Introduction to ISO SCHEMATRON

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About me

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- 15+ years of XML technology experience
- Contributor for various XML-related open source projects
- Editor of Schematron QuickFix specification developed by a W3C community group

Agenda

- ISO Schematron history
- ISO Schematron introduction
- XPath in ISO Schematron
- Schematron in the development process
- Schematron for technical and non-technical users
- Schematron Quick Fixes

What is Schematron?

A natural language for making assertions in documents

schematron

A language for making assertions about patterns found in XML documents

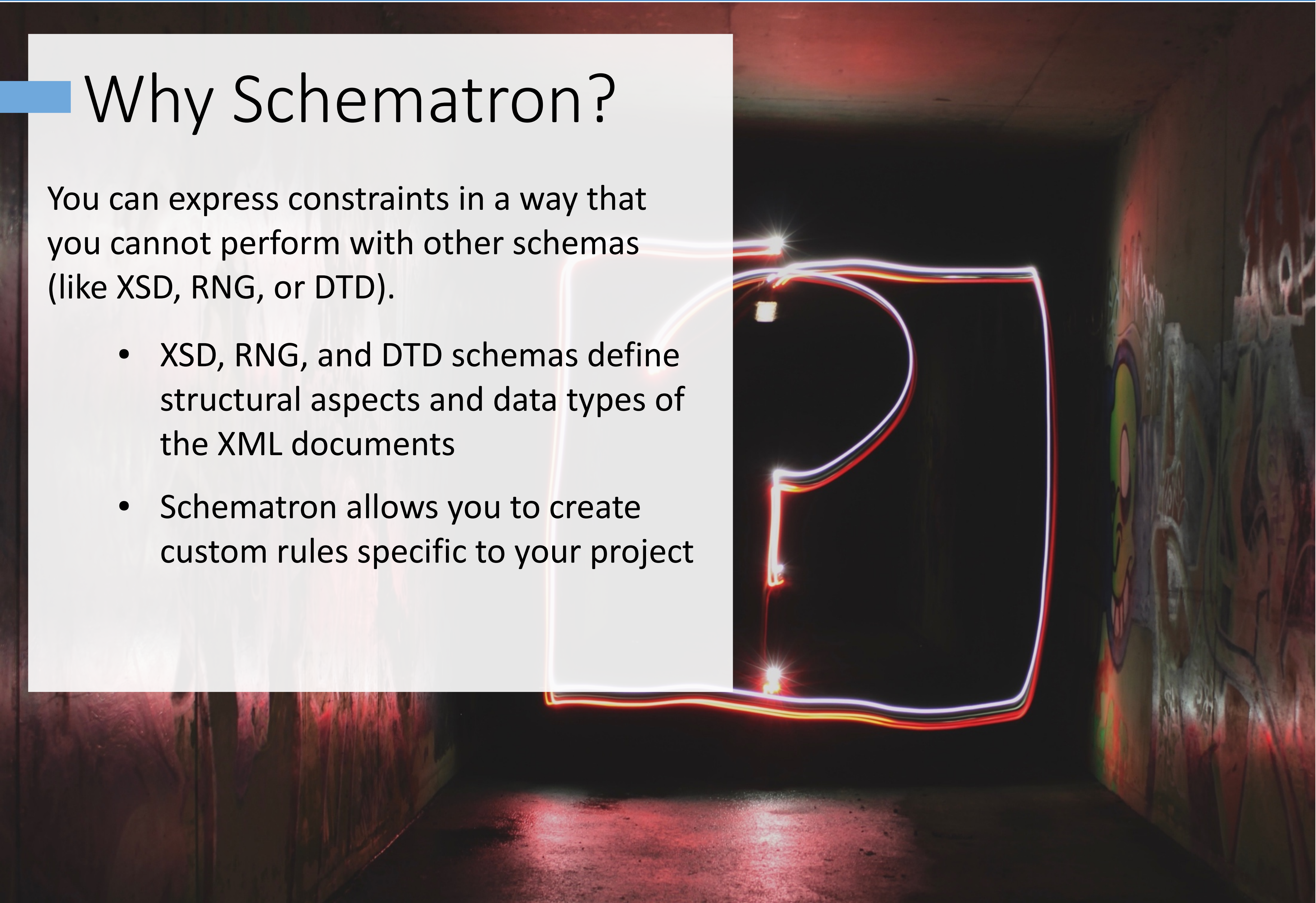
Schematron is an ISO Standard

Schematron is an ISO standard adopted by hundreds of major projects in the past decade

Schematron History

Schematron was invented by Rick Jelliffe

- Schematron 1.0 (1999), 1.3 (2000), 1.5 (2001)
- ISO Schematron (2006, 2010, 2016)

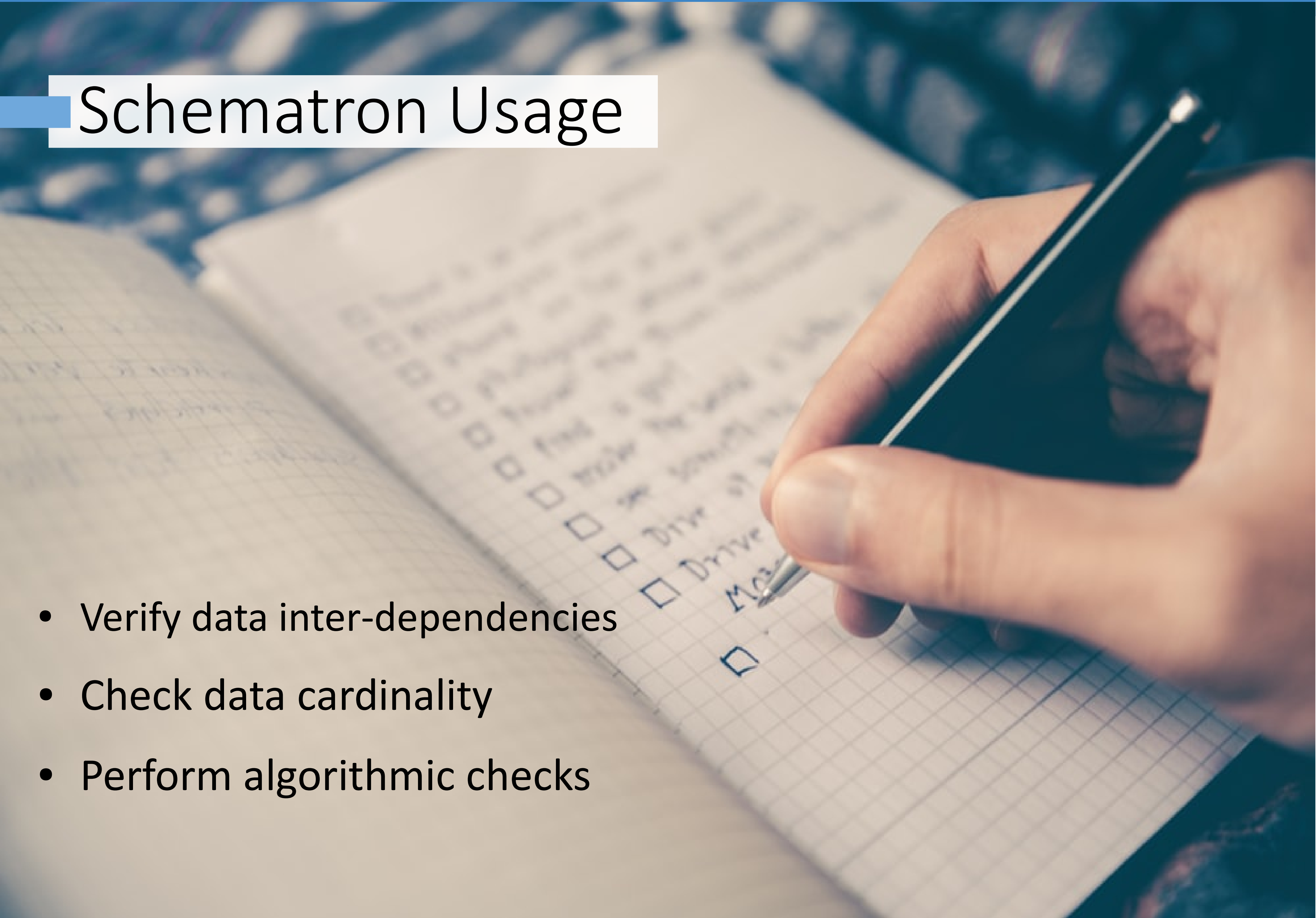


Why Schematron?

You can express constraints in a way that you cannot perform with other schemas (like XSD, RNG, or DTD).

- XSD, RNG, and DTD schemas define structural aspects and data types of the XML documents
- Schematron allows you to create custom rules specific to your project

Schematron Usage



- Verify data inter-dependencies
- Check data cardinality
- Perform algorithmic checks

