DM503
Programming B

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TYPE CASTS & FILES & EXCEPTION HANDLING

Type Conversion

- Java uses *type casts* for converting values
- (int) x: converts x into an integer
  - Example 1: ((int) 127) + 1 == 128
  - Example 2: ((int) -3.999) == -3
- (double) x: converts x into a float
  - Example 1: ((double) 42) == 42.0
  - Example 2: (double) "42" gives compilation error
- (String) x: views x as a string
  - Example: Object o = "Hello World!";
    String s = (String) o;

Catching Exceptions

- type conversion operations are error-prone
- Example:
```
Object o = new Integer(23);
Strings s = (String) o;
```

- good idea to avoid type casts
- sometimes necessary, e.g. when implementing equals method

- use try-catch statement to handle error situations
- Example 1:
```
String s;
try {
    s = (String) o;
} catch (ClassCastException e) {
    s = "ERROR"; }
```

Catching Exceptions

- use try-catch statement to handle error situations
- Example 2:

```
try {
    double x;
    x = Double.parseDouble(str);
    System.out.println("The number is " + x);
} catch (NumberFormatException e) {
    System.out.println("The number sucks.");
}
```

Arrays

- array = built-in, mutable list of fixed-length
- type declared by adding "[]" to base type
- Example: int[] speedDial;

- creation using same "new" as for objects
- size declared when creating array
- Example: speedDial = new int[20];

- also possible to fill array using "{}" while creating it
- then length determined by number of filled elements
- Example: speedDial = {65502327, 55555555};

Arrays

- array = built-in, mutable list of fixed-length
- access using "[index]" notation (both read and write, 0-based)
- size available as attribute ".length"
- Example:

```
int[] speedDial = {65502327, 55555555};
for (int i = 0; i < speedDial.length; i++) {
    System.out.println(speedDial[i]);
    speedDial[i] += 100000000;
}
for (int i = 0; i < speedDial.length; i++) {
    System.out.println(speedDial[i]);
}
```

Command Line Arguments

- command line arguments given as array of strings
- Example:

```
public class PrintCommandLine {
    public static void main(String[] args) {
        int len = args.length;
        System.out.println("got "+len+" arguments");
        for (int i = 0; i < len; i++) {
            System.out.println("args["+i+"] = "+args[i]);
        }
    }
}
```

Reading from Files

- done the same way as reading from the user
- i.e., using the class java.util.Scanner
- instead of System.in we use an object of type java.io.File
- Example (reading a file given as first argument):

```
import java.util.Scanner;  import java.io.File;
public class OpenFile {
    public static void main(String[] args) {
        File infile = new File(args[0]);
        Scanner sc = new Scanner(infile);
        while (sc.hasNext()) {
            System.out.println(sc.nextLine());
}   }   }
```

Reading from Files

- Example (reading a file given as first argument):

```
import java.util.Scanner;  import java.io.*;
public class OpenFile {
    public static void main(String[] args) {
        File infile = new File(args[0]);
        try {
            Scanner sc = new Scanner(infile);
            while (sc.hasNext()) { System.out.println(sc.nextLine()); }
        } catch (FileNotFoundException e) {
            System.out.println("Did not find your strange "+args[0]);
}   }   }
```

Writing to Files

- done the same way as writing to the screen
- i.e., using the class java.io.PrintStream
- System.out is a predefined java.io.PrintStream object
- Example (copying a file line by line):

```
import java.io.*;  import java.util.Scanner;
public class CopyFile {
    public static void main(String[] args) throws new
FileNotFoundException {
        Scanner sc = new Scanner(new File(args[0]));
        PrintStream target = new PrintStream(new File(args[1]));
        while (sc.hasNext()) {  target.println(sc.nextLine());  }
        target.close();  }   }
```

Throwing Exceptions

- Java uses throw (comparable to raise in Python)
- Example (method that receives unacceptabe input):

```
static double power(double a, int b) {
    if (b < 0) {
        String msg = "natural number expected";
        throw new IllegalArgumentException(msg);
    }
    result = 1;
    for (; b > 0; b--) {  result *= a;  }
    return result;
}
```

OBJECT ORIENTATION

Objects, Classes, and Instances

- class = description of a class of objects
- Example: a Car is defined by model, year, and colour
- object = concrete *instance* of a class
- Example: a silver Audi A4 from 2009 is an instance of Car
- Example (Car as Java class):

```
public class Car {
    public String model, colour;
    public int year;
    public Car(String model, int year, String colour) {
        this.model = model;  this.year = year;  this.colour = colour;
}   }
```

