XcodeML/Fortran
Specification

Version 1.0

Omni Compiler Project

July, 2017

History

Version 1.0: July, 2017.

- Supported the Fortran2008 features.
- Corrected the descriptions on the current specification.
  - Corrected the description on the I/O specifier.
    (wrong) value attribute
    (correct) child element
  - Added the missed attribute `is_assumed_shape` to the `indexRange` element.

Version 0.9J: March 31, 2011

- Added the `FassignStatement` element.
- Added the `FpointerAssignStatement` element.
- Deleted the `assignExpr` element.
- Deleted the `FpointerAssignExpr` element.
- Deleted the `assignExpr` element and `FpointerAssignExpr` elements in the `exprModel` model.
- Added the `FassignStatement` and `FpointerAssignStatement` elements to the `statementModel` model.
- Added the `is_assumed_size` attribute to the `indexRange` element.
- Added the `is_intrinsic` attribute to the `functionCall` element.
- Updated the description on the `statementLabel` element.
- Support for `coarray`.
  - Modified the `FbasicType` element.
  - Added the `coShape` element.
  - Added the `FcoArrayRef` element.
  - Modified the `varRef` element.
  - Modified the `alloc` element.
  - Added the `FcoArrayRef` element to the `exprModel` model.

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1 Introduction

This document describes the specification of XcodeML for Fortran 90, which is defined based on XcodeML that was originaly defined as an intermediate code of the computer languages, mainly C. To clearly distinguish both specifications, we call this specification XcodeML/Fortran. The version of XcodeML on which this is based is 0.8J.

XcodeML/Fortran has the following functions and characteristics:

- Preserves information that can be used to reconstruct a Fortran 90 program,
- Can represent the type information of the Fortran 90 programming language,
- Has syntax elements necessary for a variety of transformations, and
- Has a human-readable format (XML).

XcodeML and XcodeML/Fortran are primarily designed to be convenient to use as an intermediate code in the source code to source code converter systems(hereafter called translators). The program which converts code written in a computer language to XcodeML or XcodeML/Fortran is called the frontend program(hereinafter called frontend), the one which converts XcodeML or XcodeML/Fortran to code written in the computer language is called the backend program(hereinafter called backend) or the decompiler. In addition, there are analysis/converter programs which input/output intermediate code to statically analyze or parallelize a program within the source code translator systems.

2 `XcodeProgram` element

Programs written in XcodeML/Fortran comprises a Type table and global external definitions. The top-level element in an XcodeML/Fortran file is the `XcodeProgram` element:

Contents model

```
(typeTable, globalSymbols, globalDeclarations)
```

Child elements

name	description	R/O
`typeTable`	information on data type used by the program	R
`globalSymbols`	information on global variables used by the program	R
`globalDeclarations`	information about function and variable declarations	R

Attributes

name	type	description	R/O
`compiler-info`	text	F-to-F translator information	O
`version`	text	F-to-F translator version information	O
`time`	text	Date and time of translation	O
`language`	text	source language information	O
`source`	text	source code information	O

3 Type Table element

3.1 `typeTable` element

The `typeTable` element defines the data type information for the entire file. The element comprises the data type definition elements. Data type definition elements consists of the following elements:

Contents model

```
(FbasicType | FfunctionType | FstructType | FenumType))*
```

Child elements

name	description	R/O
`FbasicType`	the basic data type	O
`FfunctionType`	the function data type	O
`FstructType`	the derived data type	O
`FenumType`	the enumeration data type	O

Attributes

name	type	description	R/O
-	-	-	-

3.2 `coShape` element

The `coShape` element defines a coshape of a coarray.

Contents model

```
(indexRange+)
```

Child elements

name	description	R/O
`indexRange`	the lower/upper bound of codimension	R

Attributes

name	type	description	R/O
-	-	-	-

3.3 `FbasicType` element

The `FbasicType` element defines a reference to primitive types or other type definition elements.

Contents model

```
(kind?, (len | (arrayIndex | indexRange)+)?, coShape?, typeParamValues?)
```

Child elements

name	description	R/O
`kind`	Specifies the kind parameter of the type element.	O
`len`	Specifies the length of the character string. Can be specified only when the type attribute of the type is `Fcharacter`.	O
`arrayIndex`	Specified if the type element is the array type and the size is expressed by the number of the elements. Can be repeated the number of the dimension times together with the `indexRange` element.	O
`indexRange`	Specified if the type element is the array type and the size is expressed by the upper and lower bounds. Can be repeated the number of the dimension times together with the `arrayIndex` element.	O
`coShape`	Specifies the coshape of the coarray.	O
`typeParamValues`	Specifies the type parameter values.	O

Attributes

name	type	description	R/O
type	text	Specifies the type identifier of the type element in the XcodeML/Fortran.	R
ref	text	Specifies the type identifier the type refers in the XcodeML/Fortran.	O
is_public	bool	true if the type has the public attribute.	O
is_private	bool	true if the type has the private attribute.	O
is_pointer	bool	true if the type has the pointer attribute.	O
is_target	bool	true if the type has the target attribute.	O
is_external	bool	true if the type has the external attribute.	O
is_intrinsic	bool	true if the type has the intrinsic attribute.	O
is_optional	bool	true if the type has the optional attribute.	O
is_save	bool	true if the type has the save attribute.	O
is_parameter	bool	true if the type has the parameter attribute.	O
is_allocatable	bool	true if the type has the allocatable attribute.	O
intent	text	Specifies the intent attribute the value of which is 'in', 'out' or 'inout'.	O
is_protected	bool	true if the type has the protected attribute.	O
is_value	bool	true if the type has the value attribute.	O
is_volatile	bool	true if the type has the volatile attribute.	O
is_asynchronous	bool	true if the type has the asynchronous attribute.	O
is_contiguous	bool	true if the type has the contiguous attribute.	O
is_class	bool	true if the type is the class type. If no type identifier(ref) is specified, the type represents 'class(*)'.	O
is_procedure	bool	true if the type is the procedure type. If no type identifier(ref) is specified, the type represents 'procedure()'.	O
pass	text	'nopass' or 'pass' if the pass attribute is specfied.	O
pass_arg_name	text	If the pass attribute is specified and it has an argument, specifies the argument name.	O
bind	text	Specifies the kind if the type has the bind attribute. Only 'C' is available currently.	O
bind_name	text	Specifies the bind name.	O

