Create Your Own Universe

- Classes and Behavior
- Types and Objects

Review Questions

- What is the difference between a function and a void method?
- What does the return statement do?
- What is the meaning of **`private`**?
- How do you determine the type of a statement?
- Can there be, in a single program :
  - two classes with the same name?
  - two methods or attributes with the same name?
  - Two methods with the same name within the same class?

Method Overloading

- Methods are identified by their signature.
- I.e. two methods with the same name can coexist, if their parameter lists differ (in number or type)
- This is called **method overloading.**

- Oberloading is forbidden, if method calls are indistinguishable to the compiler,
  - if their signatures only differ in the return type or access modifier
  - if they can be matched through implicit parameter type casting
  - if they only differ in their static modifier.

Test: Overloading

Which methods can coexist?

```
1.  public int m(int a, String b);
2.  public void m(int a);
3.  public static void m(float a);
4.  public int m(int a, boolean b);
5.  private void m(boolean b);
6.  private void m(long a);
```

Using Overloading

```
public class BusinessCards
{   // standard version
    public static void printCards
        (String name, String address,
         int number)
    { ... }
    // more options
    public static void printCards
        (String title, String name,
         String company,
         String addres,
         int layout, int number)
    { ... }
}
```

I. Classes and Behavior

Method Specification

- All you need to know to call a method correctly is found in the **method header**:

```
public static int meth(char c)
```

- It is also called **method signature** (or footprint)
- Syntactically, a signature is a complete **method specification**.

- It does not tell you anything about the semantics → add comments!

Class Specification

- The information needed to use a class properly is called its **export interface,**
- described by the **class specification.**
- It consist of all **public declarations**:
  - Attributes: type and name
  - Methods: signatures
  - Comments explaining the samantics

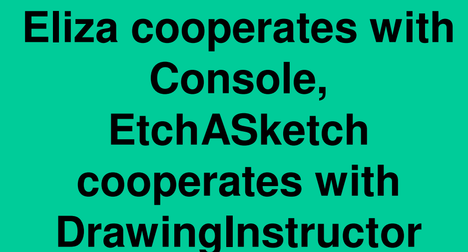
Classes "behave" and categorize

- To use a class means to call ist methods.
- Console "behaves":
  - if you call println, it will do output,
  - if you call readln, it will accept input and make it available to the caller.
- Console groups i/o behaviour
- Would you put a method called calculateMedian into Console?
  - No – it does not "fit".
  - Console methods deal with input and output.

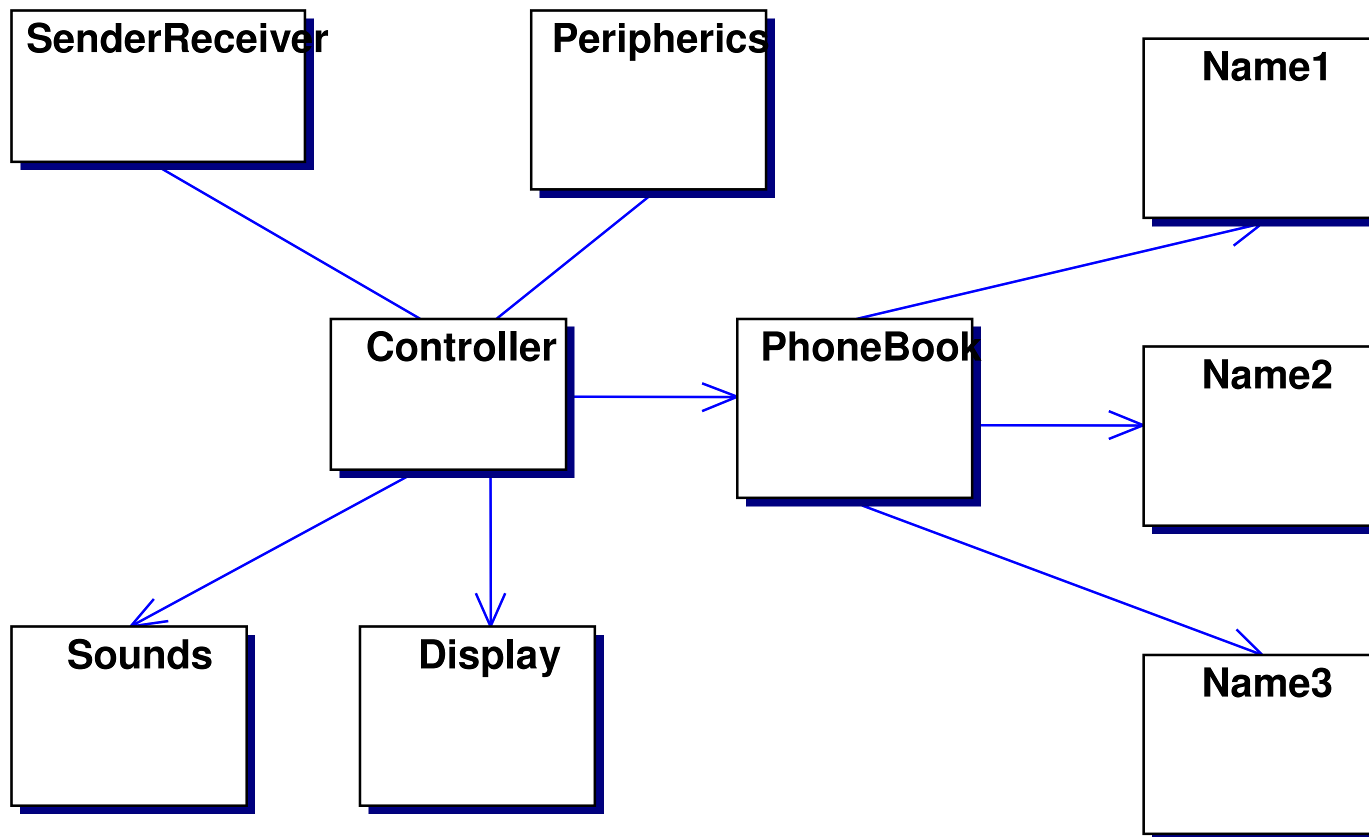
Objects

- Objects in real life
  - contain information of a certain category
  - behave (work, react)
  - coorperate or interact

- Classes in a Program
  - store information
  - behave according to their methods
  - cooperate



Cell Phone:
System of Interacting Units



Controller (incoming call)

state: free / busy

rules of behaviour:

- incoming call notification (from Sender/Receiver)
  - → busy
  - - lookup name and personalized ringing tone
  - - display name
  - - sound ringing tone
- call rejected (from Peripherals)
  - - stop ringing
  - - display neutral
  - → free
- call accepted (from Peripherals)
  - - open connection
  - - display name and time lapse
  - - open mic and phones
- call finished (from Peripherals)
  - - close connection
  - - close mic and phones
  - - display neutral
  - → free

Display

state: current text, time lapse

rules of behaviour:
- ➢display call
  - clear display
  - display required text / screen

