Classes
The Static Structure

Abstract data types equipped with a possibly partial implementation

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Style Rules

- Read page 180
- Pick a style and stick to it
- Recommend that you use Eiffel style or close approximation

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Definitions

- A **class** is a combination of a **type** and a **module**
- A *module* because it is has a data part and an operation part
- A *type* because you can declare (and therefore create) instances of a class
- An **object** (a variable) is an instance of a class
  - > **Logically, each object has its own copy of the local attributes and its own copy of the operations in the class**
- A **client** class **C** of a **suppler** class **S** uses **S** by declaring a variable of type **S**.
  - » **S is a supplier of C – C is a client of S**

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Stack – Interface

```
class STACK [ G ]

feature                    -- Enquiry and change
    full, empty : BOOLEAN      -- functions or attributes ?
    push ( x : G )             -- a procedure
    pop                        -- a procedure
    top : G                    -- function or attribute ?

end
```

- No Specification of how a stack is implemented
- No implementation of features
- Uniform access principle
  - » **client does not know, nor care, if a returned value is stored (an attribute) or computed (a function)**

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Person Class – 1

```
indexing                          -- For class level documentation
  description: "A simple person"
  author: "Gunnar Gotshalks"
  date:"2000 Jan 9"

class PERSON
create                  -- list construction features
    make

feature
    name : STRING             -- attributes are usually first
    sex : GENDER
    age : INTEGER
```

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Person Class – 2

```
make( n : STRING ; s : GENDER ; a : INTEGER ) is
  -- Create a complete non default person
do
    -- Empty body for this example creation procedure
end


set_name ( s : STRING ) is
         -- Need to explicitly set attribute values
do
name := s
end
```

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Person Class – 3

PERSON is a client of the supplier INTEGER

```
older ( a : INTEGER ) : BOOLEAN
  -- Are you older than me?
do
   if a > age then
      io_put_string ( "You are older than me. %N")
      Result := true
   else
      io_put_string ( "I am older than you. %N")
      Result := false
   end
end
end
```

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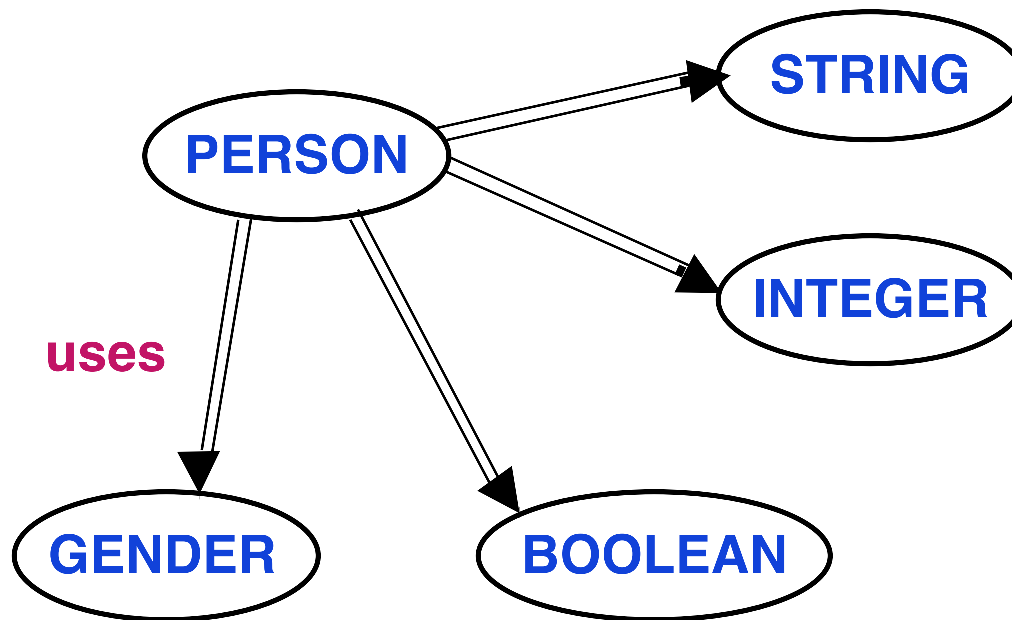
Client–Supplier BON diagram

