BSF4ooRexx

Parse, Analyze and Process XML Documents with DOM (Document Object Model) and XSLT (Extensible Stylesheet Language Transformation)

Business Programming 2

Windows GUIs (AWT)	Sockets SSL/TLS	XML SAX/DOM JSON	Scripting AOO/LO (UNO)	Rexx Script Engine	Portable GUIs (JavaFX)	Java Web Server (Tomcat)	Java Classes written in Rexx style

Prof. Rony G. Flatscher

Markup Language

- Text, marked up in HTML

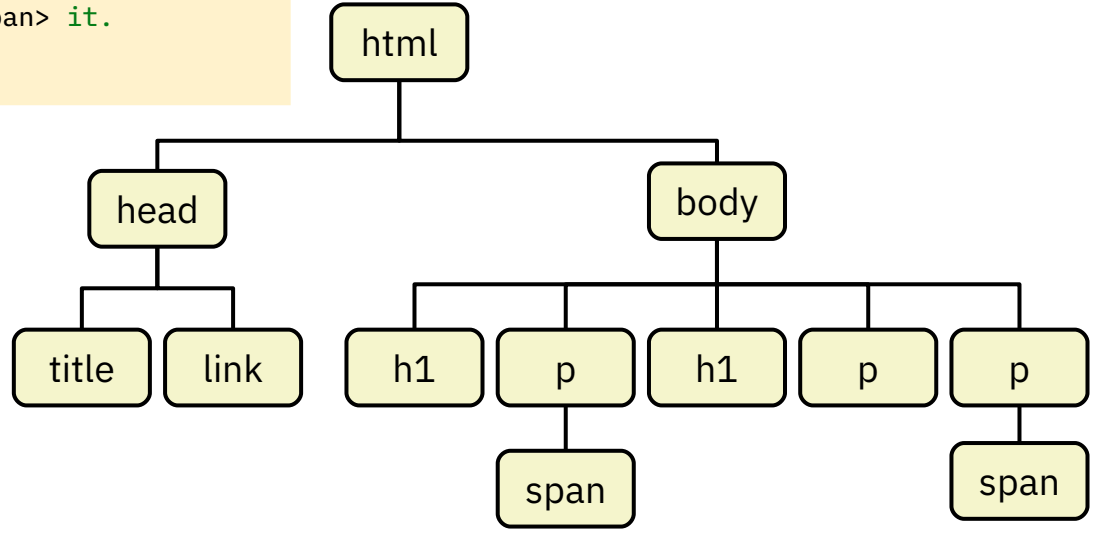
```
<html>
  <head>
     <title>This is my HTML file</title>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

Web Browser Output:

Prof. Rony G. Flatscher

Document Object Model (DOM) – Parse Tree

```
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css">
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.
     <p id="9876">This <span class="verb">is</span> it.
  </body>
</html>
```



Java DOM Parsers, 1

- A Java DOM parser processes the entire document
  - "Factory" pattern, which allows different implementations of DOM parsers to be deployed via Java
- The DOM parser creates a parse tree where each node is one of type (cf. Java documentation of org.w3c.dom.Node)
  - Attr (attribute), CDATASection (character data section), Comment, Document, DocumentFragment, DocumentType, Element, Entity, EntityReference, Notation, ProcessingInstruction, Text
- The interface definitions for nodes (cf. org.w3c.dom.Node) also include a set of methods to manipulate the parse tree
  - Search for the string "javadoc 8 org.w3c.dom.Node" or "javadoc w3c Node"

Java DOM Parsers, 2

- The interface org.xml.sax.ErrorHandler defines the methods a SAX/DOM error listener must implement
  - error(SAXParseException exception)
  - fatalError(SAXParseException exception)
  - warning(SAXParseException exception)
- org.xml.sax.SAXParseException has the following methods
  - getCause() returns a Throwable Java object representing the cause
  - getException() returns an embedded exception, if any
  - getMessage() returns a string with the detailed error message
  - toString() returns a string representation of the SAXParseException

Java DOM Parsers, 3

- Create an ooRexx listener class for handling errors/warnings
- Create an ooRexx listener object from it
- Create a Java object that embeds the ooRexx listener object
  - BSFCreateRexxProxy(rexxListenerObject,[slotArg],interfaceName[,...])
  - interfaceName denotes the Java interface name which methods the Rexx listener object handles
    - It is possible to denote more than one Java interface, if the Rexx listener object is able to handle all methods defined by them!
- Let the Java DOM parser parse the document
- Process the resulting parse tree with Rexx routines node by node

Extract Text From Any XHTML Document (1/4)

```
parse arg xmlFileName

   /* create an instance of the JAXP DocumentBuilderFactory    */
factory=bsf.loadClass("javax.xml.parsers.DocumentBuilderFactory")~newInstance
factory~setNamespaceAware(.true)    -- set desired parser to namespace aware
parser=factory~newDocumentBuilder   -- create the parser from the factory

eh=.errorHandler~new       -- create an error handler Rexx object
   -- wrap up the Rexx error handler as a Java object
javaEH=BsfCreateRexxProxy(eh, , "org.xml.sax.ErrorHandler")
parser~setErrorHandler(javaEH)   -- set the error handler for this parser

rootNode=parser~parse(xmlFileName)  -- parse the file, returns root node

   /* make important constants available via .local            */
clzDomNode=bsf.loadClass("org.w3c.dom.Node") -- load the Java interface class
.local~CDATA_SECTION_NODE=clzDomNode~CDATA_SECTION_NODE  -- save field value
.local~TEXT_NODE         =clzDomNode~TEXT_NODE           -- save field value

