

WAEBRIC: a Little Language for Markup Generation

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Abstract

WAEBRIC is a small language for generating XHTML markup. Its design is motivated by the lack of programmer friendly abstraction facilities in existing markup languages. WAEBRIC provides a user-friendly syntax to factor Web pages in self-contained functional building-blocks. This report introduces and motivates WAEBRIC, and presents its syntax and semantics.

1 Introduction

1.1 Motivation

- (X)HTML is too verbose to be typed (or read) by humans.
- Template languages feature elaborate quoting schemes that make designing templates from (X)HTML even more cumbersome.
- Template languages often do not allow functional abstraction and/or recursion.
- Template languages do not support “around” parameterization where one can reuse a piece of markup with one or more holes in it.
- Template languages often allow arbitrary computation thus violating separation of concerns guidelines.
- WYSIWYG editors have their own issues like generating inaccessible and unmaintainable XHTML code.

1.2 What WAEBRIC offers

WAEBRIC is a small programming language to factor web pages in reusable, function building blocks. Concretely, this amounts to the following:

- A WAEBRIC program consists of a number of function declarations. A function may accept a number of parameters and produces a piece of markup. Functions can be recursive.
- Markup is produced using (pre-defined) “function calls” corresponding to the tags that are part of XHTML 1.1. Keyword parameters to these functions correspond to XML attributes of the tag in question.
- The builtin operators **echo**, **comment**, **cdata** are used to produce text content, XML comments, and CDATA sections respectively.
- Limited control flow is provided through the **if/else** and the **each** iteration construct. Both these constructs operate on expressions (i.e. data, *not* markup).

- The special statement **yield** is provided to parameterize functions with additional markup. Markup arguments to a function invocation will be output where (one or more) **yield** is encountered. This mechanism is similar to (but weaker than) how Ruby block arguments are used in Markaby¹.
- WAEBRIC provides special syntax for common attributes in XHTML, such as “class” and “id”. This is inspired by HAML².

In the design of WAEBRIC, explicit care is taken that *data* can be output as markup, but markup can *never* act as data. Thus it is not possible to “compute” with generated markup. Furthermore, to enforce strict model-view separation, computation with data is limited to testing the type or presence of data and looping through data using *each*.

2 Syntax

2.1 A Simple Example

A WAEBRIC file always starts with the keyword **module** followed by an identifier that should correspond to the basename of the file. A typical WAEBRIC program looks as follows:

```

1  module homepage
2
3  site
4    index.html: home("Hello World!")
5  end
6
7  def home(msg)
8    html {
9      head title msg;
10     body echo msg;
11   }
12 end
```

This program should be in a file called `homepage.wae`. This module contains one site definition that states that `index.html` should contain the output of evaluating the function `home` with a single, string-valued argument.

If we look at the `home` function, we see that it constructs a standard HTML document containing a header with a title element and a body. Both the contents of the title element and the body will be the value passed in as `msg`. Since `html` is not defined in this module and since it is not imported either, WAEBRIC assumes it is part of XHTML 1.1 and will output the corresponding tags. Within those tags, it will generate the output of the statements enclosed in curly braces.

The `html`, `head`, `title`, `body` elements in the example are called *markup* statements (or just *markup*). Markup can be nested by juxtaposing function calls and/or standard element names. For instance, the title element (containing `msg`) will be contained in the head element. The last item in a sequence of markups can be a statement or an expression. An example of the former is the block enclosed in curly braces which is passed into the `html` element. The nesting of `msg` in the title element is an example of the latter.

2.2 Embedding

2.3 Caveat

Some notes are in order with respect to how markup juxtaposition is parsed in WAEBRIC. Basically, it boils down to the following two observations. First, an single identifier interpolated in a string is

¹<http://markaby.rubyforge.org/>

²<http://haml.hamptoncatlin.com/>

parsed as an expression whereas a single identifier in a statement context is parsed as markup (e.g. a function call or an XHTML element construction). Secondly, an identifier in the last position of a markup chain/spine is parsed as a variable (not as markup). The following examples illustrate these rules:

```

1  p; // markup
2  p p; // markup, variable
3  p p(); // markup, markup
4  echo "<p>"; // variable
5  echo "<p()>"; // markup
6  echo "<p p>"; // markup, variable
7  echo "<p p()>"; // markup, markup

```

As the example shows, parentheses can be used to force the parser to see an identifier as markup.

