



Einführung in die Programmierung Introduction to Programming

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Exercise Session 2



- Assignments
 - One assignment per week
 - Will be put online on Monday, due on Tuesday the next week
- Testat
 - You have to hand in $n - 1$ out of n assignments
 - Must include the last one
 - Show serious effort
 - You have to hand in two mock exams
 - Military service or illness -> contact assistant
- Group mailing list
 - Is everybody subscribed?



- Give you the intuition behind object-oriented (OO) programming
- Teach you about formatting your code
- Distinguishing between
 - commands and queries
 - feature declaration and feature call
- Understanding feature call chains
- Getting to know the basics of EiffelStudio

Classes and objects



- Classes are pieces of software code.
- Several classes make up a program.
- Objects are instances of classes.
- Classes define operations applicable to their instances.
 - Example: A class *STUDENT* can define operations applicable to all its instances, such as subscribing to a course, registering for an exam, etc. This means that all class *STUDENT*'s instances (such as the students Bob, Mike, Steve, etc.) will be able to subscribe themselves to a course, to register for an exam, etc.
- Only operations defined in a class can be applied to its instances.

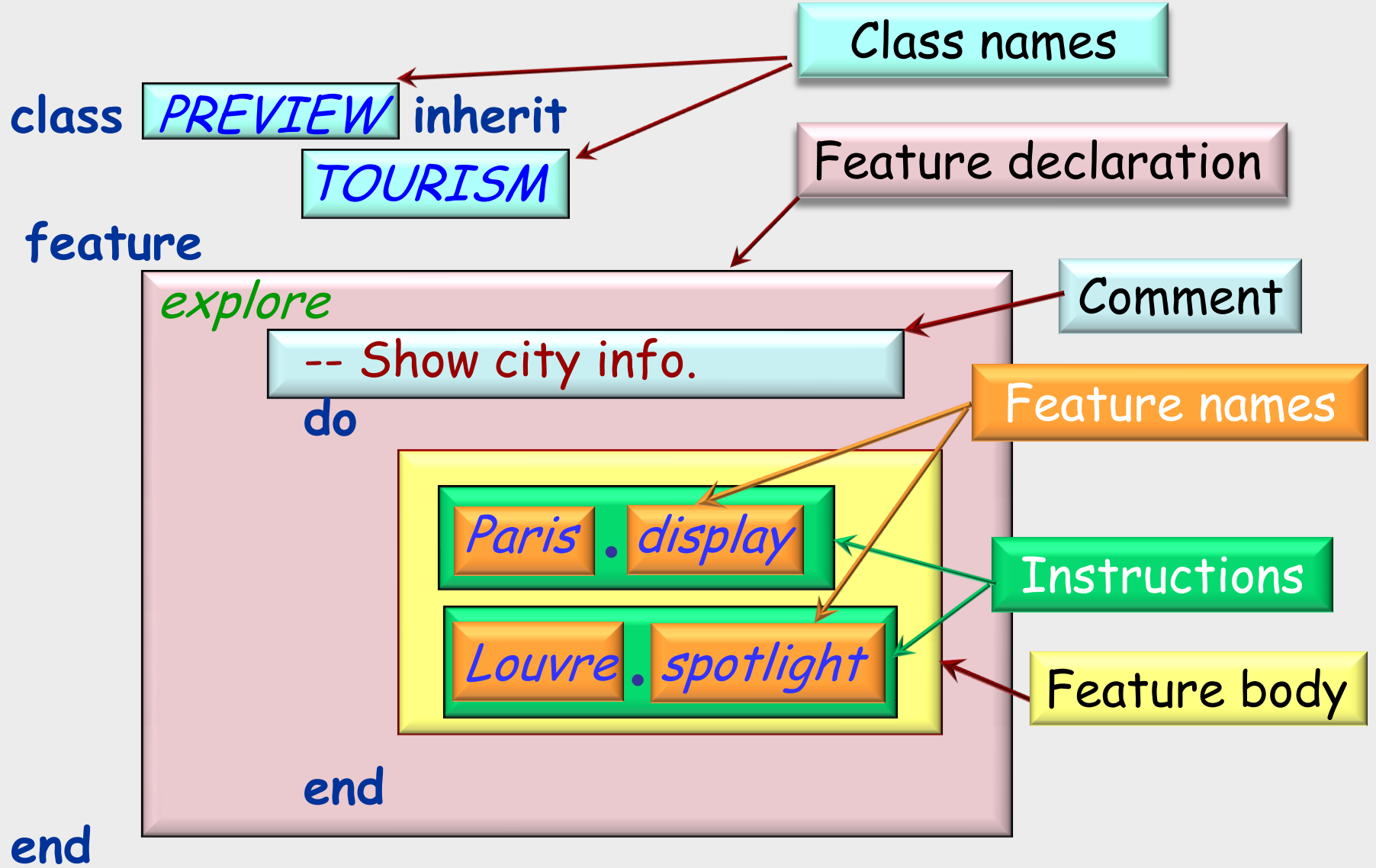
- A feature is an operation that programs may apply to certain classes of objects. A feature can be called on an object. This object is called the target of the feature call.
- Examples
 - *next_message.send*
 - *computer.shut_down*
 - *telephone.ring*
- A feature call can have arguments.
- Examples
 - *next_message.send_to (recipient)*
 - *computer.shut_down_after (3)*
 - *telephone.ring_several (10, Loud)*

