ETH Zürich
Chair of Software Engineering

Einführung in die Programmierung
Introduction to Programming

Prof. Dr. Bertrand Meyer

Exercise Session 2

Organizational

- Assignments
  - One assignment per week
  - Will be put online Monday (around 18:00)
  - Should be handed in within nine days (Wednesday, before 23:59)
- Grading
  - Assignments : not graded
    - feedback can be offered on request
  - Mock exams : graded but do not affect the final grade
  - Final exam : graded
- Group mailing list
  - Is everybody subscribed (got an email)?

Today

- Give you the intuition behind object-oriented (OO) programming
- Teach you about formatting your code
- Differentiate between
  - feature declaration and feature call
  - commands and queries
- Understand feature call chains
- Get 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 zero or more instances.

Classes and objects (continued)

- 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 as 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 all the objects of a class.

- **Feature declaration** vs. **feature call**
  - You declare a feature when you write it into a class.

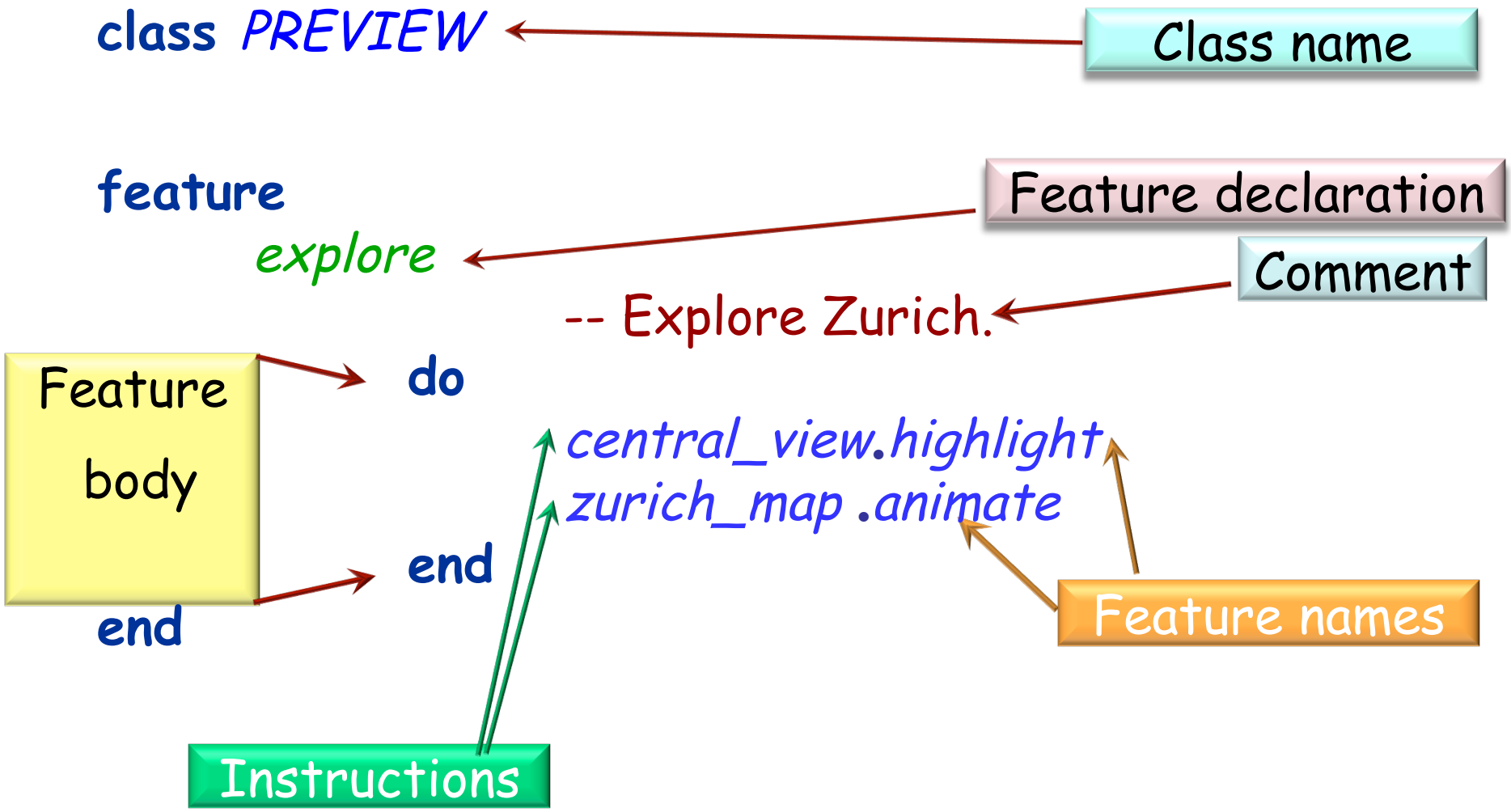
```
set_name (a_name: STRING)
                -- Set `name' to `a_name'.
        do
                name := a_name
        end
name: STRING
```

