

xmerl Application

version 1.0

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Chapter 1

xmerl User's Guide

The *xmerl* application contains modules with support for processing of xml files compliant to XML 1.0.

1.1 xmerl

1.1.1 Introduction

Features

The *xmerl* XML parser is able to parse XML documents according to the XML 1.0 standard. As default it performs well-formed parsing, (syntax checks and checks of well-formed constraints). Optionally one can also use *xmerl* as a validating parser, (validate according to referenced DTD and validating constraints). By means of for example the *xmerl_xs* module it is possible to transform the parsed result to other formats, e.g. text, HTML, XML etc.

Overview

This document does not give an introduction to XML. There are a lot of books available that describe XML from different views. At the www.W3.org¹ site you will find the XML 1.0 specification² and other related specs. One site where you can find tutorials on XML and related specs is [ZVON.org](http://www.zvon.org)³.

However, here you will find some examples of how to use and to what you can use *xmerl*. A detailed description of the user interface can be found in the reference manual.

There are two known shortcomings in *xmerl*:

- It cannot retrieve external entities on the Internet by a URL reference, only resources in the local file system.
- *xmerl* can parse Unicode encoded data. But, it fails on tag names, attribute names and other markup names that are encoded Unicode characters not mapping on ASCII.

¹URL: <http://www.w3.org>

²URL: <http://www.w3.org/TR/REC-xml/>

³URL: <http://www.zvon.org>

By parsing an XML document you will get a record, displaying the structure of the document, as return value. The record also holds the data of the document. xmerl is convenient to use in for instance the following scenarios:

You need to retrieve data from XML documents. Your Erlang software can handle information from the XML document by extracting data from the data structure received by parsing.

It is also possible to do further processing of parsed XML with xmerl. If you want to change format of the XML document to for instance HTML, text or other XML format you can transform it. There is support for such transformations in xmerl.

One may also convert arbitrary data to XML. So it for instance is easy to make it readable by humans. In this case you first create xmerl data structures out of your data, then transform it to XML.

You can find examples of these three examples of usage below.

1.1.2 xmerl User Interface Data Structure

The following records used by xmerl to save the parsed data are defined in `xmerl.hrl`

The result of a successful parsing is a tuple `{DataStructure,M}`. `M` is the XML production Misc, which is the markup that comes after the element of the document. It is returned "as is". `DataStructure` is an `xmlElement` record, that among others have the fields `name`, `parents`, `attributes` and `content` like:

```
#xmlElement{name=Name,  
            ...  
            parents=Parents,  
            ...  
            attributes=Attrs,  
            content=Content,  
            ...}
```

The name of the element is found in the `name` field. In the `parents` field is the names of the parent elements saved. `Parents` is a list of tuples where the first element in each tuple is the name of the parent element. The list is in reverse order.

The record `xmlAttribute` holds the name and value of an attribute in the fields `name` and `value`. All attributes of an element is a list of `xmlAttribute` in the field `attributes` of the `xmlElement` record.

The `content` field of the top element is a list of records that shows the structure and data of the document. If it is a simple document like:

```
<?xml version="1.0"?>  
<dog>  
Grand Danois  
</dog>
```

The parse result will be:

```
#xmlElement{name = dog,  
            ...  
            parents = [],  
            ...  
            attributes = [],  
            content = [{xmlText, [{dog,1}],1, [], "\nGrand Danois\n",text}],  
            ...  
            }
```

Where the content of the top element is: `[{xmlText, [{dog, 1}], 1, [], "\nGrand Danois\n", text}]`. Text will be returned in `xmlText` records. Though, usually documents are more complex, and the content of the top element will in that case be a nested structure with `xmlElement` records that in turn may have complex content. All of this reflects the structure of the XML document.

Space characters between markup as space, tab and line feed are normalized and returned as `xmlText` records.

Errors

An unsuccessful parse results in an error, which may be a tuple `{error, Reason}` or an exit: `{'EXIT', Reason}`. According to the XML 1.0 standard there are fatal error and error situations. The fatal errors *must* be detected by a conforming parser while an error *may* be detected. Both categories of errors are reported as fatal errors by this version of xmerl, most often as an exit.

1.1.3 Getting Started

In the following examples we use the XML file “motorcycles.xml” and the corresponding DTD “motorcycles.dtd”. `motorcycles.xml` looks like:

```
<?xml version="1.0" encoding="utf-8" ?>
<!DOCTYPE motorcycles SYSTEM "motorcycles.dtd">
<motorcycles>
  <bike year="2000" color="black">
    <name>
      <manufacturer>Suzuki</manufacturer>
      <brandName>Suzuki VL 1500</brandName>
      <additionalName>Intruder</additionalName>
    </name>
    <engine>V-engine, 2-cylinders, 1500 cc</engine>
    <kind>custom</kind>
    <drive>cardan</drive>
    <accessories>Sissy bar, luggage carrier, V&H exhaust pipes</accessories>
  </bike>
  <date>2004.08.25</date>
  <bike year="1983" color="read pearl">
    <name>
      <manufacturer>Yamaha</manufacturer>
      <brandName>XJ 400</brandName>
    </name>
    <engine>4 cylinder, 400 cc</engine>
    <kind>alround</kind>
    <drive>chain</drive>
    <comment>Good shape!</comment>
  </bike>
</motorcycles>
```

and `motorcycles.dtd` looks like:

```
<?xml version="1.0" encoding="utf-8" ?>
<!ELEMENT motorcycles (bike,date?)+ >
<!ELEMENT bike      (name,engine,kind,drive, accessories?,comment?) >
<!ELEMENT name      (manufacturer,brandName,additionalName?) >
<!ELEMENT manufacturer      (#PCDATA)>
<!ELEMENT brandName        (#PCDATA)>
<!ELEMENT additionalName    (#PCDATA)>
<!ELEMENT engine           (#PCDATA)>
<!ELEMENT kind             (#PCDATA)>
<!ELEMENT drive            (#PCDATA)>
<!ELEMENT comment          (#PCDATA)>
<!ELEMENT accessories      (#PCDATA)>

<!-- Date of the format yyyy.mm.dd -->
<!ELEMENT date              (#PCDATA)>
<!ATTLIST  bike year NMTOKEN #REQUIRED
           color NMTOKENS #REQUIRED
           condition (useless | bad | serviceable | moderate | good | excellent | new | outstanding)
```