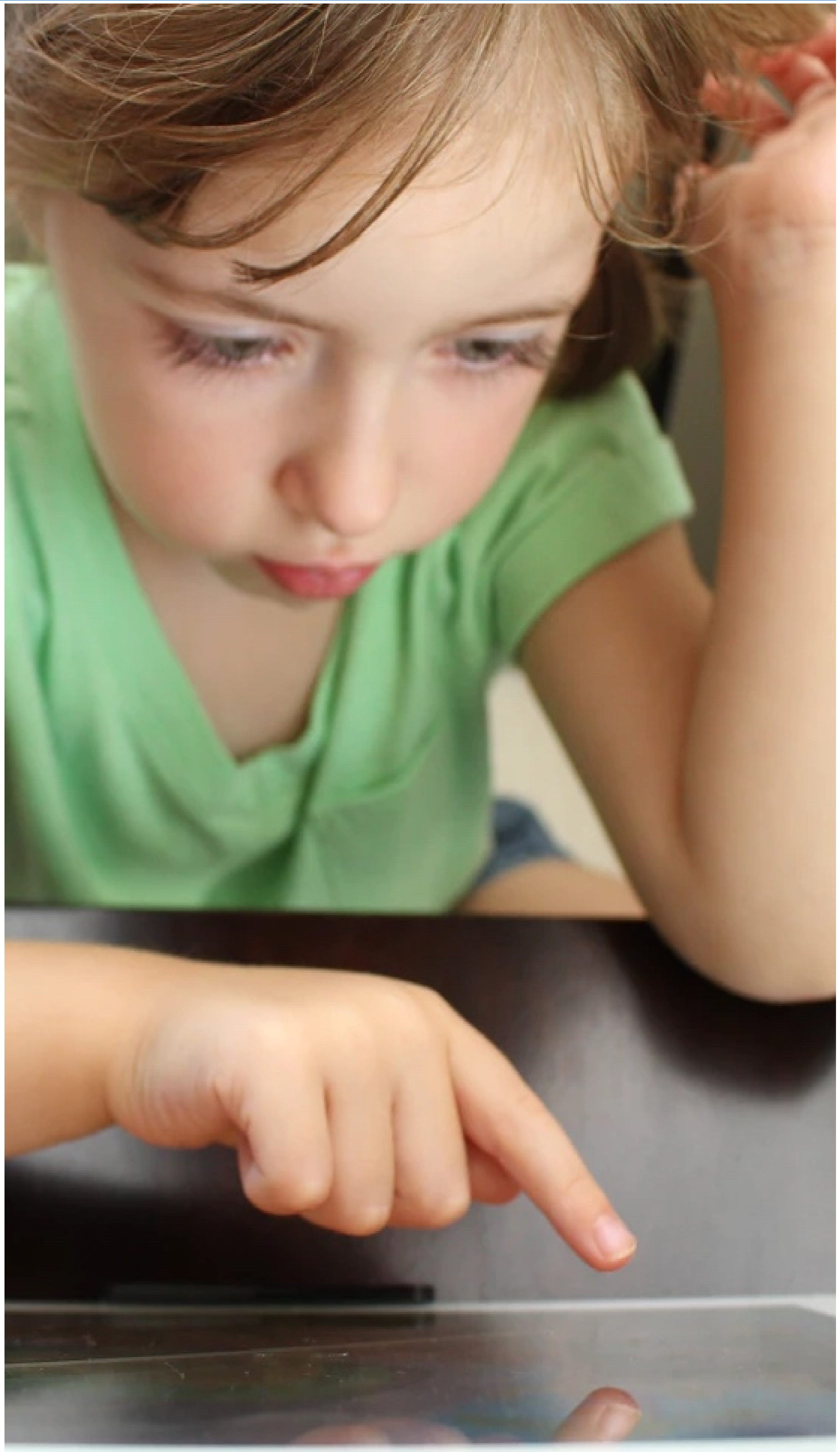
Used in Multiple Domains

- Financial
- Insurance
- Government
- Technical publishing

Schematron is Very Simple

There are only 6 basic elements:

- assert
- report
- rule
- pattern
- schema
- ns



Schematron Step-by-Step

XML

A list of books from a bookstore:

```
...
<book price="7">
   <title>XSLT 2.0 Programmer's Reference</title>
   <author>Michael Kay</author>
   <isbn>0764569090</isbn>
</book>
<book price="1100">
   <title>XSLT and XPath On The Edge</title>
   <author>Jeni Tennison</author>
   <isbn>0764547763 </isbn>
</book>
...
```

<assert>

An **assert** generates a message when a test statement evaluates to **false**

```
<assert test="@price > 10">The book price is too small</assert>
```

<report>

A **report** generates a message when a test statement evaluate to **true**.

```
<report test="@price > 1000">The book price is too big</report>
```

<rule>

A **rule** defines a context on which a list of assertions will be tested, and is comprised of one or more **assert** or **report** elements.

```
<rule context="book">
   <assert test="@price > 10">The book price is too small</assert>
   <report test="@price > 1000">The book price is too big</report>
</rule>
```

<pattern>

A set of rules giving constraints that are in some way related

```
<pattern>
    <rule context="book">
      <assert test="@price > 10">The book price is too small</assert>
       <report test="@price > 1000">The book price is too big</report>
    </rule>
</pattern>
```

<schema>

The top-level element of a Schematron schema.

```
<schema xmlns="http://purl.oclc.org/dsdl/schematron">
   <pattern>
       <rule context="book">
         <assert test="@price > 10">The book price is too small</assert>
          <report test="@price > 1000">The book price is too big</report>
       </rule>
   </pattern>
</schema>
```

Apply Schematron

```
<schema xmlns="http://purl.oclc.org/dsdl/schematron">
  <pattern>
    <rule context="book">
      <assert test="@price > 10">The book price is too small</assert>
       <report test="@price > 1000">The book price is too big</report>
    </rule>
  </pattern>
</schema>
```

Validate

```
...
<book price="7">
   <title>XSLT 2.0 Programmer's Reference</title>
   <author>Michael Kay</author>
   <isbn>0764569090</isbn>
</book>
<book price="1100">
   <title>XSLT and XPath On The Edge</title>
   <author>Jeni Tennison</author>
   <isbn>0764547763</isbn>
</book>
...
```

⚠ The price is too small

⚠ The book price is too big

<ns>

Defines a namespace prefix and URI

```
<schema xmlns="http://purl.oclc.org/dsdl/schematron">
    <ns uri="http://book.example.com" prefix="b"/>
    <pattern>
        <rule context="b:book">
         <assert test="@price > 10">The book price is too small</assert>
          <report test="@price > 1000">The book price is too big</report>
       </rule>
    </pattern>
</schema>
```

Conclusion

- Schematron is simple (6 basic elements)
- Used in multiple domains
- Schematron uses XPath

//* XPath in Schematron

What is XPath?

- A language for addressing parts of an XML document (XML Path Language)
- A W3C Recommendation in 1999
  www.w3.org/TR/xpath
- XPath versions 1.0, 2.0, 3.0, 3.1 (2017)

Schematron Uses XPath

- XPath in Schematron:
  - Rule context is expressed using an XPath expression

```
<rule context="book">
```

  - Assertions are expressed using XPath expressions that are evaluated as *true* or *false*

```
<assert test="@price > 10">
```

Basic XPath Syntax

- nodeName – select node with a specific name
- / - level selector
- // - multi-level selector
- ../ - level up selector
- @ - attribute selector

Examples

- book – select all nodes with the name “book”
- /books/book – selects all the “book” elements that are in the “books” root element
- book/title – selects the “title” elements for all the books
- /books//title – selects all the “title” elements from the “books”
- @price – selects all the price attributes

Schematron Example

```
<rule context="/books/book">
  <assert test="@price > 10">The book price is too small</assert>
</rule>
```

```
<rule context="/books/book/@price">
   <assert test=". > 10">The book price is too small</assert>
</rule>
```

Predicates

Condition in square brakes

- //book[2] – selects the second book element
- book[@price &lt; 10] – selects all the book elements with the price less than(lt) 10
- book[last()] - selects the last book element
- book[@price>1000]/author - selects all the “author” elements that are in a book with the price grater than(gt) 1000

Schematron Example

```
<rule context="book[@price lt 10] ">
   <assert test="false()">The book price is too small</assert>
</rule>
```

```
<rule context="book[@price>1000]/author">
  <assert test="text() = 'Jeni Tennison'">
     Only 'Jeni Tennison' books can have bigger price</assert>
</rule>
```

Wildcards

* - any element node selector

@* - any attribute node selector

node() - any node selector

Wildcards Examples

//* - selects all the elements from the document

//book[@*] - selects all the book elements that have an attribute

//book/* - selects all the elements from the book

XPath Functions

- For strings: concat(), substring(), contains(), substring-before(), substring-after(), translate(), normalize-space(), string-length()
- For numbers: sum(), round(), floor(), ceiling()
- Node Properties: name(), local-name(), namespace-uri()

Schematron Example

```
<rule context="books">
   <report test="sum(book/@price) > 10000">
      The books price is too big</report>
</rule>
```

```
<rule context="book/title">
  <assert test="string-length(text()) lt 30">
    Titles should be less than 30 characters</assert>
</rule>
```

XPath Version in Schematron

- *@queryBinding – determines the XPath version*

```
<schema queryBinding="xslt2">
```

Possible values: xslt, xslt2, xslt3

Conclusion

- XPath it is very important in Schematron
- Used in **rule** context and **assertions**
- Different XPath versions

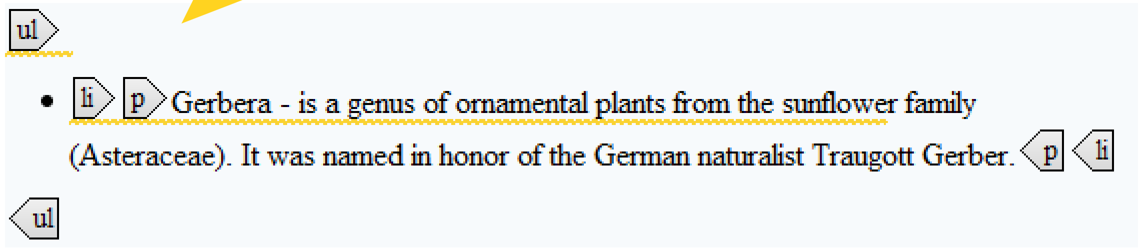
- Tutorials:
  - www.data2type.de/en/xml-xslt-xslfo/xpath/
  - www.xfront.com/xpath/
  - www.zvon.org/comp/m/xpath.html

Examples of Rules

Check Number of List Items

- Example of a rule that checks the number of list items in a list

A list must have more than one item



ul

• li p Gerbera - is a genus of ornamental plants from the sunflower family (Asteraceae). It was named in honor of the German naturalist Traugott Gerber. p li

ul

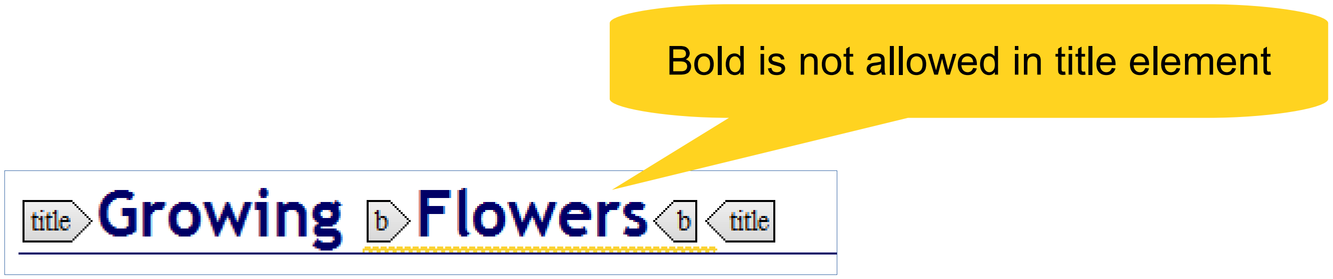
Check Number of List Items

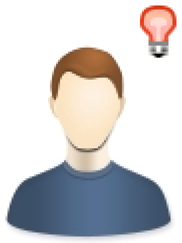
- The number of list items from an unordered list should be greater than one

```
<sch:rule context="ul">
   <sch:assert test="count(li) > 1">
      A list must have more than one item</sch:assert>
</sch:rule>
```

Styling in Titles

- Example rule that checks for styling in titles





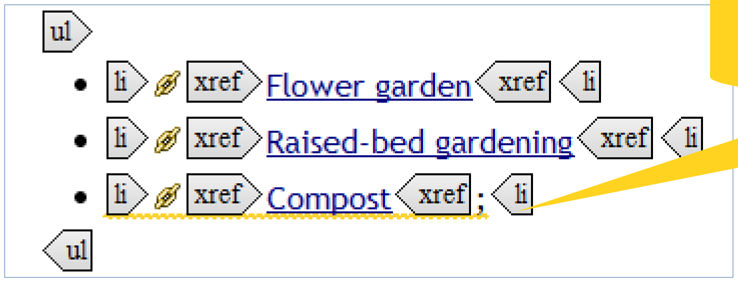
Styling in Titles

- The b element should not be used in a title or short description

```
<sch:rule context="title | shortdesc">
    <sch:report test="b">
      Bold is not allowed in <sch:name/> element</sch:report>
</sch:rule>
```

