ETH Zürich

Chair of Software Engineering

Einführung in die Programmierung
Introduction to Programming

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Exercise Session 2

Organizational

- Assignments
  - One assignment per week
  - Will be put online Friday (before 17:00)
  - Should be handed in within eleven days (Tuesday, before 23:59)
- 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?

Today

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

Classes and objects

- The main concept in Object-Oriented programming is the concept of Class.
- Classes are pieces of software code meant to model concepts, e.g. "student", "course", "university".
- Several classes make up a program in source code form.
- Objects are particular occurrences ("instances") of concepts (classes), e.g. "student Reto" or "student Lisa".
- A class *STUDENT* may have many instances.

Classes and objects (again)

- Classes are like templates (or molds) defining status and operations applicable to their instances.

- A sample class *STUDENT* can define:
  - A student's status: id, name and birthday
  - Operations applicable to all students: subscribe to a course, register for an exam.
- Each instance (object) of class *STUDENT* will store a student's name, id and birthday and will be able to execute operations such that subscribe to a course and register for an exam.

- Only operations defined in a class can be applied to its instances.

Features

- A feature is an operation that may be applied to certain classes of objects.

- **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
```

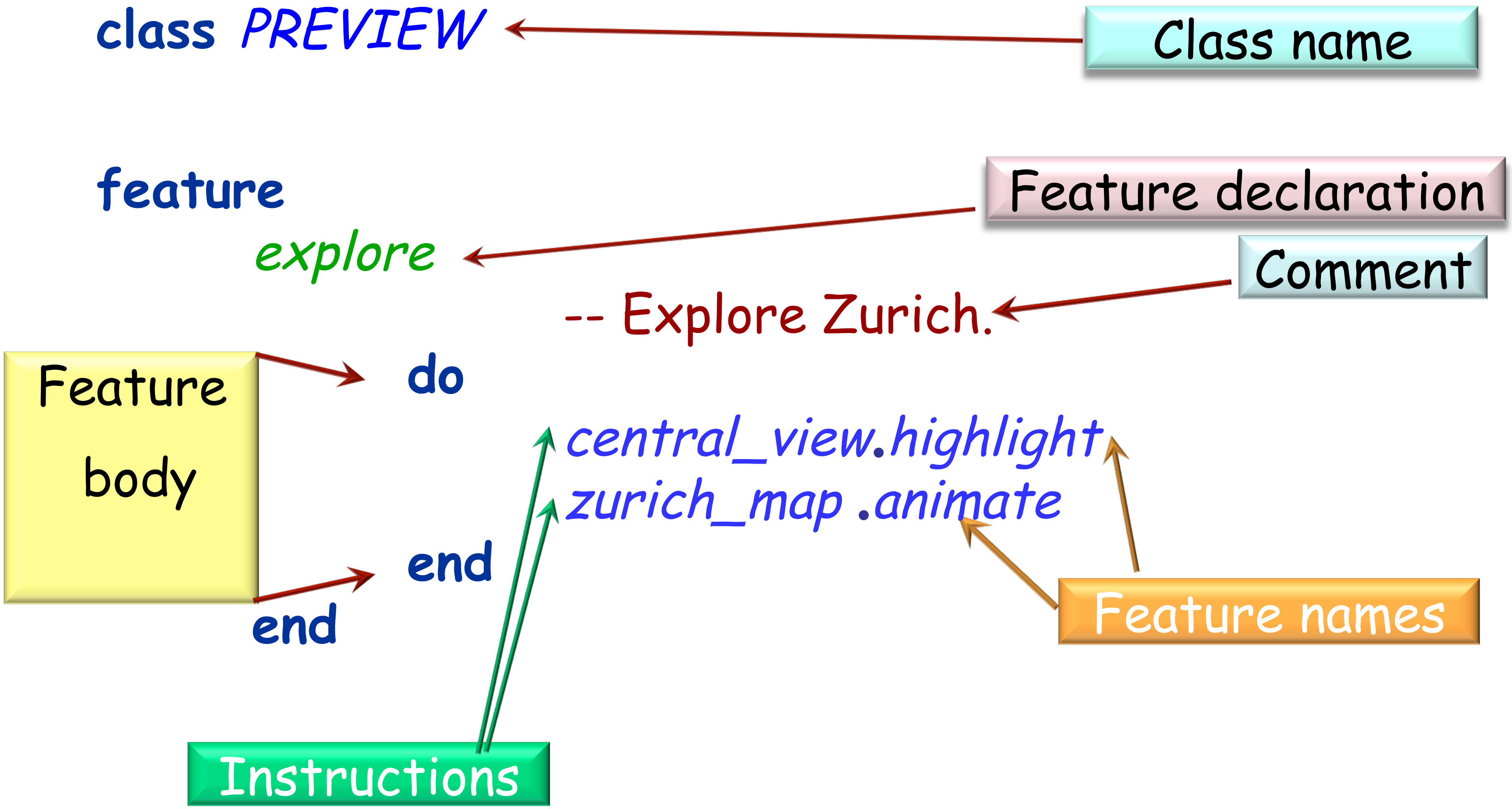
  - You call a feature when you apply it to an object.
    The object is called the **target** of this feature call.
    - *a_person.set_name ("Peter")*
  - Arguments, if any, need to be provided in feature calls.
    - *computer.shut_down*
    - *computer.shut_down_after (3)*
    - *telephone.ring_several (10, Loud)*

Features: Exercise

Hands-On

- Class *BANK_ACCOUNT* defines the following operations:
  - *deposit (a_num: INTEGER)*
  - *withdraw (a_num: 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