   /* now collect all text and CDATA nodes and display them    */
call followNode rootNode

::requires BSF.CLS      /* get the Java support */
… cut …
```

Extract Text From Any XHTML Document (2/4)

```
… cut …
::requires BSF.CLS      /* get the Java support */

::routine followNode    /* walks the document tree recursively */
  use arg node
  call processNode node             -- process received node
  if node~hasChildNodes then
  do
     children=node~getChildNodes    -- get NodeList
     loop i=0 to children~length-1  -- 0-based indexes!
        call followNode children~item(i)  -- recurse
     end
  end

::routine processNode   /* processes each node                */
  use arg node
  nodeType=node~getNodeType      -- get type of node
  if nodeType=.text_node | nodeType=.cdata_section_node then
     say pp(node~nodeValue)

::class ErrorHandler    -- a Rexx error handler ("org.xml.sax.ErrorHandler")
::method unknown        /* handles "warning", "error" and "fatalError" events */
  use arg methName, argArray  -- arguments from the Java SAX parser
  exception=argArray[1] -- retrieve SAXException argument
  .error~say(methName":" -
             "line="exception~getLineNumber",col="exception~getColumnNumber":" -
             pp(exception~getMessage))
```

Extract Text From Any XHTML Document (3/4)

XHTML

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "DTD/xhtml1-transitional.dtd">
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css"/>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

CSS

```
H1      { color: blue;
          text-align: center;
          font-family: Arial,sans-serif;
          font-size: 200%; }

body    { background-color: yellow;
          font-family: Times, Avantgarde;
          font-size: small; }

.verb   { background-color: white;
          color: red;
          font-weight: 900; }

#xyz1   { font-variant: small-caps;
          text-align: right; }

#a9876  { font-size: large; }
```

```
$ rexx dom_01.rxj example2.html
```

Output:

```
[
  ]
[
     ]
[This is my HTML file]
[
     ]
[
  ]
[
  ]
[
     ]
[Important Heading]
[
     ]
[This ]
[is]
[ the
        first paragraph.]
[
     ]
[Another Important Heading]
[
     ]
[Another paragraph.]
[
     ]
[This ]
[is]
[ it.]
[
  ]
[
]
```

Extract Text From Any XHTML Document (4/4)

- Some remarks
  - Text can be encoded as
    - Plain text (node type TEXT_NODE) or
    - CDATA sections (node type CDATA_SECTION_NODE)
    - **<[!CDATA[**...character-data...**]]>**
- Ignorable whitespace is not ignored, but treated like any whitespace
  - A node of type TEXT_NODE will be created for it
- The node types used in the Java DOM parser are retrievable via the Java interface class org.w3c.dom.Node
  - To make it easy to refer to these values from ooRexx, the types TEXT_NODE and CDATA_SECTION_NODE are retrieved and made available to all parts of the Rexx program by storing them in .local

List Elements in Document Order (1/4)

```
parse arg xmlFileName

   /* create an instance of the JAXP DocumentBuilderFactory    */
factory=bsf.loadClass("javax.xml.parsers.DocumentBuilderFactory")~newInstance
factory~setNamespaceAware(.true)    -- set desired parser to namespace aware
parser=factory~newDocumentBuilder   -- create the parser from the factory

eh=.errorHandler~new       -- create an error handler Rexx object
   -- wrap up the Rexx error handler as a Java object
javaEH=BsfCreateRexxProxy(eh, , "org.xml.sax.ErrorHandler")
parser~setErrorHandler(javaEH)   -- set the error handler for this parser

rootNode=parser~parse(xmlFileName)  -- parse the file, returns root node

   /* make important constants available via .local            */
clzDomNode=bsf.loadClass("org.w3c.dom.Node") -- load the Java interface class
.local~ELEMENT_NODE      =clzDomNode~ELEMENT_NODE        -- save field value

   /* now collect all text and CDATA nodes and display them    */
call followNode rootNode

::requires BSF.CLS      /* get the Java support */
… cut …
```

List Elements in Document Order (2/4)

```
… cut …
::requires BSF.CLS      /* get the Java support */

::routine followNode    /* walks the document tree recursively */
  use arg node
  call processNode node             -- process received node
  if node~hasChildNodes then
  do
     children=node~getChildNodes    -- get NodeList
     loop i=0 to children~length-1  -- 0-based indexes!
        call followNode children~item(i)  -- recurse
     end
  end

::routine processNode   /* processes each node                */
  use arg node
  nodeType=node~getNodeType      -- get type of node
  if nodeType=.element_Node then
     say pp(node~nodeName)


::class ErrorHandler    -- a Rexx error handler ("org.xml.sax.ErrorHandler")

::method unknown        /* handles "warning", "error" and "fatalError" events */
  use arg methName, argArray  -- arguments from the Java SAX parser
  exception=argArray[1] -- retrieve SAXException argument
  .error~say(methName":" -
             "line="exception~getLineNumber",col="exception~getColumnNumber":" -
             pp(exception~getMessage))
```

List Elements in Document Order (3/4)

XHTML

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "DTD/xhtml1-transitional.dtd">
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css"/>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

CSS

```
H1      { color: blue;
          text-align: center;
          font-family: Arial,sans-serif;
          font-size: 200%; }

body    { background-color: yellow;
          font-family: Times, Avantgarde;
          font-size: small; }