If you want to parse the XML file `motorcycles.xml` you run it in the Erlang shell like:

```
3> {ParsResult,Misc}=xmerl_scan:file("motorcycles.xml").
{{xmlElement,motorcycles,
  motorcycles,
  [],
  {xmlNamespace,[],[]},
  [],
  1,
  [],
  [{xmlText,[{motorcycles,1}],1,[],"\n  ",text},
  {xmlElement,bike,
    bike,
    [],
    {xmlNamespace,[],[]},
    [{motorcycles,1}],
    2,
    [{xmlAttribute,year,[],[],[],[]|...},
     {xmlAttribute,color,[],[],[]|...}],
    [{xmlText,[{bike,2},{motorcycles|...}],
      1,
      []|...},
     {xmlElement,name,name,[],...},
     {xmlText,[{...}|...],3|...},
     {xmlElement,engine|...},
     {xmlText|...},
     {...}|...]},
    [],
    ". ",
    undeclared},
  ...
  ],
  [],
  ". "}
```



```

    undeclared},
  []}
4>

```

If you instead receives the XML doc as a string you can parse it by `xmerl_scan:string/1`. Both `file/2` and `string/2` exists where the second argument is a list of options to the parser, see the reference manual [page 22].

1.1.4 Example: Extracting Data From XML Content

In this example consider the situation where you want to examine a particular data in the XML file. For instance, you want to check for how long each motorcycle have been recorded.

Take a look at the DTD and observe that the structure of an XML document that is conformant to this DTD must have one `motorcycles` element (the root element). The `motorcycles` element must have at least one `bike` element. After each `bike` element it may be a `date` element. The content of the `date` element is `#PCDATA` (Parsed Character DATA), i.e. raw text. Observe that if `#PCDATA` must have a "`<`" or a "`&`" character it must be written as "`<`" and "`&`" respectively. Also other character entities exists similar to the ones in HTML and SGML.

If you successfully parse the XML file with the validation on as in:
`xmerl_scan:file('motorcycles.xml', [{validation,true}])` you know that the XML document is valid and has the structure according to the DTD.

Thus, knowing the allowed structure it is easy to write a program that traverses the data structure and picks the information in the `xmlElements` records with name `date`.

Observe that white space: each space, tab or line feed, between markup results in an `xmlText` record.

1.1.5 Example: Create XML Out Of Arbitrary Data

For this task there are more than one way to go. The "brute force" method is to create the records you need and feed your data in the content and attribute fields of the appropriate element.

There is support for this in `xmerl` by the "simple-form" format. You can put your data in a simple-form data structure and feed it into `xmerl:export_simple(Content,Callback,RootAttributes)`. `Content` may be a mixture of simple-form and `xmerl` records as `xmlElement` and `xmlText`.

The Types are:

- `Content = [Element]`
- `Callback = atom()`
- `RootAttributes = [Attributes]`

Element is any of:

- `{Tag, Attributes, Content}`
- `{Tag, Content}`
- `Tag`
- `IOString`
- `#xmlText{}`
- `#xmlElement{}`
- `#xmlPI{}`

- #xmlComment{}
- #xmlDecl{}

The simple-form structure is any of {Tag, Attributes, Content}, {Tag, Content} or Tag where:

- Tag = atom()
- Attributes = [{Name, Value} | #xmlAttribute{}]
- Name = atom()
- Value = IOString | atom() | integer()

See also reference manual for xmerl [page 19]

If you want to add the information about a black Harley Davidsson 1200 cc Sportster motorcycle from 2003 that is in shape as new in the motorcycles.xml document you can put the data in a simple-form data structure like:

```
Data =
  {bike,
    [{year, "2003"}, {color, "black"}, {condition, "new"}],
    [{name,
      [{manufacturer, ["Harley Davidsson"]},
       {brandName, ["XL1200C"}],
       {additionalName, ["Sportster"]}]}],
    {engine,
      ["V-engine, 2-cylinders, 1200 cc"]},
    {kind, ["custom"]},
    {drive, ["belt"]}]}
```

In order to append this data to the end of the motorcycles.xml document you have to parse the file and add Data to the end of the root element content.

```
{RootEl, Misc} = xmerl_scan:file('motorcycles.xml'),
#xmlElement{content=Content} = RootEl,
NewContent = Content ++ lists:flatten([Data]),
NewRootEl = RootEl # xmlElement{content=NewContent},
```

Then you can run it through the export_simple/2 function:

```
{ok, IOF} = file:open('new_motorcycles.xml', [write]),
Export = xmerl:export_simple([NewRootEl], xmerl_xml),
io:format(IOF, "~s~n", [lists:flatten(Export)]),
```

The result would be:

```
<?xml version="1.0"?><motorcycles>
<bike year="2000" color="black">
  <name>
    <manufacturer>Suzuki</manufacturer>
    <brandName>Suzuki VL 1500</brandName>
    <additionalName>Intruder</additionalName>
  </name>
  <engine>V-engine, 2-cylinders, 1500 cc</engine>
```

```

    <kind>custom</kind>
    <drive>cardan</drive>
    <accessories>Sissy bar, luggage carrier,V&H exhaust pipes</accessories>
</bike>
<date>2004.08.25</date>
<bike year="1983" color="read pearl">
  <name>
    <manufacturer>Yamaha</manufacturer>
    <brandName>XJ 400</brandName>
  </name>
  <engine>4 cylinder, 400 cc</engine>
  <kind>alround</kind>
  <drive>chain</drive>
  <comment>Good shape!</comment>
</bike>
<bike year="2003" color="black" condition="new"><name><manufacturer>Harley Davidsson</manufacturer>