2.4 Data

It is not possible to compute with data in WAEBRIC, however, you can create and inspect data to a certain extent. WAEBRIC contains literal syntax for numbers, strings, symbols, lists and records (inspired by JSON³). Some examples are listed below:

```

1  123 // a number
2  "abc" // a string
3  'sym' // a symbol
4  [123, "abc", 'sym'] // a list
5  { name : "John Smith", age: 30 } // a record

```

The inspection of data is limited to testing whether an expression is of list or record type using `x.list?` and `x.record?` respectively, and obtaining a field of a record the using the dot-notation `x.y`. Testing the type of an expression can only occur in the condition of an if-statement. Finally, lists can be iterated through using the **each** statement.

2.5 Yield

In the example above, the html markup-invocation receives a block enclosed in curly braces that will be the content of the `<html></html>` element. Users can define functions that exhibit the same behaviour using **yield**. Consider the following refactoring of the example above:

```

1  def home(msg)
2    layout(msg) echo msg;
3  end
4
5  def layout(title)
6    html {
7      head title title;
8      body yield;
9    }
10 end

```

The home function now calls an auxiliary function (layout) which receives the statement **echo** msg as block-argument. The layout function inturn sets up a basic HTML skeleton (with the title argument as title) passes the **yield** statement to the body-tag. This has the effect that in the invocation of layout above, the output of **yield** will be equal to the output of **echo** msg.

Although the input-output behaviour of home is exactly the same as it was before, the page-skeleton as embodied in the layout function can now be reused in the generation other pages.

³<http://www.json.org/>

Shorthand	Equivalent longhand
div. x	div(class= x)
div# x	div(id= x)
input\$ x	input(name= x)
input: x	input(type= x)
img@ $w\%h$	img(width= w , height= h)

Table 1: Meaning of attribute shorthands

```

1 def menu(menu)
2   echo menu.title;
3   ul each (kid: menu.kids)
4     menu-item(kid);
5 end
6
7 def menu-item(item)
8   if (item.kids)
9     li menu(item);
10  else
11    li a(href=item.link) item.title;
12 end

```

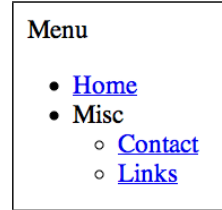


Figure 1: Recursive menus in WAEBRIC and the possible output

2.6 Attributes

2.6.1 Introduction

Both function calls and markup elements can receive parameters. They come in two forms:

1. $f(x_1 = a_1, \dots, x_n = a_n)$: if f is a tagname (for instance “div”), x_1, \dots, x_n are interpreted as XML attributes. The values are obtained from the values of the a_1, \dots, a_n respectively. In the case of a function calls, the keywords are ignored, and a_1, \dots, a_n is passed as an ordinary list of arguments (see 2 below).
2. $f(a_1, \dots, a_n)$: if f is a defined function, a_1, \dots, a_n are its arguments. In the case of markup (for instance if f is actually the tagname “input”), the list a_1, \dots, a_n is translated to the keyword parameter list value = $a_1, \dots, \text{value} = a_n$. In the case that $n > 1$ the value of “value” attribute is taken to be the value of the last keyword argument.

2.6.2 Shorthands

WAEBRIC provides shorthand notation for common XHTML attributes (inspired by Haml). See Table 1 for an overview of how this shorthand notation corresponds to regular attribute specification.

The syntax of shorthands accepts identifiers as variable part (except for the @-attribute which accepts natural numbers). The height part of the @-attribute is optional. Shorthands can be combined. For instance: p#intro.dropcaps combines the shorthands for the id and class attributes.

2.7 Recursive Menus

The example in Figure 1 shows how recursive menus could be defined in WAEBRIC. The first function, menu, receives a data object (*menu*) containing the labels, URLs and sub-menus that should be rendered in XHTML. The next statement just renders the title of the (current) menu using the built in state-

ment echo. After the title follows an unordered list containing the items of this menu. For each element in the “kids” property of *menu* the menu-item function is called.

The menu-item function first checks whether this *item* has any children (sub-menus). If so, it produces a li(st) element containing the output of a recursive call to menu. If there are no sub-menus, the result is a list element with an anchor tag which links the title of item to its URL. The result of an invocation (with the appropriate data for the *menu* parameter) of menu could look like the screen shot next to the source code.