Example

The data type definition for "integer(kind=8)" is as follows:

XcodeML/Fortran

```
<FbasicType type="TYPE_NAME" ref="Fint">
  <kind>8</kind>
</FbasicType>
```

The data type definition for "integer dimension(10, 1:10)" is as follows:

XcodeML/Fortran

```
<FbasicType type="TYPE_NAME" ref="Fint">
  <arrayIndex>
    <FintConstant type="Fint">10</FintConstant>
  </arrayIndex>
```

```
  <indexRange>
    <lowerBound>
      <FintConstant type="Fint">1</FintConstant>
    </lowerBound>
  <upperBound>
      <FintConstant type="Fint">10</FintConstant>
  </upperBound>
</FbasicType>
```

The data type definition for "`character(len=10)`" is as follows:

XcodeML/Fortran

```
<FbasicType type="TYPE_NAME" ref="Fcharacter">
  <len>
    <FintConstant type="Fint">10</FintConstant>
  </len>
</FbasicType>
```

The data type definition for "`type(s(selected_int_kind(10),100, :))`" is as follows:

XcodeML/Fortran

```
<FbasicType type="TYPE_NAME" ref="TYPE_ID_OF_S">
<typeParamValues>
  <functionCall type="Fint" is_intrinsic="true">
    <name>selected_real_kind</name>
  <arguments>
      <FintConstant type="Fint">10</FintConstant>
    </arguments>
  </functionCall>
    <FintConstant type="Fint">100</FintConstant>
      <len></len>
  <typeParamValues>
</FbasicType>
```

The data type definition for "`class(ss)`" is as follows:

XcodeML/Fortran

```
<FbasicType type="TYPE_NAME" ref="TYPE_ID_OF_S" is_class="true">
</FbasicType>
```

The data type definition for "`procedure(func1),pointer`" is as follows:

XcodeML/Fortran

```
<FbasicType type="TYPE_NAME" ref="TYPE_ID_OF_FUNC1" is_pointer="true"
 is_procedure="true">
</FbasicType>
```

The data type definition for "`integer,bind(c,name="cname")`" is as follows:

XcodeML/Fortran

```
<FbasicType type="TYPE_NAME" ref="Fint" is_bind="C" bind_name="cname">
</FbasicType>
```

3.4 FfunctionType element

The FfunctionType element defines a function data type.

Contents model

(params?)

Child elements

name	description	R/O
params	Specifies the names of the dummy arguments if the type element has arguments.	O

Attributes

name	type	description	R/O
type	text	Specifies the type identifier of the type element in the XcodeML/Fortran.	R
return_type	text	Specifies the type identifier of the data type the function returns in the XcodeML/Fortran. If the value is 'Fvoid', the type element is the subroutine, otherwise the function.	R
result_name	text	Specifies the name of the variable to set the return value specified by result clause.	O
is_recursive	bool	Specifies if the type element has the recursive attribute.	O
is_program	bool	Specifies if the type element is a main program. 1(or true) is specified if the type element is a main program. 0(or false) is specifies if the type element is the function or subroutine depending on the type of the return_type attribute.	O
is_internal	bool	Specifies if the type element is an internal subprogram.	O
is_elemental	text	Specifies if the type element has the elemental attribute.	O
is_pure	text	Specifies if the type element has the pure attribute.	O
bind	text	Specifies the kind if the type has the bind attribute. Only 'C' is available currently.	O
bind_name	text	Specifies if the bind name.	O

Example

The data type of the function foo below is as follows:

Fortran 90

```
function foo(a, b)
  integer a, b
  real foo
```

XcodeML/Fortran

```
<FfunctionType type="F0" return_type="Freal">
  <params>
    <name type="Fint">a</name>
    <name type="Fint">b</name>
  </params>
</FfunctionType>
```

3.5 `FstructType` element

The `FstructType` element defines a derived type.

Contents model

```
(typeParams?  symbols?  typeBoundProcedures?)
```

Child elements

name	description	R/O
`symbols`	Specifies the members of the type element.	R

Attributes

name	type	description	R/O
`type`	text	Specifies the type identifier of the type element in the XcodeML/Fortran.	R
`is_public`	bool	Specifies if the type element has the `public` attribute as the access qualifier. The default value is 0(or false).	O
`is_private`	bool	Specifies if the type element has the `private` attribute as the access qualifier. The default value is `0`(or `false`).	O
`is_sequence`	bool	Specifies if the type element has the `sequence` attribute in the type declaration statement. The default value is `0`(or `false`).	O
`is_internal_private`	bool	Specifies if the type element has the `praivate` attribute in the derived type definition. If so, `1`(or `true`) is set. By the restriction of Fortran 90, the `is_internal_private` attribute cannot be specified if `is_sequence` is `0`(or `false`)	O
`is_abstract`	bool	`true` if the type has the `abstract` attribute.	O
`extends`	text	Specifies the type identifier of the parent type if the type is the extended type.	O
`bind`	text	Specifies the kind if the type has the `bind` attribute. Only '`C`' is available currently.	O

