

# An Introduction to Procedural and Object-oriented Programming (ooRexx) 1

Introduction, Overview,  
Statement, Procedure, Function

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# Overview, 1

- Course
  - Basic concepts of the object-oriented paradigm
    - Standard application systems
  - Scripting language
    - Automation ("remote controlling") of applications
    - Automation of operating systems like Linux or Windows
  - Foils
    - <http://wi.wu-wien.ac.at/rgf/wu/lehre/autowin/material/foils/>
    - <http://wi.wu-wien.ac.at/rgf/wu/lehre/autojava/material/foils/>
  - Exercises
    - <http://wi.wu-wien.ac.at/rgf/wu/lehre/autowin/material/exercises/>

# Overview, 2

- Why Rexx? Why Object Rexx?
  - Simple syntax ("human-centric" language)
    - Easy and quick to learn
  - Powerful object-model
    - All important concepts of the OO-paradigm available
  - Windows Scripting Engine (WSE)
    - Full automation of Windows applications possible
- Availability of Software
  - <http://www.ooRexx.org>

# Overview, 3

- "Interactive" lecture
  - Please ask questions!
  - Do not fear "wrong", "easy" or "ridiculous " questions
  - Questioner concentrates on the answer (easier and more thorough learning of new concepts)
  - Questioner usually can rely on the fact that there are others who would like to place the same question (but don't dare/bother to do so)

# History, 1

<http://www2.hursley.ibm.com/rexx/rexxhist.htm>

- 1979 - IBM (**Mike F. Cowlshaw**, IBM-Fellow)
  - Successor of a rather cryptic script language ("EXEC") on IBM mainframes
  - Goal: to create a "human-centric" language
  - Interactive (Interpreter)
  - REXX: Acronym for "**RE**structured **eX**tended **eX**ecutor"
- Since 1987 IBM's "SAA" (System Application Architecture) "Procedural Language"
  - Strategic script language for all IBM platforms
  - Numerous commercial and open source versions of the language, available for practically all operating systems there are
- ANSI Rexx Standard in 1996
  - ANSI "Programming Language - REXX", X3.274-1996

# History, 2

- Since the beginning of the 90ies
  - Going back on an initiative of the powerful IBM user interest group "SHARE" development of an object-oriented version of REXX started
- "Object-based REXX" a.k.a. "Object REXX"
  - Fully compatible with classic ("procedural") Rexx
  - Internally fully object-oriented
    - *All classic Rexx statements are transformed into object-oriented ones internally!*
  - Powerful object model (e.g. meta-classes, multiple inheritance)
  - Still a simple syntax
  - Availability
    - 1997 part of OS/2 Warp 4 (free) and free for Warp 3 (with [SOM](#))
    - 1998 AIX (first evaluation version) and [Linux](#) (free)
    - 1998 for Windows 95 and Windows NT (with [OLEAutomation/ActiveX](#))

# History, 3

- Since 1996 development of "NetRexx" by the original author of Rexx, Mike F. Cowlshaw
  - Java in the "clothes" of Rexx
    - NetRexx-programs are translated into Java byte code
    - Simpler programming of the Java VM due to the simpler Rexx syntax
      - ~30% less Code (syntactical elements) than Java
    - Due to the Rexx syntax, easier to learn for the programming novice
- URLs for Rexx, Object Rexx, NetRexx

<http://www.RexxLA.org/>

<http://www.software.ibm.com/ad/obj-rexx/>

<http://www2.hursley.ibm.com/rexx/>

<http://www2.hursley.ibm.com/orexx/>

<http://www2.hursley.ibm.com/netrexx/>

<news:comp.lang.rexx>

# History, 4

- May 2004
  - The "Rexx Language Association" (RexxLA) and IBM start non-public negotiations about open-sourcing Object Rexx
    - IBM: Manfred Schweizer, manager of IBM's Rexx development team
    - RexxLA: Pam Taylor (experienced commercial manager, USA), Mark Hessling (maintainer of Regina and author of numerous Rexx libraries, Australia), Rony G. Flatscher (MIS professor, Austria/Europe)
- October 12th, 2004
  - IBM and the Rexx Language Association (<http://www.RexxLA.org>) announce that RexxLA will manage Object Rexx under the name "Open Object Rexx" ("ooRexx")
- April 2005
  - The Rexx Language Association releases the opensource version "Open Object Rexx" (ooRexx), homepage: <http://www.ooRexx.org>



# Basics

## Minimal Rexx-Program

```
/* a comment */  
SAY "Hello, my beloved world"
```

**Output:**

```
Hello, my beloved world
```

# Basics

## RexxTry.rex

- "RexxTry.rex"
  - Rexx-Program which allows interactive execution of Rexx statements
    - Transfers every Rexx statement entered through the keyboard to the Rexx interpreter for execution
    - Displays console-output or errors of entered Rexx statements
  - Program ends when user enters **EXIT** through the keyboard
  - Invoking the program via a command in a command line window:

```
rexx RexxTry.rex
```

```
rexx rexxtry
```

# Basics

## Notation of Program Text

- Upper or lowercase spelling irrelevant
  - All characters of a Rexx statement will be translated into uppercase and executed
  - Exception: Contents of a string remains unchanged
    - Strings are delimited by apostrophes (') or by quotes ("), e.g.