Appendix: grammar in SDF

definition

module languages/waebric/syntax/Waebric

imports

languages/waebric/syntax/Comments
languages/waebric/syntax/Modules

hiddens

context-free start-symbols Module

module languages/waebric/syntax/Comments

exports

sorts Comment CommentChar Asterisk

lexical syntax

"/*" CommentChar* "*/" → Comment {category("Comment")}
~[*] → CommentChar
Asterisk → CommentChar
Comment → LAYOUT
[*] → Asterisk
"//" ~[\\n]* [\\n] → Comment {category("Comment")}

lexical restrictions

Asterisk -/- [\\/]

context-free restrictions

LAYOUT? -/- [\\/.][\\/]

LAYOUT? -/- [\\/.][*]

module basic/Whitespace

exports

lexical syntax

[\\ \\t\\n\\r] → LAYOUT {cons("whitespace")}

context-free restrictions

LAYOUT? -/- [\\ \\t\\n\\r]

module languages/waebric/syntax/Statements

imports languages/waebric/syntax/Expressions

languages/waebric/syntax/Predicates

languages/waebric/syntax/Markup

basic/StrCon

hiddens

context-free start-symbols

Statement

exports

sorts Statement Assignment Formals

context-free syntax

```

"if" "(" Predicate ")" Statement NoElseMayFollow → Statement
"if" "(" Predicate ")" Statement "else" Statement → Statement
"each" "(" Var ":" Expression ")" Statement → Statement
"let" Assignment+ "in" Statement* "end" → Statement
"{" Statement* "}" → Statement

```

context-free syntax

```

"comment" StrCon ";" → Statement
"echo" Expression ";" → Statement
"echo" Embedding ";" → Statement
"cdata" Expression ";" → Statement
"yield" ";" → Statement

```

context-free priorities**context-free syntax**

```

Var "=" Expression ";" → Assignment

```

context-free syntax

```

"if" → IdCon {reject}
"comment" → IdCon {reject}
"echo" → IdCon {reject}
"cdata" → IdCon {reject}
"each" → IdCon {reject}
"let" → IdCon {reject}
"yield" → IdCon {reject}

```

```

sorts NoElseMayFollow

```

context-free syntax

```

→ NoElseMayFollow

```

context-free restrictions

```

NoElseMayFollow -/- [e].[l].[s].[e]

```

context-free syntax

```

"(" {Var ","}* ")" → Formals
IdCon Formals "=" Statement → Assignment

```

```

module languages/waebric/syntax/Expressions

```

```

imports basic/Whitespace

```

```

    basic/NatCon

```

```

    basic/IdentifierCon

```

```

    languages/waebric/syntax/Text

```

```

exports

```

```

sorts SymbolCon SymbolChar Expression Var KeyValuePair

```

lexical syntax

```

""" SymbolChar* → SymbolCon

```

```

~[\0-\31\\ \t\n\r\;\,\>\127-\255] → SymbolChar

lexical restrictions
SymbolCon -/- ~[\]\ \t\n\r\;\,\>]

context-free syntax
Text → Expression

context-free syntax
IdCon → Var {category("MetaVariable")}

context-free syntax
Var → Expression
SymbolCon → Expression
NatCon → Expression
Expression "." IdCon → Expression

context-free syntax
 "[" {Expression ","}* "]" → Expression
 "{" {KeyValuePair ","}* "}" → Expression
 IdCon ":" Expression → KeyValuePair

module languages/waebric/syntax/Embedding

imports languages/waebric/syntax/Markup
         languages/waebric/syntax/Text

exports

sorts PreText PostText MidText TextTail Embed Embedding

lexical syntax
 "\" TextChar* "<" → PreText
 ">" TextChar* "\" → PostText
 ">" TextChar* "<" → MidText

context-free syntax
PostText → TextTail
MidText Embed TextTail → TextTail
PreText Embed TextTail → Embedding

context-free syntax
Markup* Expression → Embed

context-free priorities
Markup* Markup → Embed
>
Designator → Markup
module languages/waebric/syntax/Markup

imports languages/waebric/syntax/Expressions
         languages/waebric/syntax/Statements
         languages/waebric/syntax/Embedding