.verb   { background-color: white;
          color: red;
          font-weight: 900; }

#xyz1   { font-variant: small-caps;
          text-align: right; }

#a9876  { font-size: large; }
```

```
$ rexx dom_02.rxj example2.html
```

Output:

```
[html]
[head]
[title]
[link]
[body]
[h1]
[p]
[span]
[h1]
[p]
[p]
[span]
```

List Elements in Document Order (4/4)

- A few remarks
  - The DOM parse tree has more nodes than shown in the output!
  - This particular program processes nodes of type ELEMENT_NODE only
  - The node types used in the Java DOM parser are retrievable via the Java interface class org.w3c.dom.Node
    - To make it easy to refer to these values from ooRexx, the type ELEMENT_NODE is retrieved and made available to all parts of the Rexx program by storing it in .local
- One could also use the Java infrastructure to filter only those node types one is interested in

List Elements Indented in Document Order (1/4)

```
parse arg xmlFileName

   /* create an instance of the JAXP DocumentBuilderFactory    */
factory=bsf.loadClass("javax.xml.parsers.DocumentBuilderFactory")~newInstance
factory~setNamespaceAware(.true)    -- set desired parser to namespace aware
parser=factory~newDocumentBuilder   -- create the parser from the factory

eh=.errorHandler~new       -- create an error handler Rexx object
   -- wrap up the Rexx error handler as a Java object
javaEH=BsfCreateRexxProxy(eh, , "org.xml.sax.ErrorHandler")
parser~setErrorHandler(javaEH)   -- set the error handler for this parser

rootNode=parser~parse(xmlFileName)  -- parse the file, returns root node

   /* make important constants available via .local            */
clzDomNode=bsf.loadClass("org.w3c.dom.Node") -- load the Java interface class
.local~ELEMENT_NODE      =clzDomNode~ELEMENT_NODE        -- save field value

   /* now collect all text and CDATA nodes and display them    */
call followNode rootNode, 0

::requires BSF.CLS      /* get the Java support */
… cut …
```

List Elements Indented in Document Order (2/4)

```
… cut …
::requires BSF.CLS      /* get the Java support */

::routine followNode    /* walks the document tree recursively */
  use arg node, level
  call processNode node, level      -- process received node
  if node~hasChildNodes then
  do
     children=node~getChildNodes    -- get NodeList
     loop i=0 to children~length-1  -- 0-based indexes!
        call followNode children~item(i), level+1  -- recurse
     end
  end

::routine processNode   /* processes each node                */
  use arg node, level
  nodeType=node~getNodeType      -- get type of node
  if nodeType=.element_Node then
     say "   "~copies(level) || pp(node~nodeName)


::class ErrorHandler    -- a Rexx error handler ("org.xml.sax.ErrorHandler")

::method unknown        /* handles "warning", "error" and "fatalError" events */
  use arg methName, argArray  -- arguments from the Java SAX parser
  exception=argArray[1] -- retrieve SAXException argument
  .error~say(methName":" -
             "line="exception~getLineNumber",col="exception~getColumnNumber":" -
             pp(exception~getMessage))
```

List Elements Indented in Document Order (3/4)

XHTML

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "DTD/xhtml1-transitional.dtd">
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css"/>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

CSS

```
H1      { color: blue;
          text-align: center;
          font-family: Arial,sans-serif;
          font-size: 200%; }

body    { background-color: yellow;
          font-family: Times, Avantgarde;
          font-size: small; }

.verb   { background-color: white;
          color: red;
          font-weight: 900; }

#xyz1   { font-variant: small-caps;
          text-align: right; }

#a9876  { font-size: large; }
```

```
$ rexx dom_03.rxj example2.html
```

Output:

```
[html]
   [head]
      [title]
      [link]
   [body]
      [h1]
      [p]
         [span]
      [h1]
      [p]
      [p]
         [span]
```

List Elements Indented in Document Order (4/4)

- Some remarks
  - The DOM parse tree has more nodes than shown in the output!
    - Note whitespace before first shown element
  - This particular program processes nodes of type ELEMENT_NODE only
  - The node types used in the Java DOM parser are retrievable via the Java interface class org.w3c.dom.Node
    - To make it easy to refer to these values from ooRexx, the type ELEMENT_NODE is retrieved and made available to all parts of the Rexx program by storing it in .local
- One could also use the Java infrastructure to filter only those node types one is interested in

List Elements with Text (1/4)

```
parse arg xmlFileName

   /* create an instance of the JAXP DocumentBuilderFactory    */
factory=bsf.loadClass("javax.xml.parsers.DocumentBuilderFactory")~newInstance
factory~setNamespaceAware(.true)    -- set desired parser to namespace aware
parser=factory~newDocumentBuilder   -- create the parser from the factory

eh=.errorHandler~new       -- create an error handler Rexx object
   -- wrap up the Rexx error handler as a Java object
javaEH=BsfCreateRexxProxy(eh, , "org.xml.sax.ErrorHandler")
parser~setErrorHandler(javaEH)   -- set the error handler for this parser

rootNode=parser~parse(xmlFileName)  -- parse the file, returns root node

   /* make important constants available via .local            */
clzDomNode=bsf.loadClass("org.w3c.dom.Node") -- load the Java interface class
.local~CDATA_SECTION_NODE=clzDomNode~CDATA_SECTION_NODE  -- save field value
.local~TEXT_NODE         =clzDomNode~TEXT_NODE           -- save field value
.local~ELEMENT_NODE      =clzDomNode~ELEMENT_NODE        -- save field value