```

If it is important to get similar indentation and newlines as in the original document you have to add `#xmlText{}` records with space and newline values in appropriate places. It may also be necessary to keep the original prolog where the DTD is referenced. If so, it is possible to pass a `RootAttribute {prolog,Value}` to `export_simple/3`. The following example code fixes those changes in the previous example:

```

Data =
  [#xmlText{value="  "},
   {bike, [{year, "2003"}, {color, "black"}, {condition, "new"}],
         [#xmlText{value="\n  "},
          {name, [#xmlText{value="\n      "},
                  {manufacturer, ["Harley Davidsson"]},
                  #xmlText{value="\n      "},
                  {brandName, ["XL1200C"]},
                  #xmlText{value="\n      "},
                  {additionalName, ["Sportster"]},
                  #xmlText{value="\n      "}]},
          {engine, ["V-engine, 2-cylinders, 1200 cc"]},
          #xmlText{value="\n      "},
          {kind, ["custom"]},
          #xmlText{value="\n      "},
          {drive, ["belt"]},
          #xmlText{value="\n      "}}],
   #xmlText{value="\n"}],
  ...
NewContent=Content++lists:flatten([Data]),
NewRootEl=RootEl#xmlElement{content=NewContent},
...
Prolog = ["<?xml version=\"1.0\" encoding=\"utf-8\" ?>
<!DOCTYPE motorcycles SYSTEM \"motorcycles.dtd\">\n"],
Export=xmerl:export_simple([NewRootEl],xmerl_xml, [{prolog,Prolog}],
...

```

The result will be:

```
<?xml version="1.0" encoding="utf-8" ?>
<!DOCTYPE motorcycles SYSTEM "motorcycles.dtd">
<motorcycles>
  <bike year="2000" color="black">
    <name>
      <manufacturer>Suzuki</manufacturer>
      <brandName>Suzuki VL 1500</brandName>
      <additionalName>Intruder</additionalName>
    </name>
    <engine>V-engine, 2-cylinders, 1500 cc</engine>
    <kind>custom</kind>
    <drive>cardan</drive>
    <accessories>Sissy bar, luggage carrier,V&H exhaust pipes</accessories>
  </bike>
  <date>2004.08.25</date>
  <bike year="1983" color="read pearl">
    <name>
      <manufacturer>Yamaha</manufacturer>
      <brandName>XJ 400</brandName>
    </name>
    <engine>4 cylinder, 400 cc</engine>
    <kind>alround</kind>
    <drive>chain</drive>
    <comment>Good shape!</comment>
  </bike>
  <bike year="2003" color="black" condition="new">
    <name>
      <manufacturer>Harley Davidsson</manufacturer>
      <brandName>XL1200C</brandName>
      <additionalName>Sportster</additionalName>
    </name><engine>V-engine, 2-cylinders, 1200 cc</engine>
    <kind>custom</kind>
    <drive>belt</drive>
  </bike>
</motorcycles>
```

1.1.6 Example: Transforming XML To HTML

Assume that you want to transform the motorcycles.xml [page 3] document to HTML. If you want the same structure and tags of the resulting HTML document as of the XML document then you can use the `xmerl:export/2` function. The following:

```
2> {Doc,Misc}=xmerl_scan:file('motorcycles.xml').
{{xmlElement,motorcycles,
  motorcycle,
  [],
  {xmlNamespace,[],[]},
  [],
  1,
  [],
  [{xmlText,[{motorcycles,1}],1,[],"\n ",text},
  {xmlElement,bike,
```

```

...
3> DocHtml=xmerl:export([Doc],xmerl.html).
["<!DOCTYPE HTML PUBLIC \"\",
 \"-//W3C//DTD HTML 4.01 Transitional//EN\",
 \"\",
 [],
 \">\n\",
 [[["<\", \"motorcycles\", \">\"],
 [\"\\n \",
 [\"<\",
 \"bike\",
 [\" \", \"year\", \"=\", \"2000\", \"\\\"\", [\" \", \"color\", \"=\", \"black\", \"\\\"\"],
 \">\"],
 ...

```

Will give the result `result_export.html`⁴

Perhaps you want to do something more arranged for human reading. Suppose that you want to list all different brands in the beginning with links to each group of motorcycles. You also want all motorcycles sorted by brand, then some flashy colours on top of it. Thus you rearrange the order of the elements and put in arbitrary HTML tags. This is possible to do by means of the XSL Transformation (XSLT)⁵ like functionality in xmerl.

Even though the following example shows one way to transform data from XML to HTML it also applies to transformations to other formats.

xmerl_xs does not implement the entire XSLT specification but the basic functionality. For all details see the reference manual [page 27]

First, some words about the xmerl_xs functionality:

You need to write template functions to be able to control what kind of output you want. Thus if you want to encapsulate a bike element in `<p>` tags you simply write a function:

```

template(E = #xmlElement{name='bike'}) ->
  [\"<p>\", xslapply(fun template/1, E), \"</p>\"];

```

With `xslapply` you tell the XSLT processor in which order it should traverse the XML structure. By default it goes in preorder traversal, but with the following we make a deliberate choice to break that order:

```

template(E = #xmlElement{name='bike'}) ->
  [\"<p>\", xslapply(fun template/1, select(\"bike/name/manufacturer\")), \"</p>\"];

```

If you want to output the content of an XML element or an attribute you will get the value as a string by the `value_of` function:

```

template(E = #xmlElement{name='motorcycles'}) ->
  [\"<p>\", value_of(select(\"bike/name/manufacturer\", E)), \"</p>\"];

```

⁴URL: `result_export.html`

⁵URL: <http://www.w3.org/Style/XSL/>

In the `xmerl_xs` functions you can provide a `select(String)` call, which is an XPath⁶ functionality. For more details see the `xmerl_xs` tutorial⁷.