  - 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)*

Features: Exercise

- 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
Class name
feature
Feature declaration
explore
Comment
-- Explore Zurich.
Feature body
do
central_view.highlight
zurich_map .animate
end
end
Feature names
Instructions

Style rules

Class names are in upper-case

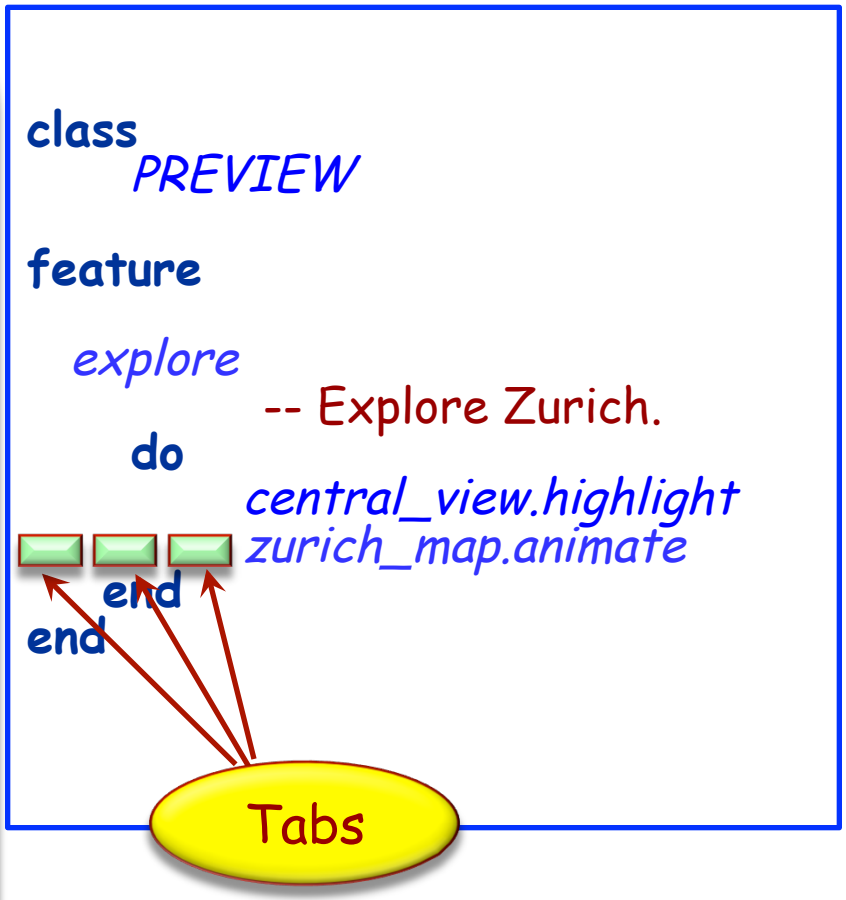
Use tabs, not spaces, to highlight the **structure** of the program: it is called **indentation**.

For feature names, use full words, not abbreviations.