```
class PREVIEW

feature
        explore
                    -- Explore Zurich.
            do
                    central_view.highlight
                    zurich_map .animate
            end
        end
```

Style rules

Class names are upper-case

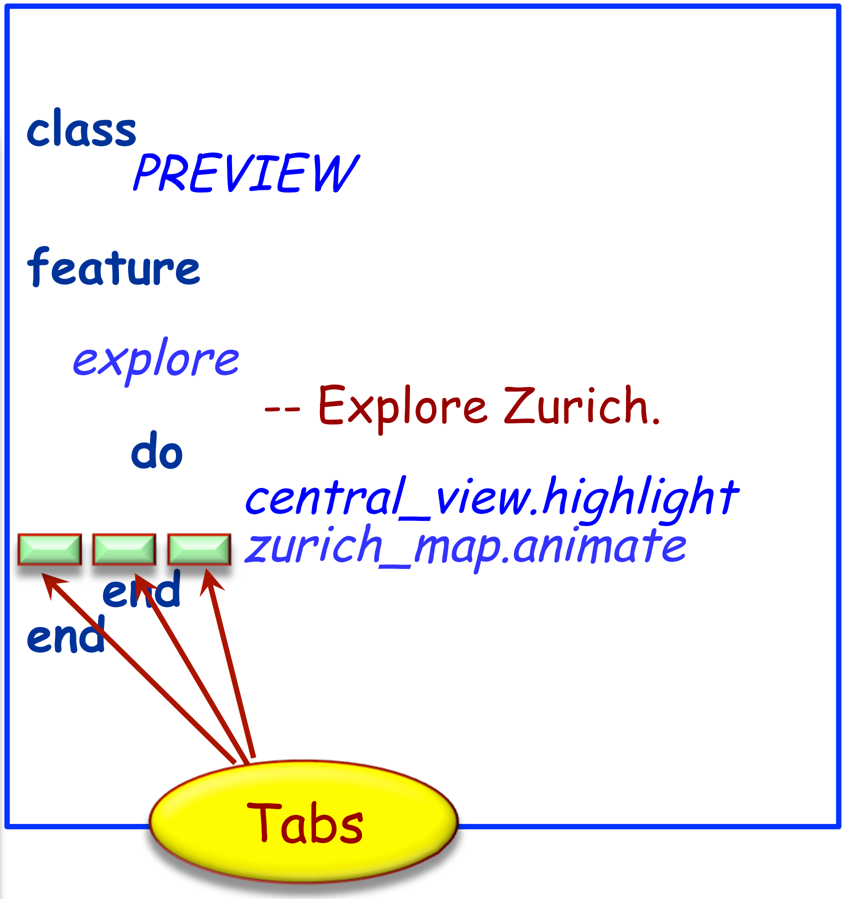
Use tabs, not spaces, to highlight the **structure** of the program: it is called **indentation.**

For feature names, use full words, 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
feature
    explore
            -- Explore Zurich.
        do
            central_view.highlight
            zurich_map.animate
        end
end
```

Another example

```
class
    BANK_ACCOUNT

feature
    deposit (a_sum: INTEGER)
            -- Add `a_sum' to the account.
        do
            balance := balance + a_sum
        end

     balance: INTEGER
end
```

Within comments, use ` and ' to quote names of arguments and features. This is because they will be taken into account by the automatic refactoring tools.