Now, back to the example where we wanted to make the output more arranged. With the template:

```
template(E = #xmlElement{name='motorcycles'}) ->
  [ "<head>\n<title>motorcycles</title>\n</head>\n",
    "<body>\n",
    "<h1>Used Motorcycles</h1>\n",
    "<ul>\n",
    remove_duplicates(value_of(select("bike/name/manufacturer",E))),
    "\n</ul>\n",
    sort_by_manufacturer(xslapply(fun template/1, E)),
    "</body>\n",
    "</html>\n"];
```

We match on the top element and embed the inner parts in an HTML body. Then we extract the string values of all motorcycle brands, sort them and removes duplicates by `remove_duplicates(value_of(select("bike/name/manufacturer", E)))`. We also process the substructure of the top element and pass it to a function that sorts all motorcycle information by brand according to the task formulation in the beginning of this example.

The next template matches on the `bike` element:

```
template(E = #xmlElement{name='bike'}) ->
  {value_of(select("name/manufacturer",E)),["<dt>",xslapply(fun template/1,select("name",E)),"</dt>"],
  "<dd><ul>\n",
  "<li style='color:green'>Manufacturing year: ",xslapply(fun template/1,select("@year",E)),"</li>\n",
  "<li style='color:red'>Color: ",xslapply(fun template/1,select("@color",E)),"</li>\n",
  "<li style='color:blue'>Shape : ",xslapply(fun template/1,select("@condition",E)),"</li>\n",
  "</ul></dd>\n"]};
```

This creates a tuple with the brand of the motorcycle and the output format. We use the brand name only for sorting purpose. We have to end the template fuction with the “built in clause” `template(E) -> built_in_rules(fun template/1, E)`.

The entire program is `motorcycles2html.erl`:

```
%%%-----
%%% File      : motorcycles2html.erl
%%% Author   : Bertil Karlsson <bertil@localhost.localdomain>
%%% Description :
%%%
%%% Created  : 2 Sep 2004 by Bertil Karlsson <bertil@localhost.localdomain>
%%%-----
-module(motorcycles2html).

-include("xmerl.hrl").

-import(xmerl_xs,
  [ xslapply/2, value_of/1, select/2, built_in_rules/2 ]).
```

⁶URL: <http://www.w3.org/TR/xpath>

⁷URL: xmerl_xs_examples.html

```

-export([process_xml/1,process_to_file/2,process_to_file/1]).

process_xml(Doc) ->
    template(Doc).

process_to_file(FileName) ->
    process_to_file(FileName,'motorcycles.xml').

process_to_file(FileName,XMLDoc) ->
    case file:open(FileName,[write]) of
        {ok,IOF} ->
            {XMLContent,_} = xmerl_scan:file(XMLDoc),
            TransformedXML=process_xml(XMLContent),
            io:format(IOF,"~s",[TransformedXML]),
            file:close(IOF);
        {error,Reason} ->
            io:format("could not open file due to ~p.~n",[Reason])
    end.

%%% templates
template(E = #xmlElement{name='motorcycles'}) ->
    [
        "<head>
<title>motorcycles</title>
</head>
",
        "<body>
",
        "<h1>Used Motorcycles</h1>
",
        "<ul>
",
        remove_duplicates(value_of(select("bike/name/manufacturer",E))),
        "
</ul>
",
        sort_by_manufacturer(xslapply(fun template/1, E)),
        "</body>
",
        "</html>
"];
template(E = #xmlElement{name='bike'}) ->
    {value_of(select("name/manufacturer",E)),["<dt>",xslapply(fun template/1,select("name",E)),"</dt>
<dd><ul>
",
        "<li style=\"color:green\">Manufacturing year: ",xslapply(fun template/1,select("@year",E)),"</li>
",
        "<li style=\"color:red\">Color: ",xslapply(fun template/1,select("@color",E)),"</li>
",
        "<li style=\"color:blue\">Shape : ",xslapply(fun template/1,select("@condition",E)),"</li>
",
        "</ul></dd>
"]}];
template(E) -> built_in_rules(fun template/1, E).

```

```
%%%%%%%%%% helper routines

%% sorts on the bike name element, unwraps the bike information and
%% inserts a line feed and indentation on each bike element.
sort_by_manufacturer(L) ->
  Tuples=[X1||X1={H,T} <- L],
  SortedTS = lists:keysort(1,Tuples),
  InsertRefName_UnWrap=
    fun([Name],V|Rest,Name,F)->
      [V|F(Rest,Name,F)];
    ([Name],V|Rest,PreviousName,F) ->
      [{"<a name=\"",Name,"\"></>"],V|F(Rest,Name,F)];
    ([,_,_) -> []
  end,
  SortedRefed=InsertRefName_UnWrap(SortedTS,no_name,InsertRefName_UnWrap),
%   SortedTs=[Y||{X,Y}<-lists:keysort(1,Tuples)],
  WS = "
",
  Fun=fun([H|T],Acc,F)->
    F(T,[H,WS|Acc],F);
    ([,Acc,F)->
      lists:reverse([WS|Acc])
  end,
  if length(SortedRefed) > 0 ->
    Fun(SortedRefed,[,Fun]);
  true -> []
end.

%% removes all but the first of an element in L and inserts a html
%% reference for each list element.
remove_duplicates(L) ->
  remove_duplicates(L,[,]).

remove_duplicates([,Acc) ->
  make_ref(lists:sort(lists:reverse(Acc)));
remove_duplicates([A|L],Acc) ->
  case lists:delete(A,L) of
    L ->
      remove_duplicates(L,[A|Acc]);
    L1 ->
      remove_duplicates([A|L1],[Acc])
  end.

make_ref([,]) -> [,];
make_ref([H]) when atom(H) ->
  "<ul><a href=\"#"++atom_to_list(H)+"\">"+atom_to_list(H)+"</a></ul>";
make_ref([H]) when list(H) ->
  "<ul><a href=\"#"++H++\">\s"+H++"</a></ul>";
make_ref([H|T]) when atom(H) ->
  ["<ul><a href=\"#"++atom_to_list(H)+"\">\s"+atom_to_list(H)+"",
```



```
</a></ul>"
    |make_ref(T)];
make_ref([H|T]) when list(H) ->
    ["<ul><a href=\"#\"++H++\">\s\"++H++",
</a></ul>" |make_ref(T)].
```