Semicolon at End of List Items

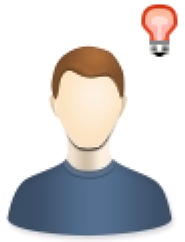
- Example of rule that checks if a semicolon is at the end of a list item



ul
- li xref Flower garden xref li
- li xref Raised-bed gardening xref li
- li xref Compost xref ; li

ul

Semicolon is not allowed at the end of a list item



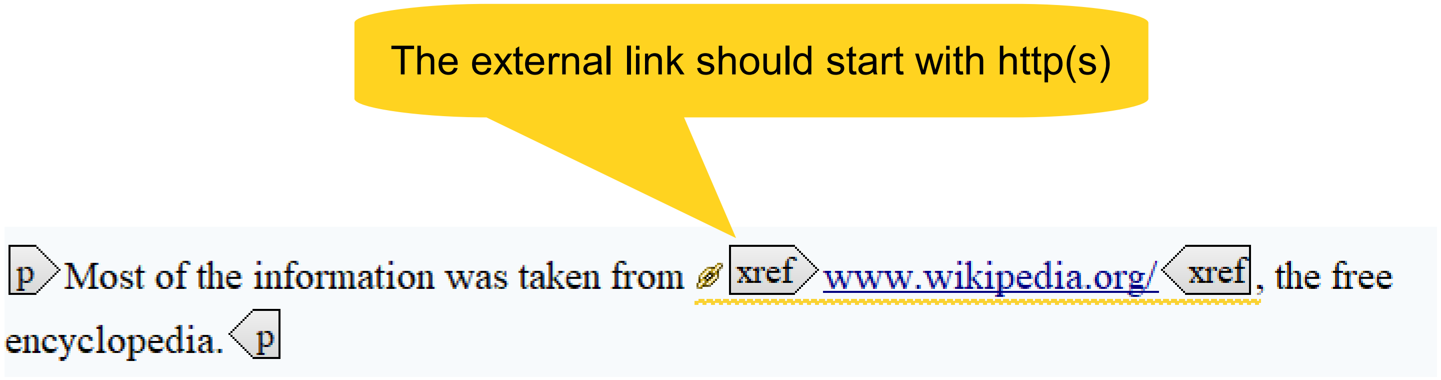
Semicolon at End of List Items

- The last text from a list item should not end with semicolon

```
 <sch:rule context="li">
    <sch:report test="ends-with(text()[last()], ';')">
        Semicolon is not allowed after list item</sch:report>
</sch:rule>
```

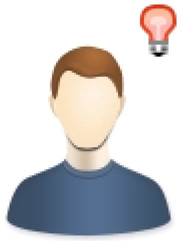
Check External Link Protocol

- Example of rule that check the external link protocol



The external link should start with http(s)

p Most of the information was taken from xref www.wikipedia.org/ xref, the free encyclopedia. p



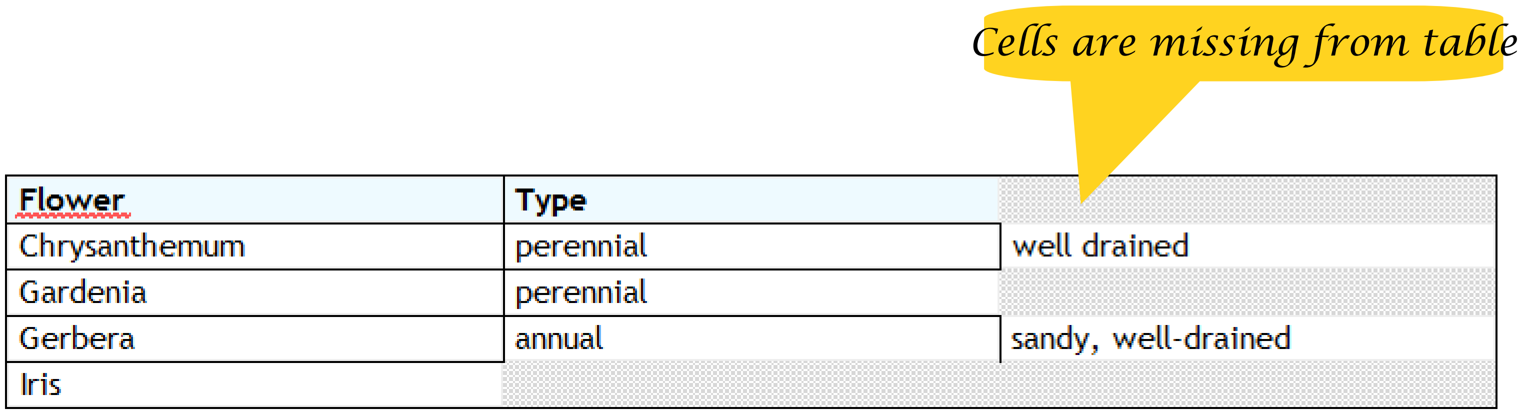
Check External Link Protocol

- The @href attribute value it is an external link and should start with http or https.

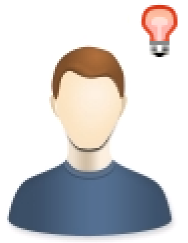
```
<rule context="xref">
   <sch:assert test="matches(@href, '^http(s?)://')">
      An link should start with http(s).</sch:assert>
</rule>
```

Missing Tables Cells

- Missing cells in a table


Cells are missing from table

Flower	Type	
Chrysanthemum	perennial	well drained
Gardenia	perennial	
Gerbera	annual	sandy, well-drained
Iris		



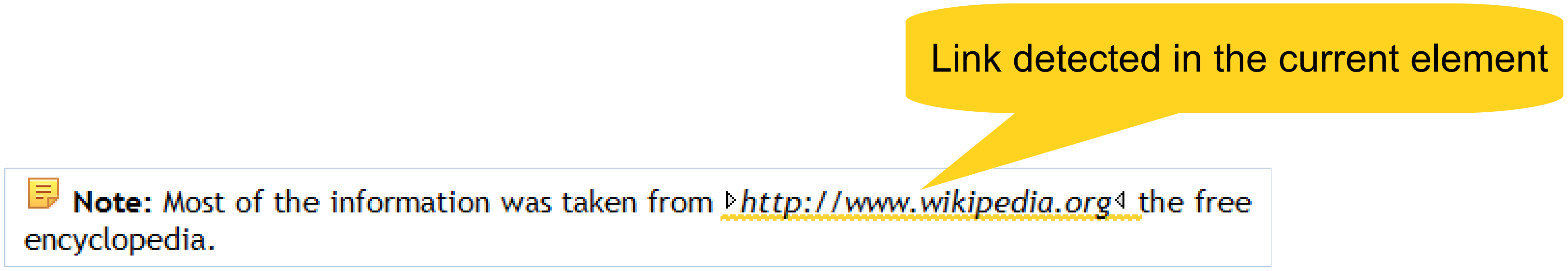
Missing Tables Cells

- Check that are the same number of cells on each row

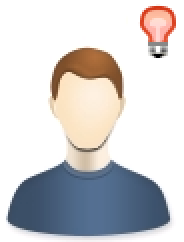
```
<sch:rule context="table">
  <sch:let name="minColumsNo" value="min(.//row/count(entry))"/>
  <sch:let name="reqColumsNo" value="max(.//row/count(entry))"/>

  <sch:assert test="$minColumsNo >= $reqColumsNo">
    Cells are missing. (The number of cells for each row must be
    <sch:value-of select="$reqColumsNo"/>)
  </sch:assert>
</sch:rule>
```

Link in Text Content

- Links are added directly in text content



Note: Most of the information was taken from *http://www.wikipedia.org* the free encyclopedia.



Link in Text Content

- Check if a link is added in text content but is not tagged as a link

```
<sch:rule context="text()">
  <sch:report test="matches(., '(http|www)\S+')
                            and local-name(parent::node()) != 'xref'">
    The link should be a xref element</sch:report>
</sch:rule>
```

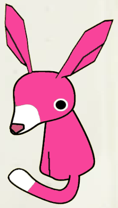
Conclusion

- Simple to complex Schematron rules
- Additional Schematron elements

<let> - A declaration of a named variable

<value-of> - Finds or calculates values from the instance document

<name> - Provides the names of nodes from the instance document



Integrating Schematron in the Development Process

Validate XML with Schematron

- Associate Schematron in the XML file

```
<?xml-model href="books.sch" type="application/xml"
                    schematypens="http://purl.oclc.org/dsdl/schematron"?>
```

- Use tool-specific association options
  - Associate Schematron file with a set of XML files (all files with a specific namespace, or from a directory)
  - Associate Schematron with all XML files from a project

Embed Schematron in XSD or RNG

- Schematron can be added in the XSD appinfo element

```
<xsd:appinfo>
  <sch:pattern>
    <sch:rule context="...">
        <sch:assert test="...">Message.</sch:assert>
    </sch:rule>
  </sch:pattern>
</xsd:appinfo>
```

- Add Schematron checks in any element on any level of an RNG schema

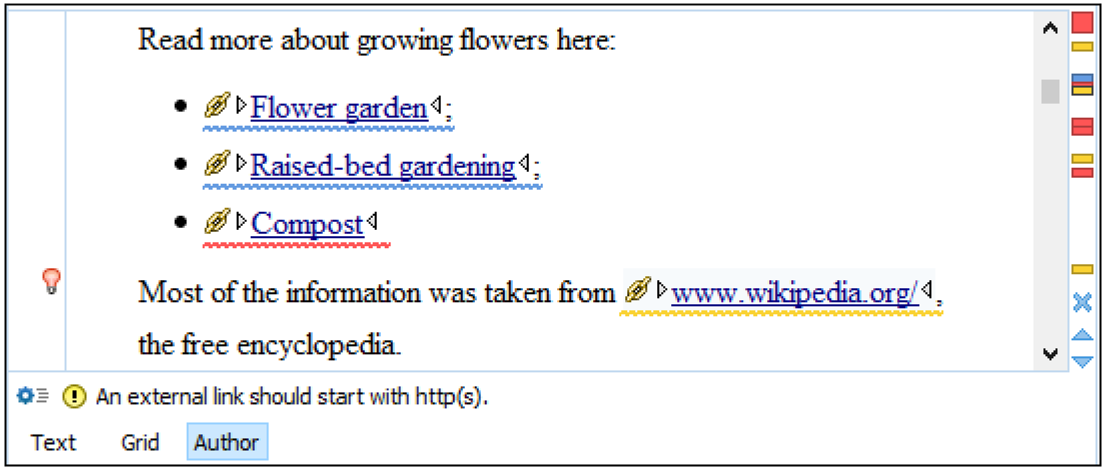
```
<grammar
    xmlns="http://relaxng.org/ns/structure/1.0"
    xmlns:sch="http://purl.oclc.org/dsdl/schematron"
    <sch:pattern>
      <sch:rule context="...">
        <sch:assert test="...">Message.</sch:assert>
      </sch:rule>
    </sch:pattern>
    <start>
     ..............
    </start>
</grammar>
```

Run Schematron Validation

- From an XML editing framework
  - Check the XML files as you type
  - Run the Schematron validation on multiple files
- Using W3C's XProc pipeline language through its "validate-with-schematron" step
- Using Apache Ant, from bat/shell
  https://github.com/Schematron/ant-schematron

Schematron Validation Result

- Messages presented in the editing framework



Read more about growing flowers here:

- Flower garden;
- Raised-bed gardening;
- Compost

Most of the information was taken from www.wikipedia.org/, the free encyclopedia.