- BON stands for

  B-usiness O-bject N-otation



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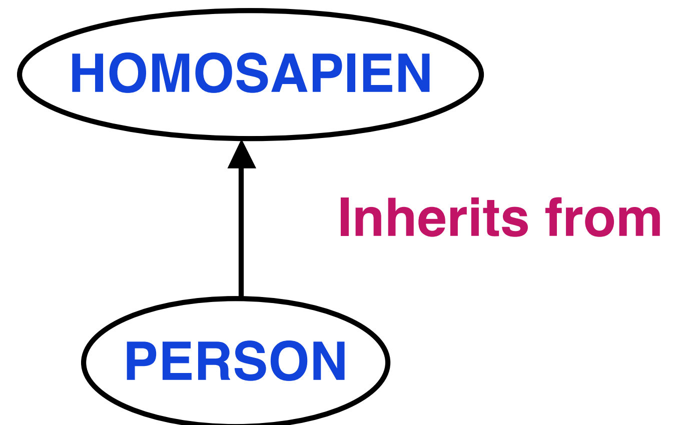
Inheritance

Eiffel text

BON diagram

```
class PERSON inherit
   HOMOSAPIEN
feature
....
end
```



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Feature Call

object . function (arguments)

- Evaluate the arguments to the **function**
- Then apply the function to the **object**
- In non OO languages this is equivalent to

function (object , arguments)

  - » **where object = Current = self = this**

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Infix Feature Call

- Can define operators to be infix to use standard notation
  - » **Thus**

    plus (other : INTEGER) : INTEGER do ... end
  - » **Is used as**

    anInt . plus (otherInt)
- Eiffel has the infix keyword
  - » **Thus**

    infix "+" (other : INTEGER) : INTEGER do ... end
  - » **is used as**

    anInt + otherInt
- Also have **prefix** for unary operators

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Current Instance

- Instance calling the feature is named Current locally

```
p1 . distance_to ( p2 )     -- example call

distance_to( p : POINT ) : REAL
  -- Distance between Current point and p

do
   if ( p /= Current ) then
      Result := sqrt( ( x - p.x )^2 + ( y - p.y )^2 )
   end
End
```


» could write as

```
Result := sqrt( ( current.x - p.x )^2
                + ( current.y - p.y )^2 )
```

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Current Instance – 2

- Partly like

  self – in Smalltalk
  this – in C++ and Java

- But uniform access principle has attributes as parameter-less functions
  - » **Thus the following is illegal as Current.x could be a function call**
    - > **You cannot assign a value to a function**

```
x : INTEGER
 t ( y : INTEGER )
do
  Current.x := y
end
```

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Current Instance – 3

- **Current** can be used in the following contexts
  - » **Passing instance as a parameter**

    a.f (Current)
  - » **Comparing with another reference**

    x = Current
  - » **Use as an anchor in anchored declarations**

    object : like Current
    - – **Will see this again in inheritance**

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Unique names features & parameters

- The following is illegal

```
a_var : INTEGER
…
 a_procedure (a_var : INTEGER )
do
  io.put_string(a_var )
end
```

a_var cannot be both a feature and a parameter of a feature

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Selective Exports

- Need to restrict access by clients
- In Java have public, protected and private
- In Eiffel can be more selective

```
class S feature
   -- all features exported -- public

feature { A , B }
   -- export only to A and B -- protected

feature { NONE }
   -- export to no one -- private, secret
   -- NOT EVEN TO S – include self if needed !

end
```

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System Execution

- Create a certain object
  - » **called the root object for the execution**
- Apply a certain procedure to that object
  - » **called the creation procedure**

This is the BIG BANG!

- Not the same as a system top
  - » **NOT the top of the architecture**
  - » **Just the start of execution**

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Class Definition

Class A class is an abstract data type equipped with a possibly partial implementation.

Deferred / Effective Class

A class which is fully implemented is said to be effective. A class which is implemented partially, or not at all, is said to be deferred. Any class is either deferred or effective.