   /* now collect all text and CDATA nodes and display them    */
call followNode rootNode, 0

::requires BSF.CLS      /* get the Java support */
… cut …
```

List Elements with Text (2/4)

```
… cut …
::requires BSF.CLS      /* get the Java support */

::routine followNode    /* walks the document tree recursively */
  use arg node, level
  call processNode node, level      -- process received node
  if node~hasChildNodes then
  do
     children=node~getChildNodes    -- get NodeList
     loop i=0 to children~length-1  -- 0-based indexes!
        call followNode children~item(i), level+1  -- recurse
     end
  end

::routine processNode   /* processes each node                */
  use arg node, level
  nodeType=node~getNodeType      -- get type of node
  if nodeType=.text_node | nodeType=.cdata_section_node then
     say "   "~copies(level) || "-->" pp(node~getNodeValue)   -- instead of getData()
  else if nodeType=.element_node then
     say "   "~copies(level) || pp(node~getNodeName)


::class ErrorHandler    -- a Rexx error handler ("org.xml.sax.ErrorHandler")

::method unknown        /* handles "warning", "error" and "fatalError" events */
  use arg methName, argArray  -- arguments from the Java SAX parser
  exception=argArray[1] -- retrieve SAXException argument
  .error~say(methName":" -
             "line="exception~getLineNumber",col="exception~getColumnNumber":" -
             pp(exception~getMessage))
```

List Elements with Text (3/4)

XHTML

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "DTD/xhtml1-transitional.dtd">
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css"/>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

CSS

```
H1      { color: blue;
          text-align: center;
          font-family: Arial,sans-serif;
          font-size: 200%; }

body    { background-color: yellow;
          font-family: Times, Avantgarde;
          font-size: small; }

.verb   { background-color: white;
          color: red;
          font-weight: 900; }

#xyz1   { font-variant: small-caps;
          text-align: right; }

#a9876  { font-size: large; }
```

```
$ rexx dom_04.rxj example2.html
```

Output:

```
[html]
      --> [
  ]
     [head]
        --> [
     ]
        [title]
           --> [This is my HTML file]
        --> [
     ]
        [link]
        --> [
  ]
     --> [
  ]
     [body]
        --> [
     ]
        [h1]
           --> [Important Heading]
        --> [
     ]
        [p]
           --> [This ]
           [span]
              --> [is]
           --> [ the
        first paragraph.]
        --> [
     ]
        [h1]
           --> [Another Important Heading]
        --> [
     ]
        [p]
           --> [Another paragraph.]
        --> [
     ]
        [p]
           --> [This ]
           [span]
              --> [is]
           --> [ it.]
        --> [
  ]
     --> [
]
```

List Elements with Text (4/4)

- Some remarks
  - The DOM parse tree has more nodes than shown in the output!
    - Note whitespace before first shown element
  - This particular program processes nodes of type ELEMENT_NODE only
  - The node types used in the Java DOM parser are retrievable via the Java interface class org.w3c.dom.Node
    - To make it easy to refer to these values from ooRexx, the type ELEMENT_NODE is retrieved and made available to all parts of the Rexx program by storing it in .local
- One could also use the Java infrastructure to filter only those node types one is interested in

Than Documented by Java!

- The default DOM parser coming with Java (Apache's Xerces2) is capable of more than what is documented in Oracle's JavaDocs!
  - The W3C interface org.w3c.dom.traversal.DocumentTraversal
    - Documentation at:
      - <http://www.w3.org/2003/01/dom2-javadoc/org/w3c/dom/traversal/DocumentTraversal.html> (2022-12-12)
    - Method createNodeIterator(...) filters nodes and returns the result as a list with the methods defined in the interface org.w3c.dom.traversal.NodeIterator for its traversal
    - Method createTreeWalker(...) filters nodes and returns the result as a tree with the methods defined in the interface org.w3c.dom.traversal.TreeWalker for its traversal

Using A NodeIterator to Iterate Over Elements

- Get the Java constant field value for showing (filtering) elements using the Java interface class org.w3c.dom.traversal.NodeFilter and the constant field named SHOW_ELEMENT
- Create a NodeIterator from the DOM parse tree and use its methods to iterate over the filtered nodes
- Hint
  - Compare the following code "dom_05.rxj" with "dom_02.rxj" above

List Elements In Document Order (*NodeIterator* 1/2)

```
parse arg xmlFileName

   /* create an instance of the JAXP DocumentBuilderFactory    */
factory=bsf.loadClass("javax.xml.parsers.DocumentBuilderFactory")~newInstance
factory~setNamespaceAware(.true)    -- set desired parser to namespace aware
parser=factory~newDocumentBuilder   -- create the parser from the factory

eh=.errorHandler~new       -- create an error handler Rexx object
   -- wrap up the Rexx error handler as a Java object
javaEH=BsfCreateRexxProxy(eh, , "org.xml.sax.ErrorHandler")
parser~setErrorHandler(javaEH)   -- set the error handler for this parser

rootNode=parser~parse(xmlFileName)  -- parse the file, returns root node

   /* get constant value to determine node types to filter     */
whatToShow=bsf.getConstant("org.w3c.dom.traversal.NodeFilter", "SHOW_ELEMENT")

   /* create a NodeIterator with only Element nodes            */
iterator=rootNode~createNodeIterator(rootNode, whatToShow, .nil, .true)

