"Camouflaging Java as Object Rexx"

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Agenda

- BSF, BSF4Rexx
  - Architecture
  - Example
- Object Rexx wrapper "BSF.cls"
  - Overview
  - Classes and methods
  - Examples
- Roundup and Outlook

BSF

- Bean Scripting Framework
  - A Java framework, making it easy for Java to invoke scripts in non-Java scripting languages
    - E.g. JavaScript, NetRexx
  - Originally developed by IBM as open source
    - Part of IBM's WebSphere to allow scripts to be deployed within Java Server Pages (JSP)
  - Fall 2003 handed over to **jakarta.apache.org**
    - Used e.g. in **ant**, **xerces**

BSF4Rexx

- BSF with a Rexx engine
  - Allows the usage of Rexx from BSF
    - Any Java program can invoke Rexx
    - Rexx scripts are able to communicate with Java objects, if made available by the Java program
  - Allows Java to be used as a huge Rexx function library
    - The public methods and public fields of every Java object and Java class object can be used by Rexx
    - If necessary, Java can be started up by Rexx

BSF4Rexx, Example

Java using Rexx

```
import com.ibm.bsf.*;    // BSF support
import java.io.*;        // exception handling
/** Java program which demonstrates how easy it is to invoke Rexx via BSF. */
public class TestSimpleExec
{
   /** Running an in-line defined Rexx script. */
   public static void main (String[] args) throws IOException
   {
       try
       {
         BSFManager mgr        = new BSFManager ();
         String     scriptCode = "SAY 'Rexx was here!'"; // a Rexx statement
                   // invoke Rexx from Java via BSF
         mgr.exec("rexx", "any debug info", 0, 0, scriptCode);
       }
       catch (BSFException e)
       {
         e.printStackTrace();
       }
   }
}
```

Yields:

```
Rexx was here!
```

BSF4Rexx, Example
Rexx Using Java

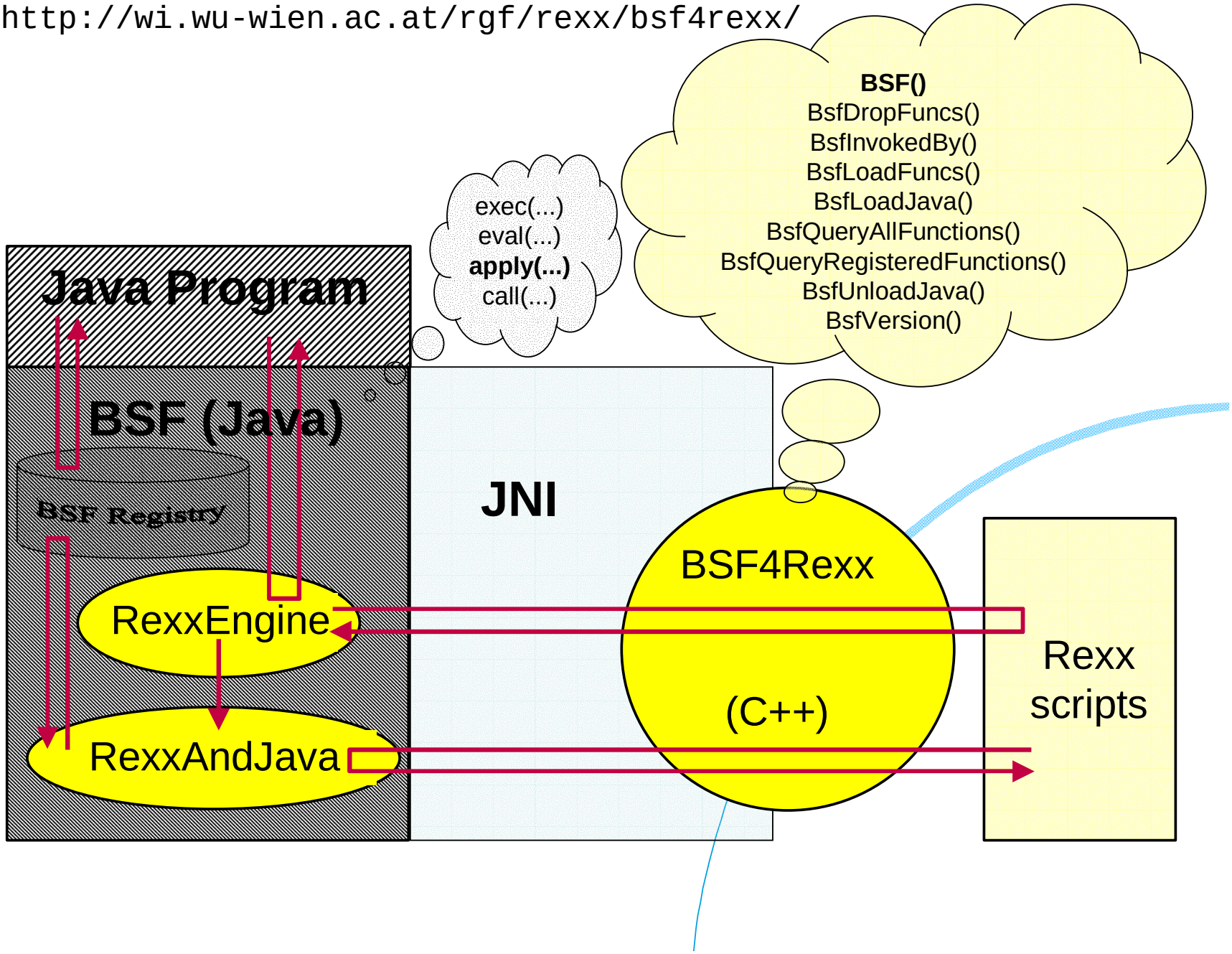
```
/* classic Rexx version, querying the installed Java version */

     /* load the BSF4Rexx functions and start a JVM, if necessary */
if rxFuncQuery("BSF") = 1 then   /* BSF() support not loaded yet ? */
do
  call rxFuncAdd "BsfLoadFuncs", "BSF4Rexx", "BsfLoadFuncs"
  call BsfLoadFuncs /* registers all remaining BSF functions */
  call BsfLoadJava  /* loads Java */
end

say "java.version:" bsf('invoke', 'System.class', 'getProperty', 'java.version')
```