Phonebook

state: current entry

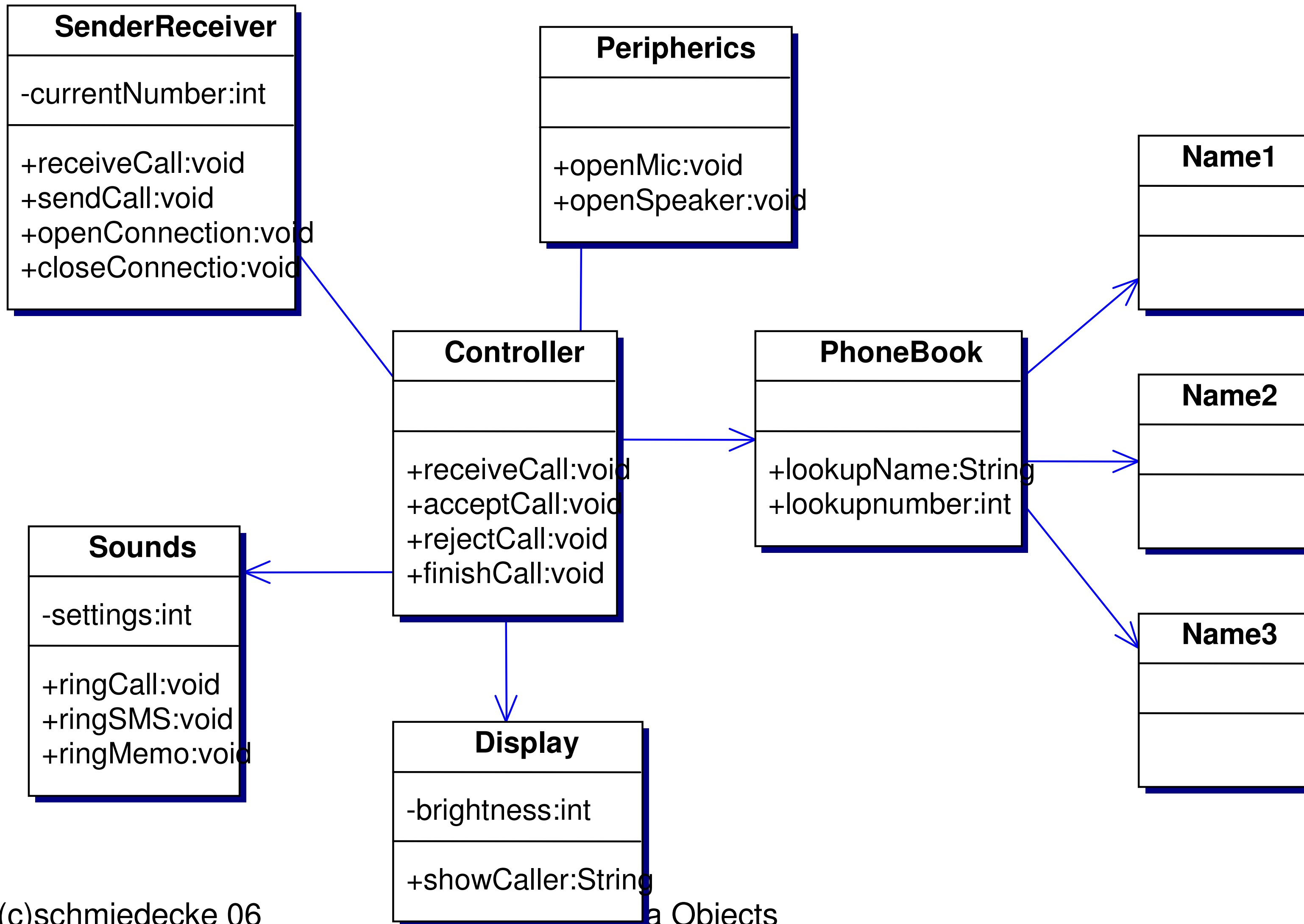
rules of behaviour:
- ➢lookup by number
  - return name and ringing sound
  - return null, if not found
- ➢lookup by name
  - -return number
  - return null, if not found

Sound

state: active / quiet, current sound

...

Cell Phone (Recieving call)



information

behavior

```
public class SenderReceiver {
  int currentCall = -100;
  public static void receiveCall(int number) {
    currentCall = number;
    Controller.receiveCall(number);
  }
  public static void sendCall(int number);
  public static void endCall();
  // ...
}
```

behavior

```
public class Controller {
  public static void receiveCall(int number) {
     Sounds.ringCall();
     String name = PhoneBook.lookupName(number);
     Display.showName(name);
  }
  public static void acceptCall();
  public static void rejectCall();
  public static void endCall();

  // ...
}
```

Programming interacting units

- I can program the Class Controller, if I have the specification of the classes Sound, Display, PhoneBook

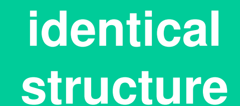
- In a System, each object contributes its behavior a the system, maybe using other objects' behavior.
- So a class can be considered an object...

II. Types and Objects

...Flaw in Concept

- Concept Class as Object credible → except for Name
- Just one class Name
- But we want many names in our phone book:

```
public class Name1 {
     static String name = "Helen";
     static int homeNumber = 007;
     static int cellNumber = 0815;
     editNumber();
}
public class Name2 {
     static String name = "Maurice";
     static int homeNumber = 2050;
     static int cellNumber = 0123;
     editNumber();
}
```



- *Problem1: program length ....*
- *Problem2: new entries*

Real Life Objects

- There are unique objects:
  - the Eiffel tower
  - the US president
  - the Control unit of your cell phone (within the system)
  - YOU...
- and there are many Objects that are instances of a type:
  - a lab workstation
  - a bicycle
  - a department
  - a phone book entry

Classes as Types

- Consider the unique object as a special case.
- Don't consider classes objects
- but as object blue prints,
  i.e. as **types:**

- A type defines
  - which information a "thing" can store → Attributes
  - and what can be done with this information
    → Methods

Class "Name" as Type

- A type defines
  - which information a "thing" can store → Attributes
  - and what can be done with this information → Methods
  - *another way of putting it: State Domain and Behavior Pattern*

Example: **Type Name**

State: name, home number, cell number, office number, group, ringing tone.

Behavior: edit name, edit number, add number, set group, set ringing tone, get home number, get cell number, ...

A Name Object (or "Name Instance")

An Object is an Entity which

- exists at runtime
- has a type
- possesses a *specific state* and
- shows a *specific behavior*

Example: **Name Object IlseSchmiedecke**

State: name = "ilse schmiedecke“
home number = 001-501-123456
cell number = 001 -251-665588
group = 24
ringing tone = emergency
Behavior: set group, get ringing tone…..

"Getter and Setter Methods"

- The state of an object is given by ist attribute values.
- Avoid making an attribute public.
- Define a set of functions to read the attributes - Getter:

```
public String getName();
public int getCellNumber();
```

- Define a set of void methods to change the attribute values - Setter:

```
public void setName(String name);
public void setCellNumber(int number);
```

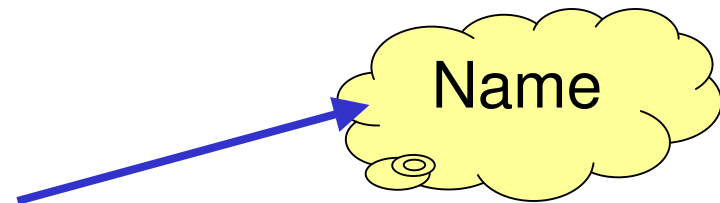
Creating Objects from Classes

- Type defined as a class:
- `public class Name { .... }`

- Object Instantiation: operator new

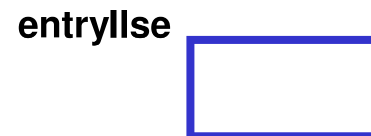
```
new Name()
```

  – creates a new object of type Name *somewhere in memory*
  – evaluating the new-expression yields a reference to the new object



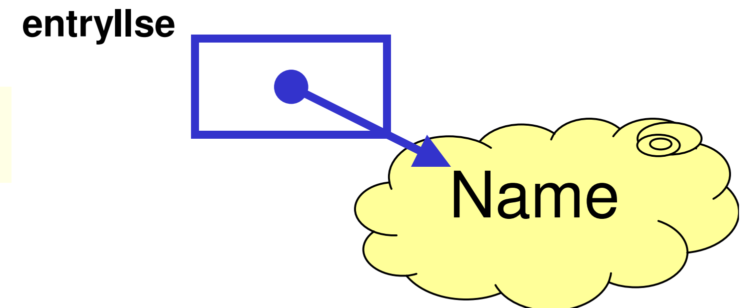
- Variable of Class Type

```
Name entryIlse;
```