Kinds of features: commands and queries

- Commands
  - Modify the state of objects
  - Do not have a return value
  - May or may not have arguments
  - Examples: register a student to a course, assign an id to a student, record the grade a student got in an exam
  - … other examples?
- Queries
  - Do not modify the state of objects
  - Do have a return value
  - May or may not have arguments
  - Examples: what is the age of a student? What is the id of a student? Is a student registered for a particular course?
  - … other examples?

Exercise: query or command?

Hands-On

- What is the balance of a bank account?
- Withdraw 400 CHF from a bank account
- Who is the owner of a bank account?
- Who are the clients of a bank whose total 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
- Deposit 300 CHF into a bank account

Command-query separation principle

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

i.e. a query

Query or command?

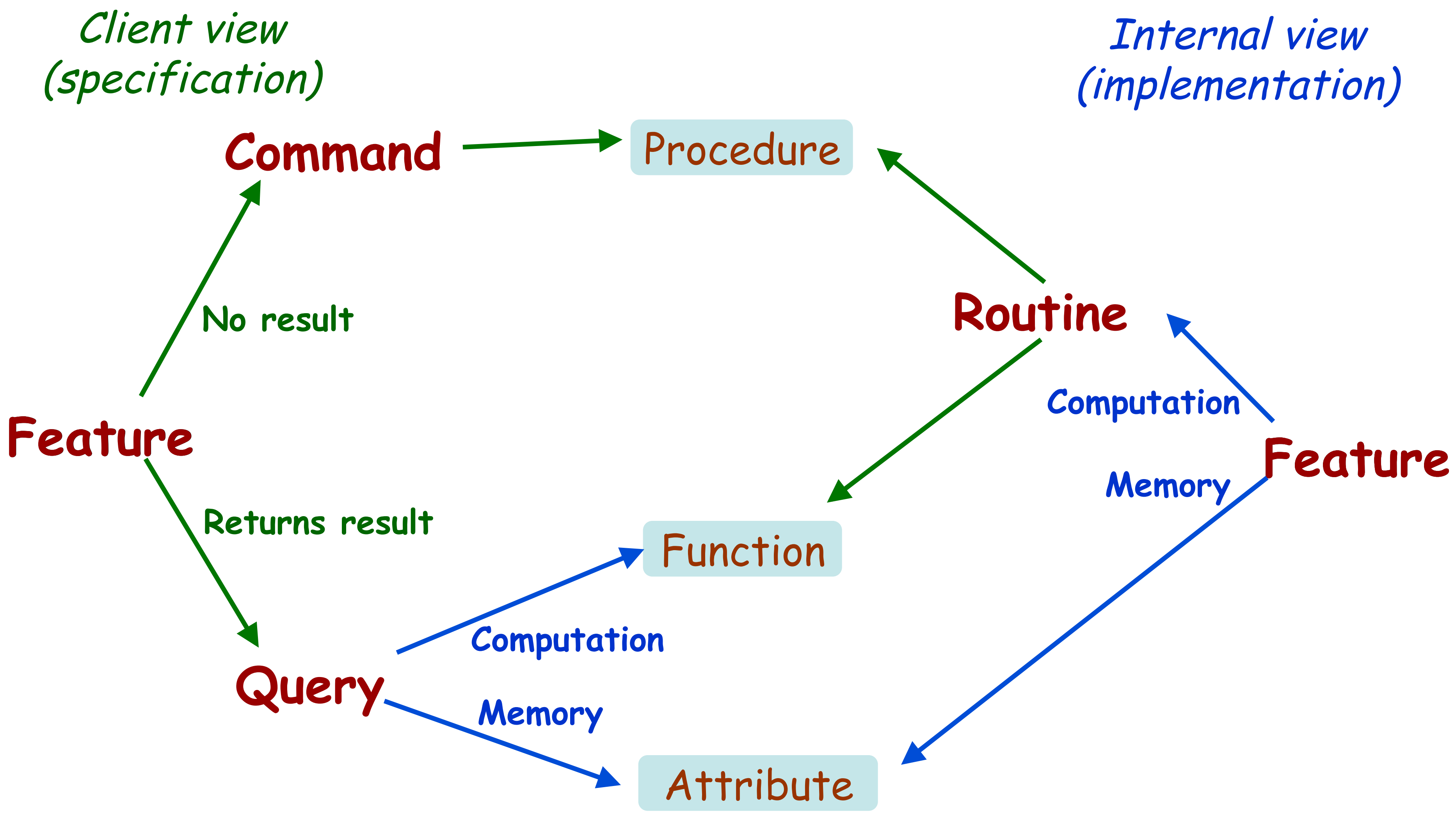
```
class DEMO

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 variable
        end                      denoting the result
                                 query
    attribute_name: T3
            -- Comment
end
```