Yields, e.g.:

```
java.version: 1.4.2
```

BSF4Rexx Architecture

http://wi.wu-wien.ac.at/rgf/rexx/bsf4rexx/



BSF4Rexx (BSFRegistry)
Pre-registered Java Objects

1) "Class.class"
2) "Object.class"
3) "Method.class"
4) "Array.class"
5) "String.class"
6) "System.class"
7) "Boolean.class"
8) "boolean.class"
9) "Byte.class"
10) "byte.class"
11) "Character.class"
12) "char.class"
13) "Double.class"
14) "double.class"
15) "Integer.class"
16) "int.class"
17) "Long.class"
18) "long.class"
19) "Float.class"
20) "float.class"
21) "Short.class"
22) "short.class"
23) "Void.class"
24) "void.class"

BSF4Rexx

BSF()-Subfunctions, 1

(1) call BSF "addEventListener", beanName, eventSetName, filter, eventText

(2) x=BSF("arrayAt", arrayObject, idx1 [, ...])

(3) l=BSF("arrayLength", arrayObject)

(4) call BSF "arrayPut", arrayObject, newValue, idx1 [, ...])

(5) call BSF *"arrayPut**Strict**"*, arrayObject, typeIndicator, newValue, idx1 [, ...])

(6) a=BSF("createArray", componentType, capacity1 [, ...])

(7) w=BSF("wrapArray", arrayObject)

(8) res= BSF("exit"' [, [retVal] [, time2wait in msec]])

(9) v=BSF("getFieldValue", beanName, fieldName)

(10) p=BSF("getPropertyValue", beanName, propertyName, index)

(11) s=BSF("getStaticValue", className, fieldName)

(12) res=BSF(**"invoke"**, beanName, methodName, arg1 [,...])

(13) res=BSF(*"invoke**Strict**"*, beanName, methodName, typeIndicator1, arg1 [, ..., ...])

