



**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

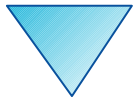
ooRexx, 1

- 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 !



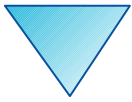
Excursus: Scopes, 3 ooRexx, 2

- 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.salary   =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-)



URLs

- 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/>>
- BSF4ooRexx on Sourceforge (ooRexx-Java bridge)
<<https://sourceforge.net/projects/bsf4ooRexx/>>
- Introduction to ooRexx (254 pages)
<<https://www.facultas.at/Flatscher>>
- JetBrains "IntelliJ IDEA", powerful IDE for all operating systems
 - <<https://www.jetbrains.com/idea/download>>, free "Community-Edition"
 - Alexander Seik's ooRexx-Plugin with readme (as of: 2019-10-03)
 - <<https://sourceforge.net/projects/bsf4ooRexx/files/Sandbox/aseik/ooRexxIDEA/beta/1.0.5/>>