If we run it like this: `motorcycles2html:process_to_file('result_xs.html', 'motorcycles2.xml')`. The result will be `result_xs.html`⁸. When the input file is of the same structure as the previous “motorcycles” XML files but it has a little more ‘bike’ elements and the ‘manufacturer’ elements are not in order.

⁸URL: `result_xs.html`

xmerl Reference Manual

Short Summaries

- Erlang Module **xmerl** [page 18] – Functions for exporting XML data to an external format.
- Erlang Module **xmerl_eventp** [page 21] – Simple event-based front-ends to `xmerl_scan` for processing of XML documents in streams and for parsing in SAX style.
- Erlang Module **xmerl_scan** [page 22] – This module is the interface to the XML parser, it handles XML 1.0.
- Erlang Module **xmerl_xpath** [page 25] – The `xmerl_xpath` module handles the entire XPath 1.0 spec XPath expressions typically occurs in XML attributes and are used to address parts of an XML document.
- Erlang Module **xmerl_xs** [page 27] – Erlang has similarities to XSLT since both languages have a functional programming approach.

xmerl

The following functions are exported:

- `callbacks(M::atom()) -> [atom()]`
[page 18] Find the list of inherited callback modules for a given module.
- `export(Data::Content, Callback) -> ExportedFormat`
[page 18] Equivalent to `export(Data, Callback, [])`.
- `export(Data::Content, Callback, RootAttrs::RootAttributes) -> ExportedFormat`
[page 18] Exports normal, well-formed XML content, using the specified callback-module.
- `export_content(Es::Content, CBs::Callbacks) -> term()`
[page 19] Exports normal XML content directly, without further context.
- `export_element(E, CB) -> term()`
[page 19] Exports a normal XML element directly, without further context.
- `export_element(E, CB::CBs, CBstate::UserState) -> ExportedFormat`
[page 19] For on-the-fly exporting during parsing (SAX style) of the XML document.
- `export_simple(Data::Content, Callback) -> ExportedFormat`
[page 19] Equivalent to `export_simple(Data, Callback, [])`.

- `export_simple(Data::Content, Callback, RootAttrs::RootAttributes) -> ExportedFormat`
[page 19] Exports "simple-form" XML content, using the specified callback-module.
- `export_simple_content(Data, Callback) -> term()`
[page 20] Exports simple XML content directly, without further context.
- `export_simple_element(Data, Callback) -> term()`
[page 20] Exports a simple XML element directly, without further context.

xmerl_eventp

The following functions are exported:

- `file_sax(Fname::string(), CallbackModule::atom(), UserState, Options::option_list()) -> NewUserState`
[page 21] Parse file containing an XML document, SAX style.
- `stream(Fname::string(), Options::option_list()) -> xmlElement()`
[page 21] Parse file containing an XML document as a stream, DOM style.
- `stream_sax(Fname, Callback::CallBackModule, UserState, Options) -> xmlElement()`
[page 21] Parse file containing an XML document as a stream, SAX style.
- `string_sax(String::list(), CallbackModule::atom(), UserState, Options::option_list()) -> xmlElement()`
[page 21] Parse file containing an XML document, SAX style.

xmerl_scan

The following functions are exported:

- `accumulate_whitespace(T::string(), S::global_state(), X3::atom(), Acc::string()) -> {Acc, T1, S1}`
[page 23] Function to accumulate and normalize whitespace.
- `cont_state(S::global_state()) -> global_state()`
[page 23] Equivalent to `cont_state(ContinuationState, S)`.
- `cont_state(X::ContinuationState, S::global_state()) -> global_state()`
[page 23] For controlling the ContinuationState, to be used in a continuation function, and called when the parser encounters the end of the byte stream.
- `event_state(S::global_state()) -> global_state()`
[page 23] Equivalent to `event_state(EventState, S)`.
- `event_state(X::EventState, S::global_state()) -> global_state()`
[page 23] For controlling the EventState, to be used in an event function, and called at the beginning and at the end of a parsed entity.
- `fetch_state(S::global_state()) -> global_state()`
[page 23] Equivalent to `fetch_state(FetchState, S)`.
- `fetch_state(X::FetchState, S::global_state()) -> global_state()`
[page 23] For controlling the FetchState, to be used in a fetch function, and called when the parser fetch an external resource (eg.