*"Richard"* , *'Richard'* , *"\{[]}\gulp!öäüß!{niX }"*

- Multiple blank characters are reduced to one blank
  - Example

```
say      "\{[]}\gulp!öäüß!{niX }"      reverse(      Abc  )
```

becomes:

```
SAY "\{[]}\gulp!öäüß!{niX }" REVERSE( ABC  )
```

# Basics

## Characters

- Characters outside of strings and comments must be from the following character set
  - Blank
  - **a** thru **z**
  - **A** thru **Z**
  - **0** thru **9**
  - Exclamation mark (**!**), backslash (**\**), question mark (**?**), equal sign (**=**), comma (**,**), dash/minus (**-**), plus (**+**), dot (**.**), Slash (**/**), parenthesis (**()**), square parentheses (**[]**), asterisk (**\***), tilde (**~**), semicolon (**;**), colon (**:**) and underline (**\_**)

# Basics

## Variables

- Variables allow storing, changing, and retrieving strings with the help of a discretionary name called an *identifier*

```
A = "Hello, my beloved world"  
a="Hello, my beloved variable"  
A      =      a      "- changed again."  
say a
```

### Output:

```
Hello, my beloved variable - changed again.
```

- Identifiers must begin with a letter, an exclamation mark, a question mark or an underline character, followed by one or more of these characters, digits, and dots.

# Basics

## Constants

- Constants never get their values changed
- It is possible to use literals which are string constants appearing verbatim in an expression
  - If one wishes to name constants, then there are two possibilities available
    - The constant value is assigned to a variable, the value of which never gets changed in the entire program, e.g.,

```
Pi = 3.14159
```

- The constant value can be saved in the local (`.local`) or global (`.environment`) environment and will be referred to by an "environment symbol", which always start with a dot, e.g.,

```
.local~pi = 3.14159 /* Store value 3.14159 in .local */  
say .pi           /* retrieves value 3.14159 from .local*/
```

# Basics

## Comments

- Comments may be nested and are allowed to span multiple lines, e.g.

```
say 3 + /* This /**/ is  
a      /* nested  
/* aha*/ comment*/ which spans  
multiple lines */ 4
```

**Output:**

7

- Line comments: at the end of a statement, comments follow after two consecutive dashes:

```
say 3 + 4 -- this yields "7"
```

**Output:**

7

# Basics

## Statements, 1

- Statements consist of all characters up to and including the semi-colon (;)
- There may an arbitrary number of statements on a line
- If the semi-colon is missing, then the end of a statement is assumed by the end of a line

```
/* Convention: A comment begins in 1. line, 1. column */  
SAY "Hello, my dear world";
```

Output:

```
Hello, my dear world
```



# Basics

## Statements, 2

- Statements may span multiple lines, but you need to indicate this with the continuation character
  - Comma or Dash as the last character on the line

```
/* Convention: A comment begins in 1. line, 1. column */  
SAY "Hello," -  
    "my beloved world";
```

### Output:

```
Hello, my beloved world
```

# Basics Block

- A block is a statement, which may comprise an arbitrary number of statements
- A block starts with the keyword **DO** and ends with **END**

```
DO
  SAY "Hello," ;
  SAY "world" ;
END;
```

```
DO
  SAY "Hello,"
  SAY "world"
END
```

Output:

```
Hello,
world
```

# Basics

## Comparisons (Test Expressions), 1

- Two values (constant, variable, results of function calls) can be compared with the following (Infix) operators (Result: 0=false or 1=true)

|                       |                                 |                           |
|-----------------------|---------------------------------|---------------------------|
| <code>=</code>        |                                 | <code>equal</code>        |
| <code>&lt;&gt;</code> | <code>!=</code> <code>\=</code> | <code>unequal</code>      |
| <code>&lt;</code>     |                                 | <code>smaller</code>      |
| <code>&lt;=</code>    |                                 | <code>smaller than</code> |
| <code>&gt;</code>     |                                 | <code>greater</code>      |
| <code>&gt;=</code>    |                                 | <code>greater than</code> |

- Negation of Boolean (0=false, 1=true) values

`\` **Negator**

# Basics

## Comparisons (Test Expressions), 2

- Boolean values can be combined

**&** "and" (`true`: if both arguments are true)

**|** "or" (`true`: if either argument are true)

**&&** "exclusive or" (`true`: if one argument is true and the other is false)

- Boolean combinations can be evaluated in a specific order if enclosed in parentheses:

```
0 & 1 | 1 Result: 1 (= true)
(0 & 1) | 1 Result: 1 (= true)
0 & (1 | 1) Result: 0 (= false)
```

# Basics

## Comparisons (Test Expressions), 3

a=1

b=2

x="Anton"

y=" Anton "

If **a = 1** then ...