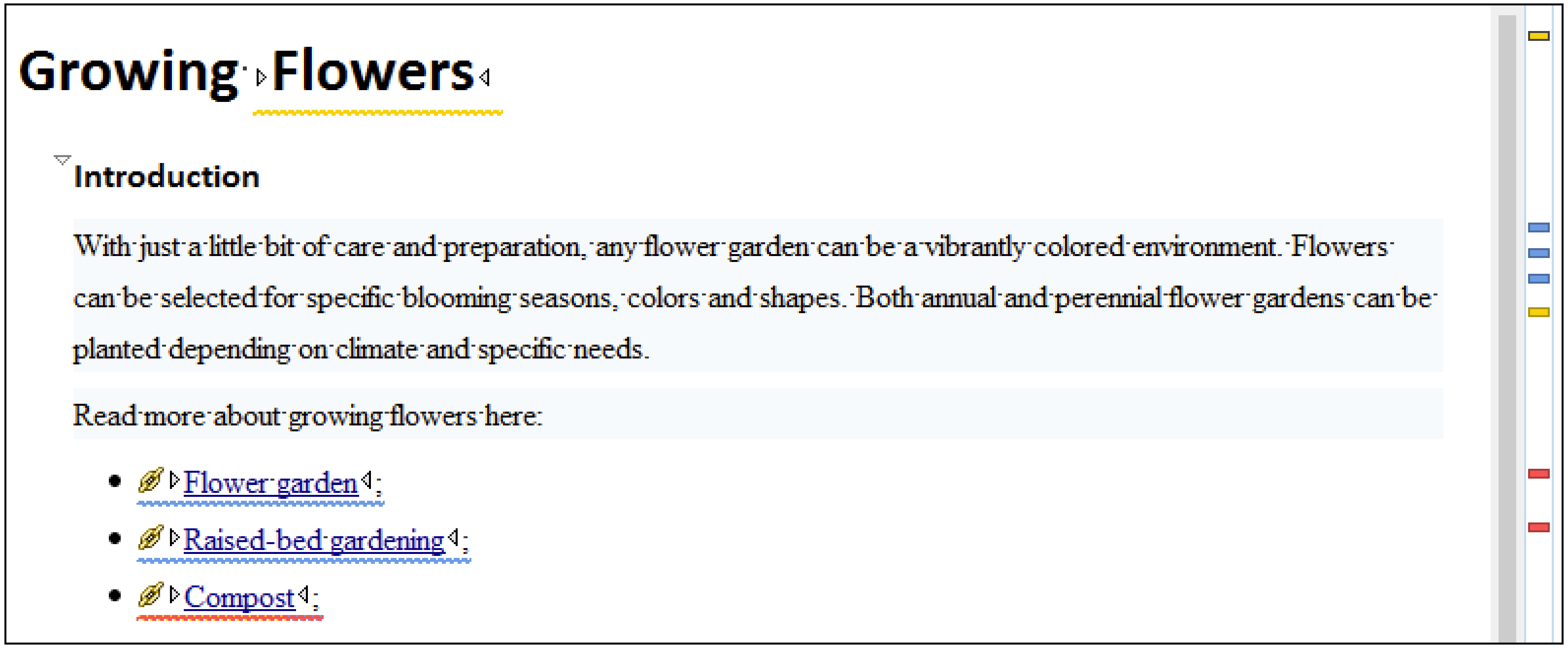
An external link should start with http(s).

- As an XML file describing the validation errors, normally in Schematron Validation Reporting Language (SVRL)

```
<svrl:failed-assert test="matches(@href, '^http(s?)://')" role="warn"
                                        location="/topic[1]/body[1]/section[1]/p[3]/xref[1]">
   <svrl:text>An external link should start with http(s).</svrl:text>
</svrl:failed-assert>
```

Schematron Messages Severity

- Severity level can be set in the value of the @role attribute from an assert or report element (fatal, error, warn, or info)
- Depending on the severity, the message can be rendered differently in an editing framework



Growing Flowers

Introduction

With just a little bit of care and preparation, any flower garden can be a vibrantly colored environment. Flowers can be selected for specific blooming seasons, colors and shapes. Both annual and perennial flower gardens can be planted depending on climate and specific needs.

Read more about growing flowers here:

- Flower garden;
- Raised-bed gardening;
- Compost;

Multilingual Support in Schematron

- Based on the Schematron diagnostic element
- A diagnostic element is used for each language
- Multilingual support defined in the Schematron specification

```
<sch:assert test="bone" diagnostics="d_en d_de">
  A dog should have a bone.
 </sch:assert>
….
<sch:diagnostics  xml:lang="en">
    <sch:diagnostic id="d_en">A dog should have a bone.<sch:diagnostic>
</sch:diagnostics>
<sch:diagnostics  xml:lang="de">
    <sch:diagnostic id="d_de">Das Hund muss ein Bein haben.</sch:diagnostic>
</sch:diagnostics>
```

Conclusion

- Multiple ways to associate and apply the validation
- Validation results as you type or in a report
- Messages with different severity
- Multilingual support

Schematron for Non-Technical Users

Create Rules

- There are more and more non-technical users that want to develop their own rules
- Providing a user interface to create the Schematron rules will be more appropriate for them

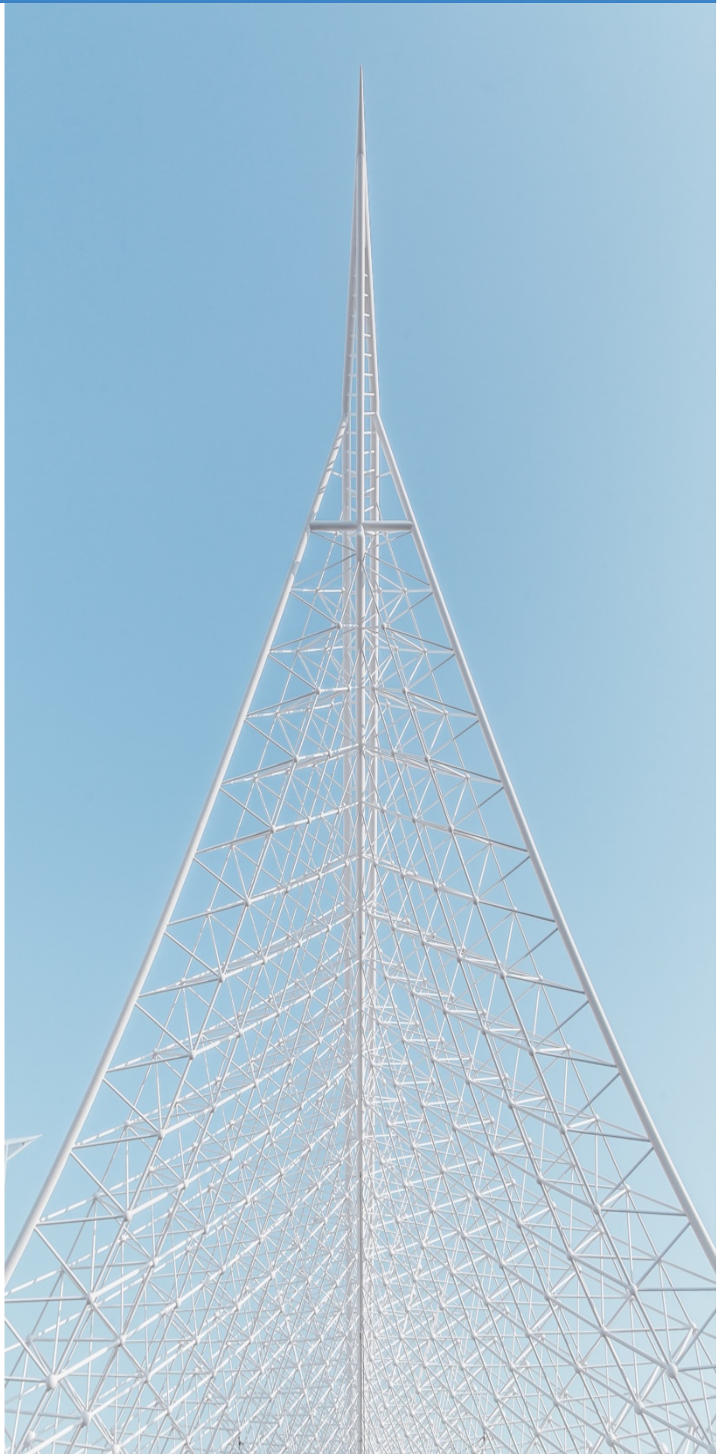
Auto-Generate Schematron Rules

- A style guide can contain information to automate the style guide checks
- An automated rule is an instantiation of a generic rule

Intelligent Integrated Style Guide

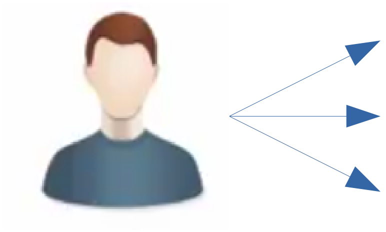
- An implementation of an intelligent style guide
- Describes and enforces rules
- Open-source project is available on GitHub

github.com/oxygenxml/integrated-styleguide



Library of Rules

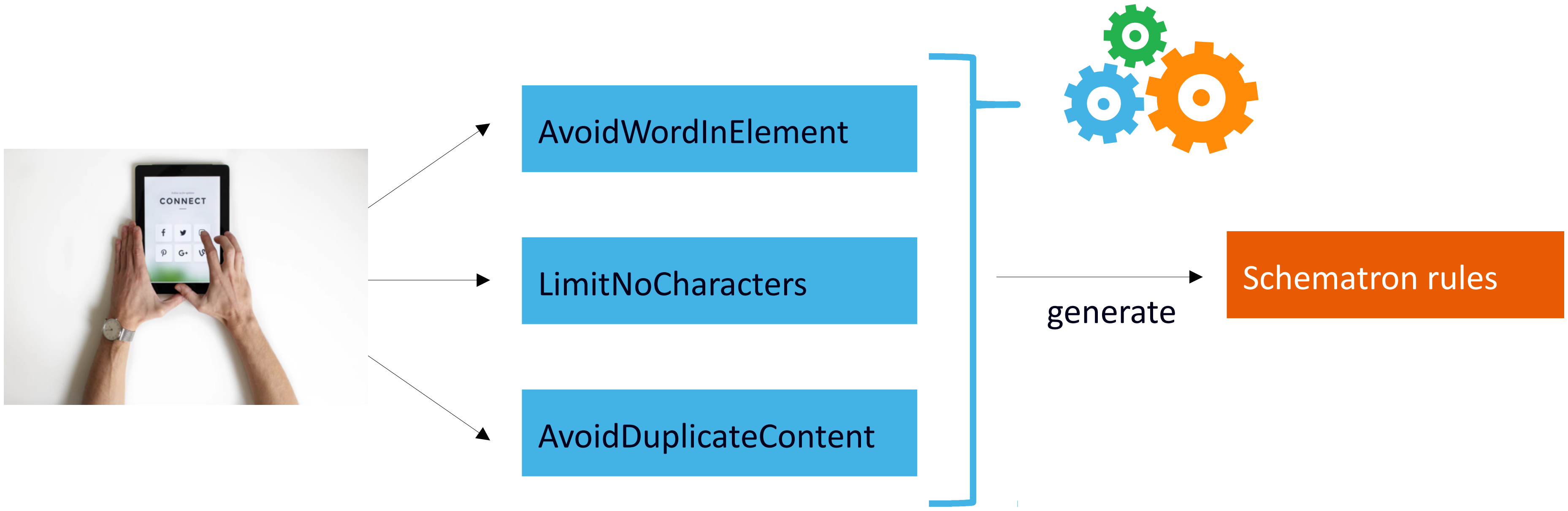
- Generic rules can be created using a library of rules
- The user can choose the rule that he wants to add