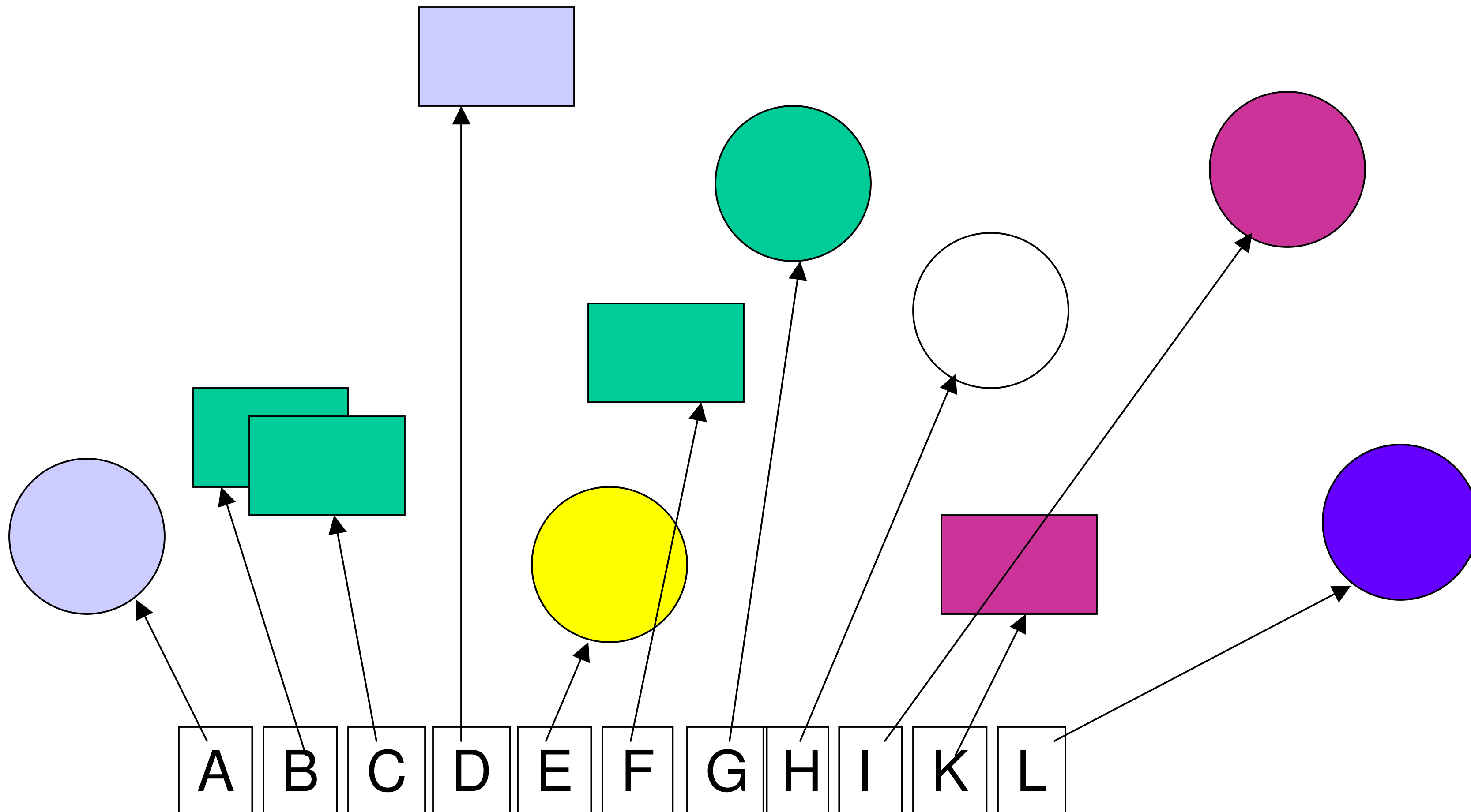
  - can store an object reference of given type:

```
entryIlse = new Name();
```



Objects and Variables

`new` can be used to create new Objects



Variables attach identifiers to them, so that they can be used.

Using different Objects

```
public class PhoneBook{
   public static void main(String[] args) {
      Name entryIlse = new Name();
      Name entryUwe = new Name();

      entryIlse.setRingingTone(emergency);
      entryUwe.setRingingtone(badinerie);
   }
}
```

not:
`Name.setRingingTone()`

- Variable (object reference) instead of class name
  action affects only one object of the class
- **`static`:**
  Attribute or method belongs to the class,
  is shared by all objects of the class,
  can even be used without any object (class name)

⇒ stop using **`static`** from now on!

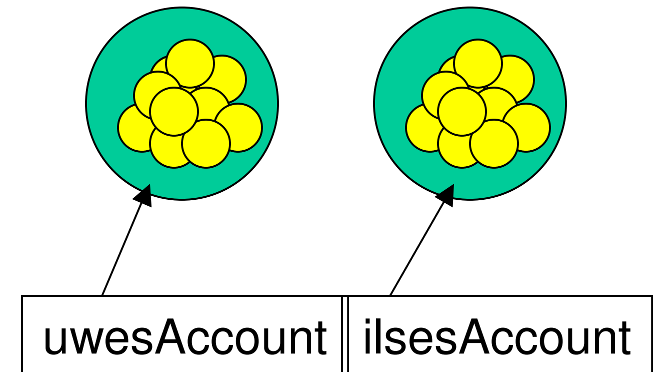
Static and Instance class Members

```
class Name {
  static int ownNumber;       // static, same for all Name objects
  static int defaultTone;
  static int defaultGroup;


  String lastName;            // object specific
  int homeNumber;             // or "instance specific"
  int officenumer;
  int cellNumber;
  String email;

  public static void setOwnNumber(int number);
  public static void setDefaultGroup(int group);
  public static void setDefaultTone(int tone);

  public int getHomeNumber();
  public void setHomeNumber();
  public int getOfficeNumber();
  public void setOfficeNumber();
  //...
}
```

Using Object Variables

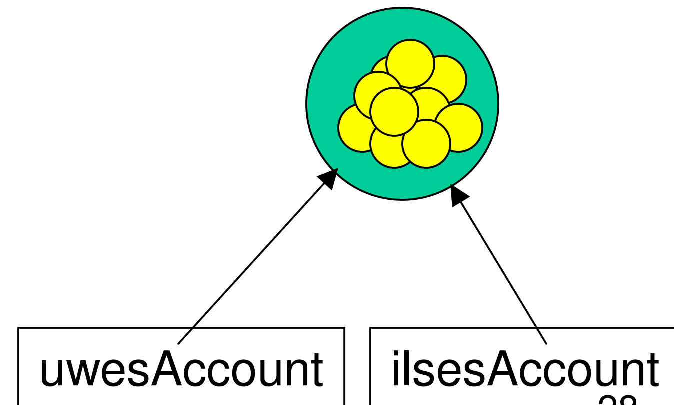
- **If two variables refer to different objects, their actions do not interfere:**

```
Account uwesAccount = new Account();
Account ilsesAccount = new Account();

ilsesAccount.withdraw(1000.00);
uwesAccount.withdraw(1000.00);
```



- **You can assign a variables to a variable, then they refer both to the same object:**

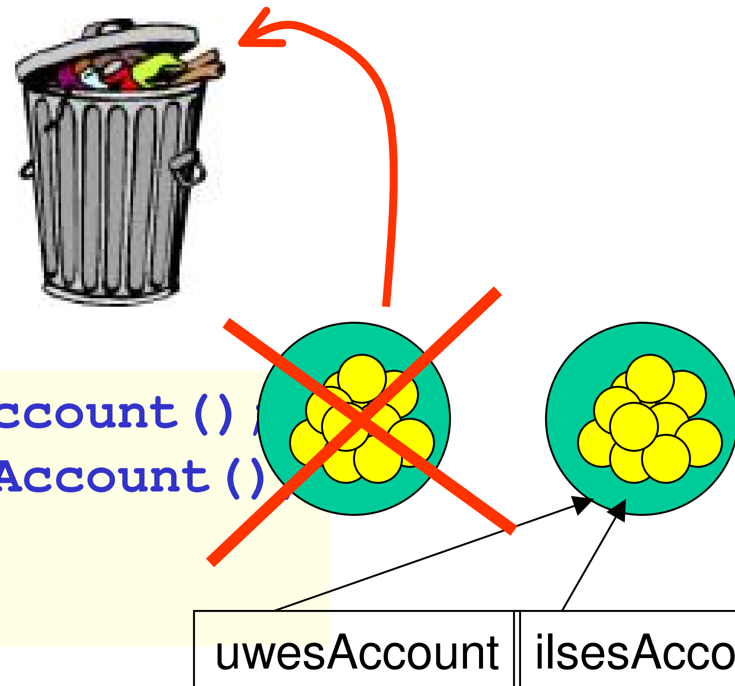
```
uwesAccount = ilsesAccount;

ilsesAccount.withhdraw(1000.00);
uwesAccount.withdraw(1000.00);
```



Loss of Objects

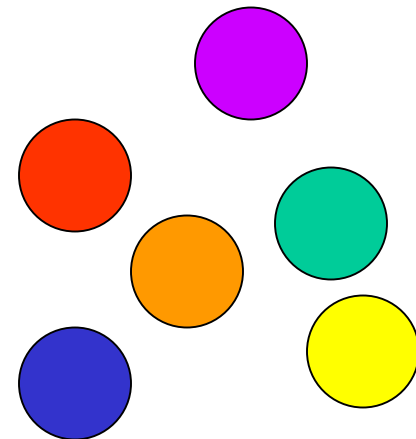
- Generally, objects live from their creation to the end of the program.
- If there is no reference to an object, it is lost (unreachable)
- In Java, a Garbage Collector collects these lost objects (at some time) and restores the storage space.

```
Account uwesAccount = new Account();
Account ilsesAccount = new Account();
uwesAccount = ilsesAccount;
// the old object is lost!
```



Juggling with Objects

```
Ball annaLeft, annaRight,
     timLeft, timRight;
annaLeft = new Ball("red");
annaRight = new Ball("blue");
timLeft = annaRight;
annaLeft = new Ball("yellow");
timRight = new Ball("green");
annaRight = annaLeft;
timLeft = new Ball("orange");
annaLeft = new Ball("purple");
```



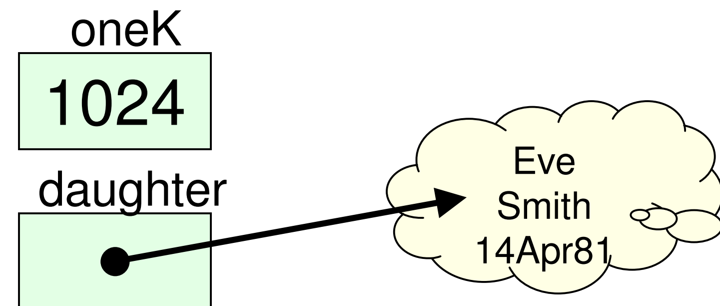
Who holds which ball? Which ones are lost?

