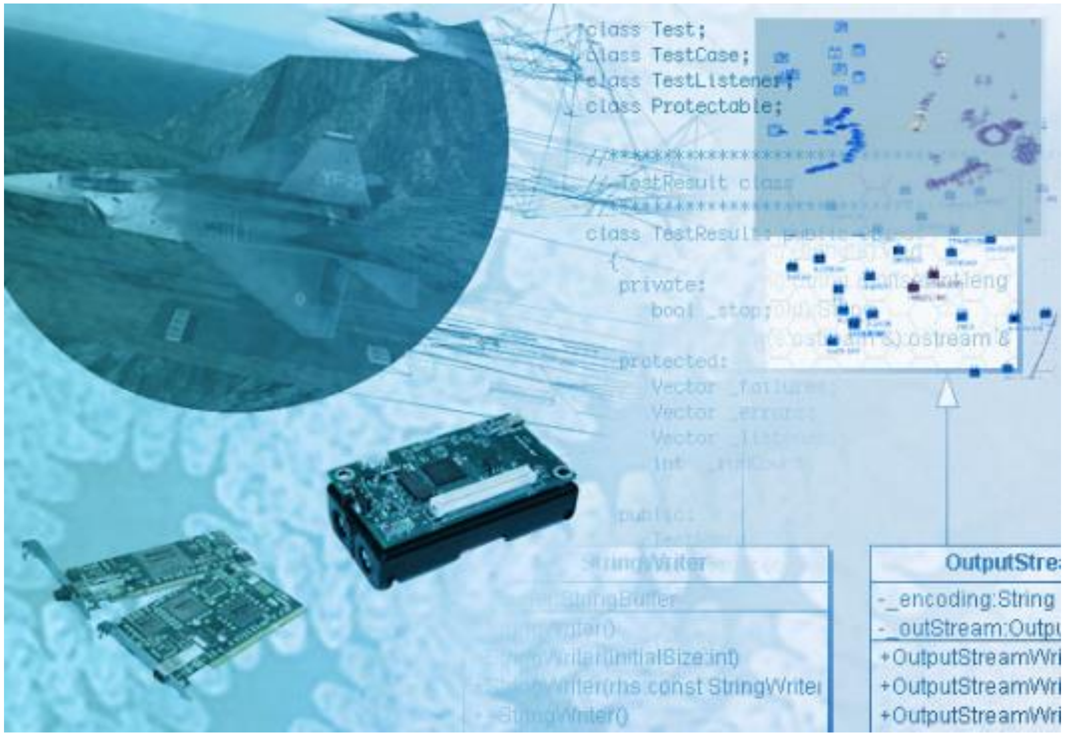
CSYE 6200

CONCEPTS OF OBJECT-ORIENTED DESIGN
SESSION 4



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ADMINISTRATION

- **Assignment #2a**
  - Due today
  - NOTE: Assignment #2 has some additions, we'll see them at the end of the lecture

- **Class TA**
  - Rishabh Sood – sood.r@northeastern.edu
  - Teams:
  - https://teams.microsoft.com/l/team/19%3ae1250a75f29a47eabc4f9d7710dc416d%40thread.tacv2/conversations?groupId=49e15d9d-e85c-4f1f-8ad6-6d1c4e4fb24d&tenantId=a8eec281-aaa3-4dae-ac9b-9a398b9215e7

- **Office Hour:**
  - Thursdays 8-9 pm EST – Online office hour in Zoom

THE LECTURE

- **Recap**
- **Object-Oriented**
  - Classes
  - Inheritance
  - Public/Private
  - Encapsulation
  - Polymorphism
- **Static**
- **ArrayList**
- **HashMap**

OBJECT-ORIENTED

OBJECT-ORIENTED

Objects, classes, and instances:

An Object

```
House houseInst1 = new House();

House houseInst2 = new House();
```

Each instance is an object of class House

Class `House` is a blueprint for making instances

```
class House {

    Address address;

    int rooms;

    int size;

    void open();

}
```

