Introduction to Programming

Lab Session 4

(With material from the ETH Zurich course “Introduction to Programming”)

September 13, 2016

INNOPOLIS UNIVERSITY

News

News

- Quiz 2 is already published and open.

News

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Note: You do not need to answer questions regarding creation procedures. They will appear again in Quiz 3.

In this Lab

- Attributes, formal arguments and local variables (we have already seen them!).
- Control Structures.
- Exercises.

Attributes

Declared inside a feature clause, but outside other features

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Declared inside a feature clause, but outside other features

```
class C
feature
    attr1: CA1

    f (arg1: A ... )
        do
            ...
        end

...
end
```

Visible anywhere inside the class

Visible outside the class (depending on their visibility)

Formal arguments

Declared after the feature name, in parenthesis:

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Declared after the feature name, in parenthesis:

```
class C
feature
    f (arg1: C1; . . . ; argn: CN)
        require
            . . .
        local
            . . .
        do
            . . .
        ensure
            . . .
        end

. . .
end
```

Visible only inside the feature body and its contracts.

Local variables

Some variables are only used by one routine. Declare them as local:

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```
class C
feature
    f (arg1: A . . . )
        require
            . . .
        local
              x, y: B
              z: C
        do
            . . .
        ensure
            . . .
        end

. . .
end
```

Visible only inside the feature body.

Summary: The scope of names

Attributes:

- declared inside a feature clause, but outside other features;
- visible inside the class;
- visible outside the class (depending on their visibility).

Formal arguments:

- declared after the feature name, in parenthesis;
- visible only inside the feature body and its contracts.

Local variables:

- declared in a local clause inside the feature;
- visible only inside the feature body.

Compilation Error? (hands-on) (1)

```
class PERSON
feature
    name: STRING

    set_name (a_name: STRING)
        do
            name := a_name
        end

    exchange_names (other: PERSON)
        local
            s : STRING
        do
            s := other.name
            other.set_name (name)
            set_name (s)
        end

    print_with_semicolon
        do
            create s.make_from_string (name)
            s.append (“;”)
            print (s)
        end
end
```

Compilation Error? (hands-on) (1)

```
class PERSON
feature
    name: STRING

    set_name (a_name: STRING)
        do
            name := a_name
        end

    exchange_names (other: PERSON)
        local
            s : STRING
        do
            s := other.name
            other.set_name (name)
            set_name (s)
        end

    print_with_semicolon
        do
            create s.make_from_string (name)
            s.append (“;”)
            print (s)
        end
end
```

This variable was not declared

Compilation Error? (hands-on) (2)

```
class PERSON
feature
. . .       -- name and set_name as before

    exchange_names (other: PERSON)
        local
            s : STRING
        do
            s := other.name
            other.set_name (name)
            set_name (s)
        end

    print_with_semicolon
        local
            s : STRING
        do
            create s.make_from_string (name)
            s.append (“;”)
            print (s)
        end
end
```

Compilation Error? (hands-on) (2)

```
class PERSON
feature
. . .       -- name and set_name as before

    exchange_names (other: PERSON)
        local
            s : STRING
        do
            s := other.name
            other.set_name (name)
            set_name (s)
        end

    print_with_semicolon
        local
            s : STRING
        do
            create s.make_from_string (name)
            s.append (“;”)
            print (s)
        end
end
```

OK: two different local variables in two routines

Compilation Error? (hands-on) (3)

```
class PERSON
feature
    name: STRING

    exchange_names (other: PERSON)
        local
            s : STRING
        do
            s := other.name
            other.set_name (name)
            set_name (s)
        end

    name: STRING

    print_with_semicolon
        do
            create s.make_from_string (name)
            s.append (“;”)
            print (s)
        end
end
```

Compilation Error? (hands-on) (3)

```
class PERSON
feature
    name: STRING

    exchange_names (other: PERSON)
        local
            s : STRING
        do
            s := other.name
            other.set_name (name)
            set_name (s)
        end

    name: STRING ← Error: an attribute with the same name was already defined.

    print_with_semicolon
        do
            create s.make_from_string (name)
            s.append (“;”)
            print (s)
        end
end
```

Compilation Error? (hands-on) (4)

```
class PERSON
feature
    nAmE: STRING

    exchange_names (other: PERSON)
        local
            s : STRING
        do
            s := other.name
            other.set_name (name)
            set_name (s)
        end

    name: STRING

    print_with_semicolon
        do
            create s.make_from_string (name)
            s.append ( “;” )
            print (s)
        end
end
```

Compilation Error? (hands-on) (4)

```
class PERSON
feature
    nAmE: STRING

    exchange_names (other: PERSON)
        local
            s : STRING
        do
            s := other.name
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        end

    name: STRING ←Error: an attribute with the same name was already defined.