Example

The `FstructType` element for the type `S` below is as follows:

Fortran 90

```
type S
    integer x1, y1;
end type S
```

XcodeML/Fortran

```
<estructType type="TYPE_NAME">
  <symbols>
    <id type="Fint">
      <name type="Fint">x1</name>
    </id>
    <id type="Fint">
      <name type="Fint">y1</name>
```

```
    </id>
  </symbols>
</FstructType>
```

The FstructType element for the type SS below is as follows:

Fortran 2008

```
type SS extend S
        integer,kind:: kind
    integer,length:: n
    real(kind):: a(n);
contains
        procedure:: f1=>f1e;
        procedure,pass(arg):: f2=>f2e;
        generic:: ff=>f1,f2
        final:: fn
end type
```

XcodeML/Fortran

```
<FstructType extends="TYPE_ID_OF_S">
  <typeParams>
    <typeParam attr="kind">
      <name>kind</name>
    </typeParam>
    <typeParam attr="len">
      <name>n</name>
    </typeParam>
  </typeParams>
  <symbols>
 <id>
      <name>a</name>
    </id>
  </symbols>
<typeBoundProcedures>
 <typeBoundProcedure>
      <name>f1</name>
          <binding>
             <name>f1e</name>
          </binding>
    </typeBoundprocedure>
<typeBoundProcedure pass="pass" arg_name="arg">
      <name>f2</name>
          <binding>
              <name>f2e</name>
          </binding>
    </typeBoundProcedure>
<typeBoundGenericProcedure>
  <name>ff</name>
  <binding>
        <name>f1</name>
```

```
<name>f2</name>
</binding>
    </typeBoundProcedure>
<finalProcedure>
      <name>fn</name>
    </finalProcedure>
  </typeBoundProcedures>
</FstructType>
```

3.6 `typeParams` element

The `typeParams` element defines type parameters of the derived type.

Contents model

`(typeParam+)`

Child elements

name	description	R/O
`typeParam`	Specifies the type parameters.	O

Attributes

name	type	description	R/O
-	-	-	-

3.7 `typeParam` element

The `typeParam` element defines each type parameter.

Contents model

`(name, value?)`

Child elements

name	description	R/O
`name`	Specifies the name of the type parameter.	R
`value`	Specifies the initial value of the type parameter.	O

Attributes

name	type	description	R/O
`type`	text	Specifies the type identifier in XcodeML/Fortran representing the type element.	R
`attr`	text	Specifies the parameter attribute by either of "`kind`" or "`length`".	R

3.8 `typeParamValues` element

The `typeParamValues` element defines type parameter values.

Contents model

```
((exprModel | len)+)
```

Child elements

name	description	R/O
exprModel	Specifies the value of the type parameter.	O
len	Specifies the value of the type parameter if the value is assumed('*') or deferred(':').	O

Attributes

name	type	description	R/O
-	-	-	-

3.9 typeBoundProcedures element

The typeBoundProcedures element defines type-bound procedures.

Contents model

```
((typeBoundprocedure|typeBoundGenericProcedure|finalProcedure)+)
```

Child elements

name	description	R/O
typeBoundProcedure	Specifies the type-bound procedure.	O
typeBoundGenericProcedure	Specifies the generic type-bound procedure.	O
finalProcedure	Specifies the final subroutine.	O

Attributes

name	type	description	R/O
-	-	-	-

3.10 typeBoundProcedure element

The typeBoundProcedure element defines each type-bound procedure.

Contents model

```
(name, binding?)
```

Child elements

name	description	R/O
name	Specifies the name of the binding.	R
binding	Specifies the procedure name the binding name is bound.	O

Attributes

name	type	description	R/O
`pass`	text	"`nopass`" or "`pass`" if the `pass` attribute is specfied.	O
`pass_arg_name`	text	If the `pass` attribute is specified and it has an argument, specifies the argument name.	O
`is_non_overridable`	bool	`true` if the element has the `non_overridable` attribute.	O
`is_deferred`	bool	`true` if the element has the `deferred` attribute.	O
`is_public`	bool	`true` if the element has the `public` attribute.	O
`is_private`	bool	`true` if the element has the `private` attribute.	O

3.11 `typeBoundGenericProcedure` element

The `typeBoundGenericProcedure` element defines a generic type-bound procedure.

Contents model

`(name, binding)`

Child elements

name	description	R/O
`name`	Specifies the generic name or the name of the defined operator. Otherwise, empty.	R
`binding`	Specifies the procedure names the binding name is bound.	R

Attributes

name	type	description	R/O
`is_operator`	bool	Specifies if the element represents a defined operator.	O
`is_assignment`	bool	Specifies it the element represents an asignment operator.	O
`is_defined_io`	text	Either of "`read(formatted)`", "`read(unformatted)`", "`write(formatted)`" or "`write(unformatted)`" is specified if the element represents a user-defined I/O procedure.	O
`is_public`	bool	`true` if the element has the `public` attribute.	O
`is_private`	bool	`true` if the element has the `private` attribute.	O

3.12 `finalProcedure` element

The `finalProcedure` element defines a `final` subroutine.

Contents model

`(name)`

Child elements

name	description	R/O
`name`	Specifies the name of the `final` subroutine.	R

Attributes

name	type	description	R/O
-	-	-	-

3.13 binding element

The binding element represents a procedure list to bind.