Result: **1** (= true)

If **a = a** then ...

Result: **1** (= true)

If **a >= b** then ...

Result: **0** (= false)

If **x = y** then ...

Result: **1** (= true)

If **x == y** then ...

Result: **0** (= false)

**a <= b & (a = 1 | b > a)**

Result: **1** (= true)

**\(a <= b & (a = 1 | b > a))**

Result: **0** (= false)

**\a**

Result: **0** (= false)

# Basics

## Branch, 1

- A branch determines which statement (block) should be executed as a result of a comparison (of a Boolean value)
  - **IF** test\_expression=.true **THEN** statement;
  - Example:

```
IF age < 19 THEN SAY "Young."
```
  - A branch can also determine what alternative statement (block) should be executed, in case the Boolean value is false
  - **IF** test\_expression=.true **THEN** statement; **ELSE** statement;
  - Examples:

```
IF age < 19 THEN SAY "Young.";  
                ELSE SAY "Old."
```

```
IF age < 1 THEN  
DO  
    SAY "Hello,"  
    SAY "my beloved world"  
END
```

# Basics

## Branch, 2

- Multiple selections (**SELECT**)

**SELECT**

```
WHEN test_expression THEN statement ;  
WHEN test_expression THEN statement ;  
/* ... additional WHEN-statements */  
OTHERWISE statement ;
```

**END**

### Example:

```
SELECT
```

```
WHEN age = 1 THEN SAY "Baby." ;  
WHEN age = 6 THEN SAY "Elementary school kid." ;  
WHEN age >= 10 THEN SAY "Big kid." ;  
OTHERWISE SAY "Unimportant." ;
```

```
END
```

# Basics

## Repetition, 1

- Principally a block can be executed repeatedly

```
DO 3  
    SAY "Aua! "  
    SAY "Oh! "  
END
```

### Output:

```
Aua!  
Oh!  
Aua!  
Oh!  
Aua!  
Oh!
```



# Basics

## Repetition, 2

- Using a variable to control the number of repetitions

```
a = 3
...
DO a
    SAY "Aua! "; SAY "Oh! "
END
```

### Output:

```
Aua!
Oh!
Aua!
Oh!
Aua!
Oh!
```

# Basics

## Repetition, 3

- Repetition using a control variable ("i" in this example)

```
DO i = 1 TO 3
  SAY "Aua! "; SAY "Oh! " i
END
```

### Output:

```
Aua!  
Oh! 1  
Aua!  
Oh! 2  
Aua!  
Oh! 3
```

# Basics

## Repetition, 4

- Repetition using a control variable ("i" in this example)

```
DO i = 1 TO 3 BY 2  
    SAY "Aua! "; SAY "Oh! " i  
END
```

### Output:

```
Aua!  
Oh! 1  
Aua!  
Oh! 3
```

# Basics

## Repetition, 5

- Repetition using a control variable ("i" in this example)

```
DO i = 3.1 TO 5.7 BY 2.1
    SAY "Aua!"; SAY "Oh!" i
END
```

### Output:

```
Aua!  
Oh! 3.1  
Aua!  
Oh! 5.2
```

# Basics

## Repetition, 6

- Conditional repetition

```
i = 2
DO WHILE i < 3
    SAY "Aua!"; SAY "Oha!" i
    i = i + 1
END
```

### Output:

Aua!

Oha! 2

# Basics

## Repetition, 7

- Conditional repetition

```
i = 3
DO WHILE i < 3
  SAY "Aua!"; SAY "Oha!" i
  i = i + 1
END
```

➔ No output, because block is not executed!

# Basics

## Repetition, 8

- Conditional repetition

```
i = 3
DO UNTIL i > 1
    SAY "Aua!"; SAY "Oha!" i
    i = i + 1
END
```

### Output:

Aua!

Oha! 3

# Basics

## Execution, 1

```
/* */  
a = 3  
b = "4"  
say a b  
say a b  
say a || b  
say a + b
```

### Output:

```
3 4  
3 4  
34  
7
```



# Basics

## Execution, 2

```
/* */  
"del *.*"
```

or:

```
/* */  
ADDRESS CMD "del *.*"
```

or:

```
/* */  
a = "del *.*"  
a
```

or:

```
/* */  
a = "del *.*"  
ADDRESS CMD a
```