    print_with_semicolon
        do
            create s.make_from_string (name)
            s.append ( “;” )
            print (s)
        end
end
```

Compilation Error? (hands-on) (5)

```
class PERSON
feature
. . .     -- name and set_name as before

    exchange_names (other: PERSON)
        do
            s := other.name
            other.set_name (name)
            set_name (s)
        end

    print_with_semicolon
        do
            create s.make_from_string (name)
            s.append (“;”)
            print (s)
        end

    s: STRING
end
```

Compilation Error? (hands-on) (5)

```
class PERSON
feature
...       -- name and set_name as before

    exchange_names (other: PERSON)
        do
            s := other.name
            other.set_name (name)
            set_name (s)
        end

    print_with_semicolon
        do
            create s.make_from_string (name)
            s.append (";")
            print (s)
        end

    s: STRING
end
```

OK: a single attribute used in both routines.

Local variables vs. attributes

Which one of the two correct versions do you like more? Why?

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        end

    print_with_semicolon
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            s : STRING
        do
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class PERSON
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        end

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        do
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            s.append (“;”)
            print (s)
        end

    s: STRING
end
```

Local variables vs. attributes

Which one of the two correct versions do you like more? Why?

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feature
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      exchange_names (other: PERSON)
            local
                  s : STRING
            do
                  s := other.name
                  other.set_name (name)
                  set_name (s)
            end

      print_with_semicolon
            local
                  s : STRING
            do
                  create s.make_from_string (name)
                  s.append (“;”)
                  print (s)
            end
end
```

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class PERSON
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      exchange_names (other: PERSON)
            do
                  s := other.name
                  other.set_name (name)
                  set_name (s)
            end

      print_with_semicolon
            do
                  create s.make_from_string (name)
                  s.append (“;”)
                  print (s)
            end

      s: STRING
end
```

When is it better to use a local variable instead of an attribute (and vice versa) ?

Result

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- Every local variable is declared with some type; and what is the type of **Result**?

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- The return value of a function is whatever value the **Result** variable has at the end of the function execution.
- At the beginning of a routine's body, **Result** (and the local variables) is initialised with the default value of its type.
- Every local variable is declared with some type; and what is the type of **Result**? It's the function's return type!

Compilation Error? (hands-on) (6)

```
class PERSON
feature
. . .      -- name and set_name as before

    exchange_names (other: PERSON)
        do
            Result := other.name
            other.set_name (name)
            set_name (Result)
        end

    name_with_semicolon: STRING
        do
            create Result .make_from_string (name)
            Result.append (“;”)
            print (Result)
        end
end
```

Compilation Error? (hands-on) (6)

```
class PERSON
feature
. . .      -- name and set_name as before

    exchange_names (other: PERSON)
        do
            Result := other.name
            other.set_name (name)
            set_name (Result)
        end

    name_with_semicolon: STRING
        do
            create Result .make_from_string (name)
            Result.append (“;”)
            print (Result)
        end
end
```

Error: Result cannot be used in a procedure.

Current

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- In object-oriented computation each routine call is performed on a certain object.
- From inside a routine we can access this object using the predefined entity **Current**.
- What is the type of **Current**?

Revisiting qualified vs. unqualified feature calls

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- If the target of a feature call is **Current**, it is omitted:
  - **Current**.*f (a)*

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Revisiting qualified vs. unqualified feature calls

- If the target of a feature call is **Current**, it is omitted:
  - **Current**.*f (a)*
  - *f (a)*
- Such a call is *unqualified*.
- Otherwise, if the target of a call is specified explicitly, the call is *qualified*

x.f (a)

Qualified or unqualified? (Hands-on)

Are the following feature calls, with their feature names underlined, qualified or unqualified?

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$\underline{x}$	

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$\underline{x}$	unqualified
$\underline{f}\ (x.a)$	

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$\underline{x}$	unqualified
$\underline{f}\,(x.a)$	unqualified
$x.\underline{y}.z$	

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$\underline{x}\ (y.f\ (a,\ b))$	

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$\underline{x}\ (y.f\ (a,\ b))$	unqualified
$f\ (x,a).\underline{y}\ (b)$	

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$f\ (x,a).\underline{y}\ (b)$	qualified
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$\textbf{Current}.\underline{x}$	qualified

Assignment to attributes

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  y := 5

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  y := 5 OK

  x.y := 5

Assignment to attributes

- Direct assignment to an attribute is only allowed if an attribute is called in an unqualified way:

y := 5	OK
x.y := 5	ERROR
Current*.y := 5*	

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Why?

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Why?

- There are two main reasons:

Assignment to attributes

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  2. Uniform Access Principle (what is it about?)

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Why?

- There are two main reasons:
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  2. Uniform Access Principle (what is it about?)

Uniform Access Principle

All services offered by a module should be available through a uniform notation, which does not betray whether they are implemented through storage or through computation.

