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 form (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 produces 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 invokation 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 Markaby[1].

- WAEBRIC provides special syntax for common attributes in XHTML, such as "class" and "id". This is inspired by HAML[2].

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:

```
module homepage

site
  index.html: home("Hello World!")
end

def home(msg)
  html {
    head title msg;
    body echo msg;
  }
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.

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 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]`http://markaby.rubyforge.org/`
[2]`http://haml.hamptoncatlin.com/`

```
p; // markup
p p; // markup, variable
p p(); // markup, markup
echo "<p>"; // variable
echo "<p()>"; // markup
echo "<p p>"; // markup, variable
echo "<p p()>"; // markup, markup
```

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

2.2 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 JSON[3]). Some examples are listed below:

```
123 // a number
"abc" // a string
'sym // a symbol
[123, "abc", 'sym] // a list
{ 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.

2.3 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:

```
def home(msg)
 layout(msg) echo msg;
end

def layout(title)
 html {
   head title title;
   body yield;
 }
end
```

The home function now calls an auxiliar 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`.

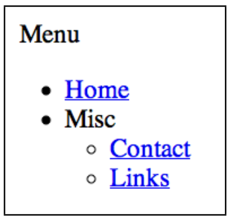
Although the input-output behaviour of `home` is exactly the same as it was before, the page-skeleton as embodied in the layout function can now be reused in the generation other pages.

2.4 Attributes

TBW

```
def menu(menu)
 echo menu.title;
 ul each (kid: menu.kids)
    menu-item(kid);
end

def menu-item(item)
 if (item.kids)
  li menu(item);
 else
  li a(href=item.link) item.title;
end
```



Menu

- Home
- Misc
  - Contact
  - Links

Figure 1: Recursive menus in WAEBRIC and the possible output

2.5 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 statement 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.

[3]http://www.json.org/

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}
  }
```