- no result
- body

- result
- body

- result
- no body

Features: the full story



General form of feature call instructions

$$\underbrace{\underbrace{Object1}.query1}_{\text{targets}}.command\ \underbrace{(object2.query2,\ object3)}_{\text{arguments}}$$

- Targets and arguments can be query calls themselves.

Hands-On

- Where are *query1*, *query2* defined?
- Where is *command* defined?

Qualified vs. unqualified feature calls

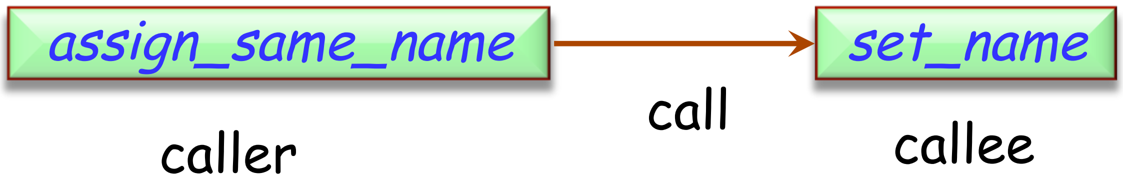
- A **qualified** feature call has an explicit target.
- An **unqualified** feature call is one whose target is the current object. The target is left out for convenience.
- The **current object** of a feature is the object on which the feature is called. (what's the other name for this object?)

```
assign_same_name (a_name: STRING; a_other_person: PERSON)
        -- Set `a_name' to current person and `a_other_person'.
    do
        a_other_person.set_name(a_name)
        set_name (a_name)
    end
```

Qualified call

Unqualified call, same as
Current.set_name (a_name)

person1.assign_same_name("Hans", person2)



EiffelStudio

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

  Integrated Development Environment

- Help & Resources
  - Online guided tour: in EiffelStudio help menu
  - http://eiffel.com/developers/presentations/
  - http://www.eiffel.com/
  - http://dev.eiffel.com/
  - http://docs.eiffel.com/
  - http://www.ecma-international.org/publications/files/ECMA-ST/ECMA-367.pdf

Components

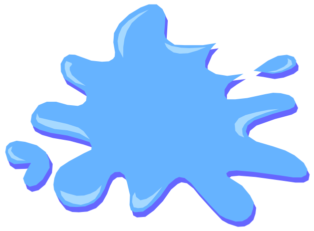
- editor
- context tool
- clusters pane
- features pane
- compiler
- project settings
- ...

Editor

- Syntax highlighting
- Syntax completion
- Auto-completion (CTRL+Space)
- Class name completion (CTRL+SHIFT+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)
- Pretty printing (CTRL+SHIFT+P)

Compiler highlights

- Melting: uses quick incremental recompilation to generate bytecode for the changed parts of the system. Used during development (corresponds to the button "Compile").
- Freezing: uses incremental recompilation to generate more efficient C code for the changed parts of the system. Initially the system is frozen (corresponds to "Freeze…").
- Finalizing: recompiles the entire system generating highly optimized code. Finalization performs extensive time and space optimizations (corresponds to "Finalize…")



Debugger: setup

- The system must be melted/frozen (finalized systems cannot be debugged).
- Setting and unsetting breakpoints
  - An efficient way consists in dropping a feature in the context tool.
  - Alternatively, you can select the flat view
  - Then click on one of the little circles in the left margin to enable/disable single breakpoints.
- Use the toolbar debug buttons to enable or disable all breakpoints globally.

Debugger: run

- 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 (or into) the next statement, or out of the current one.
- Stop the running program by clicking on the Stop button.