Introduction to Eiffel

Martin Nordio, Christian Estler
ETH Zurich

Distributed Software Engineering Lab

Overview

Part 1: Language Constructs

- Basics: class definition, if then else, expressions, loops and across, creation procedures
- Inheritance: redefinition and multiple inheritance
- Exception Handling
- Once Routines
- Style rules
- Generics
- Information Hiding

Part 2: Contracts

- Preconditions, postconditions and class invariants
- Contracts in inheritance

Part 3: Tuples and Agents

Preparation

Go to:

http://codeboard.io

If you don't have an account yet, please sign-up and sign-in before doing the exercises.

Once you're done with a programming exercise, submit your solution.

Part 1: Language constructs

1.1 BASICS

Class declaration: Eiffel vs Java:

```
class
    ACCOUNT
end
```

```
public class Account {

}
```

Constructors

```
class
    ACCOUNT
create
    make,
    make_balance
feature
    make
        do …
        end
    make_balance (i: INTEGER)
        do …
        end

end
```

```
public class Account {
    public Account() {...}
    public Account (int b) {...}
}
```

Constructors

```
class
    ACCOUNT
create
    make, make_balance,
    make_name

feature
    make
        do …
        end
    make_balance (i: INTEGER)
        do …
        end
    make_name (s: STRING)
        do …
        end
end
```

```
public class Account {
        public Account() {...}
        public Account (int b) {...}
        public Account (string s) {...}
}
```

Constructors can have any name; use the **create** clause to declare a routine as constructor

Overloading

```
class
    PRINTER

feature
    print_int (a_int: INTEGER)
        do … end

    print_real (a_real: REAL)
        do … end

    print_string (a_str: STRING)
        do … end
end
```

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

Eiffel does not support overloading!

Creating Objects

```
class
    BANK

feature
    pay_bill
        local
            b1: ACCOUNT
        do
            create b1.make
        end

end
```

```
public class Bank {
  public void payBill() {
       Account b1 = new Account();
  }
```

Creating Objects

```
class
    BANK

feature
    pay_bill
        local
            b1, b2: ACCOUNT
        do
            create b1.make
            create b2.make_balance (2)
        end

end
```

```
public class Bank {
  public void payBill() {
      Account b1 = new Account();
      Account b2 = new Account (2);
  }
```

Create objects using the **create** keyword; declare the local variables in the **local** clause

Let's code…

Go to:

https://codeboard.io/projects/16

Task: create a local ACCOUNT object in the constructor of the APPLICATION class

Task: modify the creation procedure of ACCOUNT to print a confirmation that an account was created

Task: write a new creation procedure in class ACCOUNT that lets you create an account with an initial balance; use it from APPLICATION

Creating Objects: default create

```
class
  MAIN

feature
  root
    local
      b1: BANK
    do
      create b1
      -- corresponds to
      -- create b1.default_create
      b1.pay_bill
    end

end
```

```
class
    BANK

feature
    pay_bill
        do
            ...
        end
end
```

All classes inherit from ANY (Object in Java). If no creation procedure is specified, *default_create* is used (inherited from ANY)

Creating Objects: default create

```
class
    BANK
inherit
   ANY
     redefine
        default_create
     end

create
    default_create

feature
    ...
end
```

The routine default_create can be redefined

Let’s code…

Go to:

https://codeboard.io/projects/16

Task: override the default_create in class CUSTOMER to print a confirmation message

Task: create a customer object in the APPLICATION class

Task: write a creation procedure for class CUSTOMER that takes, name, first_name and age as arguments; use it to create a customer

Features

```
class
  ACCOUNT
feature -- Initialization
  make    do … end
  make_balance (i: INTEGER)
        do … end
  make_name (s: STRING)
        do … end

feature –- Basic operations
  deposit (i: INTEGER) do … end
  withdraw (i: INTEGER) do … end
  transfer (b: ACCOUNT) do … end

feature –- Access
  balance: INTEGER do … end
end
```

```
public class Account {
  public Account() {...}
  public Account (int b) {...}
  public Account (string s) {...}
  public void deposit (int i) {...}
  public void withdraw (int i) {...}
  public void transfer(Account b) .
  public int balance() {...}
}
```