Contents model

```
(name+)
```

Child elements

name	description	R/O
name	Specifies the procedure name to bind, the interface name or the bound name.	O

Attributes

name	type	description	R/O
-	-	-	-

3.14 FenumType element

The FenumType element defines a enumeration data type.

Contents model

```
((name, value?)+)
```

Child elements

name	description	R/O
name	Specifies the name of the enumerator.	R
value	Specifies the value of the enumerator.	O

Attributes

name	type	description	R/O
-	-	-	-

4 Symbol list

4.1 globalSymbols element

The globalSymbols element defines identifiers having the global scope.

Contents model

```
(id*)
```

Child elements

name	description	R/O
id	Specifies the identifier having the global scope.	O

Attributes

name	type	description	R/O
-	-	-	-

4.2 `symbols` element

The `symbols` element defines identifiers having the local scope.

Contents model

```
(id*)
```

Child elements

name	description	R/O
`id`	Specifies the identifier having the local scope.	O

Attributes

name	type	description	R/O
-	-	-	-

5 Definition and declaration element

5.1 `globalDeclarations` element

The `globalDeclarations` element is the element to declare external variables and to define functions in the program.

Contents model

```
(FfunctionDefinition | FmoduleDefinition)*
```

Child elements

name	description	R/O
`FfunctionDefinition`	the definition of a Fortran 90 main program, function or subroutine.	O
`FmoduleDefinition`	the definition of a Fortran 90 module.	O

Attributes

name	type	description	R/O
-	-	-	-

5.2 `declarations` element

The `declarations` element is the element to declare variables etc. in the program.

Contents model

```
(varDecl | FstructDecl | externDecl | FuseDecl | FuseOnlyDecl | FinterfaceDecl |
FnamelistDecl | FequivalenceDecl | FcommonDecl | FprocedureDecl | FimportDecl)*
```

Child elements

name	description	R/O
varDecl	the definition of a variable	O
FstructDecl	the Fortran 90 derived type definition	O
externDecl	the definition of an external variable or an identifier	O
FuseDecl	the Fortran 90 use declaration	O
FuseOnlyDecl	the Fortran 90 use declaration with the only option	O
FinterfaceDecl	the Fortran 90 interface statement	O
FnamelistDecl	the Fortran 90 namelist statement	O
FequivalenceDecl	the Fortran 90 equivalence statement	O
FcommonDecl	the Fortran 90 common statement	O
FprocedureDecl	the Fortran 2003 procedure statement	O
FimportDecl	the Fortran 2003 import statement	O

Attributes

name	type	description	R/O
-	-	-	-

5.3 FfunctionDefinition element

The FfunctionDefinition element defines a program, function or subroutine. Differently from C language, arguments in Fortran are passed by references, so we prepare another entry than functionDefinition of XcodeML.

Contents model

```
(name, symbols?, params?, declarations?, body)
```

Child elements

name	description	R/O
name	Specifies the name of the function or the subroutine.	R
symbols	Specifies the symbols included in the element.	O
params	Specifies the dummy arguments.	O
declarations	Specifies the definitions and declarations included in the element.	O
body	Specifies the executable statemtents included in the element.	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

5.4 varDecl element

The varDecl element declares a variable.

Contents model

```
(name, value?)
```

Child elements

name	description	R/O
`name`	Specifies the name of the variable.	R
`value`	Specifies the initial value if present.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

5.5 `FstructDecl` element

The `FstructDecl` element defines the derived type.

Contents model

`(name)`

Child elements

name	description	R/O
`name`	Specifies the name of the derived type.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

5.6 `externDecl` element

The `externDecl` element declares an external definition.

Contents model

`(name)`

Child elements

name	description	R/O
`name`	Specifies the name of the identifier of the external definition to declare.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

5.7 `FmoduleDefinition` element

The `FmoduleDefinition` element represents a `module` statement.

Contents model

```
(symbols?, declarations?, FcontainsStatement?)
```

Child elements

name	description	R/O
symbols	Specifies the symbols included in the element.	O
declarations	Specifies the definitions and declarations included in the element.	O
FcontainsStatement	Specifies the contain statement.	O

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
name	text	Specified the module name.	R
is_sub	bool	true if the element represents a submodule.	O
parent_name	text	Specifies the name of the parent module.	O

5.8 FuseDecl element

The FuseDecl element represents an use statement without the only option.

Contents model

```
(rename*)
```

Child elements

name	description	R/O
rename	Specifies the rename.	O

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
name	text	Specifies the module name.	R
intrinsic	bool	true if the intrinsic attribute is specified. false if the non_intrinsic attribute is specified.	O

5.9 FuseOnlyDecl element

The FuseOnlyDecl element represents an use statement with the only option.

Contents model

```
(renamable*)
```

Child elements

name	description	R/O
`renamable`	Specifies the `only` list.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`name`	text	Specifies the module name.	R
`intrinsic`	bool	`true` if the `intrinsic` attribute is specified. `false` if the `non_intrinsic` attribute is specified.	O

5.10 `FinterfaceDecl` element

The `FinterfaceDecl` element represents an `interface` statement.