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It is possible to declare constant attributes, that is, attributes having a fixed value that cannot change during the program execution.

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```
class CAR
feature
. . .
    number_of_gears: INTEGER = 5
. . .
    set_number_of_gears (new_number: INTEGER)
        do
            number_of_gears := new_number
        end
end
```

Constant attributes

It is possible to declare constant attributes, that is, attributes having a fixed value that cannot change during the program execution.

```
class CAR
feature
...
    number_of_gears: INTEGER = 5
...
    set_number_of_gears (new_number: INTEGER)
        do
            number_of_gears := new_number
        end
end
```

Error: constant attributes are readonly.

Entity: the final definition

An entity in program text is a “name” that directly denotes an object. More precisely: it is one of:

Read-write entities / variables
Read-only entities

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- attribute name

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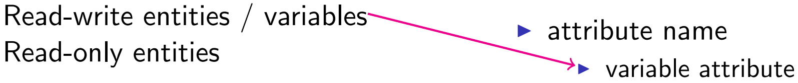

Read-write entities / variables

Read-only entities

- attribute name
    - variable attribute

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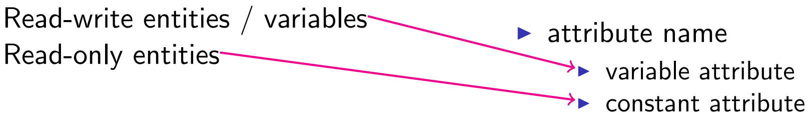

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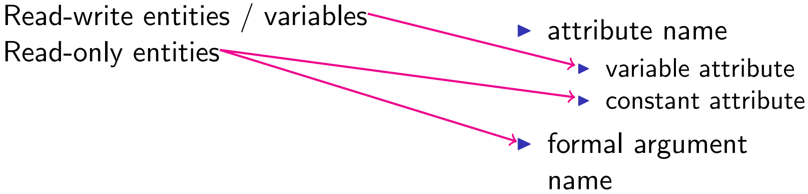

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  - constant attribute
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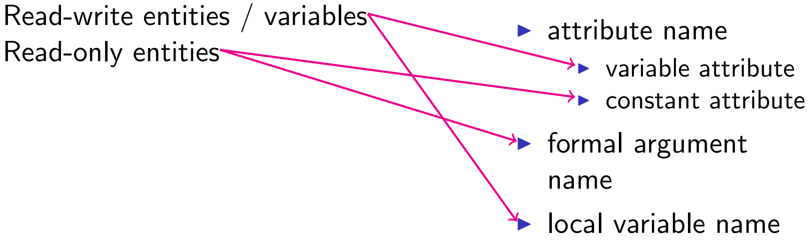

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  - variable attribute
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- local variable name

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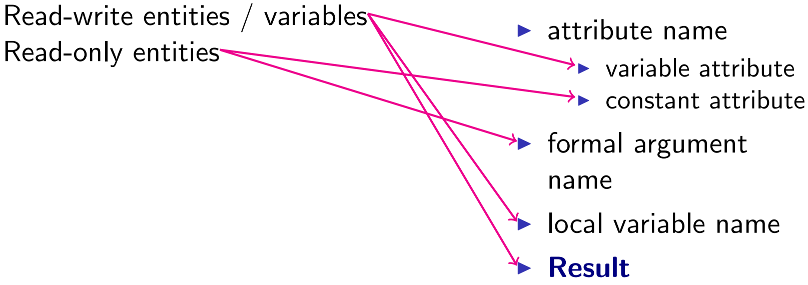

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- **Result**

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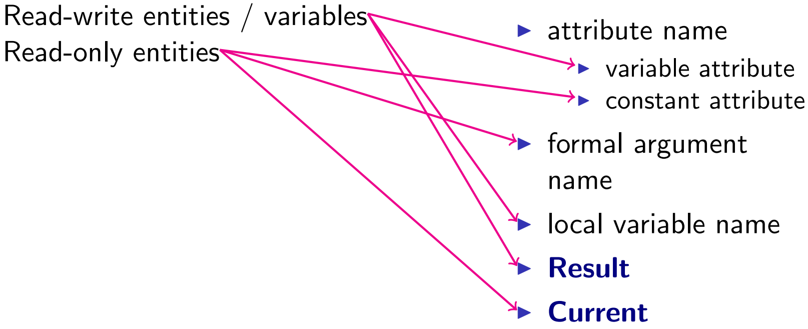

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- attribute name
  - variable attribute
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- formal argument name
- local variable name
- **Result**
- **Current**

Find 5 errors (Hands-on)