   /* process list of Element nodes                            */
node=iterator~nextNode  /* get first node                       */
loop while node<>.nil
   nrAttrs=node~getAttributes~getLength   /* get nr of attributes */
   say pp(node~getNodeName)
   node=iterator~nextNode  /* get next node                    */
end

::requires BSF.CLS      /* get the Java support */
… cut …
```

List Elements In Document Order (*NodeIterator* 2/2)

XHTML

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "DTD/xhtml1-transitional.dtd">
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css"/>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

CSS

```
H1      { color: blue;
          text-align: center;
          font-family: Arial,sans-serif;
          font-size: 200%; }

body    { background-color: yellow;
          font-family: Times, Avantgarde;
          font-size: small; }

.verb   { background-color: white;
          color: red;
          font-weight: 900; }

#xyz1   { font-variant: small-caps;
          text-align: right; }

#a9876  { font-size: large; }
```

```
$ rexx dom_05.rxj example2.html
```

Output:

```
[html]
[head]
[title]
[link]
[body]
[h1]
[p]
[span]
[h1]
[p]
[p]
[span]
```

Using A TreeWalker to Iterate over Elements

- Get the Java constant field value for showing (filtering) elements using the Java interface class org.w3c.dom.traversal.NodeFilter and the constant field named SHOW_ELEMENT
- Create a TreeWalker from the DOM parse tree and use its methods to iterate over the filtered nodes
- Note
  - The createTreeWalker() method will filter element related nodes as well (e.g. text nodes included in an element)
- Hint
  - Compare the following code "dom_06.rxj" with "dom_03.rxj" above

List Elements Indented in Document Order (*TreeWalker* 1/3)

```
parse arg xmlFileName

   /* create an instance of the JAXP DocumentBuilderFactory    */
factory=bsf.loadClass("javax.xml.parsers.DocumentBuilderFactory")~newInstance
factory~setNamespaceAware(.true)    -- set desired parser to namespace aware
parser=factory~newDocumentBuilder   -- create the parser from the factory

eh=.errorHandler~new       -- create an error handler Rexx object
   -- wrap up the Rexx error handler as a Java object
javaEH=BsfCreateRexxProxy(eh, , "org.xml.sax.ErrorHandler")
parser~setErrorHandler(javaEH)   -- set the error handler for this parser

rootNode=parser~parse(xmlFileName)  -- parse the file, returns root node

   /* get constant value to determine node types to filter     */
.local~show_element=bsf.getConstant("org.w3c.dom.traversal.NodeFilter", "SHOW_ELEMENT")
whatToShow=.show_element

   /* create a TreeWalker with only Element nodes              */
walker=rootNode~createTreeWalker(rootNode, whatToShow, .nil, .true)

   /* process list of Element nodes                            */
call walkTheTree walker~firstChild, 0

::requires BSF.CLS      /* get the Java support */
… cut …
```

List Elements Indented in Document Order (*TreeWalker* 2/3)

```
… cut …
call walkTheTree walker~firstChild, 0

::requires BSF.CLS      /* get the Java support */

::routine walkTheTree   /* walk the tree recursively                */
  use arg node, level

  say "   "~copies(level) || pp(node~getNodeName)  -- show element name indented

  child=node~firstChild       -- depth first
  do while child<>.nil
      -- there may be other node types coming with elements in a TreeWalker
     if child~getNodeType=.show_element then -- make sure only element nodes
        call walkTheTree child, level+1      -- recurse, increase level

     child=child~nextSibling  -- breadth next
  end


::class ErrorHandler    -- a Rexx error handler ("org.xml.sax.ErrorHandler")

::method unknown        /* handles "warning", "error" and "fatalError" events */
  use arg methName, argArray  -- arguments from the Java SAX parser
  exception=argArray[1] -- retrieve SAXException argument
  .error~say(methName":" -
             "line="exception~getLineNumber",col="exception~getColumnNumber":" -
             pp(exception~getMessage))
```

List Elements Indented in Document Order (*TreeWalker* 3/3)

XHTML

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "DTD/xhtml1-transitional.dtd">
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css"/>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

CSS

```
H1      { color: blue;
          text-align: center;
          font-family: Arial,sans-serif;
          font-size: 200%; }

body    { background-color: yellow;
          font-family: Times, Avantgarde;
          font-size: small; }

.verb   { background-color: white;
          color: red;
          font-weight: 900; }

#xyz1   { font-variant: small-caps;
          text-align: right; }

#a9876  { font-size: large; }
```

```
$ rexx dom_06.rxj example2.html
```

Output:

```
[html]
   [head]
      [title]
      [link]
   [body]
      [h1]
      [p]
         [span]
      [h1]
      [p]
      [p]
         [span]
```

Query Elements and Extract Text

- The returned root node object implements the interface classes
  - org.w3c.dom.Document extends org.w3c.dom.Node
    - Document methods, e.g.: getElementById(...), normalizeDocument()
  - org.w3c.dom.Element extends org.w3c.dom.Node
    - Element methods, e.g.: getElementsByTagName(...), getTagName()

  ➔ Because Document and Element extend the Node interface class all methods and constants from org.w3c.dom.Node are available as well!
    - Node methods, e.g.: cloneNode(...), hasChildNodes(), getNodeName(), getNodeType(), getNodeValue(), getNodeValue(), getTextContent()
- There are many more methods available, once we received the root node

Query Elements and Extract Text (1/4)