Contents model

```
(FmoduleProcedureDecl | FfunctionDecl)*
```

Child elements

name	description	R/O
`FmoduleProcedureDecl`	Specifies the `module procedure` statements included in the element.	O
`FfunctionDecl`	Specifies the functions and subroutines included in the element.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`name`	text	Specifies the generic name or the defined operator name.	O
`is_operator`	bool	Specifies if the interface is a defined operator.	O
`is_assignment`	bool	Specifies if the interface is a defined assignment operator.	O
`is_defined_io`	bool	Either of "`read(formatted)`", "`read(unformatted)`", "`write(formatted)`" or "`write(unformatted)`" is specified if the element represents a user-defined I/O procedure.	O
`is_abstract`	bool	`true` if the element represents an abstract interface.	O

5.11 `FmoduleProcedureDecl` element

The `FmoduleProcedureDecl` represents a `module procedure` statement in an `interface` statement.

Contents model

```
(name*)
```

Child elements

name	description	R/O
name	Specifies the procesure names.	O

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

5.12 FfunctionDecl element

The FfunctionDecl element represents a function or subroutine statement in an interface statement.

Contents model

```
(name, params?, declarations?)
```

Child elements

name	description	R/O
name	Specifies the name of the function or the subroutine.	R
params	Specifies the dummy arguments.	O
declarations	Specifies the definitions and declarations in the element.	O

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

5.13 FprocedureDecl element

The FprocedureDecl element represents a procedure statement.

Contents model

```
(name, value?)
```

Child elements

name	description	R/O
name	Specifies the name of the procedure.	R
value	Specifies the initial value if present.	O

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

5.14 `FimportDecl` element

The `FimportDecl` element represents an `import` statement.

Contents model

```
(name*)
```

Child elements

name	description	R/O
`name`	Specifies the name to import.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6 Statement element

This is an XML element which corresponds to the syntax element in the Fortran 90 statement. The line number is attached to each element as an attribute, which can be used to extract file information and the line number where the particular statement is found.

6.1 `FassignStatement` element

The `FassignStatement` element represents an assignment statement.

Contents model

```
(lValueModel, exprModel)
```

Child elements

name	description	R/O
`lValueModel`	Specifies the left-hand side expression. Refer to "9.3 lValueModel".	R
`exprModel`	Specifies the right-hand side expression. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.2 `exprStatement` element

The `exprStatement` element represents a statement expressed by an expression.

Contents model

```
(exprModel)
```

Child elements

name	description	R/O
exprModel	Specifies the expression. Refer to "9.4 exprModel"	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.3 FpointerAssignStatement element

The FpointerAssignStatement element represents a pointer assignment statement.

Contents model

```
(lValueMode, exprModel)
```

Child elements

name	description	R/O
lValueModel	Specifies the left-hand side expression. Refer to "9.3 lValueModel".	R
exprModel	Specifies the right-hand side expression. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.4 FifStatement element

The FifStatement element represents an if statement.

Contents model

```
(condition, then, else?)
```

Child elements

name	description	R/O
condition	Specifies the conditional expression.	R
then	Specifies the statement to execute if the condition falls true.	R
else	Specifies the statement to execute if the condition falls false.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`construct_name`	text	Specifies the construct name.	O

6.5 `FdoStatement` element

The `FdoStatement` element represents a `do` statement. The labeled `do` construct must be replaced by an equivalent `do` statement with the label eliminated.

Contents model

```
(Var?, indexRange?, body?)
```

Child elements

name	description	R/O
`Var`	Specifies the index variable.	O
`indexRange`	Specifies the range of of the value of the index variable.	O
`body`	Specifies the statements included in the `do` statement.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`construct_name`	text	Specifies the construct name.	O

6.6 `FdoWhileStatement` element

The `FdoWhileStatement` element represents a `do` statement with `while` used as the controlling expression. The labelled `do while` construct must be replaced by an equivalent `do while` statement with the label eliminated.

Contents model

```
(condition, body?)
```

Child elements

name	description	R/O
`condition`	Specifies the conditional expression.	R
`body`	Specifies the statements included in the `do while` statement.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`construct_name`	text	Specifies the construct name.	O

6.7 continueStatement element

The continueStatement element represents a continue statement.

Contents model

empty

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.8 FcycleStatement element

The FcycleStatement element represents a cycle statement.

Contents model

empty

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
construct_name	text	Specifies the construct name.	O

6.9 FexitStatement element

The FexitStatement element represents an exit statement.

Contents model

empty

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`construct_name`	text	Specifies the construct name.	O

6.10 `FreturnStatement` element

The `FreturnStatement` element represents a `return` statement.

Contents model

`empty`

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.11 `gotoStatement` element

The `gotoStatement` element represents a `go to` statement.

Contents model

`((params, value)?)`

Child elements

name	description	R/O
`params`	Specifies the statement label list of the computed `go to` statement. Neglected if the `label_name` attribute is specified.	O
`value`	Specifies the expression of the computed `go to` statement. Neglected if the `label_name` attribute is specified.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`label_name`	text	Specifies the statement label.	O

6.12 `statementLabel` element

The `statementLabel` element represents a statement label of the following statement.

Contents model

empty

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
label_name	text	Specifies the statement label.	R

6.13 FselectCaseStatement element

The FselectCaseStatement element represents a select case construct.

Contents model

(value, FcaseLabel*)

Child elements

name	description	R/O
value	Specifies the value to select.	R
FcaseLabel	Specifies the case statements included in the element.	O

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
construct_name	text	Specifies the construct name.	O

6.14 FcaseLabel element

The FcaseLabel element represents a case statement in a select case construct. If a FcaseLabel has neither a value element nor an indexRange element, it is assume to be the case default statement.

Contents model

((value | indexRange)*, body)

Child elements

name	description	R/O
value	Specifies the value of the selector.	O
indexRange	Specifies the range of the selector.	O
body	Specifies the statements included in the element.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`construct_name`	text	Specifies the construct name of the corresponding `select case` statement.	O

6.15 `FwhereStatement` element

The `FwhereStatement` element represents a `where` statement.