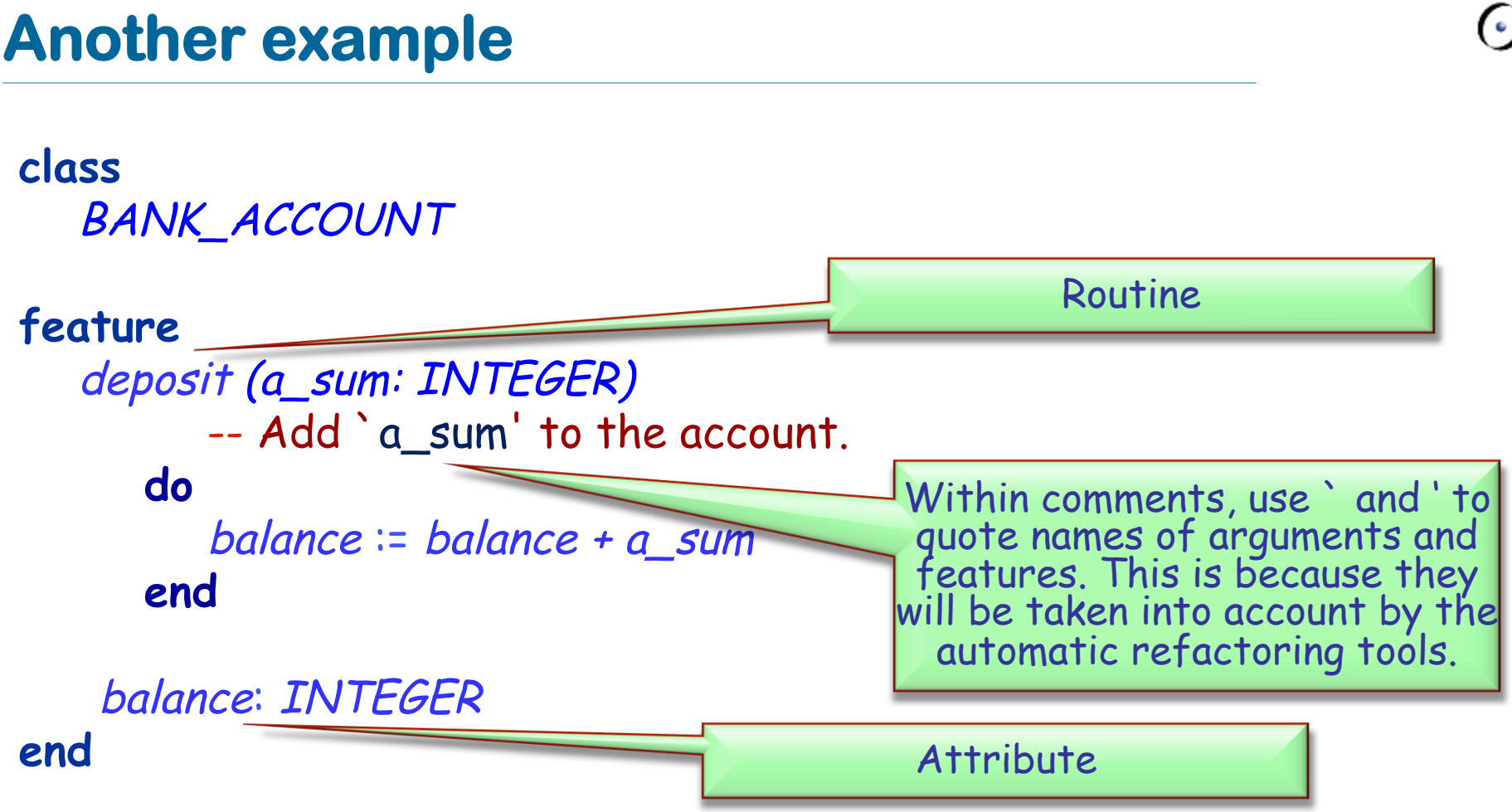
Always choose identifiers that clearly identify the intended role