CLASS FORM

- **In Java, a class may be specified using the following form:**

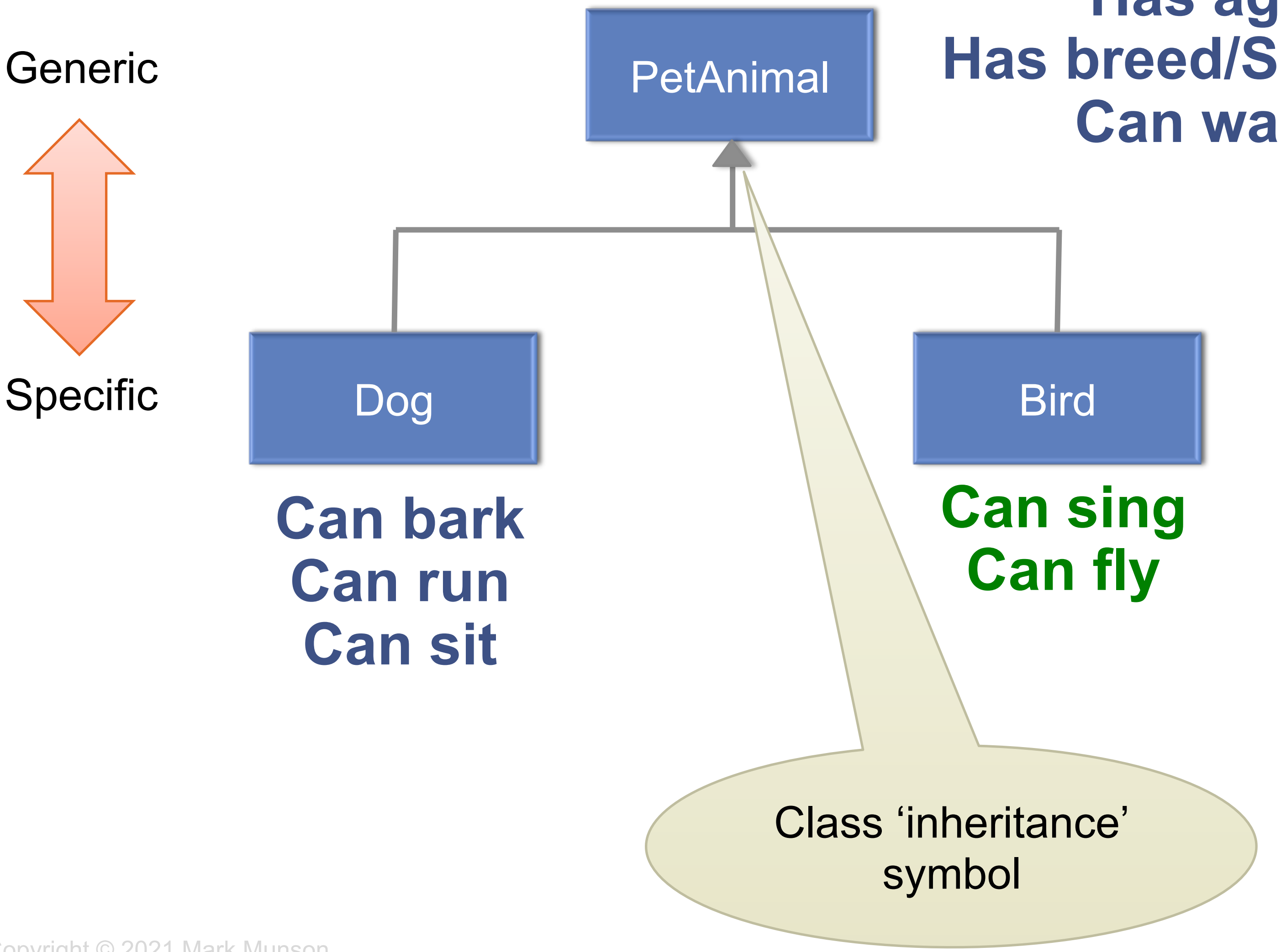
```
class classname {
  // instance variables
  type var1;
  type var2;

  // declare methods
  ret-type method1(parameters) {
     // body of method
  }
  ret-type method2(parameters) {
    // body of method
  }
}
```

OBJECT-ORIENTED

- **What does it mean to be Object-Oriented?**
  - **Inheritance**
  - Encapsulation
  - Polymorphism

OO INHERITANCE



Has color
Has age
Has breed/Species
Can walk

Can bark
Can run
Can sit

Can sing
Can fly

Class ‘inheritance’ symbol

INHERITANCE

Usage of the extends keyword allows a class to inherit public variables and methods from another 'parent' class

PetAnimal.java

```
class PetAnimal {
    Color color;
    int age;
    void walk() { … }
}
```

Dog.java

```
class Dog extends PetAnimal {
    void bark()  { … }
    void run() { … }
    void sit() { … }
}
```

OBJECT-ORIENTED

- **What does it mean to be Object-Oriented?**
  - Inheritance
  - **Encapsulation**
  - Polymorphism