(14) o=BSF("lookupBean", beanName)

(15) t=BSF("pollEventText" [, timeout in msecs])

(16) call BSF "postEventText", eventText, priority

BSF4Rexx

BSF()-Subfunctions, 2

(17) o=BSF("registerBean", beanName, beanType, arg1 [,...])

(18) o=BSF("*registerBean**Strict***", beanName, beanType, typeIndicator1, arg1 [,..., ...])

(19) v=BSF("setFieldValue", beanName, fieldName, newValue)

(20) v=BSF("*setFieldValue**Strict***", beanName, fieldName, typeIndicator, newValue)

(21) v=BSF("setPropertyValue", beanName, propertyName, index, newValue)

(22) v=BSF("*setPropertyValue**Strict***", beanName, propertyName, index, typeIndicator, newValue)

(23) call BSF "setRexxNullString", newString

(24) call BSF "sleep", time2sleep in msecs

(25) str=BSF("unregisterBean", beanName)

(26) v=BSF("version")

(27) e=BSF("wrapEnumeration", enumerableObject)

BSF4Rexx, Typing Issue, 1 "Strict"

- A newer version than the "Augsburg" version of BSF4Rexx
  - Beta version can be downloaded from
    `http://wi.wu-wien.ac.at/rgf/rexx/bsf4rexx/`
  - Allows to omit type information usually needed for Java
    - Java is a strongly typed programming language, Rexx is not!
  - "strict" allows to supply explicit type information
    - Needed under rare circumstances where Java methods of the same name and same number of arguments exis, but differ in the type of their arguments only

BSF4Rexx, Typing Issue, 2 "Strict"

- "Type indicators" preceed the argument in BSF()-subfunctions containing the word "Strict"
- "Type indicators" are one of the following strings
  - **BO**olean, **B**yte, **C**har, **D**ouble, **F**loat, **I**nt, **L**ong, **O**bject, **SH**ort, **S**tring
    - Only bold and uppercase letters need to be given
    - Java type information is given in the HTML documentation
    - "BOolean", "Byte", "Char", "Double", "Float", "Int", "Long", "SHort", "String" are the Java "primitive" data types
    - "Object" is *any* Java object

Camouflaging Java, 1

BSF.cls

– "**BSF.cls**"

- An Object Rexx package
- Defines routines, classes and methods which hide the procedural interface from Object Rexx programs
- Wraps all BSF()-subfunctions into Object Rexx Methods
- Allows to import Java classes explicitly into Object Rexx in the form of Object Rexx proxy classes
- Allows to create Object Rexx proxy objects which interact with the appropriate Java objects

Camouflaging Java, 2

BSF.cls

- "**BSF.cls**"
  - Supports Java array objects as Object Rexx array proxies
    - Allows using Java array objects as if they were Object Rexx array objects
    - Hence indexing of proxy arrays starts with 1 (and not 0)!
  - Takes advantage of Object Rexx' **UNKNOWN** mechanism
    - Allows a rather simple implementation of the needed forwarding mechanism, which forwards Object Rexx messages to Java and causes the appropriate Java methods to be invoked
  - Among other things, takes advantage of the Object Rexx destructor mechanism to automatically free registered Java objects from the BSFRegistry
    - Hence, no orphaned objects in the BSFRegistry ("object leaks")