The **feature** clause is used to group routines and for information hiding (see 1.8)

Expressions and Conditionals

```
feature
    foo
        do
            if b and (c or d) then
                x := 5
                …
            end
        end
end
```

```
public foo() {
    if (b & (c | d)) {
        x = 5;
        ...
    }
}
```

```
    foo
        do
            if b and then (c or else d) then
                …
            end
        end
end
```

```
public foo() {
    if (b && (c || d)) {
        ...
    }
}
```

Let's code…

Go to:

https://codeboard.io/projects/16

Task: write a condition that only allows to withdraw money if the balance if sufficient; otherwise print an error message; make two withdraws that show the regular and the exceptional behavior

Return and breaks

```
class
    B

feature
    foo: INTEGER
        do
            Result := 5
        end

end
```

```
public class B {
  public int foo() {
      return 5;
  }
```

Eiffel does not support neither breaks, continues nor return

Loops

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

```
public class Printer {
    public void print() {
        for(int i=0;i<10;i++) {
            …
        }
    }
}
```

Loops: Example 2

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

```
public class Printer {
    public void print() {
        int i=0;
        while(i<10) {
            i++;
        }
    }
}
```

Let's code…

Go to:

https://codeboard.io/projects/24

Task: implement the 'print_log' functionality for in the class ACCOUNT; complete class ACCOUNT to log deposits and withdraws

Loops: Traversing a list

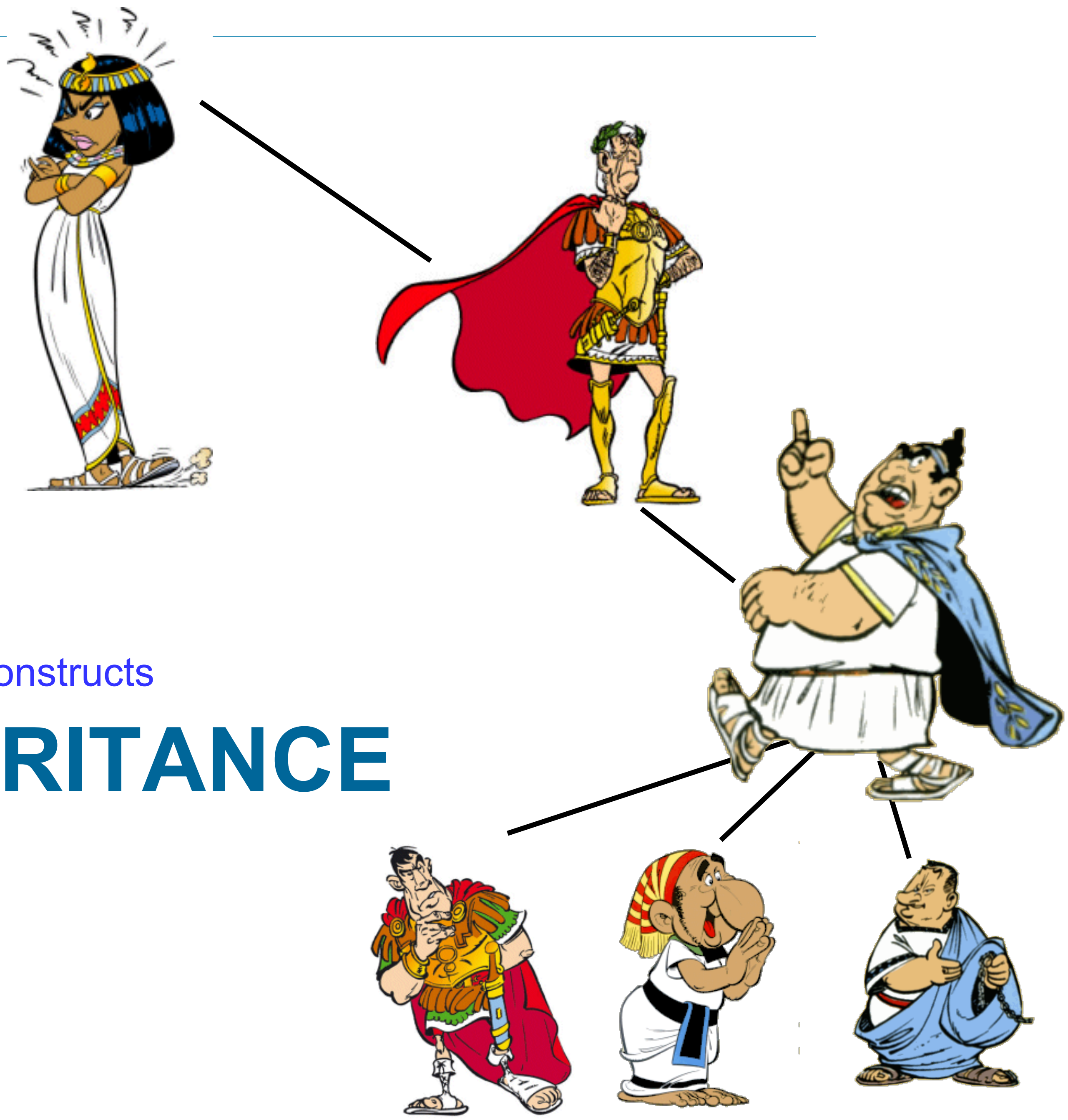
```
print_using_from
    do
        from list.start
        until list.after
        loop
            list.item.print
            list.forth
        end
    end

print_using_across
   do
        across list as e loop
           e.item.print
        end
     end
```