Contents model

`(condition, then, else?)`

Child elements

name	description	R/O
`condition`	Specifies the conditional expression.	R
`then`	Specifies the statement to execute if the condition falls true.	R
`else`	Specifies the statement to execute if the condition falls false.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.16 `FstopStatement` element

The `FstopStatement` element represents a `stop` statement.

Contents model

`empty`

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`code`	text	Specifies a stop code consisting of a string of up to five digits.	O
`message`	text	Specifies a stop code consisting of a default character constant. Neglected if the code attribute is specified.	O

6.17 Input/Output element

6.17.1 `FreadStatement, FwriteStatement` element

The `FreadStatement` element and the `FwriteStatement` element correspond to the `read` statement and the `write` statement respectively.

Contents model

```
(namedValueList, valueList)
```

Child elements

name	description	R/O
`namedValueList`	Specifies the control list.	R
`valueList`	Specifies the input or output list.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

Control list

The values for the name attribute and the child element of the `namedValue` element are as follows:

name attribute	child element	R/O
unit	Specifies either '*', the scalar default integer expression specifying the external file unit or the scalar default character variable specifying the internal file unit.	R
fmt	Specifies the format specifier, either '*', the scalar default character expression, the statement label or the scalar default integer variable.	R
nml	Specifies the name of the variable group.	O
rec	Specifies the name of the scalar default integer variable.	O
iostat	Specifies the name of the scalar default integer variable.	O
err	Specifies the statement label.	O
end	Specifies the statement label.	O
advance	Specifies the scalar default character expression.	O
size	Specifies the name of the scalar default integer variable.	O
eor	Specifies the statement label.	O
pos	Specifies the scalar integer expression.	O
iomsg	Specifies the scalar default character expression.	O
blank	Specifies the scalar default character expression.	O
pad	Specifies the scalar default character expression.	O
decimal	Specifies the scalar default character expression.	O
delim	Specifies the scalar default character expression.	O
round	Specifies the scalar default character expression.	O
sign	Specifies the scalar default character expression.	O
asynchronous	Specifies the scalar default character expression.	O
id	Specifies the name of the variable.	O

6.17.2 FprintStatement element

The FprintStatement element corresponds to the print statement.

Contents model

(valueList)

Child elements

name	description	R/O
valueList	Specifies the output list.	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
format	text	Specifies the fortmat specifier.	R

6.17.3 FrewindStatement, FendFileStatement, FbackspaceStatement element

The FrewindStatement element, the FendFileStatement element and the FbackspaceStatement element correspond to the rewind statement, the end file statement and the backspace statement respectively.

Contents model

`(namedValueList)`

Child elements

name	description	R/O
`namedValueList`	Specifies the control list.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

Control list

The values for the name attribute and the child element of the `namedValue` element are as follows:

name attribute	child element	R/O
`unit`	Specifies the scalar default integer expression specifying the external file unit.	R
`iostat`	Specifies the name of the scalar default integer variable.	O
`err`	Specifies the statement label.	O
`iomsg`	Specifies the scalar default character expression.	O

6.17.4 `FopenStatement` element

The `FopenStatement` element corresponds to the `open` statement.

Contents model

`(valueList)`

Child elements

name	description	R/O
`valueList`	Specifies the output list.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

Control list

The values for the name attribute and the child element of the `namedValue` element are as follows:

name attribute	child element	R/O
`unit`	Specifies the scalar default integer expression specifying the external file unit.	R
`iostat`	Specifies the name of the scalar default integer variable.	O
`err`	Specifies the statement label.	O
`file`	Specifies the name of the scalar default character variable containing the file name.	O
`status`	Specifies the name of the scalar default character variable.	O
`access`	Specifies the name of the scalar default character variable.	O
`form`	Specifies the name of the scalar default character variable.	O
`recl`	Specifies the name of the scalar default integer variable.	O
`blank`	Specifies the name of the scalar default character variable.	O
`position`	Specifies the name of the scalar default character variable.	O
`action`	Specifies the name of the scalar default character variable.	O
`delim`	Specifies the name of the scalar default character variable.	O
`pad`	Specifies the name of the scalar default character variable.	O
`newunit`	Specifies the name of the scalar default integer variable.	O
`iomsg`	Specifies the scalar default character expression.	O
`decimal`	Specifies the scalar default character expression.	O
`delim`	Specifies the scalar default character expression.	O
`encoding`	Specifies the scalar default character expression.	O
`round`	Specifies the scalar default character expression.	O
`sign`	Specifies the scalar default character expression.	O
`asynchronous`	Specifies the scalar default character expression.	O

6.17.5 `FcloseStatement` element

The `FcloseStatement` element corresponds to the `close` statement.

Contents model

`(valueList)`

Child elements

name	description	R/O
`valueList`	Specifies the output list.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

Control list

The values for the name attribute and the child element of the `namedValue` element are as follows:

name attribute	child element	R/O
`unit`	Specifies the scalar default integer expression specifying the external file unit.	R
`iostat`	Specifies the name of the scalar default integer variable.	O
`err`	Specifies the statement label.	O
`status`	Specifies the name of the scalar default character variable.	O
`iomsg`	Specifies the scalar default character expression.	O

6.17.6 `FinquireStatement` element

The `FinquireStatement` element corresponds to the `inquire` statement.