In Java a deferred class is called an abstract class
In Java an interface is a class with all methods deferred and no objects

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Role of Deferred Classes

- Design and analysis
- Pure description – no implementation details required
- Concentrate on architectural properties
- Provide for variations in implementation while preserving a particular type
- Provide for evolutionary development and its history

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OO Software Construction

Object oriented software construction technical definition

The building of software systems as structured collections of possibly partial abstract data type implementations

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OO Software Construction– 2

- Basis is ADT
- Need ADT implementations
- Can have partial implementations
- System is a collection of classes
  - » **with no one class particularly in charge – no top or main program**
    - > **Although an execution requires a starting location**
    - > **In principle could change**
- The collection is structured by two inter-class relations
  - » **client – user**
  - » **inheritance.**

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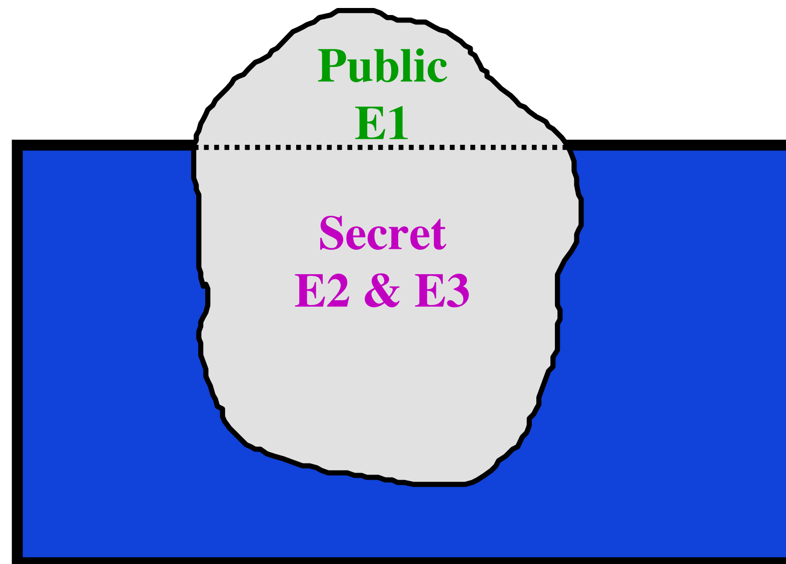
ADT to Class

- Basic steps in getting a class from an abstract data type
  - » **E1 – Create an ADT**
  - » **E2 – Chose a representation**
  - » **E3 – Create a mapping of the operations in E1 to the representation in E2**



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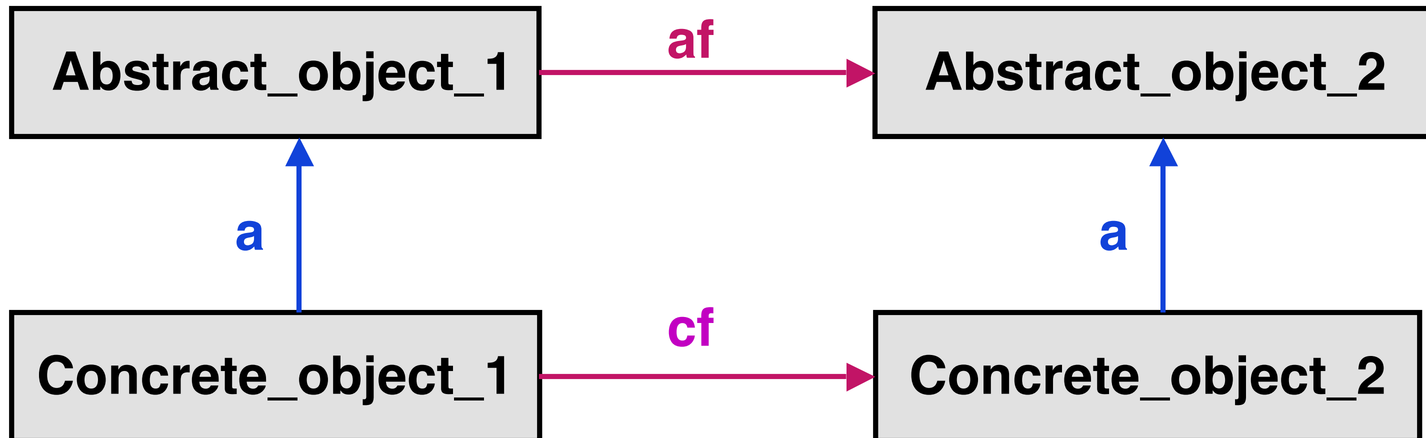
Class–ADT Relationship