Features: Exercise

Hands-On

- Class *BANK_ACCOUNT* defines and implements the following operations:
 - *deposit (i: INTEGER)*
 - *withdraw (i: INTEGER)*
 - *close*
- If *b: BANK_ACCOUNT* (*b* is an instance of class *BANK_ACCOUNT*) which of the following feature calls are possible:
 - *b.deposit (10)* ✓
 - *b.deposit* ✗
 - *b.close* ✓
 - *b.close ("Now")* ✗
 - *b.open* ✗
 - *b.withdraw (100.50)* ✗
 - *b.withdraw (0)* ✓

Class text



Style rule



For indentation, use tabs,
not spaces

Use this property to
highlight the **structure**
of the program,
particularly through
indentation

Tabs

```
class
  PREVIEW

inherit
  TOURISM

feature
  explore
    -- Show city info
    -- and route.
    do
      Paris.display
      Louvre.spotlight
      Line8.highlight
      Route1.animate
    end
  end
end
```


More style rules



Class name: all upper-case

Period in feature call: no space before or after

Names of predefined objects: start with upper-case letters

New names (for objects you define) start with lower-case letters

```
class
  PREVIEW
inherit
  TOURISM
feature
  explore
    -- Show city info
    -- and route.
  do
    Paris.display
    Louvre.spotlight
    Line8.highlight
    Route1.animate
  end
end
```

Even more style rules



For features, use full names, not abbreviations

Always choose identifiers that clearly identify the intended role

Use words from natural language (preferably English) for the names you define

For multi-word identifiers, use underscores

```
class
  PREVIEW
inherit
  TOURISM
feature
  explore
    -- Show city info
    -- and route.
  do
    Paris.display
    Louvre.spotlight
    Line8.highlight
    Line8.remove_all_sections
    Route1.animate
  end
end
```

Exercise: style rules

Hands-On

- Format this class:

```
class bank_account
feature deposit (sum: INTEGER)
  -- Add `sum` to the account.
do balance := balance + sum end
  balance: INTEGER end
```

Exercise: solution



class

BANK_ACCOUNT

feature

deposit (sum: INTEGER)

-- Add `sum` to the account.

do

balance := balance + sum

end

balance: INTEGER

end



- A feature can be a:
 - Command: a feature that may modify an object
 - Query: a feature that accesses an object



- Goal: obtain properties of objects
- Always return a value.
- Should not modify any objects.
- Examples
 - What is the name of a person?
 - What is the age of a person?
 - What is the id of a student?
 - Is a student registered for a particular course?
 - Are there any places left in a certain course?
 - ... other examples?