ACCESS MODIFIERS

PUBLIC / PRIVATE

PUBLIC / PRIVATE VARIABLES

Variables that are marked public may be accessed from outside the class.

```
class Vehicle {
   public int passengers;
   private int fuelCap;
   private double kpl;
   …
```

```
class VehicleTest {

   public static void main(String args[]) {

      Vehicle minivan = new Vehicle();

      minivan.passengers = 7; // public – OK

      minivan.fuelCap = 40; // ILLEGAL CALL

   }

}
```

PUBLIC / PRIVATE VARIABLES

- **Class instance variables that are marked private can only be accessed from methods inside their class.**
- **Accessor methods may be used to set or expose private variables.**

```
class Vehicle {
   public int passengers;
   private int fuelCap;
   private double kpl;

   public Vehicle(int passengers, int fuelCap, double kpl) {
      this.passengers = passengers;
      this.fuelCap = fuelCap;
      this.kpl = kpl;
   }

   public double getKpl() {  // A “getter” method
      return kpl;
   }
}
```

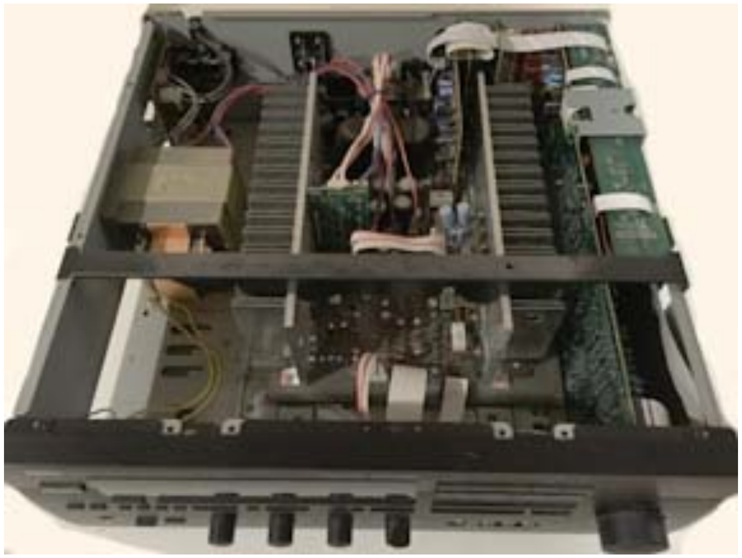
PUBLIC / PRIVATE METHODS

- **Methods marked as private may only be accessed by internal calls**
- **Public methods may be called by external classes**

```
class Vehicle {
   public int passengers;
   private int fuelCap;
   private double kpl;
…
   private double testGGECalc(int passengers, double kpl) {
      return(kpl / 1.39); // E85 to gasoline GGE (1.3900)
   }
   public double getKpl() {  // A “getter” method
      return kpl;
   }
   public double runTests() {  // A “getter” method
      return (testGGECalc(9,40));
   }
}
```

ENCAPSULATION

- The Public/Private keywords allow your code to hide internal working details while leaving important methods and variables exposed for public access.
- This technique of hiding internal object complexity is referred to as encapsulation.



Fully exposed

‘Encapsulated’

OBJECT-ORIENTED

- **What does it mean to be Object-Oriented?**
  - Inheritance
  - Encapsulation
  - **Polymorphism**

OVERLOADING METHODS

In Java, methods may share the same name, as long as the input parameter definitions are different

Procedural style:

```
void moveToInt(int x, int y) {…

void moveToDbl(double x, double y) {…

void moveToLoc(Location loc) {…
```

Java method overloading:

```
void moveTo(int x, int y) {…

void moveTo(double x, double y) {…

void moveTo(Location loc) {…
```

OVERLOADING CONSTRUCTORS

In Java, class constructors may be overloaded, just like regular methods:

```
class Location {
  private double x = 0.0;
  private double y = 0.0;

  public Location(int x, int y) {…

  public Location(double x, double y) {…

  public Location(Vector2d location) {…
```

POLYMORPHISM

- The ability for multiple methods with different parameter signatures to share the same name simplifies coding and make programming easier.
- This feature is called polymorphism, which roughly translates to ‘many forms/shapes’.

