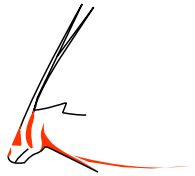
Stems a Different Way - Introducing 'oo' in 'ooRexx



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Overview

- Data type, abstract data type
  - REXX: strings, stem variables ("stems")
  - ooRexx in addition: Classes, Attributes, Methods
- Collecting values
  - REXX (and ooRexx): "Stem arrays"
  - ooRexx: *real* arrays
- Roundup

Data Type (DT), 1

- Data type
  - Defines set of valid values
  - Defines operations with those values (e.g. addition, concatenation)
  - Example 1
    - Data type Birthday
      - Defined values consist of a combination of
        - A valid date attribute and a valid time attribute
      - Defined operations
        - Set, query and change its date and time attributes

Data Type (DT), 2

- Example 2
  - Data type Person
    - Defined values consist of a combination of
      - firstName, lastName, salary attributes
    - Defined operations
      - Set, query and change its firstName, lastName, salary attributes
      - increaseSalary

Data Type (DT), 3
REXX-Problems

- No means to *explicitly* define *data structures*
- No means to *explicitly* define *operations* for certain data types
- *Data structures* can be mimicked with
  - Strings
  - Stem variables

Data Type (DT), 4
REXX, Possible Solution, 1

- Encode a data structure in a string
  - E.g. for the data type Birthday

```
"2005-09-01 16:00"
"2008-02-29 19:19"
```

  - E.g. for the data type Person

```
"Albert Einstein 45000"
"Vera WithAnyName 25000"
```

- Processing possible *only* if *everyone* knows
  - Number and sequence of encoded fields/attributes
  - Where the fields/attributes start and end

Data Type (DT), 5
REXX, Possible Solution, 2

- Represent a data structure with a stem variable
  - E.g. for the data type Birthday

```
birthday.0date="2005-09-01"; birthday.0time="16:00"
birthday.0date="2008-02-29"; birthday.0time="19:19"
```

  - E.g. using a "stem-array" for data type Person

```
person.1.firstname="Albert"; person.1.lastname="Einstein";
person.1.salary="45000"
person.2.firstname="Vera"; person.2.lastname="WithAnyName";
person.2.salary=25000
```

- Processing possible if name of fields/attributes is known!

Data Type (DT), 6
REXX, Considerations

- DT-Structure
  - Encoding as strings or in stems
    - Crook, as implementation dependent!
    - Error-prone!
- DT-Operations
  - No means to define operations for data types!
- No means to hide values/instances of data types from the programmer in order to shelter them from programming errors!
  - *Everyone* must know internal (encoding) details!

Abstract Data Type (ADT), 1

- Abstract Data type (ADT)
  - *Schema* for implementing data types
    - Definition of *attributes*
      - Yields the data structure
    - Definition of *operations* ("methods")
      - Yields the *behaviour*
  - *Schema* must be implemented
    - REXX is not designed for it, hence not suitable!
    - ooRexx is an object-oriented language and hence predestined ! :-)

Abstract Data Type (ADT), 2

- Implement any ADT in ooRexx with *directives*

  ::CLASS name

  ::ATTRIBUTE name

  ::METHOD name

  Hint: Rexx method routines are able to directly access attributes of its class by using as their first instruction the EXPOSE keyword instruction listing the attributes

- "Instances" ("objects", "values")
  - Distinct to any other instance/object/value
  - Possess all the same structure and behaviour

Abstract Data Type (ADT), 3
Implementing ADT "Birthday", 1

```
/* an ooRexx program that implements an ADT! */

::CLASS     BirthDay       /* name of the structure/class          */
::ATTRIBUTE date
::ATTRIBUTE time
```

- Creating values/instances/objects
  - Simply send the message NEW to the Rexx-Class named .Birthday
  - Message operator is the tilde (~), hence e.g.

```
bd1=.Birthday~new /* create a value         */
bd2=.Birthday~new /* create another value */
...
```

Abstract Data Type (ADT), 4
Implementing ADT "Birthday", 2

```
/* an ooRexx program that implements an ADT! */
bd1=.BirthDay~new
bd1~date="2005-09-01"
bd1~time ="16:00"

bd2=.BirthDay~new
bd2~date="2008-02-29"
bd2~time ="19:19"

say "BirthDay 1:" bd1~date bd1~time
say "BirthDay 2:" bd2~date bd2~time
```

```
::CLASS     BirthDay       /* name of the structure/class                */
::ATTRIBUTE date
::ATTRIBUTE time
```

Output:

```
BirthDay 1: 2005-09-01 16:00
BirthDay 2: 2008-02-29 19:19
```

Excursus: Scopes, 1

REXX

- Scopes
  - Determine the visibility of variables, attributes, routines and classes
- REXX-Scopes
  - *Standard-Scope*
    - Labels and variables are visible throughout the program
  - *Procedure-Scope*
    - Variables of internal routines followed by the PROCEDURE keyword statement are locally visible only

Excursus: Scopes, 2 ooRexx, 1

- Additional ooREXX-Scopes
  - *Program-Scope*
    - All Routine-directives and Class-directives of a program are visible in the entire program
    - In addition all public routines and public classes defined in another program become visible and directly accessible after that program got invoked !