```
parse arg xmlFileName
   /* create an instance of the JAXP DocumentBuilderFactory    */
factory=bsf.loadClass("javax.xml.parsers.DocumentBuilderFactory")~newInstance
factory~setNamespaceAware(.true)    -- set desired parser to namespace aware
parser=factory~newDocumentBuilder   -- create the parser from the factory

eh=.errorHandler~new       -- create an error handler Rexx object
   -- wrap up the Rexx error handler as a Java object
javaEH=BsfCreateRexxProxy(eh, , "org.xml.sax.ErrorHandler")
parser~setErrorHandler(javaEH)   -- set the error handler for this parser
rootNode=parser~parse(xmlFileName)  -- parse the file, returns root node

id="xyz1"
node=rootNode~getElementById("xyz1")-- get element node with attribute 'id' set to 'xyz1'
textNode=node~childNodes~item(0)    -- get its text node
say "node with 'id'="pp(id) "nodeName="pp(node~nodeName) "its text:" pp(textNode~nodeValue)
say "---"

tName="p"      -- paragraph tag name
nodes=rootNode~getElementsByTagName("p")  -- get all "p" nodes (a NodeList)
say "there are" pp(nodes~getLength) "nodes of type" pp(tName) "in the document:"
say
do i=0 to nodes~getLength-1         -- iterate over the 0-based NodeList
   chNodes=nodes~item(i)~childNodes -- get node's child nodes
   mb=.mutableBuffer~new
   do k=0 to chNodes~getLength-1    -- process child nodes
      call getText chNodes~item(k),mb  -- collect all text node's values
   end
   say "  text of '"tName"'-node #" pp(i+1)":" pp(mb~string)
end
::requires BSF.CLS      /* get the Java support */
… cut …
```

Query Elements and Extract Text (2/4)

```
… cut …
::requires BSF.CLS      /* get the Java support */

::routine getText       /* collect the node's children text node values */
  use arg node, mb
  -- if pos(node~nodeType, "3 4")>0 then  -- type is a text or CDATA section node?
  if wordPos(node~nodeName, "#text #cdata-section")>0 then -- a text or CDATA-section node?
     mb~append(node~nodeValue)   -- append the text value

  if node~hasChildNodes then     -- collect all the child nodes text if any
  do
      childNodes=node~getChildNodes
      do i=0 to childNodes~getLength-1 -- iterate over the child nodes
         call getText childNodes~item(i), mb
      end
  end
  return

::class ErrorHandler    -- a Rexx error handler ("org.xml.sax.ErrorHandler")

::method unknown        /* handles "warning", "error" and "fatalError" events */
  use arg methName, argArray  -- arguments from the Java SAX parser
  exception=argArray[1] -- retrieve SAXException argument
  .error~say(methName":" -
             "line="exception~getLineNumber",col="exception~getColumnNumber":" -
             pp(exception~getMessage))
```

Query Elements and Extract Text (3/4)

XHTML

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "DTD/xhtml1-transitional.dtd">
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css"/>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

CSS

```
H1      { color: blue;
          text-align: center;
          font-family: Arial,sans-serif;
          font-size: 200%; }

body    { background-color: yellow;
          font-family: Times, Avantgarde;
          font-size: small; }

.verb   { background-color: white;
          color: red;
          font-weight: 900; }

#xyz1   { font-variant: small-caps;
          text-align: right; }

#a9876  { font-size: large; }
```

```
$ rexx dom_10.rxj example2.html
```

Output:

```
node with 'id'=[xyz1] nodeName=[p] its text: [Another paragraph.]
---
there are [3] nodes of type [p] in the document:

  text of 'p'-node # [1]: [This is the
       first paragraph.]
  text of 'p'-node # [2]: [Another paragraph.]
  text of 'p'-node # [3]: [This is it.]
```

Query Elements and Extract Text (4/4)

- Some remarks
  - The DOM parse tree and the APIs get document in the Java interface classes
    - org.w3c.dom.Document, e.g. methods getElementById(...), normalizeDocument()
    - org.w3c.dom.Element e.g. method getElementsByTagName(...), it extends
      - org.w3c.dom.Node e.g. methods hasChildNodes(), getNodeName(), getNodeType()
  - The node types used in the Java DOM parser are retrievable via the Java interface class org.w3c.dom.Node
    - A *text node has* as node name "#text" and a node type of *3*
    - A *CDATA section node* has a node name "#cdata-section" and a node type of *4*
    - To find the Java documentation on the Internet you can use a search string like "javadoc 8 w3c Node" or "javadoc w3c Node"
  - Extracting text can be sometimes simplified with the Node method getTextContent()

Query Elements and Extract Text: Simpler (1/2)

```
parse arg xmlFileName
   /* create an instance of the JAXP DocumentBuilderFactory    */
factory=bsf.loadClass("javax.xml.parsers.DocumentBuilderFactory")~newInstance
factory~setNamespaceAware(.true)    -- set desired parser to namespace aware
parser=factory~newDocumentBuilder   -- create the parser from the factory

eh=.errorHandler~new       -- create an error handler Rexx object
   -- wrap up the Rexx error handler as a Java object
javaEH=BsfCreateRexxProxy(eh, , "org.xml.sax.ErrorHandler")
parser~setErrorHandler(javaEH)      -- set the error handler for this parser
rootNode=parser~parse(xmlFileName)  -- parse the file, returns root node
   -- use DOM to process the parse tree
id="xyz1"
node=rootNode~getElementById("xyz1")-- get element node with attribute 'id' set to 'xyz1'
say "node~getTextContent:" pp(node~getTextContent)
say "---"

tName="p"      -- paragraph tag name
nodes=rootNode~getElementsByTagName("p")  -- get all "p" nodes (a NodeList)
say "there are" pp(nodes~getLength) "nodes of type" pp(tName) "in the document:"
say
do i=0 to nodes~getLength-1         -- iterate over the 0-based NodeList
   say "  nodes~item(i)~getTextContent:" pp(nodes~item(i)~getTextContent)
end