BSF4Rexx, Example
Object Rexx Using Java

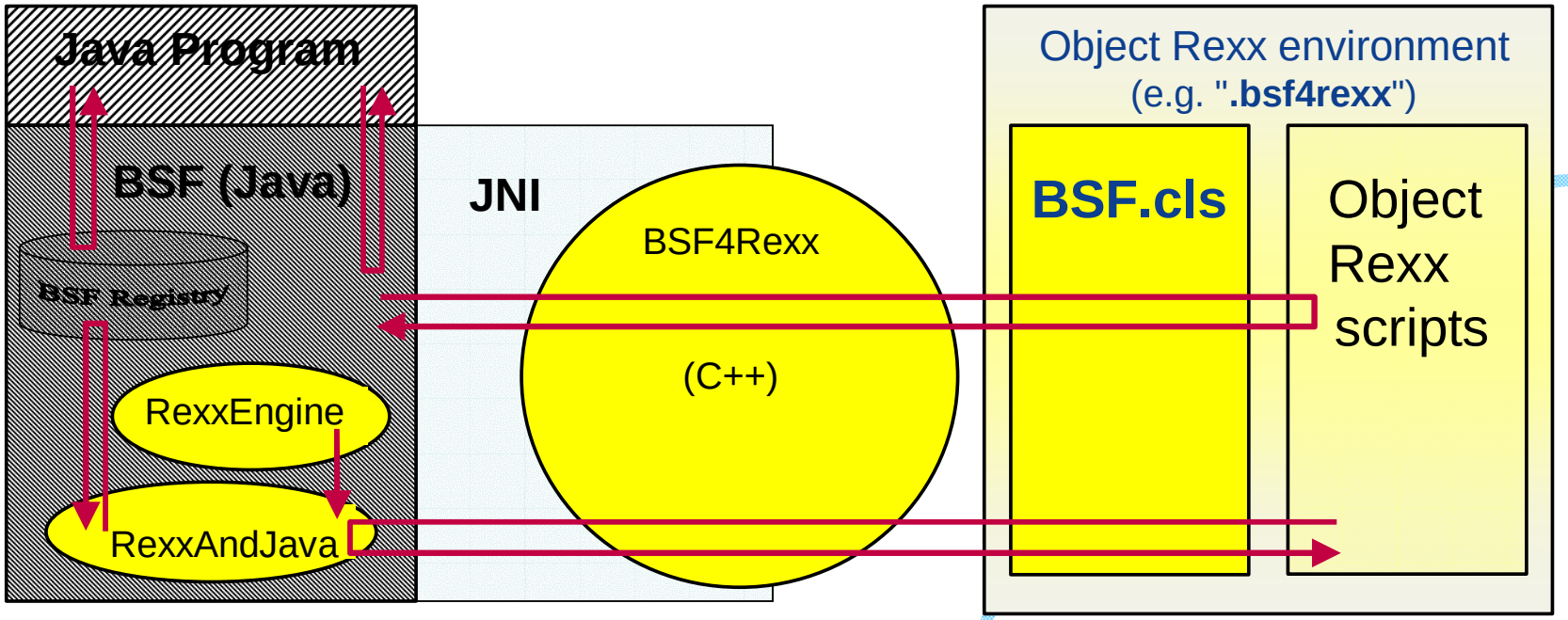
```
/* Object Rexx version */

say "java.version:" .bsf4rexx~system.class ~getProperty('java.version')

::requires "BSF.cls" -- loads the Object Rexx (camouflaging) support
```

Yields, e.g.:

```
java.version: 1.4.2
```

Camouflaging Java, 3

Architecture



BSF4Rexx (BSFRegistry)
Pre-registered Java Class Objects

- Object Rexx directory "**.BSF4Rexx**"

1) .bsf4rexx~Class.class
2) .bsf4rexx~Object.class
3) .bsf4rexx~Method.class
4) .bsf4rexx~Array.class
5) .bsf4rexx~String.class
6) .bsf4rexx~System.class
7) .bsf4rexx~Boolean.class
8) *.bsf4rexx~**boolean***
9) .bsf4rexx~Byte.class
10) *.bsf4rexx~**byte***
11) .bsf4rexx~Character.class
12) *.bsf4rexx~**char***
13) .bsf4rexx~Double.class
14) *.bsf4rexx~**double***
15) .bsf4rexx~Integer.class
16) *.bsf4rexx~**int***
17) .bsf4rexx~Long.class
18) *.bsf4rexx~**long***
19) .bsf4rexx~Float.class
20) *.bsf4rexx~**float***
21) .bsf4rexx~Short.class
22) *.bsf4rexx~**short***
23) .bsf4rexx~Void.class
24) *.bsf4rexx~**void***

BSF.cls, 1
Public Routines and Classes

- Routine **bsf.checkResult**
  - Expects a string, returns proxy object if a Java object, string else
- Class **BSF**
  - Proxy class to camouflage Java
- Class **BSF_PROXY**
  - Subclass of **BSF**
  - Wraps a string referring to a BSFRegistry entry into a BSF proxy object