Summary: Types

- Object types define object patterns.
- Variables of object types store references to objects.
- Using an object reference, you can call the object's methods.
- An object can have different states depending on ist attribute values.

- Primitive types have a direct representation on the machine– e.g. numbers.
- Values of primitve types are elements of a fixed set of values.
  They have no states.
- Variables of primitive types store values directly, not references to values.
- They cannot be used for method calls (but used with operators instead).

```
int oneK = 1024;
oneK.double() // error!

Person daughter = eve;
```



Some Java Standard Types

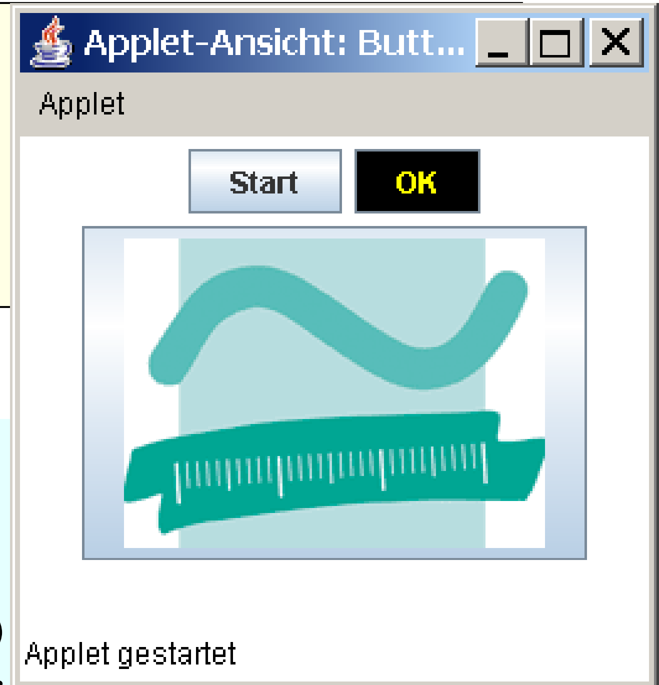
- `String`:
  - capitalize, get length, concatenate ...
- `DialogBox`
  - define text, show box, ...
- `JButton`
  - define text, change color, add action
- `Vector`
  - add object, find object, ...

....

Type JButton

```
JButton button1 = new JButton();
JButton button2 = new JButton();
JButton button3 = new JButton();
```

3 JButton objects




```
public void start() {
    button1.setText("Start");
    button2.setText("OK");
    button2.setForeground(Color.yellow);
    button2.setBackground(Color.black);
    button3.setIcon(new ImageIcon("tfh-logo_new.gif"));

}
```

Type String

```
String text = „    Niceto see you!    ";
text=text.trim();                  // → "Nice to see you!"
text=text.toUpperCase()            // → "NICE TO SEE YOU!"
text=text.toLowerCase()            // → "nice to see you!"
c = text.charAt(3)                 // → 'e' (always start with 0!!)
text = "hello, " + text            // → "hello, nice to see you!
text=text.replace(',','-');        // → "hello - nice to see you!"
```

String Literals

- special feature of class String:
  String objects can be "directly denoted"

```
String greeting = "Hi, old folks!"
```

- the text in quotes is called a Literal

- abbrieviating

```
String greeting =
     new String("Hi, old folks!");
```

The Java Documentation

String (Java 2 Platform SE v1.4.2) - Microsoft Internet Explorer

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Address http://java.sun.com/j2se/1.4.2/docs/api/

http://java.sun.com/j2se/1.5.0/docs/api/

java.beans.beanc
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Package
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StringBuffer
System
Thread
ThreadGroup
ThreadLocal
Throwable
Void

Exceptions

Overview Package Class Use Tree Deprecated Index Help *Java™ Std.*

PREV CLASS NEXT CLASS FRAMES NO FRAMES

SUMMARY: NESTED | FIELD | CONSTR | METHOD DETAIL: FIELD | CONSTR | METHOD

java.lang

Class String

```
java.lang.Object
  └java.lang.String
```

All Implemented Interfaces:

CharSequence, Comparable, Serializable

public final class **String**
extends Object
implements Serializable, Comparable, CharSequence

The `String` class represents character strings. All string literals in Java programs, such as `"abc"`, are implemented as instances of this class.

String (Java 2 Platform SE v1.4.2) - Microsoft Internet Explorer

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Address http://java.sun.com/j2se/1.4.2/docs/api/ Go

java.beans.bear
java.io
java.lang
java.lang.ref
java.lang.reflect
java.math

Package
Process
Runtime
RuntimePermiss
SecurityManage
Short
StackTraceElem
StrictMath
String
StringBuffer
System
Thread
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Exceptions

Method Summary

char	**charAt**(int index) Returns the character at the specified index.
int	**compareTo**(Object o) Compares this String to another Object.
int	**compareTo**(String anotherString) Compares two strings lexicographically.
int	**compareToIgnoreCase**(String str) Compares two strings lexicographically, ignoring case differences.
String	**concat**(String str) Concatenates the specified string to the end of this string.
boolean	**contentEquals**(StringBuffer sb) Returns `true` if and only if this `String` represents the same sequence of characters as the specified `StringBuffer`.
static String	**copyValueOf**(char[] data) Returns a String that represents the character sequence in the array specified.

cs101: Type Console

```
//...one of the cs101 library types:

    Console.print("Hel");
    Console.print("lo");
    Console.print(" World");
    Console.println("!");
    Console.println("Good morning!");

    Console.readln();
```

```
Hello World!
Good morning!
```

The cs101 Documentation

http://www.tfh-berlin.de/~ischmied
/Pr15/Uebungen/cs101Lib/Doc/

Console (Documentation for CS101 Package Problem Set) - Microsoft Internet Explorer

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CS101 Package

All Classes

ClientDialog
ClientWire
Coerce
ColorField
ConnectionRejecte
Connector
Console
Console
CreationException
DefaultFrame
DefaultGameFrame

Constructor Summary

Console() Create and display a new Console.

Method Summary

void	**print**(java.lang.String s) Write a line to Console.
void	**println**(java.lang.String s) Write a String to Console.
java.lang.String	**readln**() Read a line from Console.

My Computer

Example Person

Imagine a type for storing and working on personal data as follows:

```
public class Person {
    String name;
    String firstname;
    String address;
    String telefon;
    String fax;
    String bankaccount;
}
```

```
Person eva = new  Person();
eva.name = "Mayer";
eva.firstname = "Eva Maria";
Person adam = new Person();
adam.name = "Mayer";
adam.firstname = "Sven Adam";
```

Object State: Attributes

- Attributes are variables defined on class level. They belong to the type's blueprint.

```
class Person {
  String name;
  //....
}
```

- The state of an object of type Person at a given time is defined by the values of its attributes :

```
eva. name = "Müller";    // Initialisation
eva. name = adam.name;   // Marriage with Adam
```

- Attributes define the state of an object.
- Methods may use and modify this state.