Excursus: Scopes, 3
ooRexx, 2

- Additional ooREXX-Scopes
  - *Routine-Scope*
    - Managed as if it was a proper REXX-Programm
      - *Standard-Scope*
    - Therefore can include internal routines
      - *Procedure-Scope*
    - Can access all the routines and classes of the program
      - *Program-Scope*

Excursus: Scopes, 4 ooRexx, 3

- Additional ooREXX-Scopes
  - *Method-Scope*
    - Like *Routine-Scope*
    - In addition
      - Direct access to attributes of its class possible
        - First instruction must be the EXPOSE-keyword instruction with blank delimited attribute names

Excursus: Scopes, 5 Overview

- REXX and ooRexx
  - *Standard-scope*: labels, variables
  - *Procedure-scope*: local variables
- ooRexx
  - *Programm-scope*: routines, classes
  - *Routine-scope*
    - Like a proper program
    - Scopes: *Standard*, *Procedure*, *Program*
  - *Method-Scope*
    - Like *Routine-Scope*
    - Additionally EXPOSE allows directly accessing to attributes

Abstract Data Type (ADT), 5
Implementing ADT "Person", 1

```
p1=.person~new                  /* create an instance/value/object        */
p1~firstName ="Albert"
p1~lastName="Einstein"
p1~salary  =45000

p2=.person~new                  /* create an instance/value/object        */
p2~firstName ="Vera"
p2~lastName="WithAnyName"
p2~salary  =25000

say "Person 1:        " p1~firstName p1~lastName p1~salary
say "Person 2:        " p2~firstName p2~lastName p2~salary
say "sum of salaries:" p1~salary + p2~salary
```

```
::CLASS Person                  /* name of the structure/class            */
::ATTRIBUTE firstName
::ATTRIBUTE lastName
::ATTRIBUTE salary
```

Output:

```
Person 1:        Albert Einstein 45000
Person 2:        Vera WithAnyName 25000
sum of salaries: 70000
```

Abstract Data Type (ADT), 6 Implementing ADT "Person", 2

```
p1=.person~new              /* create an instance/value/object        */
p1~firstName ="Albert"
p1~lastName="Einstein"
p1~salary  =45000

p2=.person~new              /* create an instance/value/object        */
p2~firstName ="Vera"
p2~lastName="WithAnyName"
p2~salary  =25000

say "Person 1:           " p1~firstName p1~lastName p1~salary
say "Person 2:           " p2~firstName p2~lastName p2~salary
p1~increaseSalary(10000)    /* increase salary                        */
say "Person 1:        ->" p1~firstName p1~lastName p1~salary
say "sum of salaries: ->" p1~salary + p2~salary

::CLASS Person              /* name of the structure/class            */
::ATTRIBUTE firstName
::ATTRIBUTE lastName
::ATTRIBUTE salary

::METHOD increaseSalary     /* increaseSalary method                  */
  EXPOSE salary                /* access "salary" attribute directly  */
  USE ARG increaseBy           /* fetch increase amount               */
  salary=salary+increaseBy     /* add and save result in attribute    */
```

Output:

```
Person 1:           Albert Einstein 45000
Person 2:           Vera WithAnyName 25000
Person 1:        -> Albert Einstein 55000
sum of salaries: -> 80000
```

Fun with Methods: INIT, 1

Creating Objects/Instances/Values

- Objects/instances/values
  - Can be simply created by sending the message NEW to the class which will return a newly created value
- If a method INIT exists in the class then it will be invoked from the NEW method
  - If one supplies arguments to the NEW-message, then they will be forwarded to INIT in the same order!
  - The INIT-method carries also the name "constructor method" or short: "constructor"