Contents model

```
(namedValueList, valueList)
```

Child elements

name	description	R/O
`namedValueList`	Specifies the control list.	R
`valueList`	Specifies the input or output list.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

Control list

The values for the name attribute and the child element of the `namedValue` element are as follows:

name attribute	child element	R/O
`iolength`	Specifies the scalar default integer expression. If this is specifies, no other specifiers can be specified and the output list must be specified by the `valueList` element.	O
`unit`	Specifies the scalar default integer expression specifying the external file unit.	O
`file`	Specifies the name of the scalar default character variable containing the file name.	O
`iostat`	Specifies the name of the scalar default integer variable.	O
`err`	Specifies the statement label.	O
`exist`	Specifies the name of the scalar default logical variable.	O
`opened`	Specifies the name of the scalar default logical variable.	O
`number`	Specifies the name of the scalar default integer variable.	O
`named`	Specifies the name of the scalar default logical variable.	O
`name`	Specifies the name of the scalar default character variable.	O
`access`	Specifies the name of the scalar default character variable.	O
`sequential`	Specifies the name of the scalar default character variable.	O
`direct`	Specifies the name of the scalar default character variable.	O
`form`	Specifies the name of the scalar default character variable.	O
`formatted`	Specifies the name of the scalar default character variable.	O
`unformatted`	Specifies the name of the scalar default character variable.	O
`recl`	Specifies the name of the scalar default integer variable.	O
`nextrecl`	Specifies the name of the scalar default integer variable.	O
`blank`	Specifies the name of the scalar default character variable.	O
`position`	Specifies the name of the scalar default character variable.	O
`action`	Specifies the name of the scalar default character variable.	O
`read`	Specifies the name of the scalar default character variable.	O
`write`	Specifies the name of the scalar default character variable.	O
`rewrite`	Specifies the name of the scalar default character variable.	O
`delim`	Specifies the name of the scalar default character variable.	O
`pad`	Specifies the name of the scalar default character variable.	O
`pending`	Specifies the name of the scalar default logical variable.	O
`pos`	Specifies the scalar default integer expression.	O
`size`	Specifies the scalar default integer expression.	O
`iomsg`	Specifies the scalar default character expression.	O
`decimal`	Specifies the scalar default character expression.	O
`delim`	Specifies the scalar default character expression.	O
`encoding`	Specifies the scalar default character expression.	O
`round`	Specifies the scalar default character expression.	O
`sign`	Specifies the scalar default character expression.	O
`stream`	Specifies the scalar default character expression.	O
`asynchronous`	Specifies the scalar default character expression.	O
`is`	Specifies the scalar integer expression.	O

6.17.7 `FwaitStatement` element

The `Fwait` element corresponds to the `wait` statement.

Contents model

`empty`

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

Control list

The values for the name attribute and the child element of the `namedValue` element are as follows:

name attribute	child element	R/O
`unit`	Specifies either '`*`', the scalar default integer expression specifying the external file unit or the scalar default character variable specifying the internal file unit.	R
`err`	Specifies the statement label.	O
`end`	Specifies the statement label.	O
`eor`	Specifies the statement label.	O
`iostat`	Specifies the scalar default integer variable.	O
`iomsg`	Specifies the scalar default character expression.	O
`id`	Specifies the scalar default integer expression.	O

6.17.8 `FflushStatement` element

The `FflushStatement` element corresponds to the `flush` statement.

Contents model

`empty`

Child elements

name	description	R/O
	-	-

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

Control list

The values for the name attribute and the child element of the `namedValue` element are as follows:

name attribute	child element	R/O
`unit`	Specifies the scalar default integer expression specifying the external file unit.	R
`err`	Specifies the statement label.	O
`iomsg`	Specifies the scalar default character expression.	O
`iostat`	Specifies the scalar default integer variable.	O

6.18 `FformatDecl` element

The `FformatDecl` element represents a `format` statement.

Contents model

`empty`

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`format`	text	Specifies the character string representing the format specification.	R

6.19 `FdataDecl` element

The `FdataDecl` element represents a `data` statement.

Contents model

`((varList, valueList)+)`

Child elements

name	description	R/O
`varList`	Specifies the object list.	R
`valueList`	Specifies the value list.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.20 FnamelistDecl element

The FnamelistDecl element represents a namelist statement.

Contents model

(varList+)

Child elements

name	description	R/O
varList	Specifies the name of the variable group and the list of the element variables.	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.21 FequivalenceDecl element

The FequivalenceDecl element represents an equivalent statement.

Contents model

((varRef, varList)+)

Child elements

name	description	R/O
varRef	Specifies the object. The object must be a variable, array element or substring.	R
varList	Specifies the object list.	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.22 FcommonDecl element

The FcommonDecl element represents a common statement.

Contents model

(varList+)

Child elements

name	description	R/O
varList	Specifies the name of the common block and the list of the variable names.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.23 `FentryDecl` element

The `FentryDecl` element represents an `entry` statement.

Contents model

```
(name, symbols?, params?)
```

Child elements

name	description	R/O
`name`	Specifies the name of entry.	R
`symbols`	Specifies the symbols included in the element.	O
`params`	Specifies the dummy arguments.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.24 Allocation element

The following elements define the allocate statements.

6.24.1 `FallocateStatement` element

The `FallocateStatement` element represents an `allocate` statement.