Attributes

- attributes belonging to each object are *member variables*
- they are declared by giving their types inside the class
- Example:

```
public class Car {
    public String model, colour;
    public int year;
    …
}
```

- visibility can be public, protected, package or private
- for now only public or private:
  - public = usable (read and write) for everyone
  - private = usable (read and write) for the class

Getters and Setters

- getter = return value of a private attribute
- setter = change value of a private attribute
- Example:

```
public class Car {
    private String model;
    public String getModel() {
        return this.model;
    }
    public void setModel(String model) {
        this.model = model;
    } …
}
```

Getters and Setters

- very useful to abstract from internal representation
- Example:

```
public class Car { // built after 1920
    private byte year;
    public int getYear() {
        return this.year >= 20 ? this.year + 1900 : this.year + 2000;
    }
    public void setYear(int year) {
        this.year = (byte) year % 100;
    } …
}
```

Static Attributes

- attributes belonging to the class are *static attributes*
- declaration by static and giving their types inside the class
- Example:

```
public class Car {
    private static int number = 0;
    public Car(String model, int year, String colour) {
        this.model = model;  this.year = year;  this.colour = colour;
        Car.number++;
    }
    public int getNumberOfCars() {  return number;  }
}
```

Initializing Global and Local Variables

- local variable = variable declared in a block
- global variable = member variable or static attribute
- all local and all global variables can be initialized
- Example:

```
public class Car {
    private static int number = 0;
    public String model = "Skoda Fabia";
    public Car(String model, int year, String colour) {
        boolean[] wheelOk = new boolean[4];
    }
}
```

Constructors

- objects are created by using "new"
- Example: Car mine = new Car("VW Passat", 2003, "black");
- Execution:
  - Java Runtime Environment reserves memory for object
  - constructor with matching parameter list is called
- constructor is a special method with no (given) return type
- Example:

```
public class Car {
    public Car(String model, int year, String colour) {
        this.model = model;  this.year = year;  this.colour = colour;
    } …
}
```

Constructors

- more than one constructor possible (different parameter lists)
- constructors can use each other in first line using "this(…);"
- Example:

```
public class Car {
    public Car(String model, int year, String colour) {
        this.model = model;  this.year = year;  this.colour = colour;
    }
    public Car(String model, byte year, String colour) {
        this(model, year > 20 ? 1900+year : 2000+year, colour);
    }
    …
}
```

Overloading

- overloading = more than one function of the same name
- allowed as long as parameter lists are different
- different return types is not sufficient!
- Example:

```
public class Car {
    …
    public void setColour(String colour) {  this.colour = colour;  }
    public void setColour(String colour, boolean dark) {
        if (dark) {  colour = "dark"+colour;  }
        this.colour = colour;
    }
}
```

Printing Objects

- printing objects does not give the desired result
- Example:

```
System.out.println(new Car("Audi A1", 2011, "red"));
```

- method "public String toString()" (like __str__ in Python)
- Example:

```
public class Car {
    …
    public String toString() {
        return this.colour+" "+this.model+" from "+this.year;
    }
}
```

ADVANCED OBJECT-ORIENTATION

Object-Oriented Design

- classes often do not exist in isolation from each other
- a vehicle database might have classes for cars and trucks
- in such situation, having a common superclass useful
- Example:

```
public class Vehicle {
    public String model;
    public int year;
    public Vehicle(string model, int year) {
        this.model = model;  this.year = year;
    }
    public String toString() {return this.model+" from "+this.year;}
}
```