```
class VECTOR
feature
    x, y : REAL

    copy_from (other : VECTOR)
        do
            Current := other
        end

    copy_to (other : VECTOR)
        do
            create other
            other.x := x
            other.y := y
        end

    reset
        do
            create Current
        end
end
```

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Control Structures

Conditional

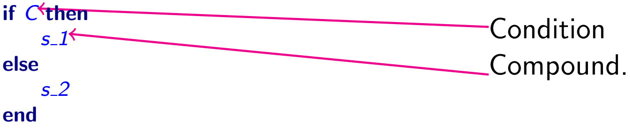
```
if C then
    s_1
else
    s_2
end
```

Conditional

```
if C then
    s_1
else
    s_2
end
```

Condition

Conditional

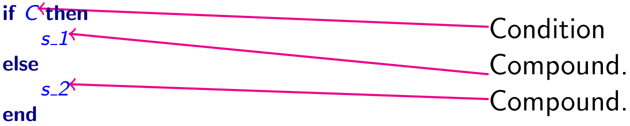


```
if C then
    s_1
else
    s_2
end
```

Condition

Compound.

Conditional



```
if C then
    s_1
else
    s_2
end
```

Condition

Compound.

Compound.

Multiple choice

If all the conditions have a specific structure, you can use the syntax:

```
inspect expression
when  const_1  then
    s_1
when  const_2  then
    s_2
...
when  const_n1 .. const_n2  then
    s_n
else
    s_2
end
```

Multiple choice

If all the conditions have a specific structure, you can use the syntax:

```
inspect expression
when  const_1  then
     s_1
when  const_2  then
     s_2
...
when  const_n1 .. const_n2  then
     s_n
else
     s_2
end
```

Integer or character expression.

Multiple choice

If all the conditions have a specific structure, you can use the syntax:

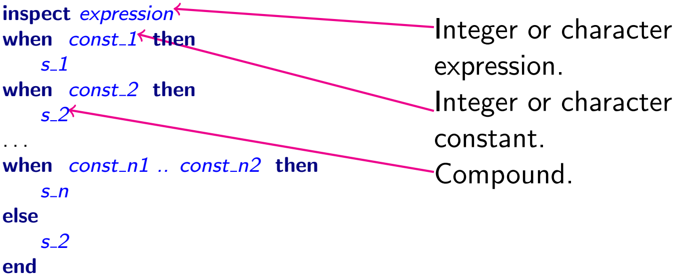
```
inspect expression
when  const_1  then
     s_1
when  const_2  then
     s_2
. . .
when  const_n1 .. const_n2  then
     s_n
else
     s_2
end
```

Integer or character expression.

Integer or character constant.

Multiple choice

If all the conditions have a specific structure, you can use the syntax:



```
inspect expression
when  const_1  then
    s_1
when  const_2  then
    s_2
. . .
when  const_n1 .. const_n2  then
    s_n
else
    s_2
end
```

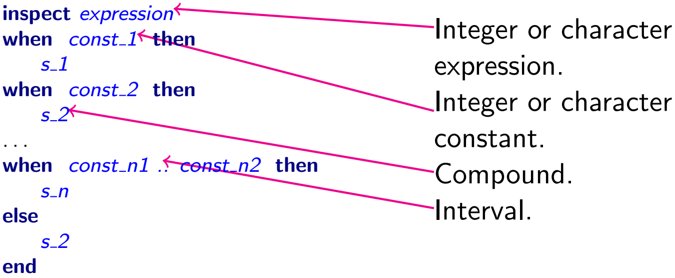
Integer or character expression.

Integer or character constant.

Compound.

Multiple choice

If all the conditions have a specific structure, you can use the syntax:



```
inspect expression
when  const_1  then
    s_1
when  const_2  then
    s_2
...
when  const_n1 .. const_n2  then
    s_n
else
    s_2
end
```

Integer or character expression.

Integer or character constant.

Compound.

Interval.

Loop: basic form

```
from
      initialisation
until
      exit_condition
loop
     body
end
```

Loop: basic form

```
from
    initialisation
until
    exit_condition
loop
    body
end
```

Compound.

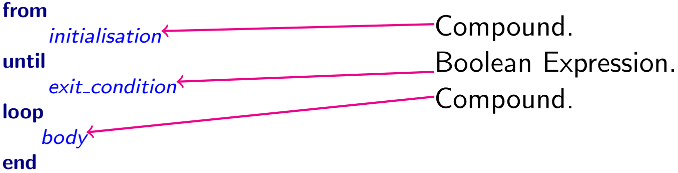
Loop: basic form

```
from
    initialisation
until
    exit_condition
loop
    body
end
```

Compound.

Boolean Expression.

Loop: basic form



```
from
    initialisation
until
    exit_condition
loop
    body
end
```

Compound.

Boolean Expression.

Compound.

across

```
across
    data_structure as var
loop
    body -- using var
end
```

Exercises

Exercises can be found in: `https://drive.google.com/open?id=0B1GMHm59JFjqRmlybG5HWGpfSlE`.

Thank you!