- Goal: produce a change on an object, or several
- Does not return a value.
- May modify objects.
- Examples
 - Register a student to a course
 - Assign an id to a student
 - Record the grade a student got in an exam
 - ... other examples?

Exercise: query or command?

Hands-On

- What is the balance of a bank account?
- Withdraw some money from a bank account
- Who is the owner of a bank account?
- Who are the clients of a bank whose deposits are over 100,000 CHF?
- Change the account type of a client
- How much money can a client withdraw at a time?
- Set a minimum limit for the balance of accounts
- Is Steve Jobs a client of Credit Suisse?



"**Asking** a question **shouldn't change** the answer"

i.e. a query

Query or command?



class *DEMO*

feature

command

procedure_name (*a1*: *T1*; *a2*, *a3*: *T2*)

-- *Comment*

do

...

end

query

function_name (*a1*: *T1*; *a2*, *a3*: *T2*): *T3*

-- *Comment*

do

Result := ...

predefined local
variable denoting
the result

end

query

attribute_name: *T3*

-- *Comment*

end

➤ no result

➤ body

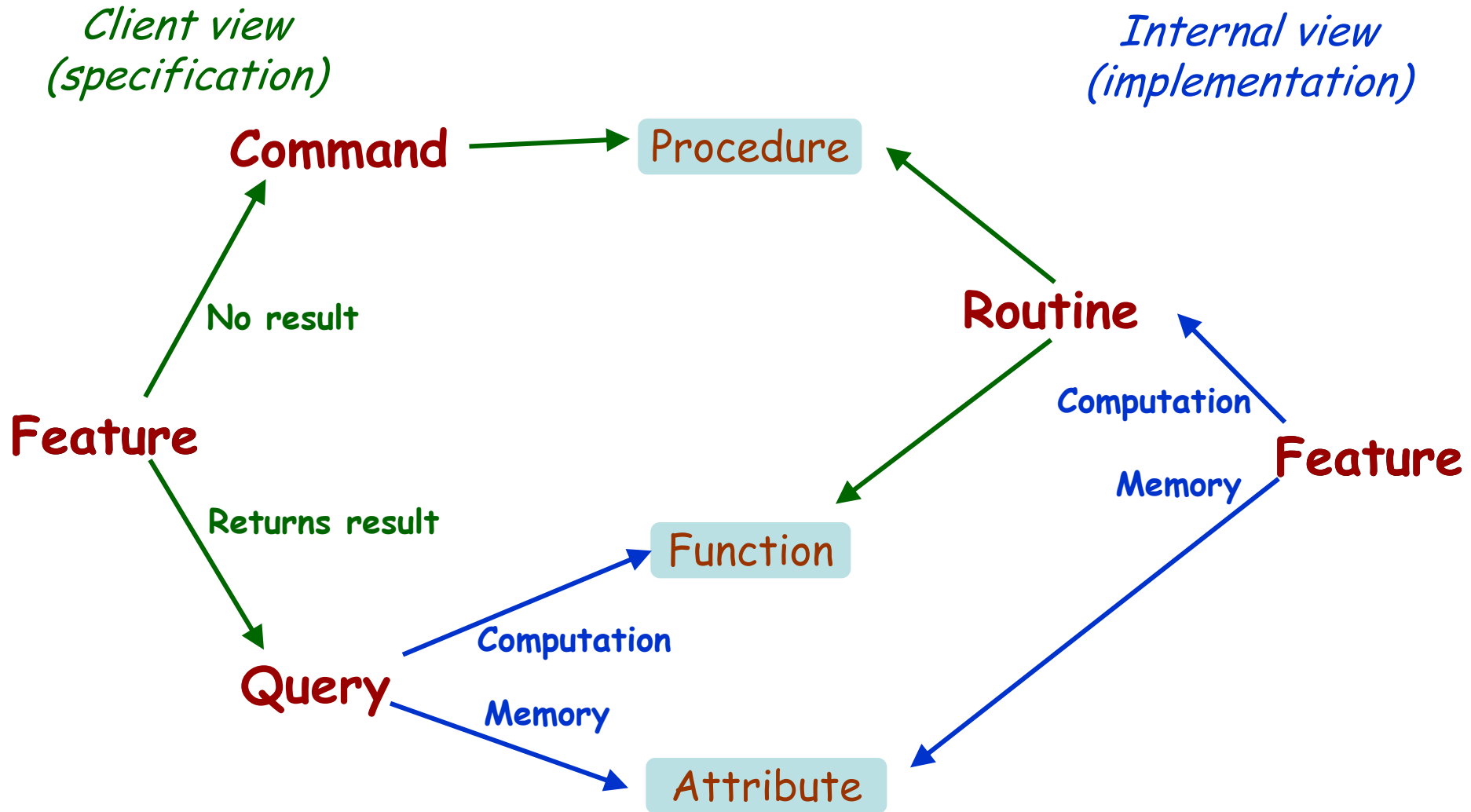
➤ result

➤ body

➤ result

➤ no body

Features: the full story



Feature declaration vs. feature call