Fun with Methods: INIT, 2

Creating Objects/Instances/Values

```
p1=.person~new("Albert", "Einstein", 45000)  /* create with values       */
p2=.person~new("Vera", "WithAnyName", 25000) /* create with values       */

say "Person 1:         " p1~firstName p1~lastName p1~salary
say "Person 2:         " p2~firstName p2~lastName p2~salary
say "sum of salaries:" p1~salary + p2~salary
```

```
::CLASS Person              /* name of the structure/class               */
::ATTRIBUTE firstName
::ATTRIBUTE lastName
::ATTRIBUTE salary

::METHOD increaseSalary     /* increaseSalary method                     */
  EXPOSE salary             /* access "salary" attribute directly        */
  USE ARG increaseBy        /* fetch increase amount                     */
  salary=salary+increaseBy  /* add and save result in attribute          */

::METHOD INIT               /* constructor method                        */
  EXPOSE firstName lastName salary    /* access attributes directly      */
  USE ARG firstName, lastName, salary /* assign arguments to attributes  */
```

Output:

```
Person 1:         Albert Einstein 45000
Person 2:         Vera WithAnyName 25000
sum of salaries: 70000
```

Fun with Methods: UNINIT, 1

Destroying Objects/Instances/Values

- Objects/instances/values
  - If values are not referenced anymore then the "garbage collector" destroys them
- If a method with the name UNINIT exists in a class, then the garbage collector will invoke it right before destroying the value
  - E.g. useful to release global locks, writing logs etc.
  - The UNINIT-method is also known as the "destructor method" or short: "destructor"

Fun with Methods: UNINIT, 2

Destroying Objects/Instances/Values

```
p1=.person~new("Albert", "Einstein", 45000)  /* create with values       */
p2=.person~new("Vera", "WithAnyName", 25000) /* create with values       */

say "Person 1:        " p1~firstName p1~lastName p1~salary
say "Person 2:        " p2~firstName p2~lastName p2~salary
say "sum of salaries:" p1~salary + p2~salary
drop p2; drop p1             /* delete variables, objects become garbage  */
call sysSleep 5              /* sleep five seconds                        */
say "end of main program!"

::CLASS Person               /* name of the structure/class               */
::ATTRIBUTE firstName
::ATTRIBUTE lastName
::ATTRIBUTE salary

::METHOD increaseSalary      /* increaseSalary method                     */
  EXPOSE salary              /* access "salary" attribute directly        */
  USE ARG increaseBy         /* fetch increase amount                     */
  salary=salary+increaseBy   /* add and save result in attribute          */

::METHOD INIT                /* constructor method                        */
  EXPOSE firstName lastName salary    /* access attributes directly         */
  USE ARG firstName, lastName, salary /* assign arguments to attributes     */

::METHOD UNINIT              /* destructor method                         */
  EXPOSE firstName lastName salary  /* access attributes directly         */
  say 'Object <'firstName lastName salary'> about to be destroyed...'
```

Output (maybe):

```
Person 1:        Albert Einstein 45000
Person 2:        Vera WithAnyName 25000
sum of salaries: 70000
end of main program!
Object <Vera WithAnyName 25000> about to be destroyed...
Object <Albert Einstein 45000> about to be destroyed...
```

Collecting Values, 1

- "Stem-arrays"
  - Convention
    - Stem variable with the tail "0" contains the sum of stored values starting with the tail "1"
  - Only possibility in REXX to collect and to process values
  - ooRexx allows for collecting any kind of values in such stem arrays

Collecting Values, 2 "Stem-Arrays", 1

```
person.1.firstName ="Albert"
person.1.lastName="Einstein"
person.1.slary   =45000        /* <-- typical typing error!                */

person.2.firstName ="Vera"
person.2.lastName="WithAnyName"
person.2.salary  =25000
person.0=2

do i=1 to person.0   /* iterate over all persons                           */
   say "Person #" i":" person.i.firstName person.i.lastName person.i.salary
end
```

Output:

```
Person # 1: Albert Einstein PERSON.1.SALARY
Person # 2: Vera WithAnyName 25000
```

Collecting Values, 3 "Stem-Arrays", 2

```
person.1=.person~new("Albert", "Einstein", 45000)
person.2=.person~new("Vera", "WithAnyName", 25000)
person.0=2

do i=1 to person.0   /* iterate over all persons                          */
   say "Person #" i":" person.i~firstName person.i~lastName person.i~salary
end
```

```
::CLASS Person              /* name of the structure/class                */
::ATTRIBUTE firstName
::ATTRIBUTE lastName
::ATTRIBUTE salary

::METHOD INIT               /* constructor method                         */
  EXPOSE firstName lastName salary     /* access attributes directly      */
  USE ARG firstName, lastName, salary  /* assign arguments to attributes*/
```

Output:

```
Person # 1: Albert Einstein 45000
Person # 2: Vera WithAnyName 25000
```

Collecting Values, 4 ooRexx

- ooRexx has *real* arrays !
  - Simple to create
    - ooRexx 5.0 beta even allows creating them from a list
  - Easy to use and to iterate over the collection
    - E.g. DO...OVER
- Hint
  - ooRexx comes with many different kinds of classes/types that allow one to collect and process values!