- `file(Filename::string()) -> {xmlElement(), Rest}`
[page 23] Equivalent to `file(Filename, [])`.
- `file(Filename::string(), Options::option_list()) -> {xmlElement(), Rest}`
[page 23] Parse file containing an XML document.
- `hook_state(S::global_state()) -> global_state()`
[page 24] Equivalent to `hook_state(HookState, S)`.
- `hook_state(X::HookState, S::global_state()) -> global_state()`
[page 24] For controlling the HookState, to be used in a hook function, and called when the parser has parsed a complete entity.
- `rules_state(S::global_state()) -> global_state()`
[page 24] Equivalent to `rules_state(RulesState, S)`.
- `rules_state(X::RulesState, S::global_state()) -> global_state()`
[page 24] For controlling the RulesState, to be used in a rules function, and called when the parser store scanner information in a rules database.
- `string(Text::list()) -> {xmlElement(), Rest}`
[page 24] Equivalent to `string(Test, [])`.
- `string(Text::list(), Options::option_list()) -> {xmlElement(), Rest}`
[page 24] Parse string containing an XML document.
- `user_state(S::global_state()) -> global_state()`
[page 24] Equivalent to `user_state(UserState, S)`.
- `user_state(X::UserState, S::global_state()) -> global_state()`
[page 24] For controlling the UserState, to be used in a user function.

xmerl_xpath

The following functions are exported:

- `string(Str, Doc) -> docEntity()`
[page 25] Equivalent to `string(Str, Doc, [])`.
- `string(Str, Doc, Options) -> docEntity()`
[page 25] Equivalent to `string(Str, Doc, [], Doc, Options)`.
- `string(Str, Node, Parents, Doc, Options) -> docEntity()`
[page 26] Extracts the nodes from the parsed XML tree according to XPath.

xmerl_xs

The following functions are exported:

- `built_in_rules(Fun, E) -> List`
[page 27] The default fallback behaviour.
- `select(String::string(), E) -> E`
[page 27] Extracts the nodes from the xml tree according to XPath.
- `value_of(E) -> List`
[page 27] Concatenates all text nodes within the tree.
- `xslapply(Fun::Function, EList::list()) -> List`
[page 28] `xslapply` is a wrapper to make things look similar to `xsl:apply-templates`.

xmerl

Erlang Module

Functions for exporting XML data to an external format.

Exports

`callbacks(M::atom()) -> [atom()]`

Find the list of inherited callback modules for a given module.

`export(Data::Content, Callback) -> ExportedFormat`

Equivalent to `export(Data, Callback, [])` [page 18].

`export(Data::Content, Callback, RootAttrs::RootAttributes) -> ExportedFormat`

Types:

- `Content = [Element]`
- `Callback = atom()`
- `RootAttributes = [XmlAttribute]`

Exports normal, well-formed XML content, using the specified callback-module.

Element is any of:

- `#xmlText{}`
- `#xmlElement{}`
- `#xmlPI{}`
- `#xmlComment{}`
- `#xmlDecl{}`

(See `xmerl.hrl` for the record definitions.) Text in `#xmlText{}` elements can be deep lists of characters and/or binaries.

`RootAttributes` is a list of `#XmlAttribute{}` attributes for the `#root#` element, which implicitly becomes the parent of the given `Content`. The tag-handler function for `#root#` is thus called with the complete exported data of `Content`. Root attributes can be used to specify e.g. encoding or other metadata of an XML or HTML document.

The `Callback` module should contain hook functions for all tags present in the data structure. A hook function must have the following format:

`Tag(Data, Attributes, Parents, E)`

where `E` is the corresponding `#xmlElement{}`, `Data` is the already-exported contents of `E` and `Attributes` is the list of `#xmlAttribute{}` records of `E`. Finally, `Parents` is the list of parent nodes of `E`, on the form `[[ParentTag::atom(), ParentPosition::integer()]]`.

The hook function should return either the data to be exported, or a tuple `{'#xml-alias#', NewTag::atom()}`, or a tuple `{'#xml-redefine#', Content}`, where `Content` is a content list (which can be on simple-form; see `export_simple/2` for details).

A callback module can inherit definitions from other callback modules, through the required function `'#xml-inheritance#() -> [ModuleName::atom()]`.

See also: `export/2` [page 18], `export_simple/3` [page 19].

```
export_content(Es::Content, CBs::Callbacks) -> term()
```

Types:

- Content = [Element]
- Callback = [atom()]

Exports normal XML content directly, without further context.

```
export_element(E, CB) -> term()
```

Exports a normal XML element directly, without further context.

```
export_element(E, CB::CBs, CBstate::UserState) -> ExportedFormat
```

For on-the-fly exporting during parsing (SAX style) of the XML document.

```
export_simple(Data::Content, Callback) -> ExportedFormat
```

Equivalent to `export_simple(Data, Callback, [])` [page 19].

```
export_simple(Data::Content, Callback, RootAttrs::RootAttributes) -> ExportedFormat
```

Types:

- Content = [Element]
- Callback = atom()
- RootAttributes = [XmlAttribute]

Exports “simple-form” XML content, using the specified callback-module.

Element is any of:

- {Tag, Attributes, Content}
- {Tag, Content}
- Tag
- IOString
- #xmlText{}
- #xmlElement{}
- #xmlPI{}
- #xmlComment{}
- #xmlDecl{}

where

- Tag = atom()
- Attributes = [{Name, Value}]
- Name = atom()
- Value = IOString | atom() | integer()

Normal-form XML elements can thus be included in the simple-form representation. Note that content lists must be flat. An IOString is a (possibly deep) list of characters and/or binaries.

RootAttributes is a list of:

- XmlAttributes = #xmlAttribute{}

See `export/3` for details on the callback module and the root attributes. The XML-data is always converted to normal form before being passed to the callback module.

See also: `export/3` [page 18], `export_simple/2` [page 19].

`export_simple_content(Data, Callback) -> term()`

Exports simple XML content directly, without further context.

`export_simple_element(Data, Callback) -> term()`

Exports a simple XML element directly, without further context.

xmerl_eventp

Erlang Module

Simple event-based front-ends to `xmerl_scan` for processing of XML documents in streams and for parsing in SAX style. Each contain more elaborate settings of `xmerl_scan` that makes usage of the customization functions.