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

For multi-word identifiers, use underscores



Another example



The state of the object is defined by the values of its attributes

Kinds of features: commands and queries

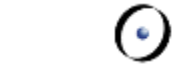
- Commands
  - Modify the state of objects
  - Do not have a return value
  - May or may not have arguments
  - Examples: register a student to a course, assign an id to a student, record the grade a student got in an exam
  - … other examples?
- Queries
  - Do not modify the state of objects
  - Do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

- Tell the balance of a bank account
- Withdraw 400 CHF from a bank account
- Who is the owner of a bank account?
- List 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
    procedure_name (a1: T1; a2, a3: T2)
            -- Comment
        do
            ...
        end

    function_name (a1: T1; a2, a3: T2): T3
            -- Comment
        do
            Result := ...
        end

    attribute_name: T3
            -- Comment
end
```

command

- no result
- body

query

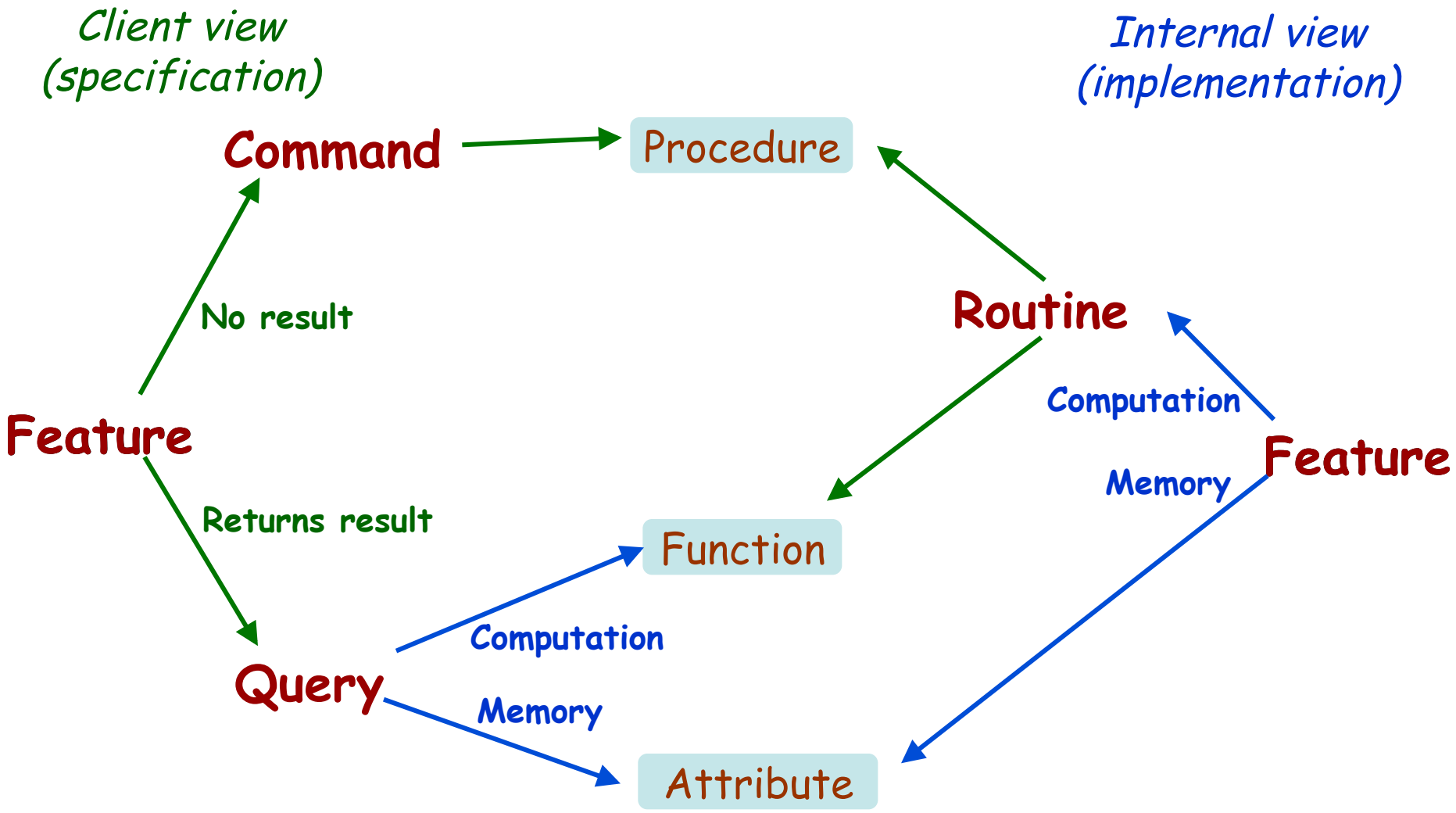
- result
- body

Predefined variable denoting the result

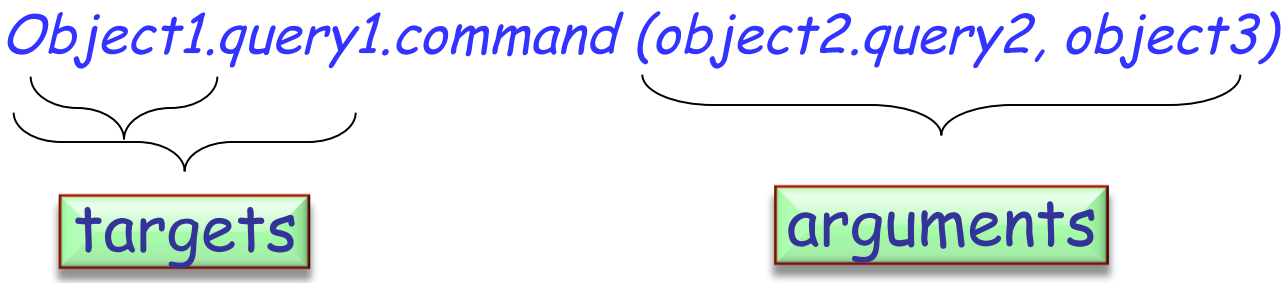
query

- result
- no body

Features: the full story



General form of feature call instructions



- Targets and arguments can be query calls themselves.

Hands-On

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

Qualified vs. unqualified feature calls

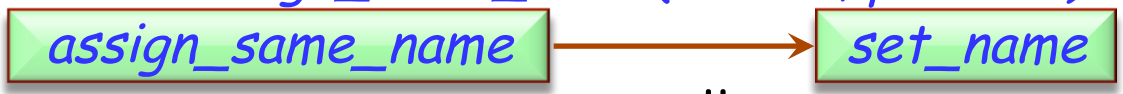
- All features have to be called on some **target** (**object**.)
- The **current object** is the name of the target object from the perspective of the feature that was called. I.e., when x.f is called, Current is x during the execution of f.
  - A **qualified** feature call has an explicit target.
  - An **unqualified** feature call has Current as an implicit target.