ACCESS MODIFIERS

STATIC

STATIC

- **Static is one of the more difficult keywords to understand, because it’s used in many different contexts**
  - Static member variables
  - Static methods
  - Static blocks
  - Static classes

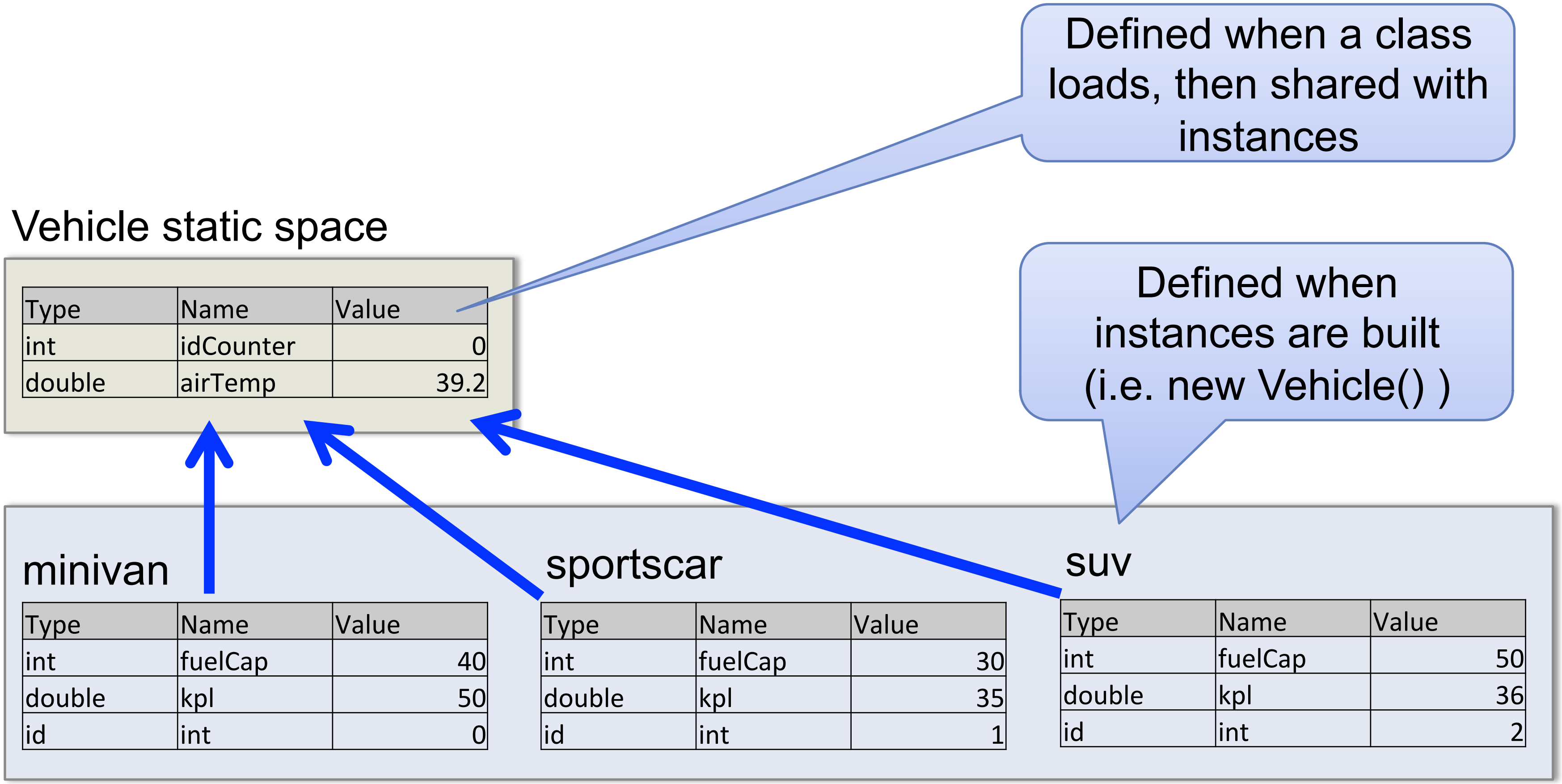
STATIC VARIABLES

- **If a class variable is marked as static, it be shared by all instances of the class**
- **Altering a static variable in one class changes it for all other class instances**

```
class Vehicle {
   static int idCounter = 0;
   static double airTempC = 39.2;
   private int fuelCap;
   private double kpl;
   private int id;
…

   private Vehicle() {
      id = idCounter++; // record the current value, then increment
   }
…
}
```