Initialising Objects

- There is an initial state for each object:
  - start value of ist attributes.
- Java implicitly initializes all attributes
  - with default values (0, false, ' ', null)
- Explicit Initialization:
  - combined with attribute declaration
  - by initializing attributes "from outside"
  - through constructors

```
public class Person {
   int age = 18;  // explicite Initialisation
   int children;  // implicitely: 0
}
```

```
Person anna = new Person();
anna.children = 10;  // Initialisation from outside
```

(

Constructors

- constructors are methods that are called, when an Object is created (new)
- A constructor has the classe's name and no return type
- A constructor may have parameters
- constructors can be overloaded.

```
public class Person {
   int age, children;
   String firstname, name;

   public Person() {    // Standard constructor
     age = 18;
     name = "Mustermann";
   }
   public Person(String secondname) {
                      // additional constructor
      age = 18;
      name = secondname;
   }
}
```

So, now we can create and initialize all the objects we would like to use in our "own universe"....

After the break: let's learn about interfaces.

Create Your Own Universe

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Review Questions

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- What does the return statement do?
- What is the meaning of `private`?
- How do you determine the type of a statement?
- Can there be, in a single program :
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  - if they can be matched through implicit parameter type casting
  - if they only differ in their static modifier.

Test: Overloading

Which methods can coexist?

```
1. public int m(int a, String b);
2. public void m(int a);
3. public static void m(float a);
4. public int m(int a, boolean b);
5. private void m(boolean b);
6. private void m(long a);
```

Using Overloading

```
public class BusinessCards
{   // standard version
    public static void printCards
        (String name, String address,
         int number)
    { ... }
    // more options
    public static void printCards
        (String title, String name,
         String company,
         String addres,
         int layout, int number)
    { ... }
}
```

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- All you need to know to call a method correctly is found in the **method header**:

```
public static int meth(char c)
```

- It is also called **method signature** (or footprint)
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- The information needed to use a class properly is called its **export interface,**
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- It consist of all **public declarations**:
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  - Comments explaining the samantics

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- Console groups i/o behaviour
- Would you put a method called calculateMedian into Console?
  - No – it does not "fit".
  - Console methods deal with input and output.

Objects

- Objects in real life
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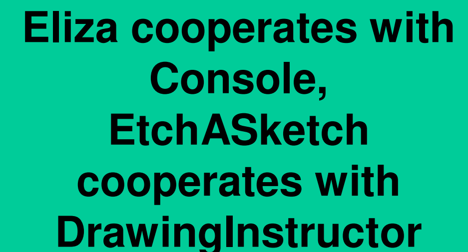
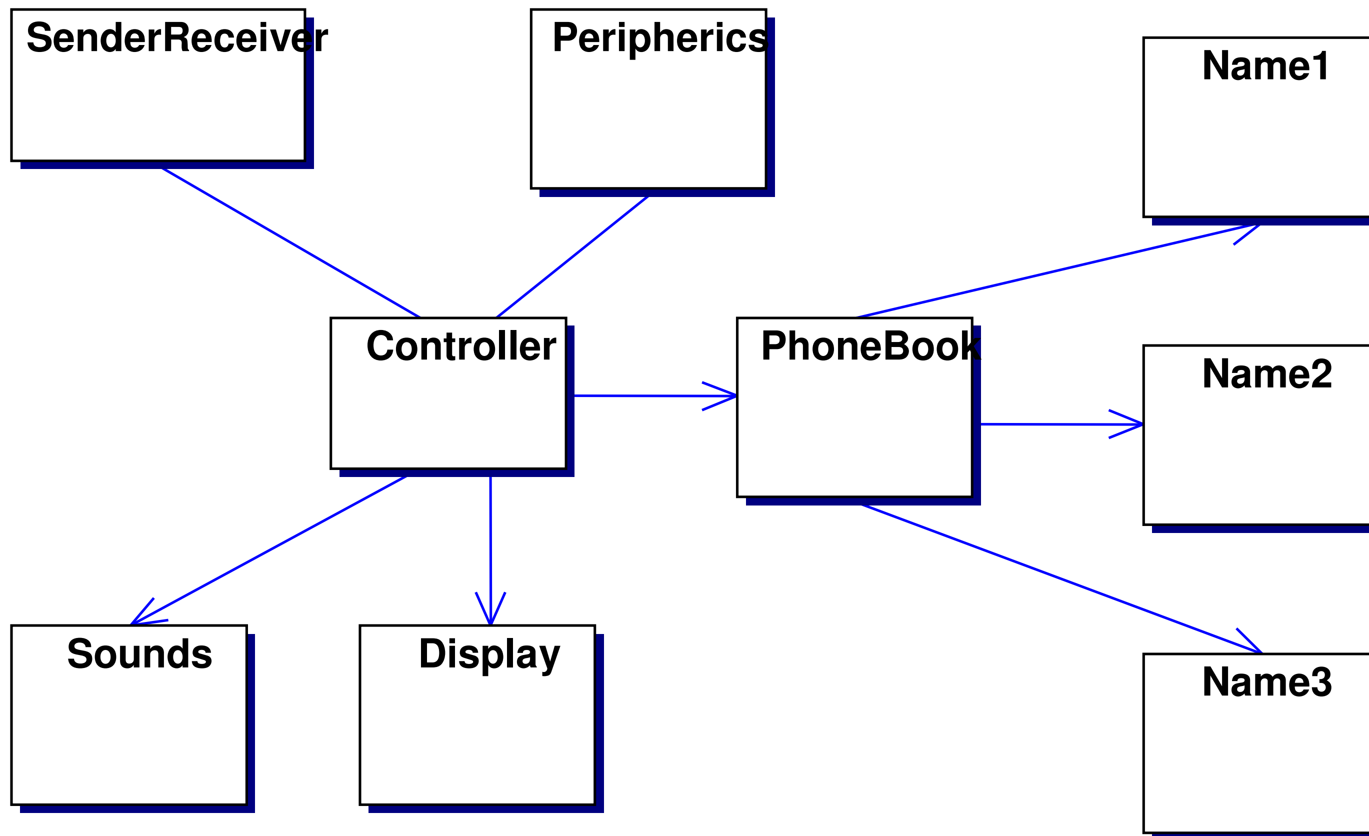
  - behave (work, react)
  - coorperate or interact
- Classes in a Program
  - store information
  - behave according to their methods
  - cooperate



Cell Phone:
System of Interacting Units



Controller (incoming call)

state: free / busy

rules of behaviour:

- incoming call notification (from Sender/Receiver)
  - → busy
  - - lookup name and personalized ringing tone
  - - display name
  - - sound ringing tone
- call rejected (from Peripherals)
  - - stop ringing
  - - display neutral
  - → free
- call accepted (from Peripherals)
  - - open connection
  - - display name and time lapse
  - - open mic and phones
- call finished (from Peripherals)
  - - close connection
  - - close mic and phones
  - - display neutral
  - → free

Display

state: current text, time lapse

rules of behaviour:

➢display call

- clear display
- display required text / screen

Phonebook

state: current entry

rules of behaviour:

➢lookup by number

- return name and ringing sound
- return null, if not found

➢lookup by name

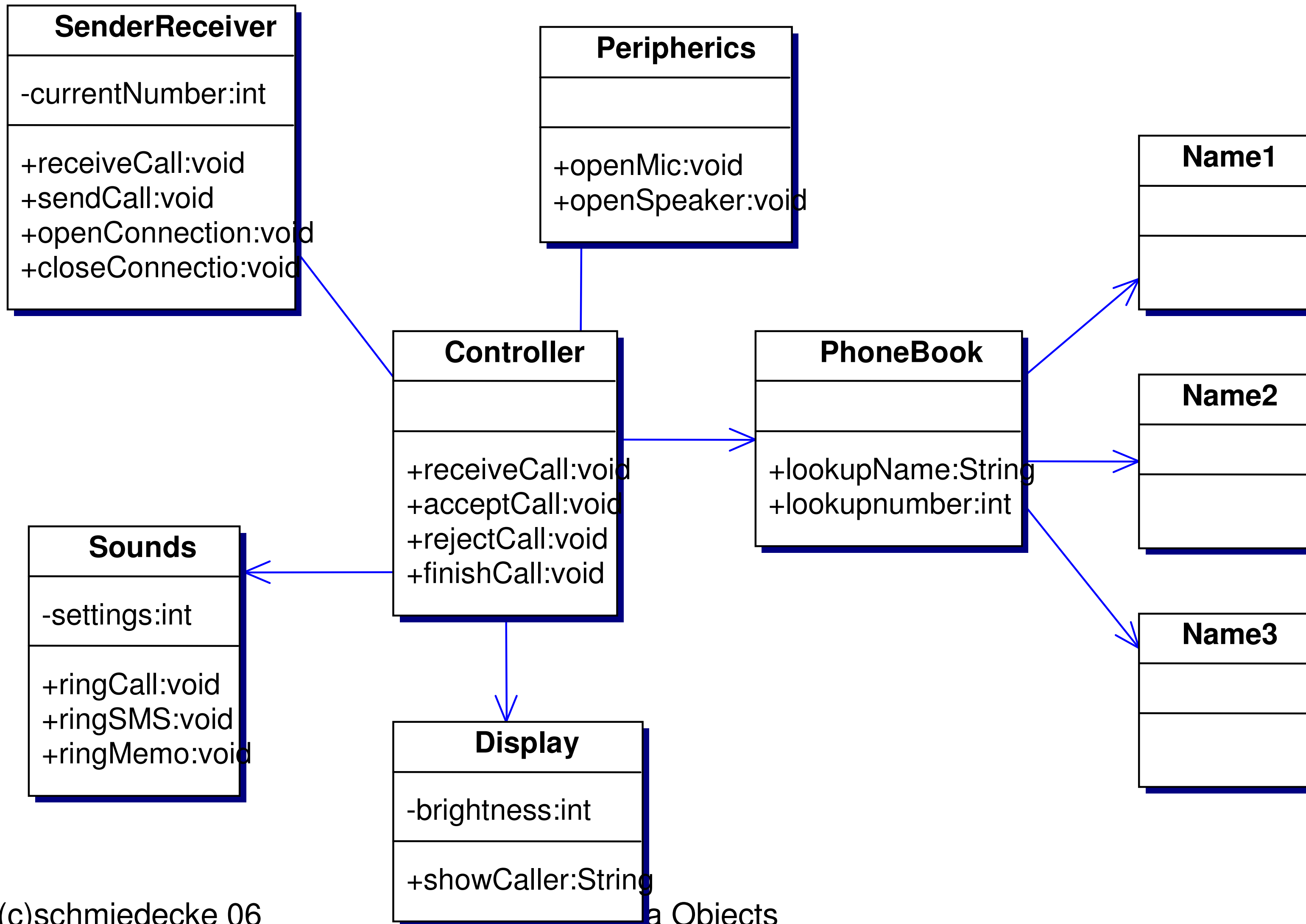
-return number
- return null, if not found

Sound

state: active / quiet, current sound

...

Cell Phone (Recieving call)



information

behavior

```
public class SenderReceiver {
  int currentCall = -100;
  public static void receiveCall(int number) {
    currentCall = number;
    Controller.receiveCall(number);
  }
  public static void sendCall(int number);
  public static void endCall();
  // ...
}
```

behavior

```
public class Controller {
  public static void receiveCall(int number) {
     Sounds.ringCall();
     String name = PhoneBook.lookupName(number);
     Display.showName(name);
  }
  public static void acceptCall();
  public static void rejectCall();
  public static void endCall();

  // ...
}
```

Programming interacting units

- I can program the Class Controller, if I have the specification of the classes Sound, Display, PhoneBook

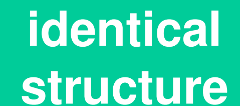
- In a System, each object contributes its behavior a the system, maybe using other objects' behavior.
- So a class can be considered an object...

II. Types and Objects

...Flaw in Concept

- Concept Class as Object credible → except for Name
- Just one class Name
- But we want many names in our phone book:

```
public class Name1 {
    static String name = "Helen";
    static int homeNumber = 007;
    static int cellNumber = 0815;
    editNumber();
}
public class Name2 {
    static String name = "Maurice";
    static int homeNumber = 2050;
    static int cellNumber = 0123;
    editNumber();
}
```



- *Problem1: program length ....*
- *Problem2: new entries*

Real Life Objects

- There are unique objects:
  - the Eiffel tower
  - the US president
  - the Control unit of your cell phone (within the system)
  - YOU...
- and there are many Objects that are instances of a type:
  - a lab workstation
  - a bicycle
  - a department
  - a phone book entry

Classes as Types

- Consider the unique object as a special case.
- Don't consider classes objects
- but as object blue prints,
  i.e. as **types:**

- A type defines
  - which information a "thing" can store → Attributes
  - and what can be done with this information
    → Methods

Class "Name" as Type

- A type defines
  - which information a "thing" can store → Attributes
  - and what can be done with this information → Methods
  - *another way of putting it: State Domain and Behavior Pattern*

Example: **Type Name**

State: name, home number, cell number, office number, group, ringing tone.

Behavior: edit name, edit number, add number, set group, set ringing tone, get home number, get cell number, ...

A Name Object (or "Name Instance")

An Object is an Entity which

- exists at runtime
- has a type
- possesses a *specific state* and
- shows a *specific behavior*

Example: **Name Object IlseSchmiedecke**

State: name = "ilse schmiedecke“
home number = 001-501-123456
cell number = 001 -251-665588
group = 24
ringing tone = emergency
Behavior: set group, get ringing tone…..

"Getter and Setter Methods"

- The state of an object is given by ist attribute values.
- Avoid making an attribute public.
- Define a set of functions to read the attributes - Getter:

```
public String getName();
public int getCellNumber();
```

- Define a set of void methods to change the attribute values - Setter:

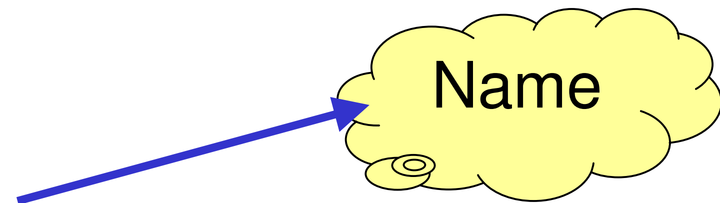
```
public void setName(String name);
public void setCellNumber(int number);
```

Creating Objects from Classes

- Type defined as a class:
-
```
public class Name { .... }
```

- Object Instantiation: operator new

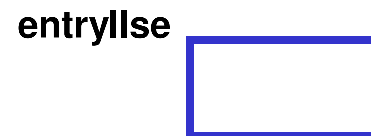
```
new Name()
```



  – creates a new object of type Name *somewhere in memory*
  – evaluating the new-expression yields a reference to the new object

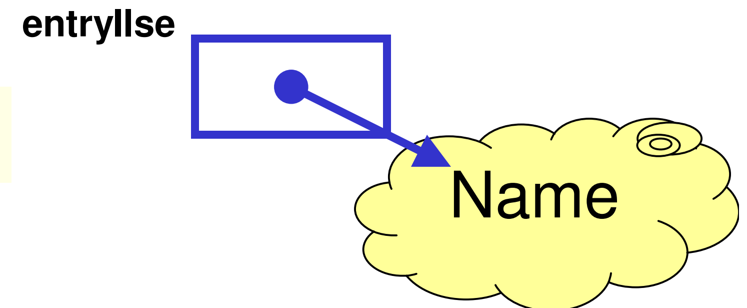
- Variable of Class Type

```
Name entryIlse;
```