Avoid a word in a certain element
Limit the number of words
Avoid duplicate content

Abstract Patterns

Library of rules implemented using abstract patterns



Abstract Pattern

- Allows to reuse patterns by making them generic

```
<pattern id="LimitNoOfWords" abstract="true">
    <rule context="$parentElement">
      <let name="words" value="count(tokenize(normalize-space(.), ' '))"/>
      <assert test="$words le $maxWords">
        $message You have <value-of select="$words"/> word(s).
      </assert>
      <assert test="$words ge $minWords">
        $message You have <value-of select="$words"/> word(s).
     </assert>
    </rule>
 </pattern>
```

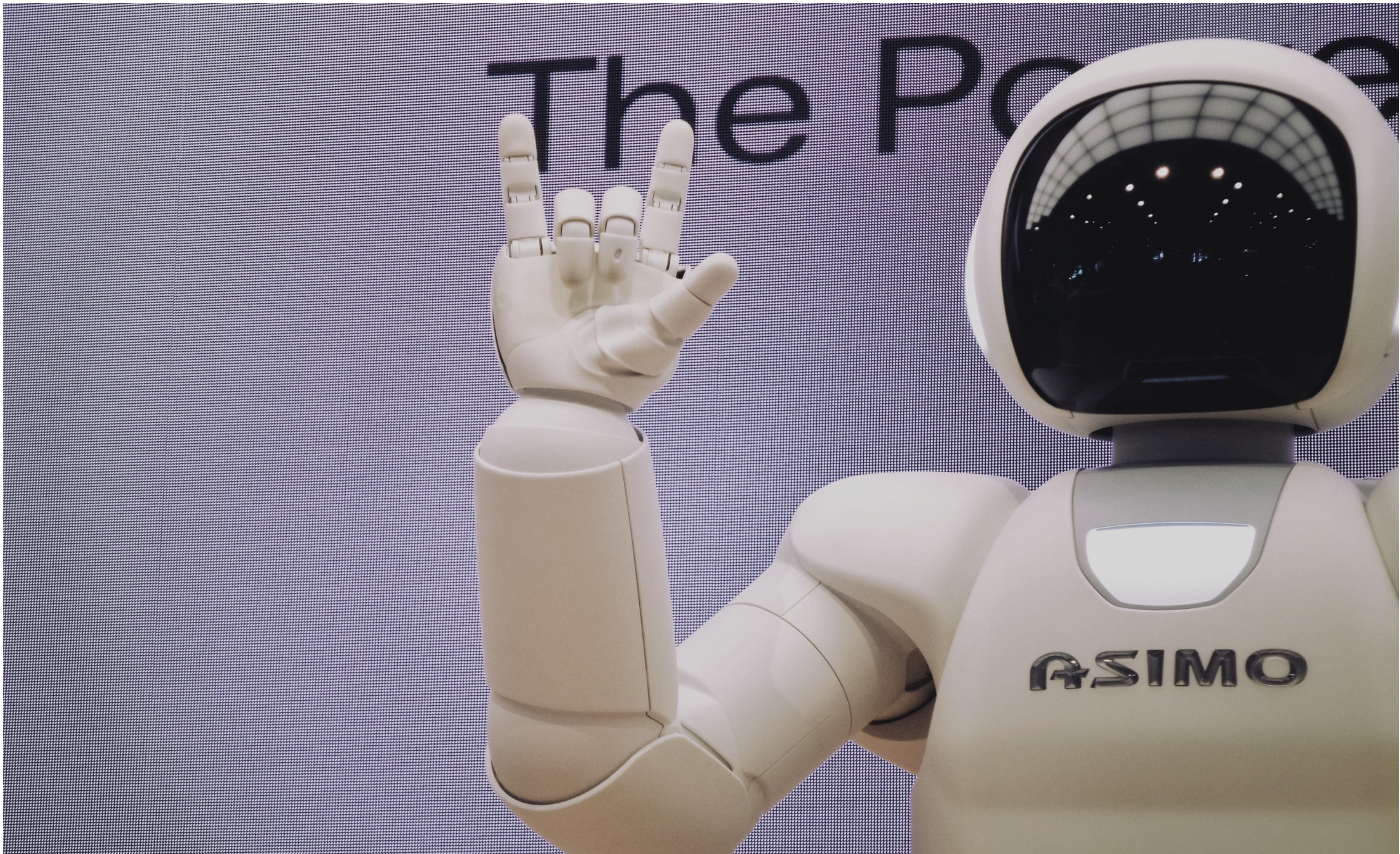
Pattern Instantiation

- Refer an abstract pattern and specifies values for parameters

```
<pattern is-a="LimitNoOfWords">
   <param name="parentElement" value="shortdesc"/>
    <param name="minWords" value="1"/>
    <param name="maxWords" value="50"/>
    <param name="message" value="Keep short descriptions between 1 and 50 words!"/>
 </pattern>
```

```
<pattern is-a="LimitNoOfWords">
   <param name="parentElement" value="title"/>
     <param name="minWords" value="1"/>
     <param name="maxWords" value="8"/>
     <param name="message" value="Keep titles between 1 and 8 words."/>
</pattern>
```

Chatbot to Generate Schematron



Generate Schematron Patterns

"Paragraphs should have less than 100 words"

↓

Dialogflow

↓

```
<sch:pattern is-a="limitElement">
   <sch:param name="element" value="p"/>
   <sch:param name="limit" value="maximum"/>
   <sch:param name="size" value="100"/>
   <sch:param name="unit" value="words"/>
   <sch:param name="message" value="p should contain maximum 100 words"/>
</sch:pattern>
```

Schematron for Technical Users

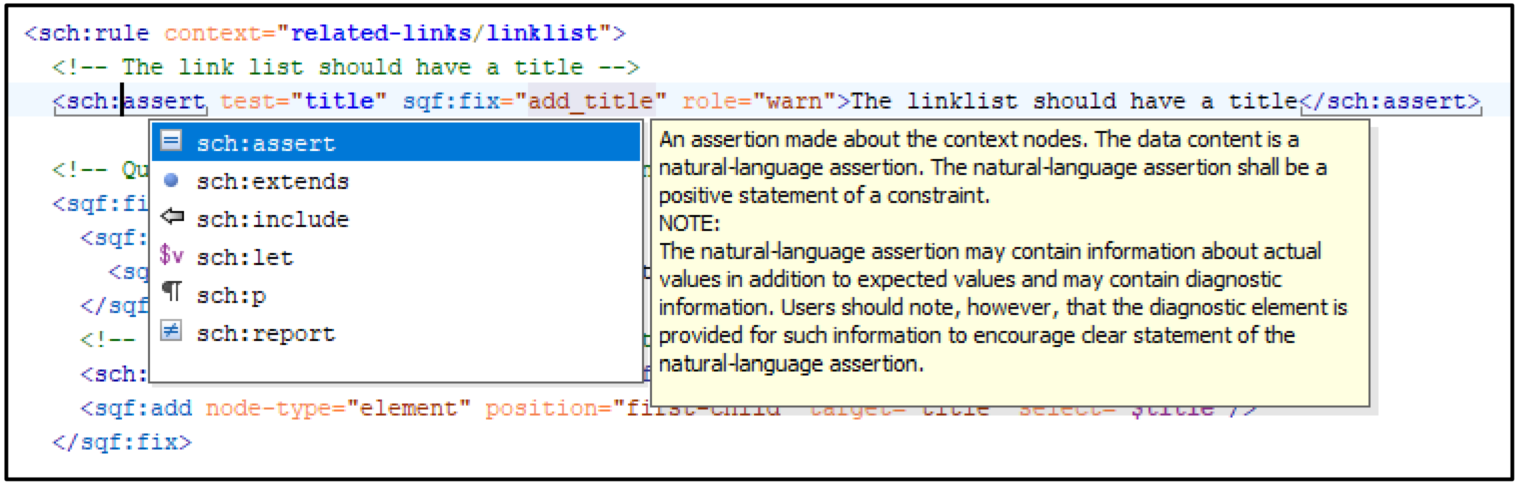
```
                <Link href={'#!/' + name}>[illegible]
              ) : (
                <Link href={'#!/' + name + '/' + [illegible]
              )
            )}
          </div>
          <Preview code={code} evalInContext={[illegible]} />
        </div>
        {showCode ? (
          <div>
            <Editor code={code} onChange={onChange} />
            <button type="button" className={[illegible]}>
              Hide code
            </button>
          </div>
        ) : (
          <button type="button" className={[illegible]}>
            Show code
          </button>
        )}
      </div>
    );
```

Environment to Develop Schematron Schemas

- Editor
- Validation
- Search and refactoring
- Working with modules
- Unit testing

Editor

- Syntax highlighting - to improve the readability of the content
- Content completion assistant - offering proposals that are valid at the cursor position
- Documentation - with information about the particular proposal