::requires BSF.CLS      /* get the Java support */

::class ErrorHandler    -- a Rexx error handler ("org.xml.sax.ErrorHandler")
::method unknown        /* handles "warning", "error" and "fatalError" events */
  use arg methName, argArray  -- arguments from the Java SAX parser
  exception=argArray[1] -- retrieve SAXException argument
  .error~say(methName":" "line="exception~getLineNumber",col="exception~getColumnNumber":" pp(exception~getMessage))
```

Query Elements and Extract Text: Simpler (2/2)

XHTML

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "DTD/xhtml1-transitional.dtd">
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css"/>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

CSS

```
H1      { color: blue;
          text-align: center;
          font-family: Arial,sans-serif;
          font-size: 200%; }

body    { background-color: yellow;
          font-family: Times, Avantgarde;
          font-size: small; }

.verb   { background-color: white;
          color: red;
          font-weight: 900; }

#xyz1   { font-variant: small-caps;
          text-align: right; }

#a9876  { font-size: large; }
```

```
$ rexx dom_10_simpler.rxj example2.html
```

Output:

```
node with 'id'=[xyz1] nodeName=[p] its text: [Another paragraph.]
---
there are [3] nodes of type [p] in the document:

  text of 'p'-node # [1]: [This is the
       first paragraph.]
  text of 'p'-node # [2]: [Another paragraph.]
  text of 'p'-node # [3]: [This is it.]
```

Process XML Files with XSLT (Extensible Stylesheet Language Transformation)

- XML based powerful transformation language
  - Allows to transform a XML document into any other XML, HTML or text document
  - Uses W3C's DOM (document object model) standard
    - Selection (of parts) of a XML document using XPATH queries (element names, attribute values)
    - Transformation allows among many other things to apply XSLT functions
- The JRE has built-in support for transforming XML files using XSL stylesheets
  - The Rexx program dom_11.rxj on the next slide demonstrates how transforming *any* XML file with *any* XSL stylesheet can be carried out

Process XML Files with XSLT

```
/* Process a XML file with the indicated XSL stylesheet. */
parse arg xmlFile xslFile   -- get filenames
signal on syntax
factory = bsf.loadClass("javax.xml.transform.TransformerFactory")~newInstance
clzStreamSource = bsf.importClass("javax.xml.transform.stream.StreamSource")
transformer = factory~newTransformer( clzStreamSource~new(xslFile) )
xmlSource   = clzStreamSource~new(xmlFile)
streamResult= .bsf~new("javax.xml.transform.stream.StreamResult", .java.lang.System~out)
transformer~transform(xmlsource, streamResult)
exit

syntax:     -- show Java exception chain to become able to understand some of the Java errors
   co=condition('o')    -- get Rexx condition information
   say ppJavaExceptionChain(co, .true)  -- show Java stacktrace
   say "---"
   raise propagate      -- reraise condition to let ooRexx handle it

::requires "BSF.CLS"    -- get ooRexx-Java bridge
```

Process *XHTML* Files with XSLT (1/1)

XHTML
example2.html

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "DTD/xhtml1-transitional.dtd">
<html>
  <head>
     <title>This is my HTML file</title>
     <link rel="stylesheet" type="text/css" href="example2.css"/>
  </head>
  <body>
     <h1>Important Heading</h1>
     <p>This <span class="verb">is</span> the
        first paragraph.</p>
     <h1>Another Important Heading</h1>
     <p id="xyz1">Another paragraph.</p>
     <p id="a9876">This <span class="verb">is</span> it.</p>
  </body>
</html>
```

XSL
example2.xsl

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
                              xmlns:xhtml="http://www.w3.org/1999/xhtml">
<xsl:output omit-xml-declaration="yes" />

<xsl:template match="node()">
   <xsl:apply-templates select="node()"/>
</xsl:template>

<xsl:template match="xhtml:h1">
element name "<xsl:value-of select="name()"/>": <xsl:value-of select="."/>
</xsl:template>

</xsl:stylesheet>
```

```
$ rexx dom_11.rxj example2.html example2.xsl
```

Output:

```
element name "h1": Important Heading
element name "h1": Another Important Heading
```

Process XML Files with XSLT (1/2)

XML
rexx.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<creators>
  <rexx>
    <title>REXX</title>
    <author>Cowlishaw, Mike F.</author>
    <country>Great Britain</country>
    <company>IBM</company>
    <since>1979</since>
  </rexx>
  <rexx>
    <title>ooRexx (Open Object Rexx)</title>
    <author>McGuire, Rick; Nash, Simon</author>
    <country>USA; Great Britain</country>
    <company>RexxLA (non-profit SIG)</company>
    <since>1988 (IBM), 2005 (RexxLA.org)</since>
  </rexx>
  <rexx>
    <title>NetRexx</title>
    <author>Cowlishaw, Mike F.</author>
    <country>Great Britain</country>
    <company>IBM</company>
    <since>1996 (IBM), 2011 (RexxLA.org)</since>
  </rexx>
  <rexx>
    <title>brexx</title>
    <author>Vlachoudis, Vassilis N.</author>
    <country>Greece/France/Switzerland</country>
    <company>n/a (CERN)</company>
    <since>1992</since>
  </rexx>
  <rexx>
    <title>Regina</title>
    <author>Hessling, Mark; Chistensen, Anders</author>
    <country>Australia; Norway</country>
    <company>SINTEF</company>
    <since>1993 ?</since>
  </rexx>
  <rexx>
    <title>ARexx</title>
    <author>Hawes, William S.</author>
    <country>USA</country>
    <company>Amiga (Commodore)</company>
    <since>1987</since>
  </rexx>
</creators>
```

XSL
rexx.xsl

```
<?xml version="1.0" encoding="UTF-8"?>
<xsl:stylesheet version="1.0"
xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
<xsl:template match="/">
  <html>
  <body>
    <h2>Overview of Some Rexx Interpreters</h2>
    <table border="1" style="background-color: LightGoldenrodYellow; border=1; ">
      <tr style="background-color: BurlyWood">
        <th>Title</th>
        <th>Author</th>
        <th>Country</th>
        <th>Since</th>
      </tr>
      <xsl:for-each select="creators/rexx">
      <xsl:sort select="since"/>
      <tr>
        <td><xsl:value-of select="title" /></td>
        <td><xsl:value-of select="author" /></td>
        <td><xsl:value-of select="country" /></td>
        <td><xsl:value-of select="since" /></td>
      </tr>
      </xsl:for-each>
    </table>
  </body>
  </html>
</xsl:template>
</xsl:stylesheet>
```

Process XML Files with XSLT (2/2)

```
$ rexx dom_11.rxj rexx.xml rexx.xsl
```

Output:

```
<html>
    <body>
        <h2>Overview of Some Rexx Interpreters</h2>
        <table border="1" style="background-color: LightGoldenrodYellow; border=1; ">
            <tr style="background-color: BurlyWood">
                <th>Title</th><th>Author</th><th>Country</th><th>Since</th>
            </tr>
            <tr>
                <td>REXX</td><td>Cowlishaw, Mike F.</td><td>Great Britain</td><td>1979</td>
            </tr>
            <tr>
                <td>ARexx</td><td>Hawes, William S.</td><td>USA</td><td>1987</td>
            </tr>
            <tr>
                <td>ooRexx (Open Object Rexx)</td><td>McGuire, Rick; Nash, Simon</td><td>USA; Great Britain</td><td>1988 (IBM), 2005 (RexxLA.org)</td>
            </tr>
            <tr>
                <td>brexx</td><td>Vlachoudis, Vassilis N.</td><td>Greece/France/Switzerland</td><td>1992</td>
            </tr>
            <tr>
                <td>Regina</td><td>Hessling, Mark; Chistensen, Anders</td><td>Australia; Norway</td><td>1993 ?</td>
            </tr>
            <tr>
                <td>NetRexx</td><td>Cowlishaw, Mike F.</td><td>Great Britain</td><td>1996 (IBM), 2011 (RexxLA.org)</td>
            </tr>
        </table>
    </body>
</html>
```

Overview of Some Rexx Interpreters

Title	Author	Country	Since
REXX	Cowlishaw, Mike F.	Great Britain	1979
ARexx	Hawes, William S.	USA	1987
ooRexx (Open Object Rexx)	McGuire, Rick; Nash, Simon	USA; Great Britain	1988 (IBM), 2005 (RexxLA.org)
brexx	Vlachoudis, Vassilis N.	Greece/France/Switzerland	1992
Regina	Hessling, Mark; Chistensen, Anders	Australia; Norway	1993 ?
NetRexx	Cowlishaw, Mike F.	Great Britain	1996 (IBM), 2011 (RexxLA.org)

Roundup

- Parsing any XML encoded document possible
  - Using BSF4ooRexx
  - Exploiting Java's functionality for parsing XML documents
- DOM parsing
  - DOM parser first creates parse tree
  - One may directly walk the DOM parse tree or use the traversal methods to filter the DOM parse tree into a NodeIterator or TreeWalker
- Rather easy, needs enough memory for the parse tree
- Easy to exploit from ooRexx !

Further Information

- DOM specific URLs (2023-01-16)
  - <http://www.saxproject.org/>
  - <http://www.cafeconleche.org/books/xmljava/chapters/index.html>
  - <http://docs.oracle.com/javase/7/docs/api/org/w3c/dom/package-summary.html>
  - W3C:
    - <http://www.w3.org/2003/01/dom2-javadoc/org/w3c/dom/traversal/DocumentTraversal.html>
  - Apache Xerces2:
    - <http://xerces.apache.org/xerces2-j/javadocs/api/org/w3c/dom/traversal/DocumentTraversal.html>
- Tutorials, e.g. (2023-01-16)
  - XML: <https://www.w3schools.com/xml/default.asp>
  - XPATH: <https://www.w3schools.com/xml/xpath_intro.asp>
  - XML DOM: <https://www.w3schools.com/xml/dom_intro.asp>
  - XSLT: <https://www.w3schools.com/xml/xsl_intro.asp>
- Sample files installed with BSF4ooRexx
  - BSF4ooRexx850/samples/SAX
  - BSF4ooRexx850/samples/DOM