BSF.cls, 2
Proxy Class **BSF**

- Execute "BSF.cls" either with **call** or **::requires**

```
call "BSF.cls"
::requires "BSF.cls"
```

- Allows to import Java classes and interact with them as if they were Object Rexx classes

.bsf~import(rexxName, javaName)

```
.bsf~import("javaFrame", "java.awt.Frame")
f=.javaFrame~new("hi!")~~show~~toFront~~setSize(200,100)
```

- Allows to create Java objects

```
.bsf~import("javaFrame", "java.awt.Frame")
f1=.javaFrame~new("hi!") -- using an imported Java class
f2=.BSF~new("java.awt.Frame", "hi!") – using .BSF directly
```

BSF.cls, 3
Proxy Class **BSF**

- Proxy objects
  - Object Rexx objects which represent Java objects
    - Such Java objects *must* be stored in the BSFRegistry!
  - Sending Java messages to Object Rexx proxies will usually raise the UNKNOWN condition
    - UNKNOWN method forwards the unknown message with the supplied arguments to Java
    - Any resulting value will be returned to Object Rexx
      - If result is a Java object, then an Object Rexx proxy object will be returned

BSF.cls, 4
Proxy Class **BSF**

- Procedural BSF()-subfunctions available as (mangled) instance methods:

(1) bsf.addEventListener
(2) bsf.exit
(3) bsf.invoke
*(4) bsf.invoke**Strict***
(5) bsf.getFieldValue
(6) bsf.setFieldValue
*(7) bsf.setFieldValue**Strict***
(8) bsf.getPropertyValue
(9) bsf.setPropertyValue
*(10) bsf.setPropertyValue**Strict***

- Procedural BSF()-subfunctions available as class methods:

(11) exit
(12) sleep
(13) lookupBean
(14) pollEventText
(15) getStaticValue
(16) postEventText
(17) wrapArray
(18) createArray
(19) wrapEnumeration
(20) setRexxNullString

BSF.cls – Some Remarks, 1
Strong Typing

- Strong typing
  - If necessary, use the "strict" version of the methods
  - If needed while creating instances of Java classes (i.e. need for a strict version of the class method "new")
    - Import the appropriate Java class into Object Rexx
      - `.bsf~import("rexxName", "javaName")`
    - Use "**newStrict**" instead of "**new**"
      - Importing will create a "newStrict" class method on the fly

```
.bsf~import("javaFrame", "java.awt.Frame")
f1=.javaFrame~newStrict("String", "Hi there!")
-- or:
f2=.javaFrame~new("Hi there!")
```

BSF.cls – Some Remarks, 2
Creating and Using Java Arrays

```
-- create a two-dimensional (5x10) Java Array of type String
arr=.bsf~createArray(.bsf4rexx~string.class, 5, 10)

arr[1,1]="First Element in Java array."        -- place an element
arr~put("Last Element in Java array.", 5, 10) -- place another one

do i over arr       -- loop over elements in array
   say i
end
```

Yields:

```
First Element in Java array.
Last Element in Java array.
```

Roundup and Outlook, 1

- Using the new beta version of "BSF4Rexx" there is no type information needed anymore
  - As a result it is ***much easier to use*** for Rexx programmers
- "BSF.cls" successfully camouflages Java as Object Rexx
  - Object Rexx proxy classes and proxy objects
  - Object Rexx messages are forwarded to the appropriate Java objects
  - Java arrays appear as if they were Object Rexx arrays

Roundup and Outlook, 2

- BSF4Rexx
  - New version in the works, a beta available
  - An even newer version in alpha (on this machine ☺)
    - Will get a new namespace, namely
      - org.rexxla.bsf
    - Will be the same for IBM's and Apache's BSF
      - JNI-DLLs will cater for the differences
      - Java code remains the same for both implementations
      - Easier to maintain and to deploy
    - Glimpse on some other features
      - Will add multithreadability for Object Rexx
      - Additional features to simplify usage even more
  - Plan to distribute the final version via SourceForge