```
assign_same_name (a_name: STRING; a_other_person: PERSON)
        ame' to current person and
        her_person.set_name(a_name)
        set_name (a_name)
end
```

Unqualified call, same as *Current.set_name (a_name)*

Qualified call

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



caller — call — callee

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…"), this may take longer.

Debugger: setup

- The system must be melted/frozen (finalized systems cannot be debugged).
- Setting and unsetting breakpoints
  - An efficient way consists of dropping the feature you want the breakpoint in, into 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

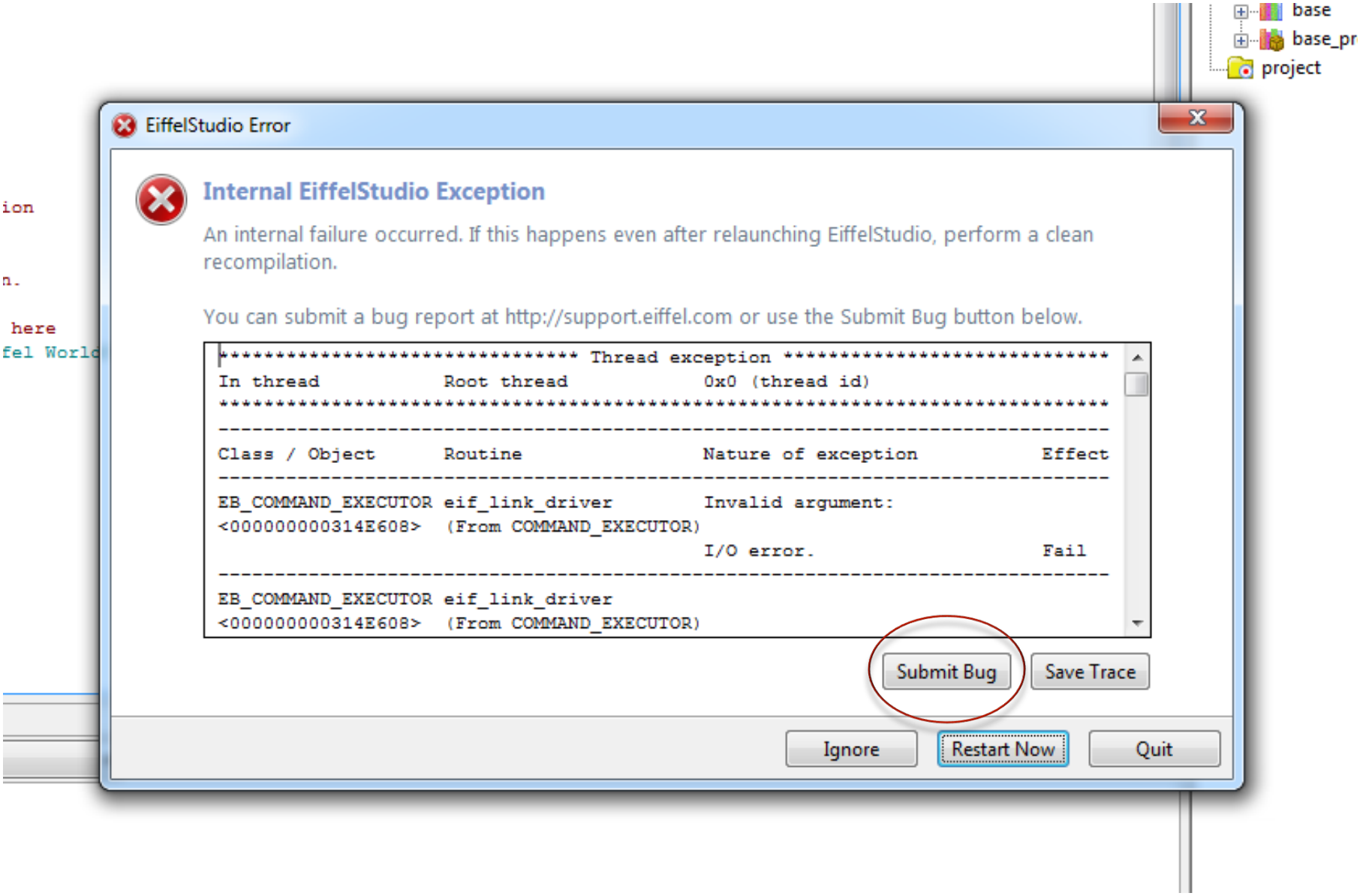