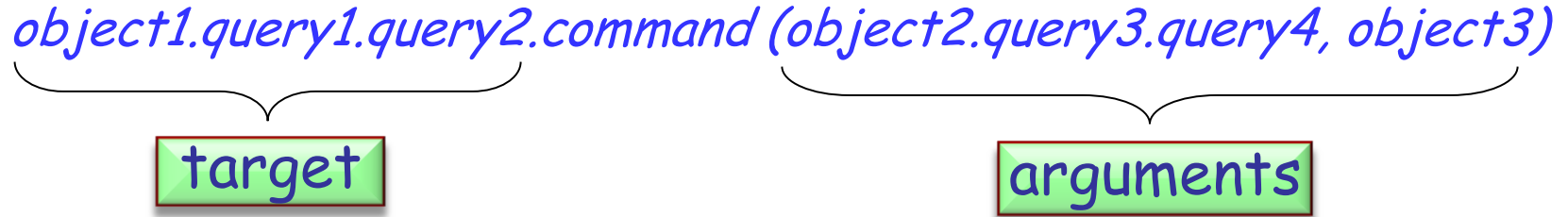
- You declare a feature when you write it into a class.

```
set_name (a_name: STRING)  
  -- Set 'name' to 'a_name'.  
  do  
    name := a_name  
  end
```

- You call a feature when you apply it to an object.

```
a_person.set_name ("Peter")
```

General form of feature call instructions



- Targets and arguments can contain feature calls themselves.

Hands-On

- Where are *query1*, *query2*, *query3* and *query4* defined?
- Where is *command* defined?

Unqualified vs. qualified feature calls



- It is possible to leave out the target in a feature call. Such a call is called **unqualified**. The implicit target will be the current object. A **qualified** feature call has a target.
- The **current object** in a feature is always the instance of the surrounding class.

```
assign_same_name (a_name: STRING; a_other_person: PERSON)  
  -- Set 'a_name' to this person and 'a_other_person'.
```

```
do
```

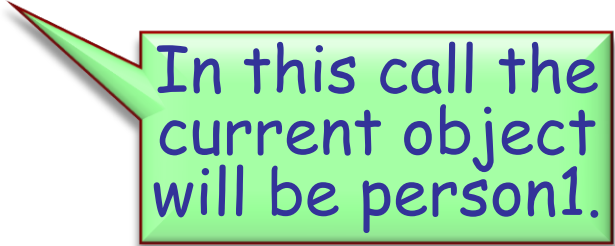
```
  a_other_person.set_name(a_name) 
```

```
  set_name(a_name)
```

```
end
```

 unqualified call:
Current.set_name(a_name)

```
person1.assign_same_name("Hans", person2)
```

 In this call the current object will be person1.

