

Getting Data from the Web with R

Part 3: Basics of XML

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```
<?xml version="1.0" encoding="UTF-8"?>
<movies>
  <movie mins="126" lang="eng">
    <title>Good Will Hunting</title>
    <director>
      <first_name>Gus</first_name>
      <last_name>Van Sant</last_name>
    </director>
    <year>1998</year>
    <genre>drama</genre>
  </movie>
  <movie mins="106" lang="spa">
    <title>Y tu mama tambien</title>
    <director>
      <first_name>Alfonso</first_name>
      <last_name>Cuaron</last_name>
    </director>
    <year>2001</year>
    <genre>drama</genre>
  </movie>
</movies>
```

Readme

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Lectures Menu

Slide Decks

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5. Handling JSON data
6. HTTP Basics and the RCurl package
7. Getting data via Web Forms
8. Getting data via Web APIs

Basics of XML and HTML

Goal

XML & HTML

The goal of these slides is to give you a **crash introduction to XML and HTML** so you can get a good grasp of those formats for the rest of the lectures

Synopsis

In a nutshell

We'll cover a the following concepts:

- ▶ Importance of XML and HTML
- ▶ Hierarchical Structure
- ▶ Document Object Model (DOM)

Some References

- ▶ XML Files website (<http://www.xmlfiles.com>)
by Jan Egil Refsnes
- ▶ XML in a Nutshell
by Elliotte Rusty Harold; W. Scott Means
- ▶ XML Tutorial (<http://www.w3schools.com/xml/default.asp>)
by w3schools
- ▶ Introduction to Data Technologies
by Paul Murrell
- ▶ XML and Web Technologies for Data Sciences with R
by Deb Nolan and Duncan Temple Lang

XML and HTML

Why you should care about XML and HTML?

- ▶ Large amounts of data and information are stored, shared and distributed using HTML and XML-dialects
- ▶ They are widely adopted and used in many applications
- ▶ Working with data from the Web means dealing with HTML

XML

eXtensible Markup Language

```
1 <?xml version="1.0" encoding="ISO8859-1" ?>
2 <CATALOG>
3   <PLANT>
4     <COMMON>Bloodroot</COMMON>
5     <BOTANICAL>Sanguinaria canadensis</BOTANICAL>
6     <ZONE>4</ZONE>
7     <LIGHT>Mostly Shady</LIGHT>
8     <PRICE>$2.44</PRICE>
9     <AVAILABILITY>031599</AVAILABILITY>
10  </PLANT>
11
12  <PLANT>
13    <COMMON>Columbine</COMMON>
14    <BOTANICAL>Aquilegia canadensis</BOTANICAL>
15    <ZONE>3</ZONE>
16    <LIGHT>Mostly Shady</LIGHT>
17    <PRICE>$9.37</PRICE>
18    <AVAILABILITY>030699</AVAILABILITY>
19  </PLANT>
20
21  <PLANT>
22    <COMMON>Marsh Marigold</COMMON>
23    <BOTANICAL>Caltha palustris</BOTANICAL>
24    <ZONE>4</ZONE>
25    <LIGHT>Mostly Sunny</LIGHT>
26    <PRICE>$6.81</PRICE>
27    <AVAILABILITY>051799</AVAILABILITY>
28  </PLANT>
29
30  <PLANT>
```

Some Definitions

“XML is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable”

<http://en.wikipedia.org/wiki/XML>

“XML is a data description language used for describing data”

Paul Murrell

Introduction to Data Technologies

Some Definitions

“XML is a very general structure with which we can define any number of new formats to represent arbitrary data”

“XML is a standard for the semantic, hierarchical representation of data”

Deb Nolan & Duncan Temple Lang

XML and Web Technologies for Data Sciences with R

About XML

XML

XML stands for **eXtensible Markup Language**

Broadly speaking ...

XML provides a flexible framework to create formats for describing and representing data

Markups

Markup

A **markup** is a sequence of characters or other symbols inserted at certain places in a document to indicate either:


- ▶ how the content should be displayed when printed or in screen
- ▶ describe the document's structure

Markup Language

A markup language is a system for **annotating** (i.e. *marking*) a document in a way that the content is distinguished from its representation (eg LaTeX, PostScript, HTML, SVG)

Markups

XML Markups

In XML (as well as in HTML) the marks (aka *tags*) are defined using angle brackets: 

`<mark>`Text marked with special tag`</mark>`

Extensible

Extensible?

The concept of *extensibility* means that we can define our own marks, the order in which they occur, and how they should be processed. For example:

- ▶ `<my_mark>`
- ▶ `<awesome>`
- ▶ `<boring>`
- ▶ `<pathetic>`

About XML

XML is NOT

- ▶ a programming language
- ▶ a network transfer protocol
- ▶ a database

XML is

- ▶ more than a markup language
- ▶ a generic language that provides structure and syntax for representing any type of information
- ▶ a meta-language: it allows us to create or define other languages

XML Applications

Some XML dialects

- ▶ **KML** (*Keyhole Markup Language*) for describing geo-spatial information used in Google Earth, Google Maps, Google Sky
- ▶ **SVG** (*Scalable Vector Graphics*) for visual graphical displays of two-dimensional graphics with support for interactivity and animation
- ▶ **PMML** (*Predictive Model Markup Language*) for describing and exchanging models produced by data mining and machine learning algorithms

XML Applications (con't)

Some XML dialects

- ▶ **RSS** (*Rich Site Summary*) feeds for publishing blog entries
- ▶ **SDMX** (*Statistical Data and Metadata Exchange*) for organizing and exchanging statistical information
- ▶ **GML** (*Geography Markup Language*) for representing geographical features
- ▶ **SBML** (*Systems Biology Markup Language*) for describing biological systems

Minimalist Example



XML Example

Ultra Simple XML