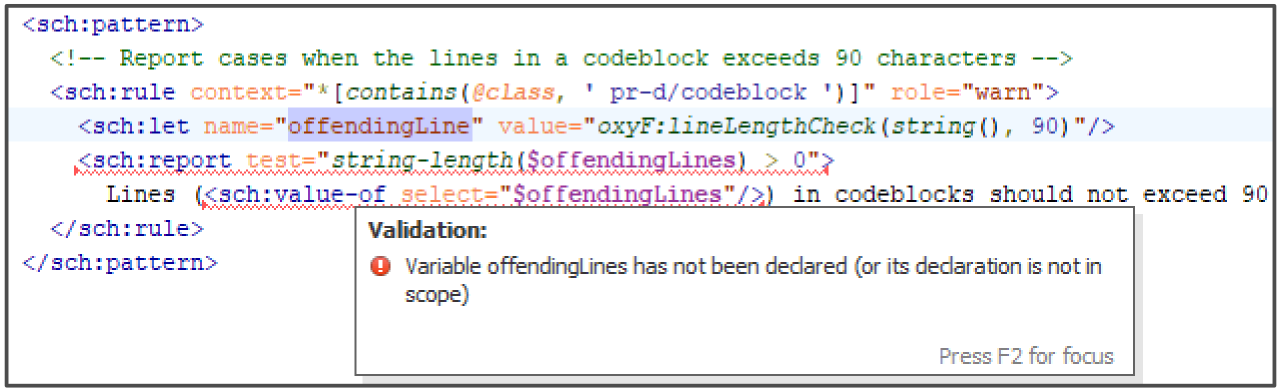


```
<sch:rule context="related-links/linklist">
  <!-- The link list should have a title -->
  <sch:assert test="title" sqf:fix="add_title" role="warn">The linklist should have a title</sch:assert>

  <!-- Qu
  <sqf:fi
    <sqf:
      <sq
    </sqf
    <!--
    <sch:
    <sqf:add node-type="element" position="first-child" target="title" select="$title"/>
  </sqf:fix>
```

An assertion made about the context nodes. The data content is a natural-language assertion. The natural-language assertion shall be a positive statement of a constraint.
NOTE:
The natural-language assertion may contain information about actual values in addition to expected values and may contain diagnostic information. Users should note, however, that the diagnostic element is provided for such information to encourage clear statement of the natural-language assertion.

Validate

- Validate Schematron schemas, and highlight problems directly in the editor
- Validate Schematron modules in context
- Support for validation as you type



```
<sch:pattern>
  <!-- Report cases when the lines in a codeblock exceeds 90 characters -->
  <sch:rule context="*[contains(@class, ' pr-d/codeblock ')]" role="warn">
    <sch:let name="offendingLine" value="oxyF:lineLengthCheck(string(), 90)"/>
    <sch:report test="string-length($offendingLines) > 0">
      Lines (<sch:value-of select="$offendingLines"/>) in codeblocks should not exceed 90
  </sch:rule>
</sch:pattern>
```

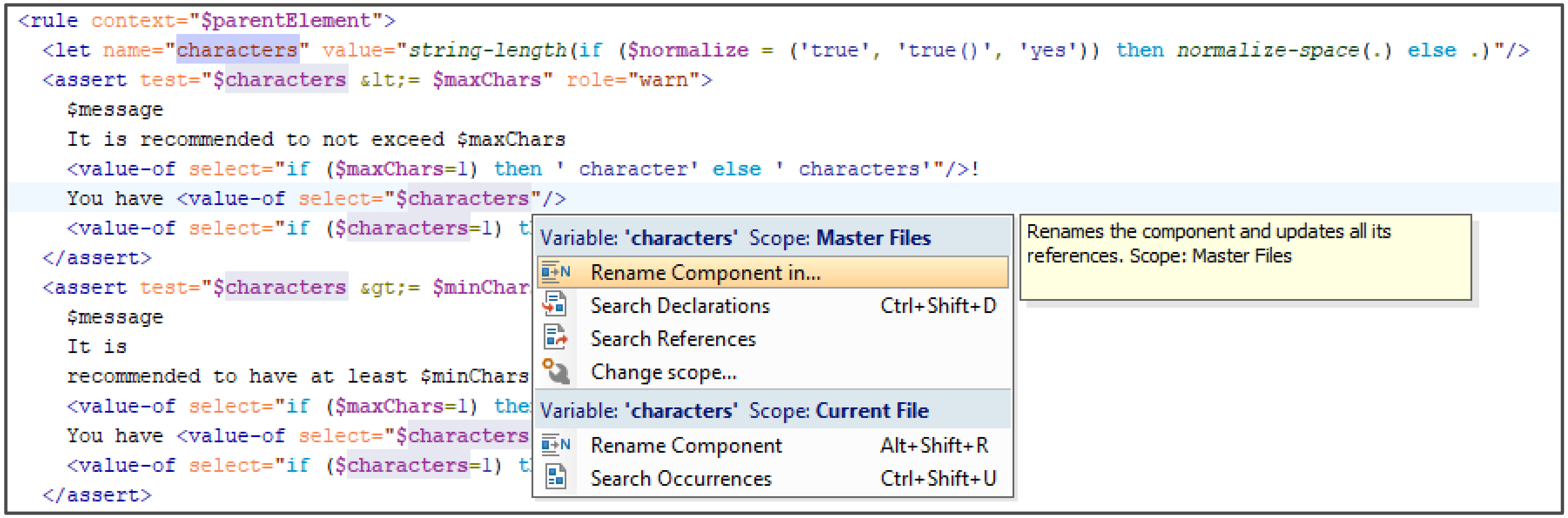
Validation:

Variable offendingLines has not been declared (or its declaration is not in scope)

Press F2 for focus

Search and Refactoring

- Find references to variables, pattern, phases, or diagnostics
- Support for renaming all references from the current document, or in the entire hierarchy
- Preview the changes



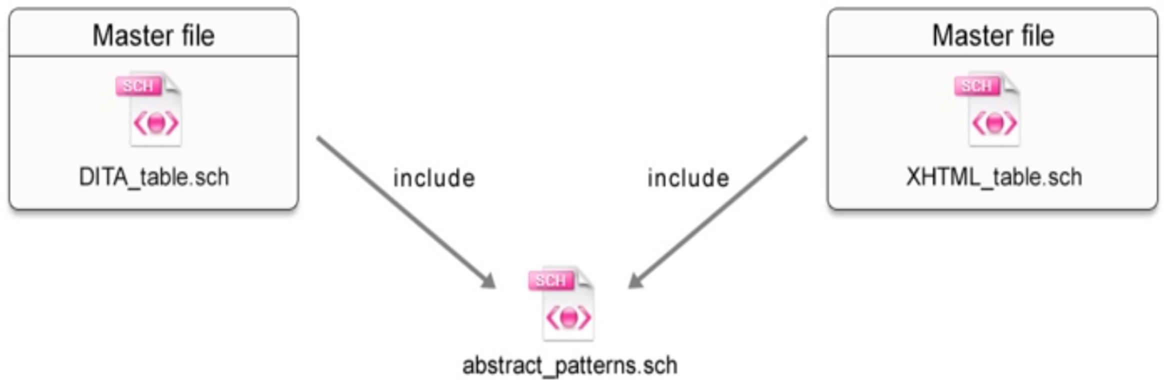
```
<rule context="$parentElement">
  <let name="characters" value="string-length(if ($normalize = ('true', 'true()', 'yes')) then normalize-space(.) else .)"/>
  <assert test="$characters &lt;= $maxChars" role="warn">
    $message
    It is recommended to not exceed $maxChars
    <value-of select="if ($maxChars=1) then ' character' else ' characters'"/>!
    You have <value-of select="$characters"/>
    <value-of select="if ($characters=1) t
  </assert>
  <assert test="$characters &gt;= $minChar
    $message
    It is
    recommended to have at least $minChars
    <value-of select="if ($maxChars=1) the
    You have <value-of select="$characters
    <value-of select="if ($characters=1) t
  </assert>
```

Variable: 'characters' Scope: Master Files
Rename Component in...
Search Declarations Ctrl+Shift+D
Search References
Change scope...
Variable: 'characters' Scope: Current File
Rename Component Alt+Shift+R
Search Occurrences Ctrl+Shift+U

Renames the component and updates all its references. Scope: Master Files

Working with Modules

- Visualize the hierarchy of modules
- Support for editing a Schematron module in the context
- Moving and renaming modules



Test Schematron Rules

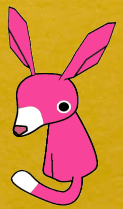
- Developing Schematron schema also involves testing
- Make sure Schematron rules work as expected
- Apply multiple XML examples over the Schematron rules and check the results

XSpec

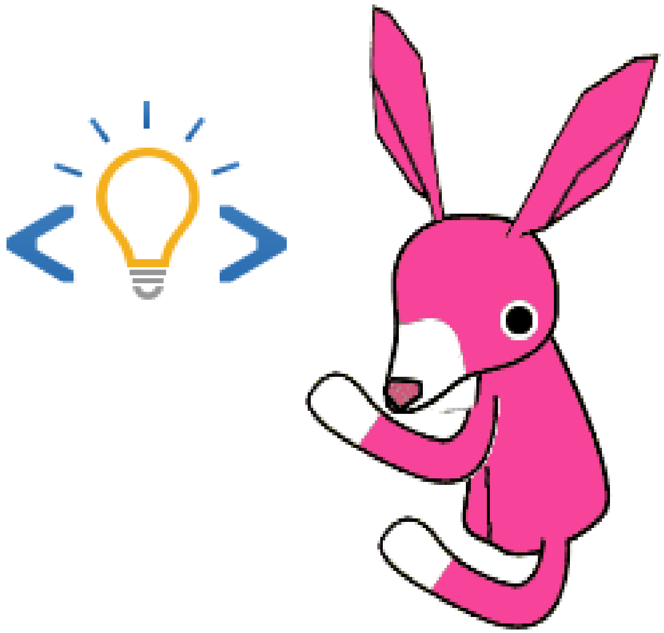
- Solution to create Schematron unit tests
- Unit test and BDD (Behaviour Driven Development) framework
    - https://github.com/xspec/xspec/
- Oxygen XSpec Helper View plugin
    - github.com/xspec/oXygen-XML-editor-xspec-support
- Tutorials
    - github.com/xspec/xspec/wiki/Getting-Started-with-XSpec-and-Schematron
    - oxygenxml.com/events/2018/webinar_xspec_unit_testing_for_xslt_and_schematron.html

Conclusion

- User interface for non-technical users
- Library of rules using abstract patterns
- Editing, validation, and refactoring for technical users
- Test cases for Schematron



Schematron Quick Fixes



Schematron Fix Proposals

- Schematron assertion messages are not always enough for the user to find a solution
- It is better to have some proposals to correct the Schematron reported problem
- Similar to spell check proposals