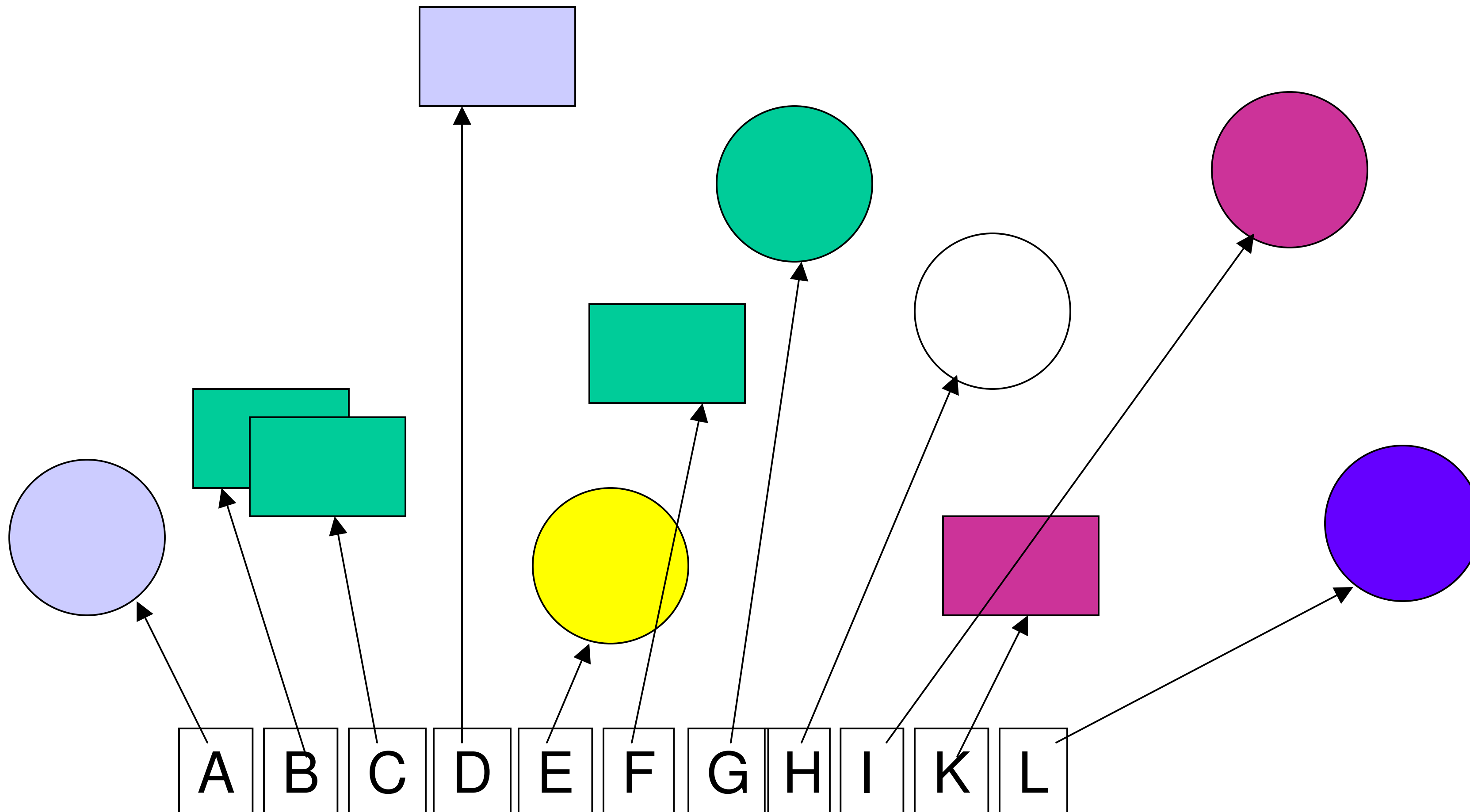
  - can store an object reference of given type:

```
entryIlse = new Name();
```



Objects and Variables

`new` can be used to create new Objects



Variables attach identifiers to them, so that they can be used.

Using different Objects

```
public class PhoneBook{
   public static void main(String[] args) {
      Name entryIlse = new Name();
      Name entryUwe = new Name();

      entryIlse.setRingingTone(emergency);
      entryUwe.setRingingtone(badinerie);
   }
}
```

not:
`Name.setRingingTone()`

- Variable (object reference) instead of class name
  action affects only one object of the class
- **`static`:**
  Attribute or method belongs to the class,
  is shared by all objects of the class,
  can even be used without any object (class name)

⇒ stop using **`static`** from now on!

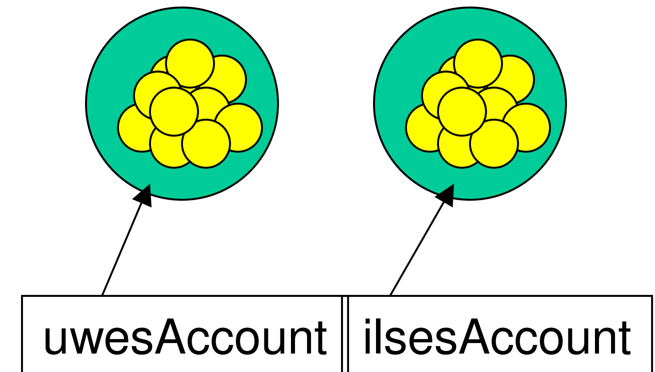
Static and Instance class Members

```
class Name {
  static int ownNumber;       // static, same for all Name objects
  static int defaultTone;
  static int defaultGroup;


  String lastName;            // object specific
  int homeNumber;             // or "instance specific"
  int officenumer;
  int cellNumber;
  String email;

  public static void setOwnNumber(int number);
  public static void setDefaultGroup(int group);
  public static void setDefaultTone(int tone);

  public int getHomeNumber();
  public void setHomeNumber();
  public int getOfficeNumber();
  public void setOfficeNumber();
  //...
}
```

Using Object Variables

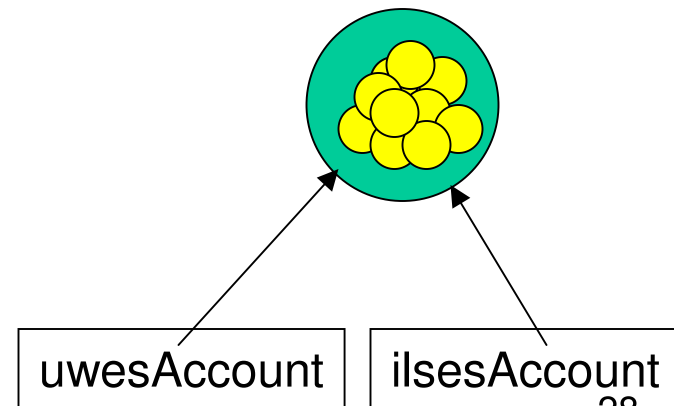
- **If two variables refer to different objects, their actions do not interfere:**

```
Account uwesAccount = new Account();
Account ilsesAccount = new Account();

ilsesAccount.withdraw(1000.00);
uwesAccount.withdraw(1000.00);
```



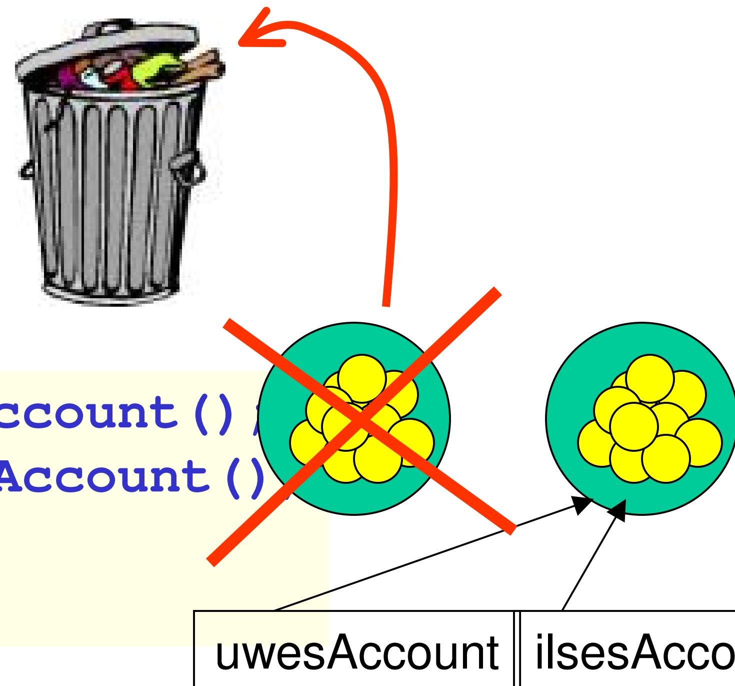
- **You can assign a variables to a variable, then they refer both to the same object:**

```
uwesAccount = ilsesAccount;

ilsesAccount.withhdraw(1000.00);
uwesAccount.withdraw(1000.00);
```



Loss of Objects

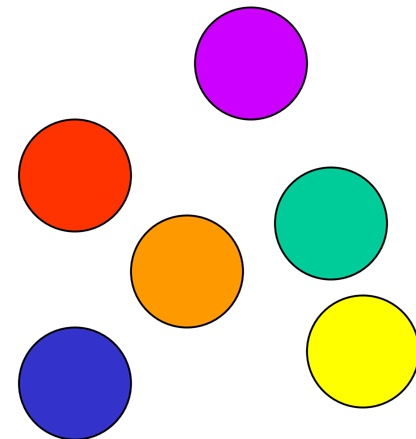
- Generally, objects live from their creation to the end of the program.
- If there is no reference to an object, it is lost (unreachable)
- In Java, a Garbage Collector collects these lost objects (at some time) and restores the storage space.




```
Account uwesAccount = new Account();
Account ilsesAccount = new Account();
uwesAccount = ilsesAccount;
// the old object is lost!
```

Juggling with Objects

```
Ball annaLeft, annaRight,
     timLeft, timRight;
annaLeft = new Ball("red");
annaRight = new Ball("blue");
timLeft = annaRight;
annaLeft = new Ball("yellow");
timRight = new Ball("green");
annaRight = annaLeft;
timLeft = new Ball("orange");
annaLeft = new Ball("purple");
```



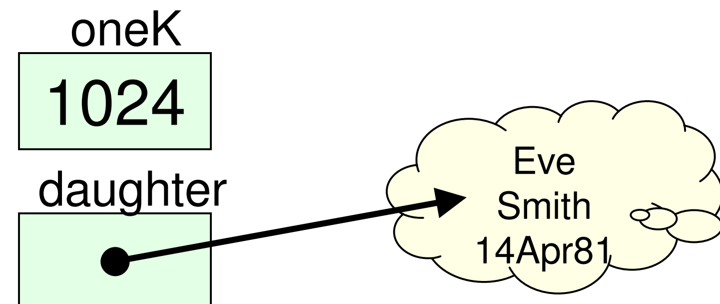
Who holds which ball? Which ones are lost?