STATIC VARIABLES



Defined when a class loads, then shared with instances

Vehicle static space

Type	Name	Value
int	idCounter	0
double	airTemp	39.2

Defined when instances are built (i.e. new Vehicle())

minivan

Type	Name	Value
int	fuelCap	40
double	kpl	50
id	int	0

sportscar

Type	Name	Value
int	fuelCap	30
double	kpl	35
id	int	1

suv

Type	Name	Value
int	fuelCap	50
double	kpl	36
id	int	2

STATIC CODE BLOCKS

- If a block of code is marked as static, it will execute upon loading
- **Static blocks can only use static class variables**

```
class Vehicle {
   static int networkPort;
   private int fuelCap;
   private double kpl;
…
   static {
      networkPort = NetworkLoader.getVehPort();
   }

   private double loadFromServer() {
      connectServer(networkPort);
   }

   public double runTests() {…
}
```

STATIC METHODS

- A static method may be called without the need for creating an instance variable.
- A static method cannot use class instance variables, and can only reference static class variables

```
class Vehicle {
   static int idCounter = 0;
   static double airTempC = 39.2;
   private int fuelCap;
…
   static double getDrag(double Cd, double SArea, double Velo )
      return(Air.Pressure / (Air.Rspec * airTempC )); // Drag
   }
…
}
```

- To call a static method without an instance, use the name of the class:

```
 Double drag = Vehicle.getDrag(cd, area, v);
```

WRAPPER CLASSES

- **Each of the primitive data types may be wrapped to create an Object.**
- **The wrapper classes are:**
  - Double, Float
  - Byte, Short, Integer, Long
  - Character
- **Each wrapper class can hold a single primitive value**
- **Static convenience methods allow for parsing, conversion, and manipulation of the primitive type**
  - Convert string “true” or “false” into a boolean
  - Convert a string number “3.145” into a double

CHARACTER STATIC METHODS

- **The Character wrapper class has many useful methods**
  - static boolean isDigit(char character)
  - static boolean isISOControl(char character)
  - static boolean isLetter(char character)
  - static boolean isLetterorDigit(char character)
  - static char toLowerCase()
  - static char toUpperCase()

```
char numC = ‘9’;
boolean numChk = Character.isDigit(numC);
```

STRING METHODS

- **The String class has many useful methods**
  - Char charAt(int index)
  - String toLowerCase() – convert all upper-case to lower
  - String toUpperCase() – convert all lower-case to upper
  - String trim() – remove ‘white space’ from before and after
  - String replace(char oldchar, char newchar)

- **Useful static methods**
  - void format(String format, Object… args)
  - String valueOf(double d) – convert a number to a string
  - String valueOf(int i) – convert a number to a string

ARRAYLIST

A PROBLEM WITH ARRAYS: ONE-DIMENSIONAL ARRAYS

A one-dimensional array is declared using the form:

type array-name[ ] = *new type[size]*;

What if we need more than 10?

Examples:

```
int samples[] = new int[10];

for (int i = 0; i < samples.length; i++)
    samples[i] = i;
```

ARRAYLIST

- **ArrayList provides a list of objects (i.e. Elements), which may be accessed using the List interface**

```
ArrayList vehicleList = new ArrayList(16);
```

- **Typical ArrayList operations**
  - boolean isEmpty() – true if empty
  - int size() – the number of entries in the list
  - add(Object o)
  - Object get(int index)
  - int indexOf(Object o)
  - Object remove(int index)
  - void remove(int index)
  - void clear()

```
vehicleList.add(new Vehicle(“Ford”,”Mustang”));
```

ARRAYLIST (CONT.)

- ArrayList may be typed to ensure that all Elements are of the specified type

```
ArrayList<Vehicle> carList = new ArrayList<Vehicle>();
```

- A normal for loop may be used to access each element

```
for (int i = 0; i < carList.size(); i++) {
   Vehicle car = carList.get(i);
   // do something
   }
```

- A typed list may be iterated over within a for loop:

```
for (Vehicle car : carList ) { // do something }
```

HASHMAP

HASHMAP

- **HashMap provides a list of objects (i.e. Elements), which may be accessed using the Map interface**

```
HashMap vehicleMap = new HashMap();
                    <Integer, Vehicle>
```

- **Typical HashMap operations**
  - boolean isEmpty() – true if empty
  - int size() – the number of entries in the map
  - Object put(Object key, Object value)
  - Object get(Object key)
  - Object remove(Object key)
  - void remove(Object key Object value)
  - void clear()
- **Type identifiers may be added to improve coding:**

```
HashMap<String, Vehicle> vehicleMap = new HashMap<String,
Vehicle)();
```

```
vehicleMap.put(vehicle.getName(), vehicle);
```

```
     if(vehicleMap.containsKey(“Nissan”)){}
```