Collecting Values, 5
ooRexx Has *Real* Arrays, 1

```
persons=.Array~new          /* create an array                          */
persons[1]=.person~new("Albert", "Einstein", 45000)
persons[2]=.person~new("Vera", "WithAnyName", 25000)

do p over persons           /* iterate over all persons                 */
   say "Person:" p~firstName p~lastName p~salary
end
```

```
::CLASS Person              /* name of the structure/class              */
::ATTRIBUTE firstName
::ATTRIBUTE lastName
::ATTRIBUTE salary

::METHOD INIT          /* constructor method                            */
  EXPOSE firstName lastName salary    /* access attributes directly     */
  USE ARG firstName, lastName, salary /* assign arguments to attributes */
```

Output:

```
Person: Albert Einstein 45000
Person: Vera WithAnyName 25000
```

Collecting Values, 6 ooRexx

- Arrays can be *sorted*! :)
  - Simply define a method named compareTo
    - Will receive the other value to compare to by the sort method defined in the Array class
    - Method must return the value
      - "1", if our value is regarded to be larger
      - "0", if both values are regarded to be the same
      - "-1", if other value is regarded to be larger

Collecting Values, 7
ooRexx Has *Real* Arrays, 2

```
persons=.Array~new          /* create an array                              */
persons[1]=.person~new("Albert", "Einstein", 45000)
persons[2]=.person~new("Vera", "WithAnyName", 25000)

do p over persons~sort      /* iterate over all persons in sorted order     */
   say "Person:" p~firstName p~lastName p~salary
end
```

```
::CLASS Person              /* name of the structure/class                  */
::ATTRIBUTE firstName
::ATTRIBUTE lastName
::ATTRIBUTE salary

::METHOD INIT          /* constructor method                                */
  EXPOSE firstName lastName salary     /* access attributes directly        */
  USE ARG firstName, lastName, salary  /* assign arguments to attributes    */
```

```
::METHOD compareTo          /* comparison method for sorting                */
  EXPOSE salary             /* access attribute directly                    */
  use arg other             /* other person to compare to                   */
  if other~salary<salary then return 1 /* our salary is greater             */
  if other~salary=salary then return 0 /* salaries are the same             */
  return -1                 /* other salary is greater                      */
```

Output:

```
Person: Vera WithAnyName 25000
Person: Albert Einstein 45000
```

Roundup

- REXX
  - Data structures can be hardly represented
  - Defining operations for data structures not possible
- ooRexx
  - Defining data structures incredibly easy
  - Defining operations for data structures: ditto! :)
  - Very powerful and versatile
  - Values can be simply collected with the help of arrays and in addition can be easily sorted! 8-)

Links

- RexxLA-Homepage (non-profit SIG, owner of ooRexx, BSF4ooRexx)
  <http://www.rexxla.org/>
- ooRexx 5.0 beta on Sourceforge
  <https://sourceforge.net/projects/oorexx/files/oorexx/5.0.0beta/>
  - Introduction to ooRexx on Windows, Slides ("Business Programming 1")
    - <http://wi.wu.ac.at/rgf/wu/lehre/autowin/material/foils/>
- BSF4ooRexx on Sourceforge (ooRexx-Java bridge)
  <https://sourceforge.net/projects/bsf4oorexx/>
  - Introduction to BSF4ooRexx (Windows, Mac, Unix), Slides ("Business Programming 2")
    - <http://wi.wu.ac.at/rgf/wu/lehre/autojava/material/foils/>
- Student's work, including ooRexx, BSF4ooRexx
  <http://wi.wu.ac.at/rgf/diplomarbeiten/>
- JetBrains "IntelliJ IDEA", powerful IDE for all operating systems
  - <https://www.jetbrains.com/idea/download>, free "Community-Edition"
    - Students and lecturers can use the professional edition for free
  - Alexander Seik's ooRexx-Plugin with readme (as of: 2021-11-07)
    - <https://sourceforge.net/projects/bsf4oorexx/files/Sandbox/aseik/ooRexxIDEA/GA/2.0.4/>
- Introduction to ooRexx (254 pages, covers ooRexx 4.2)
  <https://www.facultas.at/Flatscher>