```


hiddens

context-free start-symbols Markup

exports

sorts Markup Designator Attribute Arguments Argument

context-free syntax

"(" {Argument ","}* ")" → Arguments

Var "=" Expression → Argument

Expression → Argument

context-free syntax

Designator Arguments → Markup

Designator → Markup

context-free priorities

Markup+ Statement → Statement {non-assoc}

>

{

Markup ";" → Statement

Markup+ Markup ";" → Statement

Markup+ Expression ";" → Statement

Markup+ Embedding ";" → Statement

}

context-free priorities

Markup+ Markup ";" → Statement

>

Designator → Markup

context-free syntax

IdCon Attribute* → Designator

context-free syntax

"#" IdCon → Attribute

"." IdCon → Attribute

"\$" IdCon → Attribute

":" IdCon → Attribute

"@" w:NatCon "%" h:NatCon → Attribute

"@" w:NatCon → Attribute

module basic/IdentifierCon

exports

sorts IdCon

lexical syntax

head:[A-Za-z] tail:[A-Za-z\0-9]* → IdCon {cons("default")}

lexical restrictions

```

IdCon -/- [A-Za-z\0-9]
module basic/NatCon

exports

sorts NatCon

lexical syntax

[0-9]+ → NatCon {cons("digits")}

lexical restrictions

NatCon -/- [0-9]
module languages/waebric/syntax/Modules

imports
    languages/waebric/syntax/Functions
    languages/waebric/syntax/Sites

exports

sorts ModuleId Import ModuleElement Module Modules

context-free syntax
    {IdCon "."}+ → ModuleId
    "import" ModuleId → Import

    FunctionDef → ModuleElement
    Import → ModuleElement
    Site → ModuleElement
    "module" ModuleId ModuleElement* → Module

    Module* → Modules

context-free syntax
    "module" → IdCon {reject}
    "import" → IdCon {reject}
    "def" → IdCon {reject}
    "end" → IdCon {reject}
    "site" → IdCon {reject}
module languages/waebric/syntax/Text

hiddens
context-free start-symbols
    Text

exports

sorts Text TextChar EscQuote Amp TextCharRef TextEntityRef

lexical syntax
    "\"" TextChar* "\"" → Text
    ~[\0-\31&"\<\128-\255] \/ [\n\r\t] → TextChar

```

```

[\\][\"] → EscQuote
[\\&] → Amp
Amp → TextChar
EscQuote → TextChar
TextCharRef → TextChar {category("Constant")}
TextEntityRef → TextChar {category("Constant")}

%% Copied from XML grammar
"&#" [0-9]+ ";" → TextCharRef
"&#x" [0-9a-fA-F]+ ";" → TextCharRef
"&" [a-zA-Z\\_:] [a-zA-Z0-9\\.\\_\\:]* ";" → TextEntityRef

lexical restrictions
  Amp -/- [\\#0-9a-zA-Z\\_:]
module languages/waebric/syntax/Sites

imports languages/waebric/syntax/Markup

exports
sorts Mapping Mappings FileName DirName Site Path FileExt Directory PathElement

context-free syntax
  "site" Mappings "end" → Site
  Path ":" Markup → Mapping
  DirName "/" FileName → Path
  FileName → Path
  Directory → DirName
  {Mapping ";" }* → Mappings

context-free syntax%%priorities
  Path ":" Markup → Mapping %%>
  %%Expression → Markup

context-free restrictions
  DirName -/- ~[\\/]
  "/" -/- [\\ \\t\\n\\r\\.\\/]

lexical syntax
  ~[\\ \\t\\n\\r\\.\\/] + → PathElement
  [a-zA-Z0-9]+ → FileExt
  {PathElement "/" }+ → Directory
  PathElement "." FileExt → FileName

lexical restrictions
  FileExt -/- [a-zA-Z0-9]
module basic/StrCon

exports

sorts StrCon StrChar

lexical syntax

```

```

"\n" → StrChar {cons("newline")}
"\t" → StrChar {cons("tab")}
"\"" → StrChar {cons("quote")}
"\" → StrChar {cons("backslash")}
"\\" a:[0-9]b:[0-9]c:[0-9] → StrChar {cons("decimal")}
~[\0-\31\n\t\"\\] → StrChar {cons("normal")}

["] chars:StrChar* ["] → StrCon {cons("default")}
module languages/waebric/syntax/Functions

imports languages/waebric/syntax/Statements

exports

sorts FunctionDef

context-free syntax
  "def" IdCon Formals? Statement* "end" → FunctionDef

module languages/waebric/syntax/Predicates

imports languages/waebric/syntax/Expressions

exports

sorts Predicate Type

context-free syntax
  "list" → Type
  "record" → Type
  "string" → Type

context-free syntax
  Expression → Predicate
  Expression "." Type "?" → Predicate

context-free priorities
  "!" Predicate → Predicate
  >
  {left:
    Predicate "&&" Predicate → Predicate {left}
    Predicate "||" Predicate → Predicate {left}
  }

```