- Run the program by clicking on the Run button.
- Pause by clicking on the Pause button or wait for a triggered breakpoint.
- Analyze the program:
  - Use the call stack pane to browse through the call stack.
  - Use the object tool to inspect the current object, the locals and arguments.
- Run the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

Found a bug in EiffelStudio?

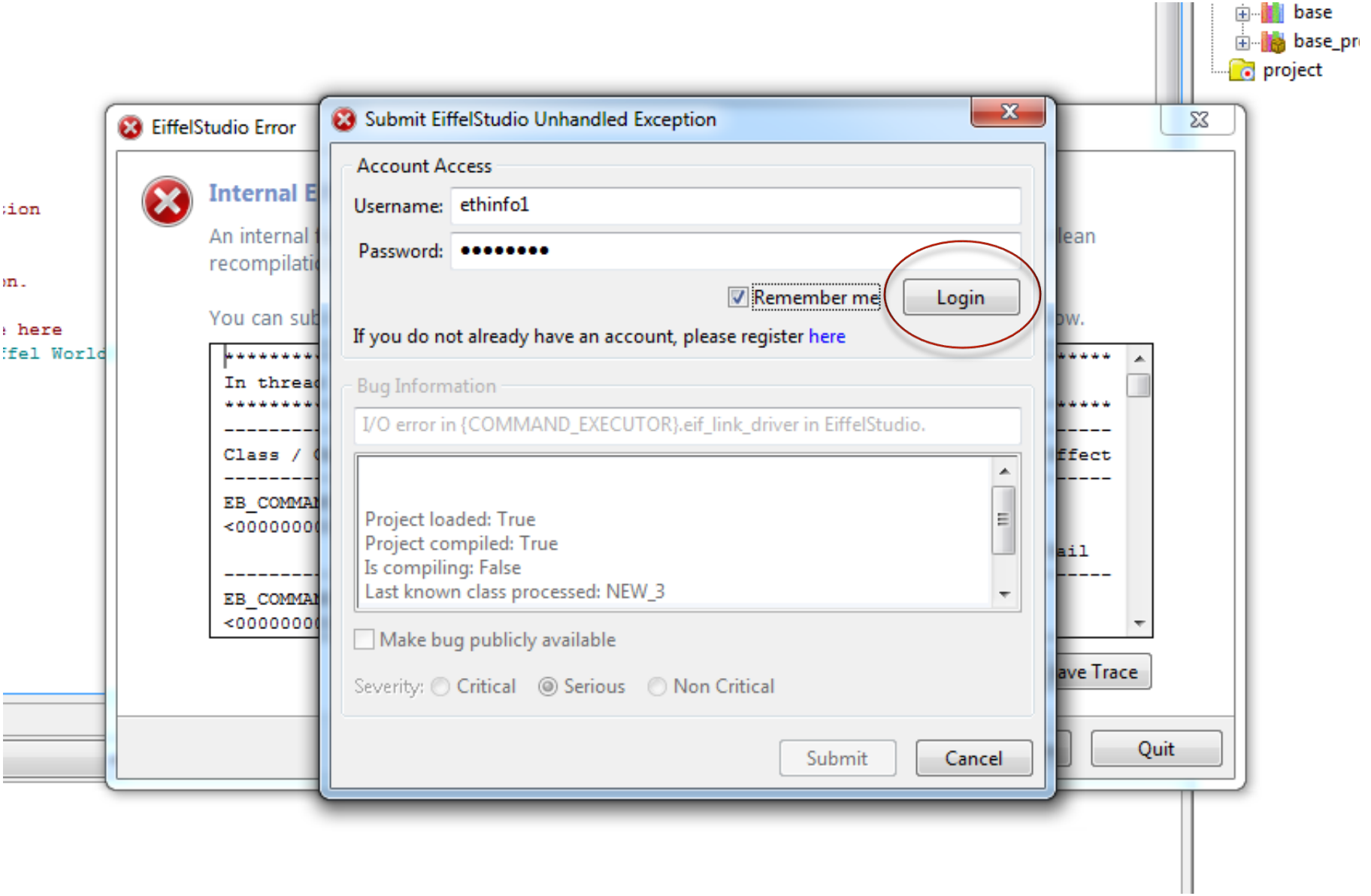
If EiffelStudio happens to crash:

- You should submit an official bug report by pressing the button that appears when EiffelStudio crashes
- Login: ethinfo1, Password: ethinfo1

How to submit a bug 1: submit bug



How to submit a bug 2: login



How to submit a bug 3: submit