» **a – maps a concrete object into an abstract object**

» **af – function that maps abstract object 1 into abstract object 2**

» **cf – function that maps concrete object 1 into concrete object 2**

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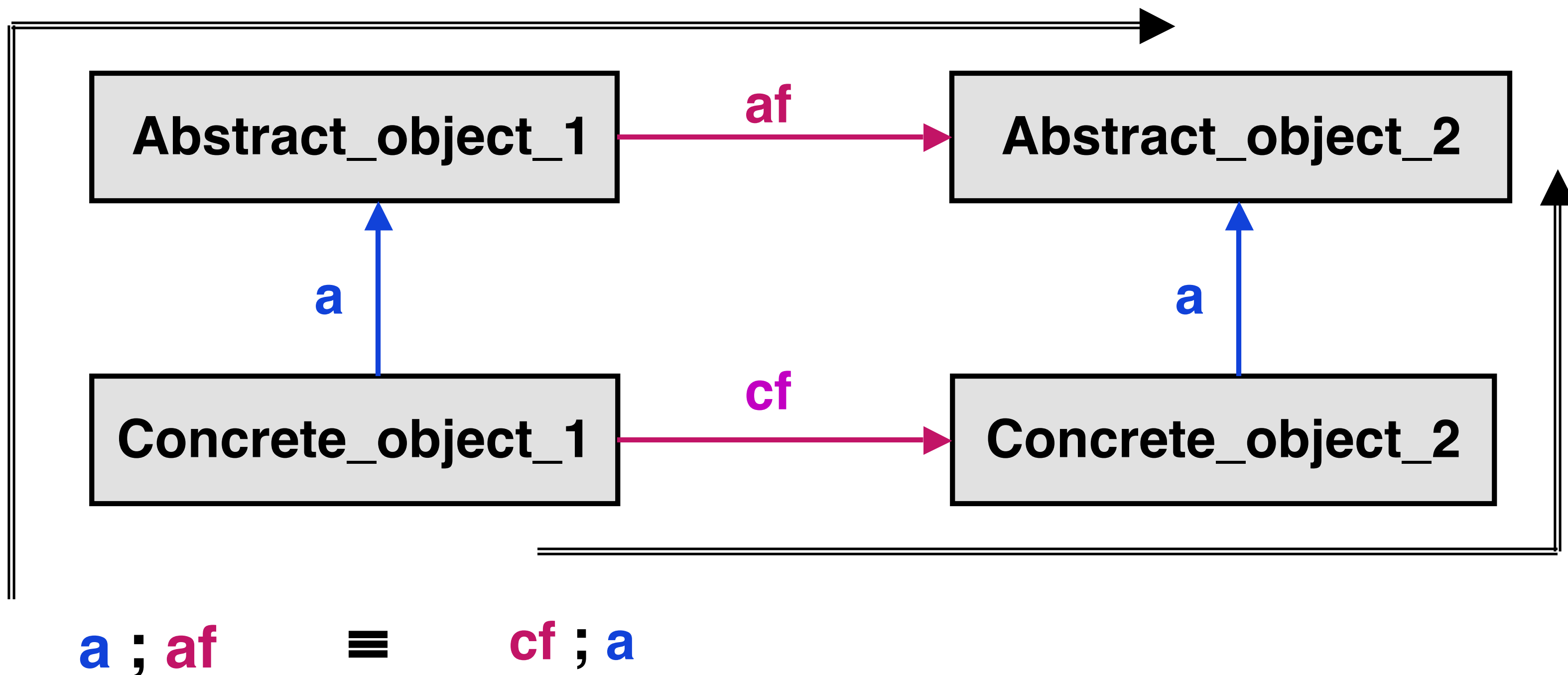
Class–ADT Consistency Property



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