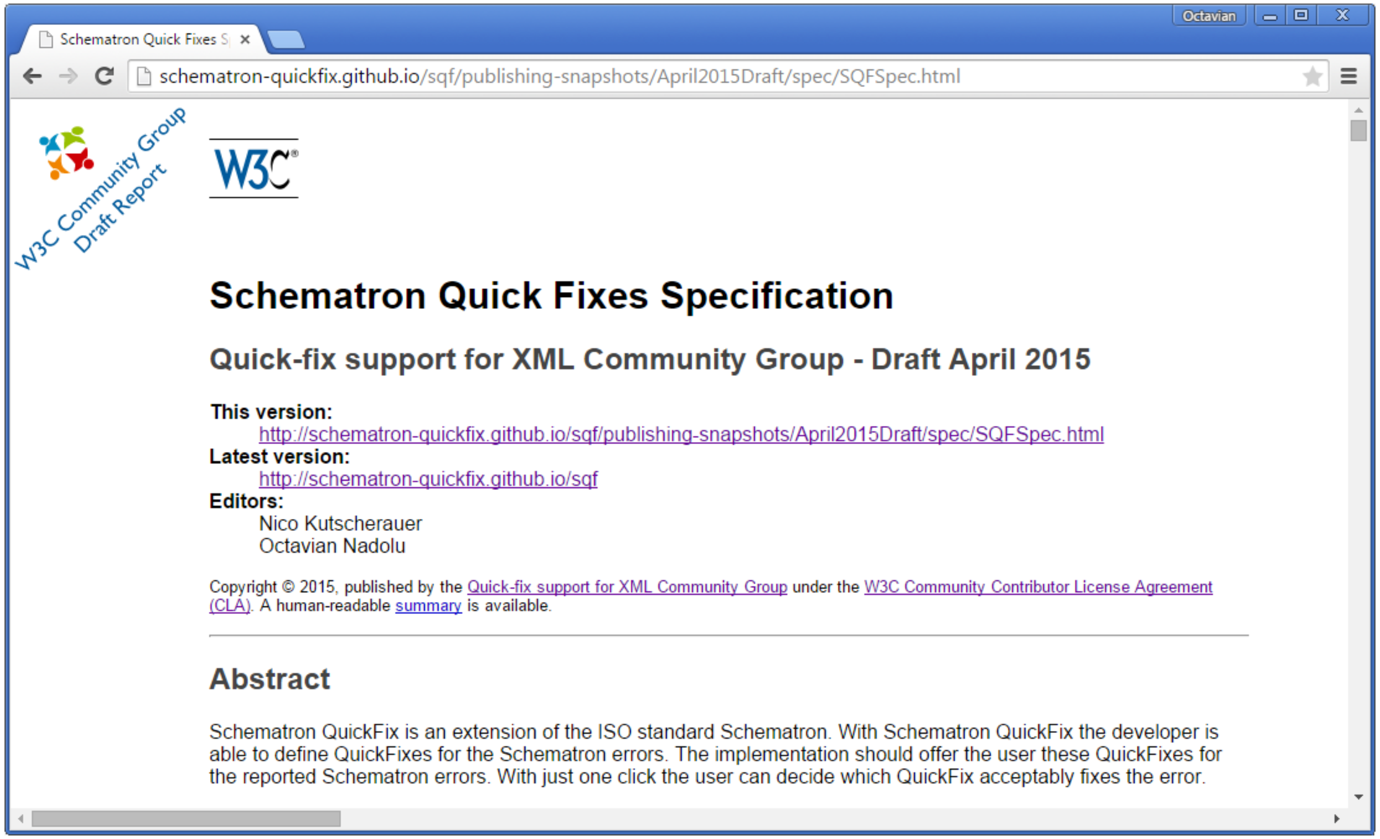
Schematron Quick Fix Proposals

- User-defined fixes for Schematron errors
- Schematron Quick Fix (SQF) language
  - Extension of the Schematron language
  - SQF initiated by Nico Kutscherauer

SQF

www.schematron-quickfix.com
github.com/schematron-quickfix/sqf

Schematron Quick Fixes Spec


Schematron Quick Fixes S
Octavian
schematron-quickfix.github.io/sqf/publishing-snapshots/April2015Draft/spec/SQFSpec.html
W3C Community Group Draft Report
W3C

Schematron Quick Fixes Specification

Quick-fix support for XML Community Group - Draft April 2015

This version:
http://schematron-quickfix.github.io/sqf/publishing-snapshots/April2015Draft/spec/SQFSpec.html
Latest version:
http://schematron-quickfix.github.io/sqf
Editors:
Nico Kutscherauer
Octavian Nadolu

Copyright © 2015, published by the Quick-fix support for XML Community Group under the W3C Community Contributor License Agreement (CLA). A human-readable summary is available.

Abstract

Schematron QuickFix is an extension of the ISO standard Schematron. With Schematron QuickFix the developer is able to define QuickFixes for the Schematron errors. The implementation should offer the user these QuickFixes for the reported Schematron errors. With just one click the user can decide which QuickFix acceptably fixes the error.

www.w3.org/community/quickfix

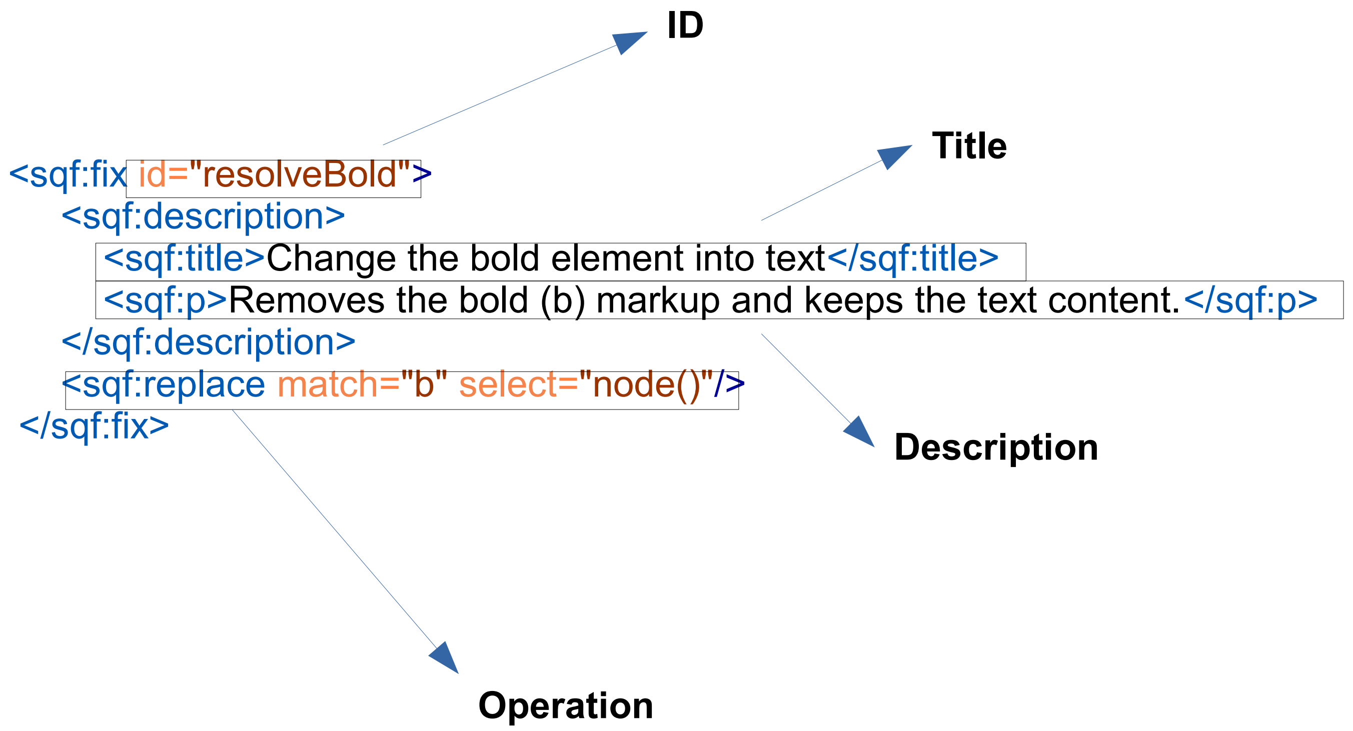
schematron-quickfix.github.io/sqf

SQF Extension of Schematron

- Added as Schematron annotations
- Associate fixes with assert and report elements

```
<rule context="title">
    <report test="b" sqf:fix="resolveBold">
      Bold is not allowed in title element</report>

    <sqf:fix id="resolveBold">
      <sqf:description>
        <sqf:title>Change the bold element into text</sqf:title>
        <sqf:p>Removes the bold (b) markup and keeps the text content.</sqf:p>
      </sqf:description>
      <sqf:replace match="b" select="node()"/>
    </sqf:fix>
 </rule>
```

Schematron Quick Fix (SQF)



```
<sqf:fix id="resolveBold">
    <sqf:description>
      <sqf:title>Change the bold element into text</sqf:title>
      <sqf:p>Removes the bold (b) markup and keeps the text content.</sqf:p>
    </sqf:description>
    <sqf:replace match="b" select="node()"/>
 </sqf:fix>
```

SQF Operations

The following 4 types of operations are supported:

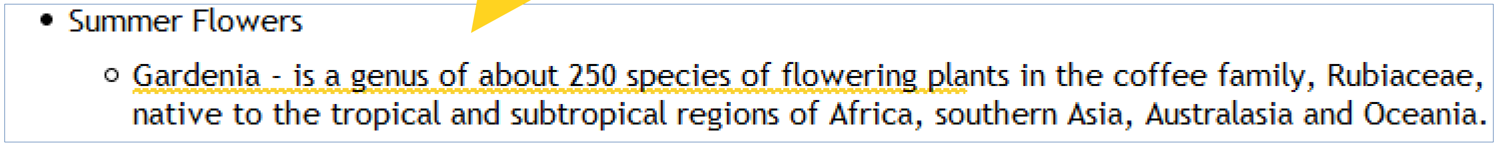
- <sqf:add> - To add a new node or fragment in the document
- <sqf:delete> - To remove a node from the document
- <sqf:replace> - To replace a node with another node or fragment
- <sqf:stringReplace> - To replace text content with other text or a fragment

Introduction to SQF Through Examples

1. SQF “add” Operation

- Example of using the “add” operation: add new list item in a list

List contains only one item



- Summer Flowers
    - Gardenia - is a genus of about 250 species of flowering plants in the coffee family, Rubiaceae, native to the tropical and subtropical regions of Africa, southern Asia, Australasia and Oceania.