Summary: Types

- Object types define object patterns.
- Variables of object types store references to objects.
- Using an object reference, you can call the object's methods.
- An object can have different states depending on ist attribute values.

- Primitive types have a direct representation on the machine– e.g. numbers.
- Values of primitve types are elements of a fixed set of values.
  They have no states.
- Variables of primitive types store values directly, not references to values.
- They cannot be used for method calls (but used with operators instead).

```
int oneK = 1024;
oneK.double() // error!

Person daughter = eve;
```



Some Java Standard Types

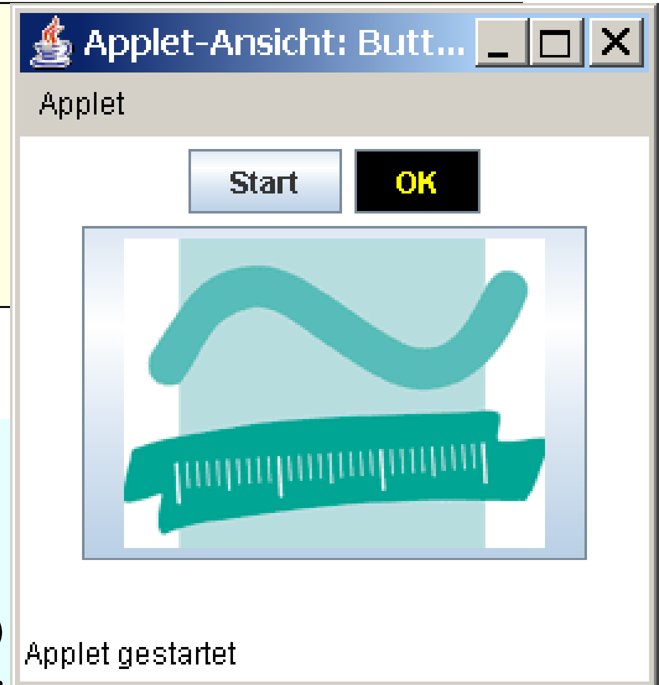
- `String`:
  - capitalize, get length, concatenate ...
- `DialogBox`
  - define text, show box, ...
- `JButton`
  - define text, change color, add action
- `Vector`
  - add object, find object, ...

....

Type JButton

```
JButton button1 = new JButton();
JButton button2 = new JButton();
JButton button3 = new JButton();
```

3 JButton objects




```
public void start() {
    button1.setText("Start");
    button2.setText("OK");
    button2.setForeground(Color.yellow);
    button2.setBackground(Color.black);
    button3.setIcon(new ImageIcon("tfh-logo_new.gif"));

}
```

Type String

```
String text = „    Niceto see you!    ";
text=text.trim();              // → "Nice to see you!"
text=text.toUpperCase()        // → "NICE TO SEE YOU!"
text=text.toLowerCase()        // → "nice to see you!"
c = text.charAt(3)             // → 'e' (always start with 0!!)
text = "hello, " + text        // → "hello, nice to see you!
text=text.replace(',','-');    // → "hello - nice to see you!"
```

String Literals

- special feature of class String:
  String objects can be "directly denoted"

```
String greeting = "Hi, old folks!"
```

- the text in quotes is called a Literal

- abbrieviating

```
String greeting =
     new String("Hi, old folks!");
```

The Java Documentation

http://java.sun.com/j2se/1.5.0/docs/api/

String (Java 2 Platform SE v1.4.2) - Microsoft Internet Explorer

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Address http://java.sun.com/j2se/1.4.2/docs/api/

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Exceptions

Overview Package **Class** Use Tree Deprecated Index Help *Java™*
Std.

PREV CLASS NEXT CLASS FRAMES NO FRAMES
SUMMARY: NESTED | FIELD | CONSTR | METHOD DETAIL: FIELD | CONSTR | METHOD

java.lang

Class String

```
java.lang.Object
  └java.lang.String
```

All Implemented Interfaces:
CharSequence, Comparable, Serializable

public final class **String**
extends Object
implements Serializable, Comparable, CharSequence

The `String` class represents character strings. All string literals in Java programs, such as `"abc"`, are implemented as instances of this class.

String (Java 2 Platform SE v1.4.2) - Microsoft Internet Explorer

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Address http://java.sun.com/j2se/1.4.2/docs/api/ Go

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String
StringBuffer
System
Thread
ThreadGroup
ThreadLocal
Throwable
Void

Exceptions

Method Summary

char	**charAt**(int index) Returns the character at the specified index.
int	**compareTo**(Object o) Compares this String to another Object.
int	**compareTo**(String anotherString) Compares two strings lexicographically.
int	**compareToIgnoreCase**(String str) Compares two strings lexicographically, ignoring case differences.
String	**concat**(String str) Concatenates the specified string to the end of this string.
boolean	**contentEquals**(StringBuffer sb) Returns `true` if and only if this `String` represents the same sequence of characters as the specified `StringBuffer`.
static String	**copyValueOf**(char[] data) Returns a String that represents the character sequence in the array specified.

cs101: Type Console

```
//...one of the cs101 library types:

   Console.print("Hel");
   Console.print("lo");
   Console.print(" World");
   Console.println("!");
   Console.println("Good morning!");

   Console.readln();
```

```
Hello World!
Good morning!
```

The cs101 Documentation

http://www.tfh-berlin.de/~ischmied /Pr15/Uebungen/cs101Lib/Doc/

Console (Documentation for CS101 Package Problem Set) - Microsoft Internet Explorer

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Address F:\Prog1\Pr15\Uebungen\cs101Lib\Doc\index.html Go

CS101 Package

All Classes

ClientDialog
ClientWire
Coerce
ColorField
ConnectionRejecte
Connector
Console
Console
CreationException
DefaultFrame
DefaultGameFrame

Constructor Summary

`Console()`
Create and display a new Console.

Method Summary

void	`print(java.lang.String s)` Write a line to Console.
void	`println(java.lang.String s)` Write a String to Console.
java.lang.String	`readln()` Read a line from Console.

My Computer

Example Person

Imagine a type for storing and working on personal data as follows:

```
public class Person {
    String name;
    String firstname;
    String address;
    String telefon;
    String fax;
    String bankaccount;
}
```

```
Person eva = new  Person();
eva.name = "Mayer";
eva.firstname = "Eva Maria";
Person adam = new Person();
adam.name = "Mayer";
adam.firstname = "Sven Adam";
```

Object State: Attributes

- Attributes are variables defined on class level. They belong to the type's blueprint.

```
class Person {
  String name;
  //....
}
```

- The state of an object of type Person at a given time is defined by the values of its attributes :

```
eva. name = "Müller";    // Initialisation
eva. name = adam.name;   // Marriage with Adam
```

- Attributes define the state of an object.
- Methods may use and modify this state.

Initialising Objects

- There is an initial state for each object:
  - start value of ist attributes.
- Java implicitly initializes all attributes
  - with default values (0, false, ' ', null)
- Explicit Initialization:
  - combined with attribute declaration
  - by initializing attributes "from outside"
  - through constructors

```
public class Person {
   int age = 18;  // explicite Initialisation
   int children;  // implicitely: 0
}
```

```
Person anna = new Person();
anna.children = 10;  // Initialisation from outside
```

Constructors

- constructors are methods that are called, when an Object is created (new)
- A constructor has the classe's name and no return type
- A constructor may have parameters
- constructors can be overloaded.

```
public class Person {
   int age, children;
   String firstname, name;

   public Person() {   // Standard constructor
     age = 18;
     name = "Mustermann";
   }
   public Person(String secondname) {
                       // additional constructor
      age = 18;
      name = secondname;
   }
}
```

So, now we can create and initialize all the objects we would like to use in our "own universe"....

After the break:
let's learn about interfaces.