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

Basic Types

Eiffel:	Java:
BOOLEAN	boolean
CHARACTER	char, byte
INTEGER	short, int
INTEGER_64	long
REAL	float
DOUBLE	double
STRING	String



Part 1: Language constructs

1.2 INHERITANCE

Deferred Class (abstract class)

```
deferred class
    ACCOUNT

feature
    deposit (a_num: INT)
        deferred
        end

end
```

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

A class must be **deferred** if it has at least one deferred routine. A class can be deferred without any deferred routines.

Simple Inheritance

```
class
    ACCOUNT
inherit
    ANY
end
```

```
public class Account
        extends Object {

}
```

Let's code…

Go to:

https://codeboard.io/projects/25

Task: create a deferred class PERSON; move the properties 'name' and 'age' from class CUSTOMER into the deferred class PERSON; make sure the program behavior did not change

Feature redefinition

```
class
    ACCOUNT
inherit
    ANY
            redefine out end

feature

    out: STRING
        do
            Result := "abc"
        end
end
```

```
public class Account
    extends Object {

    String toString() {
        return "abc";
    }

}
```

All routines that are redefined must be listed in the inherit clause.

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();
      }

}
```

Multiple Inheritance

```
class
    A
feature
    foo do end
end
```

```
class
    B
feature
    foo do end
end
```

Option 1:

```
class
    C
inherit
    A
    B rename foo  as foo_b end
end
```

Class *C* will have two features *foo* and *foo_b*

Option 2:

```
class
    C
inherit
    A
    B undefine foo end
end
```

foo from *B* becomes deferred; implemented in *C* by *foo* from *A*

Let’s code…

Go to:

https://codeboard.io/projects/26

Task: redefine the ‘print_self’ routine in class B to print the correct message

Task: redefine the ‘print_self’ routine in class C to print the correct message; what happens when you try to compile?

Task: resolve the conflict that was created due to multiple inheritance (hint: there are the 2 options to do that?

Structure of inherit clause

```
inherit
    A
    rename
        …
    undefine
        …
    redefine
        …
    end
    B
    rename
        …
    undefine
        …
    redefine
        …
    end
```

A **redefine** clause must structured in the order *rename, undefine, redefine*.

Frozen class / frozen routine

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

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

```
class
    ACCOUNT
feature
    frozen deposit (a_num: INT)
      do
          …
      end
end
```

```
class Account {
        final void deposit(int a) {
                …
        }
}
```

A frozen class cannot be inherited; a frozen routine cannot be redefined.

Expanded class

```
expanded class
    MY_INT
end
```

int, float, double, char