Add new list item

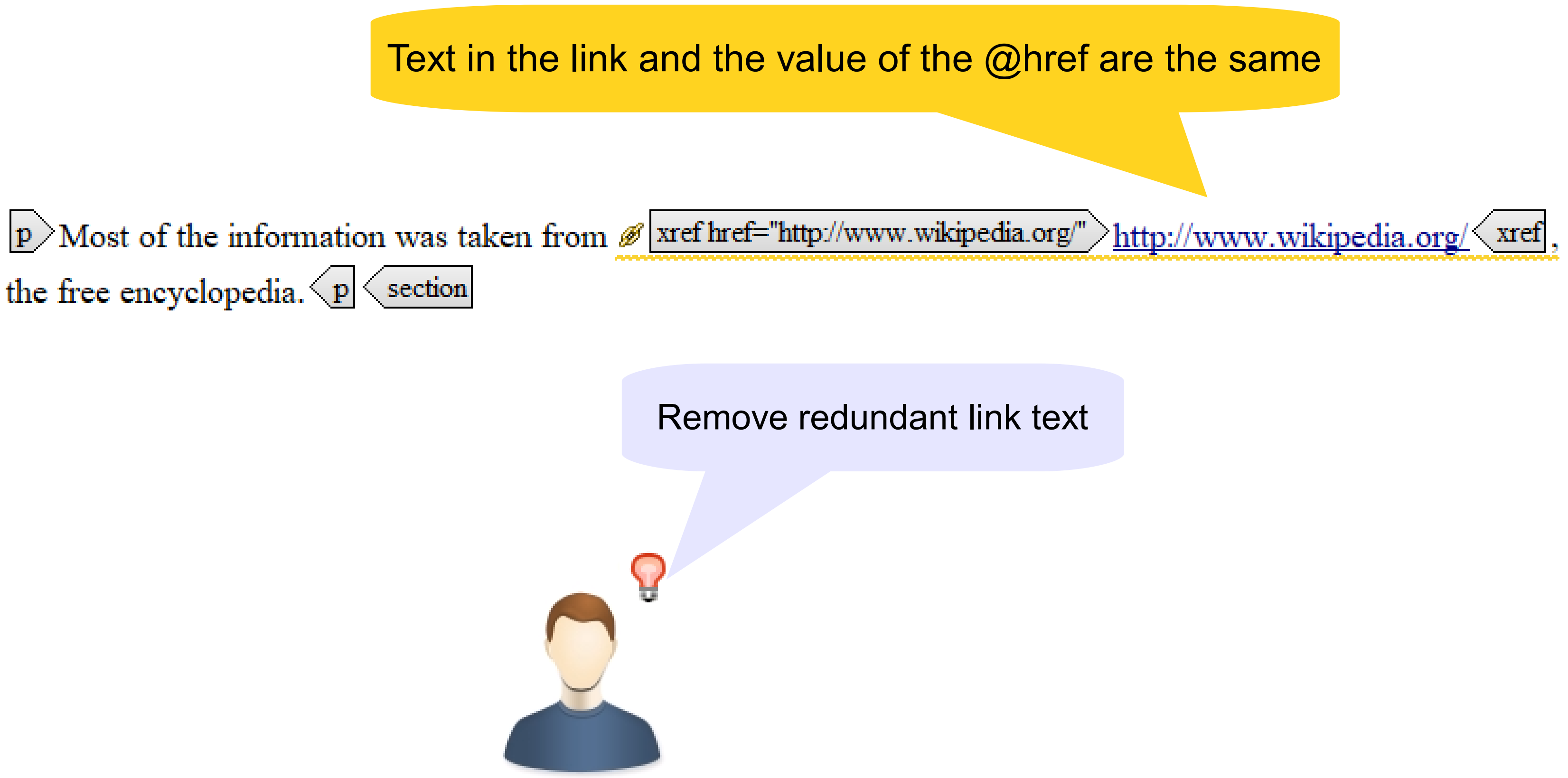
1. SQF “add” Operation

- <sqf:add> element allows you to add one or more nodes to the XML instance

```
<rule context="ul">
    <assert test="count(li) > 1" sqf:fix="addListItem">A list must have more
   than one item.</assert>

    <sqf:fix id="addListItem">
        <sqf:description>
            <sqf:title>Add new list item</sqf:title>
        </sqf:description>
        <sqf:add node-type="element" target="li" position="last-child"/>
    </sqf:fix>
</rule>
```

2. SQF "delete" Operation

- Example of using the "delete" operation: remove redundant link text


Text in the link and the value of the @href are the same
Remove redundant link text

p Most of the information was taken from xref href="http://www.wikipedia.org/" http://www.wikipedia.org/ xref , the free encyclopedia. p section

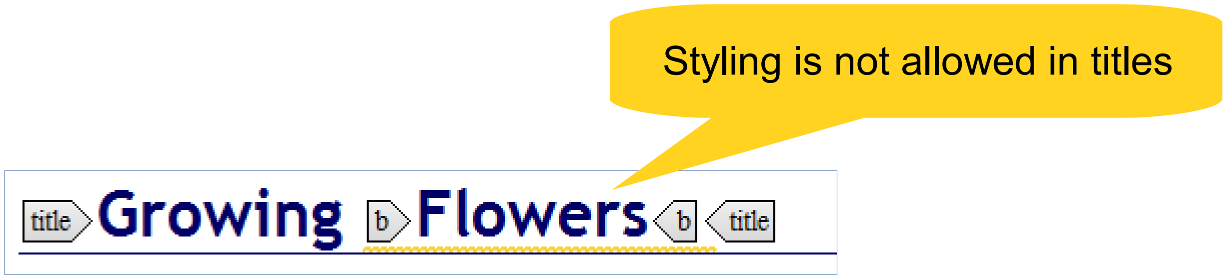
2. SQF “delete” Operation

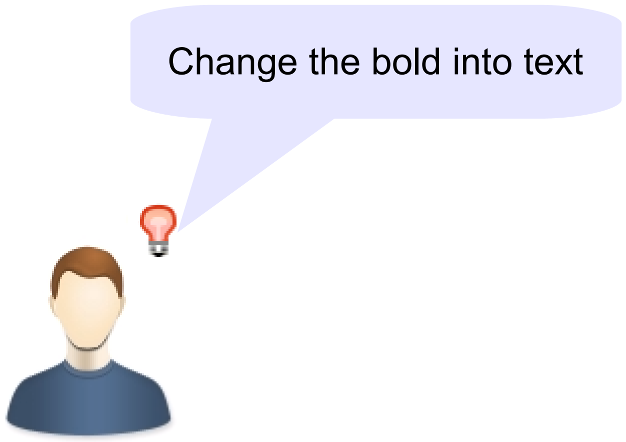
- <sqf:delete> element specifies the nodes for the deletion

```
<rule context="xref">
    <report test="@href = text()" sqf:fix="removeText">
        Link text is same as @href attribute value. Please remove.</report>

    <sqf:fix id="removeText">
        <sqf:description>
            <sqf:title>Remove redundant link text</sqf:title>
        </sqf:description>
        <sqf:delete match="text()"/>
    </sqf:fix>
</rule>
```

3. SQF “replace” Operation

- Example of using the “replace” operation: replace bold element with text





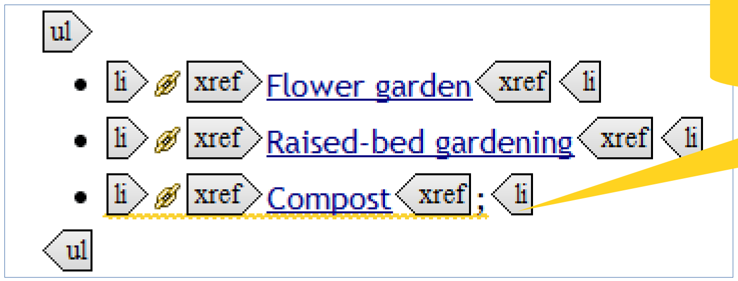
3. SQF “replace” Operation

- <sqf:replace> element specifies the nodes to be replaced and the replacing content

```
<rule context="title">
    <report test="b" sqf:fix="resolveBold">
        Bold is not allowed in title element.</report>

    <sqf:fix id="resolveBold">
        <sqf:description>
            <sqf:title>Change the bold into text</sqf:title>
        </sqf:description>
        <sqf:replace match="b" select="node()"/>
    </sqf:fix>
</rule>
```

4. SQF “stringReplace” Operation

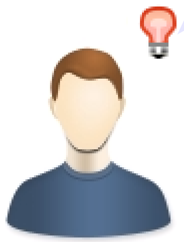
- Example of using the “stringReplace” operation: replace semicolon with full stop



```
ul
• li xref Flower garden xref li
• li xref Raised-bed gardening xref li
• li xref Compost xref ; li
ul
```

Semicolon is not allowed at the end of a list item

Replace semicolon with full stop



4. SQF “stringReplace” Operation

- <sqf:stringReplace> element defines the nodes that will replace the substrings

```
<rule context="li">
   <report test="ends-with(text()[last()], ';')" sqf:fix="replaceSemicolon">
      Semicolon is not allowed after list item</report>

   <sqf:fix id="replaceSemicolon">
      <sqf:description>
         <sqf:title>Replace semicolon with full stop</sqf:title>
      </sqf:description>
      <sqf:stringReplace match="text()[last()]" regex=";$" select="'.'"/>
   </sqf:fix>
</rule>
```

Conclusions

- Schematron Quick Fix language is simple
- You can define custom fixes for your project
- Just 4 types of operations

SQF Implementations

- <oXygen/> XML Editor validation engine

  http://www.oxygenxml.com

- Escali Schematron engine

  http://schematron-quickfix.com/escali_xsm.html

  - Escali Schematron command-line tool
  - Oxygen plugin for invoking Escali Schematron

Projects Using SQF

Thieme - publishing company uses a custom framework to create and edit XML documents

parsX - a product developed by pagina GmbH used to facilitate EPUB production

ART-DECOR - an open-source tool suite that supports SDOs active in the healthcare industry

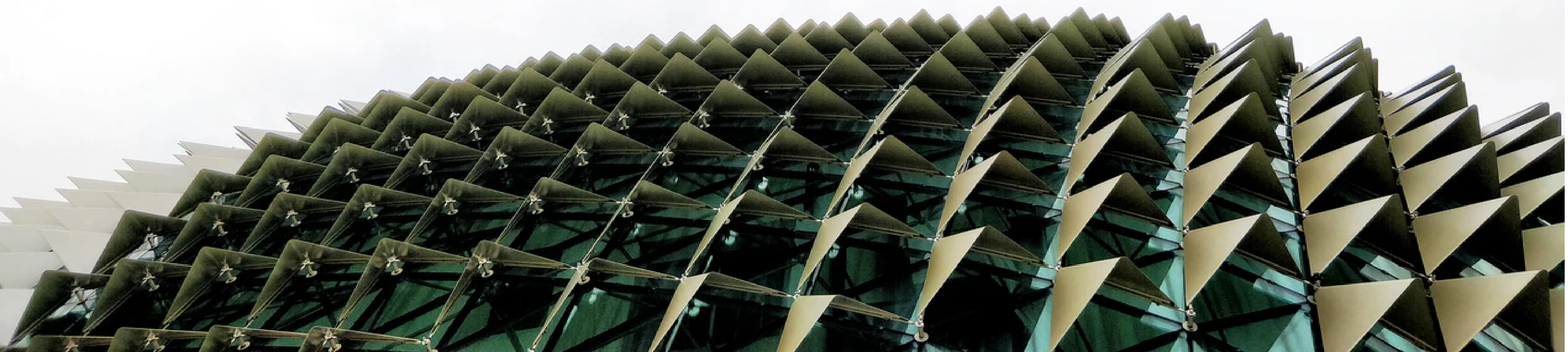
Sample SQF embedded in XSD

ATX custom framework – used by a major automotive manufacturer

Resources

- Schematron official site
- Schematron specification
- Schematron Quick Fix specification

Sample files:
github.com/octavianN/Schematron-step-by-step



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STUTTGART, 12. – 14. NOVEMBER

Questions?

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