- EiffelStudio is a software tool (IDE) to develop Eiffel programs.

Integrated Development Environment

- Help & Resources

- Online tour in the help of EiffelStudio
- <http://www.eiffel.com/>
- <http://docs.eiffel.com/>
- <http://www.ecma-international.org/publications/files/ECMA-ST/ECMA-367.pdf>



- editor
- context tool
- clusters pane
- features pane
- compiler
- project settings
- ...



- Syntax highlighting
- Syntax completion
- Class name completion (SHIFT+CTRL+Space)
- Smart indenting
- Block indenting or unindenting (TAB and SHIFT+TAB)
- Block commenting or uncommenting (CTRL+K and SHIFT+CTRL+K)
- Infinite level of Undo/Redo (reset after a save)
- Quick search features (first CTRL+F to enter words then F3 and SHIFT+F3)

- Uses incremental compilation
 - freezing: Generates C code from the whole system and then compiles it to machine code. This code is used during development. Initially the system is frozen.
 - melting: Generates bytecode for the changed parts of the system. This is much faster than freezing. This code is used during development.
 - finalizing: Creates an executable production version. Finalization performs extensive time and space optimizations.





- The system must be melted/frozen (finalized systems cannot be debugged).
- Set / delete breakpoints
 - An efficient way of adding breakpoints consists in dropping a feature in the context tool.
 - Click in the margin to enable/disable single breakpoints.
- Use the toolbar debug buttons to enable or disable all breakpoints globally.



- Run the program by clicking on the Run button.
- Pause by clicking on the Pause button or wait for a triggered breakpoint.
- Analyze the program:
 - Use the call stack pane to browse through the call stack.
 - Use the object tool to inspect the current object, the locals and arguments.
- Run the program or step over / into the next statement.
- Stop the running program by clicking on the Stop button.



The following slides contain advanced material and are optional.



- Syntax comparison: Eiffel vs Java
- Naming in Eiffel
- Feature comments: Less is better (sometimes...)

Eiffel vs Java: Class declaration



```
class  
    ACCOUNT  
end
```

```
class Account {  
  
}
```



```
class
    ACCOUNT
inherit
    ANY
end
```

```
public class Account
    extends Object {
}
}
```




```
class
  ACCOUNT
inherit
  ANY
  redefine out end
feature
  out: STRING
  do
    Result := "abc"
  end
end
```

```
public class Account
  extends Object {
  String toString() {
    return "abc";
  }
}
```

Eiffel vs Java: Precursor call



```
class
  ACCOUNT
inherit
  ANY
  redefine out end
feature
  out: STRING
  do
    Result :=
      Precursor {ANY}
  end
end
```

```
public class Account
  extends Object {
  String toString() {
    return super();
  }
}
```

```
deferred class
  ACCOUNT
feature
  deposit (a: INT)
  deferred
  end
end
```

```
abstract class Account {
  abstract void
  deposit(int a);
}
```



```
frozen class
    ACCOUNT
inherit
    ANY
end
```

```
final class Account
    extends Object {
}
}
```



expanded class
ACCOUNT
end

int, float, double, char



```
class
    ACCOUNT
create
    make
feature
    make do end
end
```

```
public class Account {
    public Account() {}
}
```

Eiffel vs Java: Constructor overloading



```
class
  ACCOUNT
create
  make, make_amount
feature
  make do end
  make_amount (a: INT)
  do end

end
```

```
public class Account {
  public Account() {}
  public Account(int a) {}
}
```

Eiffel vs Java: Overloading



```
class
  PRINTER
feature
  print_int (a: INTEGER)
    do end
  print_real (a: REAL)
    do end
  print_string (s: STRING)
    do end
end
```

```
public class Printer {
  public print(int i) {}
  public print(float f) {}
  public print(String s)
  {}
}
```