Exports

```
file_sax(Fname::string(), CallbackModule::atom(), UserState, Options::option_list())  
-> NewUserState
```

Parse file containing an XML document, SAX style. Wrapper for a call to the XML parser `xmerl_scan` with a `hook_fun` for using `xmerl` export functionality directly after an entity is parsed.

```
stream(Fname::string(), Options::option_list()) -> xmlElement()
```

Parse file containing an XML document as a stream, DOM style. Wrapper for a call to the XML parser `xmerl_scan` with a `continuation_fun` for handling streams of XML data. Note that the `continuation_fun`, `acc_fun`, `fetch_fun`, `rules` and `close_fun` options cannot be user defined using this parser.

```
stream_sax(Fname, Callback::CallbackModule, UserState, Options) -> xmlElement()
```

Types:

- `Fname` = `string()`
- `CallbackModule` = `atom()`
- `Options` = `option_list()`

Parse file containing an XML document as a stream, SAX style. Wrapper for a call to the XML parser `xmerl_scan` with a `continuation_fun` for handling streams of XML data. Note that the `continuation_fun`, `acc_fun`, `fetch_fun`, `rules`, `hook_fun`, `close_fun` and `user_state` options cannot be user defined using this parser.

```
string_sax(String::list(), CallbackModule::atom(), UserState, Options::option_list())  
-> xmlElement()
```

Parse file containing an XML document, SAX style. Wrapper for a call to the XML parser `xmerl_scan` with a `hook_fun` for using `xmerl` export functionality directly after an entity is parsed.

xmerl_scan

Erlang Module

This module is the interface to the XML parser, it handles XML 1.0. The XML parser is activated through `xmerl_scan:string/[1,2]` or `xmerl_scan:file/[1,2]`. It returns records of the type defined in `xmerl.hrl`. See also tutorial¹ on customization functions.

Data Types

abstract datatype: `global_state()` The global state of the scanner, represented by the `#xmerl_scanner{}` record.

abstract datatype: `option_list()` Options allow to customize the behaviour of the scanner. See also tutorial² on customization functions.

Possible options are:

- `{acc_fun, Fun}` Call back function to accumulate contents of entity.
- `{continuation_fun, Fun} | {continuation_fun, Fun, ContinuationState}`
Call back function to decide what to do if the scanner runs into EOF before the document is complete.
- `{event_fun, Fun} | {event_fun, Fun, EventState}` Call back function to handle scanner events.
- `{fetch_fun, Fun} | {fetch_fun, Fun, FetchState}` Call back function to fetch an external resource.
- `{hook_fun, Fun} | {hook_fun, Fun, HookState}` Call back function to process the document entities once identified.
- `{close_fun, Fun}` Called when document has been completely parsed.
- `{rules, ReadFun, WriteFun, RulesState} | {rules, Rules}` Handles storing of scanner information when parsing.
- `{user_state, UserState}` Global state variable accessible from all customization functions
- `{fetch_path, PathList}` PathList is a list of directories to search when fetching files. If the file in question is not in the `fetch_path`, the URI will be used as a file name.
- `{space, Flag}` 'preserve' (default) to preserve spaces, 'normalize' to accumulate consecutive whitespace and replace it with one space.
- `{line, Line}` To specify starting line for scanning in document which contains fragments of XML.
- `{namespace_conformant, Flag}` Controls whether to behave as a namespace conformant XML parser, 'false' (default) to not otherwise 'true'.
- `{validation, Flag}` Controls whether to process as a validating XML parser, 'false' (default) to not otherwise 'true'.

¹URL: `xmerl_examples.html`

²URL: `xmerl_examples.html`

- `{quiet, Flag}` Set to 'true' if xmerl should behave quietly and not output any information to standard output (default 'false').
- `{doctype_DTD, DTD}` Allows to specify DTD name when it isn't available in the XML document.
- `{xmlbase, Dir}` XML Base directory. If using string/1 default is current directory. If using file/1 default is directory of given file.
- `{encoding, Enc}` Set default character set used (default UTF-8). This character set is used only if not explicitly given by the XML declaration.

Exports

```
accumulate_whitespace(T::string(), S::global_state(), X3::atom(), Acc::string()) ->
  {Acc, T1, S1}
```

Function to accumulate and normalize whitespace.

```
cont_state(S::global_state()) -> global_state()
```

Equivalent to `cont_state(ContinuationState, S)` [page 23].

```
cont_state(X::ContinuationState, S::global_state()) -> global_state()
```

For controlling the `ContinuationState`, to be used in a continuation function, and called when the parser encounters the end of the byte stream. See tutorial³ on customization functions.

```
event_state(S::global_state()) -> global_state()
```

Equivalent to `event_state(EventState, S)` [page 23].

```
event_state(X::EventState, S::global_state()) -> global_state()
```

For controlling the `EventState`, to be used in an event function, and called at the beginning and at the end of a parsed entity. See tutorial⁴ on customization functions.

```
fetch_state(S::global_state()) -> global_state()
```

Equivalent to `fetch_state(FetchState, S)` [page 23].

```
fetch_state(X::FetchState, S::global_state()) -> global_state()
```

For controlling the `FetchState`, to be used in a fetch function, and called when the parser fetch an external resource (eg. a DTD). See tutorial⁵ on customization functions.

```
file(Filename::string()) -> {xmlElement(), Rest}
```

Types:

- `Rest = list()`

³URL: [xmerl_examples.html](#)

⁴URL: [xmerl_examples.html](#)

⁵URL: [xmerl_examples.html](#)

Equivalent to `file(Filename, [])` [page 24].

```
file(Filename::string(), Options::option_list()) -> {xmlElement(), Rest}
```

Types:

- Rest = list()

Parse file containing an XML document

```
hook_state(S::global_state()) -> global_state()
```

Equivalent to `hook_state(HookState, S)` [page 24].

```
hook_state(X::HookState, S::global_state()) -> global_state()
```