```
<movie>  
  Good Will Hunting  
</movie>
```

- ▶ one single element *movie*
- ▶ start-tag: `<movie>`
- ▶ end-tag: `</movie>`
- ▶ content: `Good Will Hunting`

XML Example

Ultra Simple XML

```
<movie mins="126" lang="en">  
  Good Will Hunting  
</movie>
```

- ▶ xml elements can have **attributes**
- ▶ attributes: **mins** (minutes) and **lang** (language)
- ▶ attributes are *attached* to the element's start tag
- ▶ attribute values **must be quoted!**

XML Example

Minimalist XML

```
<movie mins="126" lang="en">  
  <title>Good Will Hunting</title>  
  <director>Gus Van Sant</director>  
  <year>1998</year>  
  <genre>drama</genre>  
</movie>
```

- ▶ an xml element may contain other elements
- ▶ *movie* contains several elements: *title*, *director*, *year*, *genre*

XML Example

Simple XML

```
<movie mins="126" lang="en">  
  <title>Good Will Hunting</title>  
  <director>  
    <first_name>Gus</first_name>  
    <last_name>Van Sant</last_name>  
  </director>  
  <year>1998</year>  
  <genre>drama</genre>  
</movie>
```

- Now *director* has two child elements: *first_name* and *last_name*

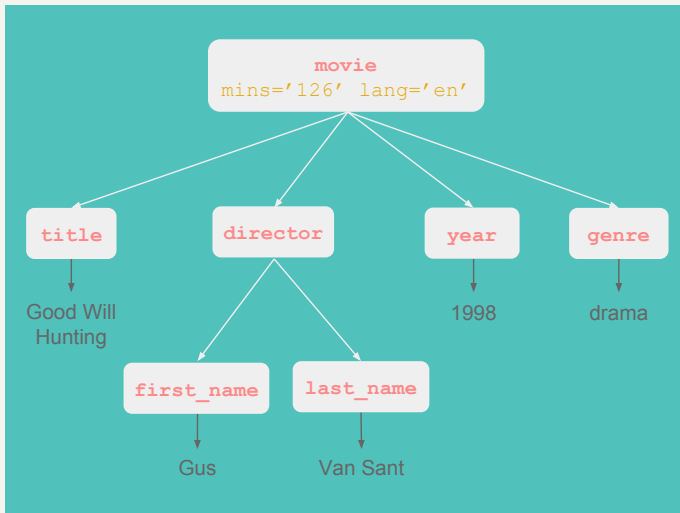
XML Hierarchy Structure

Conceptual XML

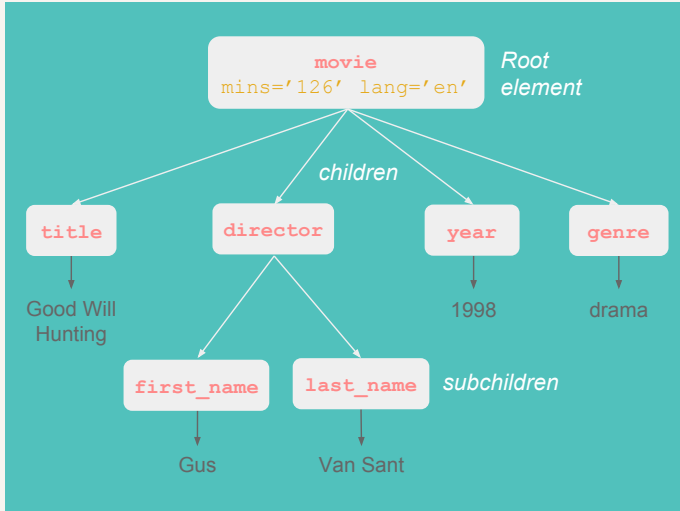
```
<Root>  
  <child_1>...</child_1>  
  <child_2>...</child_2>  
    <subchild>...</subchild>  
  <child_3>...</child_3>  
</Root>
```

- ▶ An XML document can be represented with a **tree structure**
- ▶ An XML document must have **one single Root** element
- ▶ The Root may contain child elements
- ▶ A child element may contain subchild elements

XML Tree Structure



XML Tree Structure (con't)



Well-Formedness

Well-formed XML

We say that an XML document is **well-formed** when it obeys the basic syntax rules of XML. Some of those rules are:

- ▶ one root element containing the rest of elements
- ▶ properly nested elements
- ▶ self-closing tags
- ▶ attributes appear in start-tags of elements
- ▶ attribute values must be quoted
- ▶ element names and attribute names are case sensitive

Well-Formedness

Importance of Well-formed XML

Not well-formed XML documents produce potentially fatal errors or warnings when parsed.

Documents may be well-formed but not valid. Well-formed just guarantees that the document meets the basic XML structure, not that the content is valid.