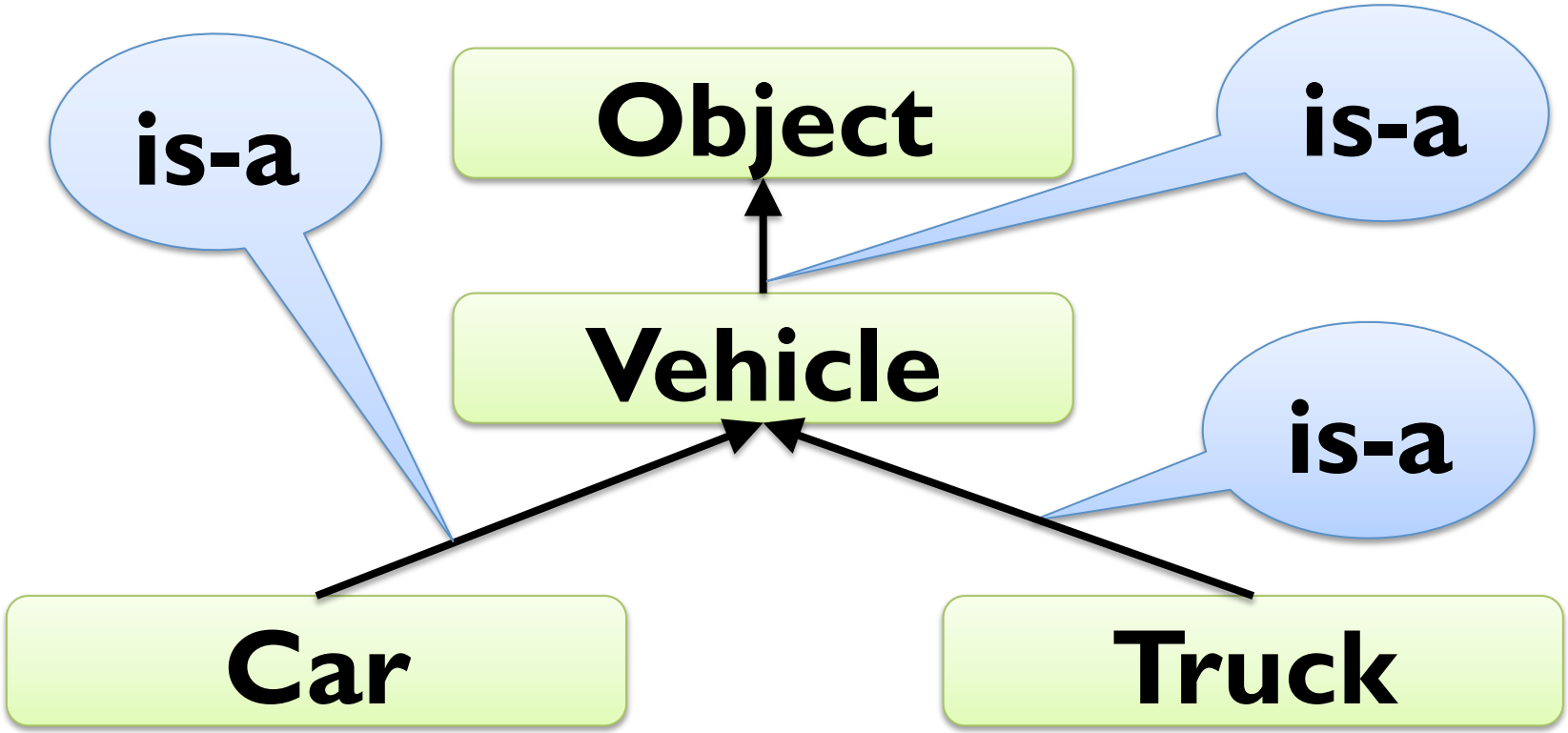
Extending Classes

- Car and Truck then *extend* the Vehicle class
- Example:

```
public class Car extends Vehicle {
    public String colour;
    public Car(string model, int year, String colour) {
        this.colour = colour;     // this makes NO SENSE
    }
    public String toString() {  return this.colour;  }
}
public class Truck extends Vehicle {
    public double maxLoad;
    …  }
```

Class Hierarchy

- class hierarchies are parts of class diagrams
- for our example we have:



Abstract Classes

- often, superclasses should not have instances
- in our example, we want no objects of class Vehicle
- can be achieved by declaring the class to be *abstract*
- Example:

```
public abstract class Vehicle {
    public String model;
    public int year;
    public Vehicle(string model, int year) {
        this.model = model;  this.year = year;
    }
    public String toString() {return this.model+" from "+this.year;}
}
```

Accessing Attributes

- attributes of superclasses can be accessed using "this"
- Example:

```
public class Car extends Vehicle {
    public String colour;
    public Car(string model, int year, String colour) {
        this.model = model;  this.year = year;  this.colour = colour;
    }
    public String toString() {
        return this.colour+" "+this.model+" from "+this.year;
    }
}
```

Accessing Superclass

- methods of superclasses can be accessed using "super"
- Example:

```
public class Car extends Vehicle {
    public String colour;
    public Car(string model, int year, String colour) {
        this.model = model;  this.year = year;  this.colour = colour;
    }
    public String toString() {
        return this.colour+" "+super.toString();
    }
}
```

Superclass Constructors

- constructors of superclasses can be accessed using "super"
- Example:

```
public class Car extends Vehicle {
    public String colour;
    public Car(string model, int year, String colour) {
        super(model, year);
        this.colour = colour;
    }
    public String toString() {
        return this.colour+" "+super.toString();
    }
}
```