Eiffel vs Java: Exception Handling



```
class
  PRINTER
feature
  print_int (a: INTEGER)
    do
      (create EXCEPTION).raise
    rescue
      retry
    end
end
```

```
public class Printer {
  public print(int i) {
    try {
      throw new Exception()
    }
    catch(Exception e) {
    }
  }
}
```

Eiffel vs Java: Conditional



```
class
  PRINTER
feature
  print
  do
    if True then

  else

  end
end
end
```

```
public class Printer {
  public print() {
    if (true) {
    }
    else {
    }
  }
}
```

Eiffel vs Java: Loop 1



```
print  
  local  
    i: INTEGER  
  do  
    from  
      i := 1  
    until  
      i >= 10  
    loop  
      i := i + 1  
    end  
  end  
end
```

```
public class Printer {  
  public print() {  
    for(int i=1;i<10;i++) {  
    }  
  }  
}
```

Eiffel vs Java: Loop 2



```
print  
  local  
    i: INTEGER  
  do  
    from  
      i := 1  
    until  
      i >= 10  
    loop  
      i := i + 1  
    end  
  end  
end
```

```
public class Printer {  
  public print() {  
    int i=1;  
    while(i<10) {  
      i++;  
    }  
  }  
}
```

Eiffel vs Java: Loop 3



```
print  
do  
  from  
    list.start  
  until  
    list.after  
  loop  
    list.item.print  
    list.forth  
  end  
end
```

```
public class Printer {  
  public print() {  
    for(Element e: list) {  
      e.print();  
    }  
  }  
}
```

ECMA committee is discussing about foreach for Eiffel



- Full words, no abbreviations (with some exceptions)
- Classes have global namespace
 - Name clashes arise
- Usually, classes are prefixed with a library prefix
 - Traffic: TRAFFIC_
 - EiffelVision2: EV_
 - Base is not prefixed



- Full words, no abbreviations (with some exceptions)
- Features have namespace per class hierarchy
 - Introducing features in parent classes, can clash with features from descendants



- Locals and arguments share namespace with features
 - Name clashes arise when a feature is introduced, which has the same name as a local (even in parent)
- To prevent name clashes:
 - Locals are prefixed with **l_**
 - Some exceptions like „i“ exist
 - Arguments are prefixed with **a_**



tangent_from (p: POINT): LINE

- Return the tangent line to the current circle
- going through the point p, if the point
- is outside of the current circle.

require

outside_circle: not has (p)

Example is from http://dev.eiffel.com/Style_Guidelines



tangent_from (p: POINT): LINE

- The tangent line to the current circle
- going through the point p, if the point
- is outside of the current circle.

require

outside_circle: not has (p)

Feature comments: Version 3



tangent_from (p: POINT): LINE

- Tangent line to current circle from point p
- if the point is outside of the current circle.

require

outside_circle: not has (p)

Feature comments: Version 4



tangent_from (p: POINT): LINE

-- Tangent line to current circle from point p.

require

outside_circle: not has (p)



tangent_from (p: POINT): LINE

-- Tangent from p.

require

outside_circle: not has (p)



```
tangent_from (p: POINT): LINE
```

```
-- Tangent from p.
```

```
--
```

```
-- `p`: The point from ...
```

```
-- `Result`: The tangent line ...
```

```
--
```

```
-- The tangent is calculated using the
```

```
-- following algorithm:
```

```
-- ...
```

```
require
```

```
outside_circle: not has (p)
```

Feature comments: Inherited comments



tangent_ from (p: POINT): LINE

-- <Precursor>

require

outside_circle: not has (p)

Ideas for future sessions



- Inheritance concepts: Single/Multiple/Non-conforming
- CAT Calls (Covariance and generics)
- Once/Multiple inheritance vs. Static
- Exception handling
- Design by contract in depth
- Void-safety
- Modeling concepts
- Best practices in Eiffel
- A look at ECMA specification of Eiffel