Additional XML Elements

Some Additional Elements

Example with extra elemets

```
<?xml version="1.0"? encoding="UTF-8" ?>
<![CDATA[ a > 5 & b < 10 ]]>
<?GS print(format = TRUE)>
<!DOCTYPE Movie>
<!-- This is a commet -->
<movie mins="126" lang="en">
  <title>Good Will Hunting</title>
  <director>
    <first_name>Gus</first_name>
    <last_name>Van Sant</last_name>
  </director>
  <year>1998</year>
  <genre>drama</genre>
</movie>
```

Additional Elements

Additional (optional) XML elements

Markup	Description
<code><?xml ></code>	XML Declaration identifies content as an XML document
<code><?PI ></code>	Processing Instruction processing instructions passed to application PI
<code><!DOCTYPE ></code>	Document-type Declaration defines the structure of an XML document
<code><![CDATA[]]></code>	CDATA Character Data anything inside a CDATA is ignored by the parser
<code><!-- --></code>	Comment for writing comments

DTD

Document-Type Declaration

The Document-type Declaration identifies the **type** of the document. The *type* indicates the structure of a **valid** document:

- ▶ what elements are allowed to be present
- ▶ how elements can be combined
- ▶ how elements must be ordered

Basically, the DTD specifies what the format allows to do.

Wrapping Up

About XML

About XML

- ▶ designed to store and transfer data
- ▶ designed to be self-descriptive
- ▶ tags are not predefined and can be extended

Characteristics of XML

XML is

- ▶ a generic language that provides structure and syntax for many markup dialects
- ▶ is a syntax or format for defining markup languages
- ▶ a standard for the semantic, hierarchical representation of data
- ▶ provides a general approach for representing all types of information dialects

XML document example

Simple XML

```
<?xml version="1.0"?>
<!DOCTYPE movies>
<movie mins="126" lang="en">
  <!-- this is a comment -->
  <title>Good Will Hunting</title>
  <director>
    <first_name>Gus</first_name>
    <last_name>Van Sant</last_name>
  </director>
  <year>1998</year>
  <genre>drama</genre>
</movie>
```

XML Tree Structure

Each Node can have:

- ▶ a Name
- ▶ any number of attributes
- ▶ optional content
- ▶ other nested elements

Traversing the tree

There's a **unique** path from the root node to any given node