For controlling the HookState, to be used in a hook function, and called when the parser has parsed a complete entity. See tutorial⁶ on customization functions.

```
rules_state(S::global_state()) -> global_state()
```

Equivalent to `rules_state(RulesState, S)` [page 24].

```
rules_state(X::RulesState, S::global_state()) -> global_state()
```

For controlling the RulesState, to be used in a rules function, and called when the parser store scanner information in a rules database. See tutorial⁷ on customization functions.

```
string(Text::list()) -> {xmlElement(), Rest}
```

Types:

- Rest = list()

Equivalent to `string(Test, [])` [page 24].

```
string(Text::list(), Options::option_list()) -> {xmlElement(), Rest}
```

Types:

- Rest = list()

Parse string containing an XML document

```
user_state(S::global_state()) -> global_state()
```

Equivalent to `user_state(UserState, S)` [page 24].

```
user_state(X::UserState, S::global_state()) -> global_state()
```

For controlling the UserState, to be used in a user function. See tutorial⁸ on customization functions.

⁶URL: [xmerl_examples.html](#)

⁷URL: [xmerl_examples.html](#)

⁸URL: [xmerl_examples.html](#)

xmerl_xpath

Erlang Module

The `xmerl_xpath` module handles the entire XPath 1.0 spec XPath expressions typically occurs in XML attributes and are used to address parts of an XML document. The grammar is defined in `xmerl_xpath_parse.yrl`. The core functions are defined in `xmerl_xpath_pred.erl`.

Some useful shell commands for debugging the XPath parser

```
c(xmerl_xpath_scan).
yecc:yecc("xmerl_xpath_parse.yrl", "xmerl_xpath_parse", true, []).
c(xmerl_xpath_parse).
```

```
xmerl_xpath_parse:parse(xmerl_xpath_scan:tokens("position() > -1")).
xmerl_xpath_parse:parse(xmerl_xpath_scan:tokens("5 * 6 div 2")).
xmerl_xpath_parse:parse(xmerl_xpath_scan:tokens("5 + 6 mod 2")).
xmerl_xpath_parse:parse(xmerl_xpath_scan:tokens("5 * 6")).
xmerl_xpath_parse:parse(xmerl_xpath_scan:tokens("----6")).
xmerl_xpath_parse:parse(xmerl_xpath_scan:tokens("parent::node()")).
xmerl_xpath_parse:parse(xmerl_xpath_scan:tokens("descendant-or-self::node()")).
xmerl_xpath_parse:parse(xmerl_xpath_scan:tokens("parent::processing-instruction('foo')")).
```

Data Types

```
docEntity() = xmlElement() | xmlAttribute() | xmlText() | xmlPI() | xmlComment()
```

```
nodeEntity() = xmlElement() | xmlAttribute() | xmlText() | xmlPI() | xmlNamespace() |
```

abstract datatype: `option_list()` Options allows to customize the behaviour of the XPath scanner.

Possible options are:

`{namespace, #xmlNamespace}` Set namespace nodes, from `XmlNamespace`, in `xmlContext`

`{namespace, Nodes}` Set namespace nodes in `xmlContext`.

Exports

```
string(Str, Doc) -> docEntity()
```

Equivalent to `string(Str, Doc, [])` [page 26].

```
string(Str, Doc, Options) -> docEntity()
```

Equivalent to `string(Str, Doc, [], Doc, Options)` [page 26].

`string(Str, Node, Parents, Doc, Options) -> docEntity()`

Types:

- `Str = xpathString()`
- `Node = nodeEntity()`
- `Parents = parentList()`
- `Doc = nodeEntity()`
- `Options = option_list()`

Extracts the nodes from the parsed XML tree according to XPath.

xmerl_xs

Erlang Module

Erlang has similarities to XSLT since both languages have a functional programming approach. Using `xmerl_xpath` it is possible to write XSLT like transforms in Erlang. XSLT stylesheets are often used when transforming XML documents, to other XML documents or (X)HTML for presentation. There are a number of brick-sized books written on the topic. XSLT contains quite many functions and learning them all may take some effort, which could be a reason why the author only has reached a basic level of understanding. This document assumes a basic level of understanding of XSLT.

Since XSLT is based on a functional programming approach with pattern matching and recursion it is possible to write similar style sheets in Erlang. At least for basic transforms. This document describes how to use the XPath implementation together with Erlangs pattern matching and a couple of functions to write XSLT like transforms.

This approach is probably easier for an Erlanger but if you need to use real XSLT stylesheets in order to “comply to the standard” there is an adapter available to the Sablotron XSLT package which is written in C++. See also the Tutorial⁹.

Exports

`built_in_rules(Fun, E) -> List`

The default fallback behaviour. Template funs should end with:
`template(E) -> built_in_rules(fun template/1, E).`

`select(String::string(), E) -> E`

Extracts the nodes from the xml tree according to XPath.
See also: `value_of/1` [page 27].

`value_of(E) -> List`

Types:

- `E = unknown()`

Concatenates all text nodes within the tree.

Example:

⁹URL: xmerl_xs_examples.html

```
<xsl:template match="title">
  <div align="center">
    <h1><xsl:value-of select="." /></h1>
  </div>
</xsl:template>
```

becomes:

```
template(E = #xmlElement{name='title'}) ->
  ["<div align="center"><h1>",
   value_of(select(".", E)), "</h1></div>"]
```

```
xslapply(Fun::Function, EList::list()) -> List
```

Types:

- Function = () -> list()

xslapply is a wrapper to make things look similar to xsl:apply-templates.

Example, original XSLT:

```
<xsl:template match="doc/title">
  <h1>
    <xsl:apply-templates/>
  </h1>
</xsl:template>
```

becomes in Erlang:

```
template(E = #xmlElement{ parents=[{'doc',_}|_], name='title'}) ->
  ["<h1>",
   xslapply(fun template/1, E),
   "</h1>"];
```


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