Contents model

```
(alloc+, alloc_opt*)
```

Child elements

name	description	R/O
`alloc`	Specifies the allocation list.	R
`alloc_opt`	Specifies the allocation option.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`stat_name`	text	Specifies the name of status variable.	O
`type`	text	Specifies the type identifier if the type is specified.	O

Example

The `FallocateStatement` element for the `allocate` statement below is as follows:

Fortran 2008

```
Class(t),pointer :: x(:)
Class(*),pointer :: a(:),b(:)
allocate(et::x(100),a(100))
allocate(b,source=a,stat=s)
```

XcodeML/Fortran

```
<FallocateStatement type="ID_OF_ET">
  <alloc>
    <Var>x</Var>
    <arrayIndex>
      <FintConstant>100</FintConstant>
    </arrayIndex>
  </alloc>
  <alloc>
     <Var>a</Var>
     <arrayIndex>
       <FintConstant>100</FintConstant>
     </arrayIndex>
   </alloc>
</FallocateStatement>
<FallocateStatement>
  <alloc>
    <Var>b</Var>
  </alloc>
  <alloc\_opt kind="source">
     <Var>a</Var>
  </alloc\_opt>
  <alloc\_opt kind="stat">
     <Var>s</Var>
  </alloc\_opt>
</FallocateStatement>
```

6.24.2 `FdeallocateStatement` element

The `FdeallocateStatement` element represents a `deallocate` statement.

Contents model

`(alloc+, alloc_opt*)`

Child elements

name	description	R/O
`alloc`	Specifies the name of the allocate object list.	R
`alloc_opt`	Specifies the allocation option.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`stat_name`	text	Specifies the name of status variable.	O

6.24.3 `FnullifyStatement` element

The `FnullifyStatement` element represents a `nullify` statement.

Contents model

```
(alloc+)
```

Child elements

name	description	R/O
`alloc`	Specifies the pointer object list.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.25 `FpragmaStatement` element

The `FpragmaStatement` element represents a directive of OpenMP 3.0 begining with '`!$`' or '`!$OMP`'. It has the content as text data.

Contents model

```
(#PCDATA)
```

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.26 `FcontainsStatement` element

The `FcontainsStatement` element represents a `contains` statement.

Contents model

```
(FfunctionDefinition+)
```

Child elements

name	description	R/O
`FfunctionDefinition`	Specifies the functions and subroutines included in the element.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.27 `condition` element

The `condition` element represents a conditional expression.

Contents model

`(exprModel)`

Child elements

name	description	R/O
`exprModel`	Specifies the expression. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
-	-	-	-

6.28 `then` element

The `then` element represents a block executed if the condition falls true.

Contents model

`(body)`

Child elements

name	description	R/O
`body`	Specifies the statements included in the `then` statement.	R

Attributes

name	type	description	R/O
-	-	-	-

6.29 `else` element

The `else` element represents a block executed if the condition falls false.

Contents model

`(body)`

Child elements

name	description	R/O
`name`	Specifies the statements included int the `else` statement.	R

Attributes

name	type	description	R/O
-	-	-	-

6.30 `alloc` element

The `alloc` element represents an object in the allocation list of the `allocate` and `deallocate` statement and in the pointer list of the `nullify` statement.

Contents model

```
((FmemberRef | Var), (arrayIndex | indexRange)?, coShape?*)
```

Child elements

name	description	R/O
`FmemberRef`	Specifies the reference to the component of the structure.	R
`Var`	Specifies the variable.	R
`arrayIndex`	Specified if the type element is the array type and the size is expressed by the number of the elements. Can be repeated the number of the dimension times together with the `indexRange` element. Neglected if the element is a child element of the `FnullifyStatement`.	O
`indexRange`	Specified if the type element is the array type and the size is expressed by the upper and lower bounds. Can be repeated the number of the dimension times together with the `arrayIndex` element. Neglected if the element is a child element of the `FnullifyStatement`.	O
`coShape`	Specified if the element represents the allocation of a coarray.	O

Attributes

name	type	description	R/O
-	-	-	-

6.31 `allocOpt` element

The `allocOpt` element represents an `alloc` option.

Contents model

```
(exprModel+)
```

Child elements

name	description	R/O
`exprModel`	Specifies the expression for the value of the element.	R

Attributes

name	type	description	R/O
kind	text	Specifies "errmsg", "mold", "source" or "stat" as the kind of the alloc option.	R

6.32 forallStatement element

The forAllStatement element represents a forall construct.

Contents model

```
((var, indexRange)+, condition?, body)
```

Child elements

name	description	R/O
var	Specifies the index variable.	O
indexRange	Specifies the value range of the index variable.	O
condition	Specifies the masking condition.	O
body	Specifies the content statements of the forall construct.	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
type	text	Specifies the type identifier if the type is specified.	O
construct_name	text	Specifies the construct name.	O

Example

The forallStatement element for the forall construct below is as follows:

Fortran 2008

```
forall (i=1:n,j=1:m,ix(i,j)>0)
 ix(i,j)=0
end forall
```

XcodeML/Fortran

```
<forallStatement>
  <Var>i</Var>
  <indexRange>
    <lowerBound>
      <FintConstant>1</FintConstant>
    </lowerBound>
    <upperBound>
      <Var>n</Var>
    </upperBound>
    <step>
      <FintConstant>1</FintConstant>
    </step>
  </indexRange>
```

```
    <Var>j </Var>
  <indexRange>
    <lowerBound>
      <FintConstant>1</FintConstant>
    </lowerBound>
    <upperBound>
      <Var>m</Var>
    </upperBound>
    <step>
      <FintConstant>1</FintConstant>
    </step>
  </indexRange>
  <condition>
     <logGTExpr>
       <FarrayRef>
         <varRef>
           <Var>ix</Var>
         </varRef>
         <arrayIndex>
           <Var>i</Var>
         </arrayIndex>
         <arrayIndex>
           <Var>j</Var>
         </arrayIndex>
       </FarrayRef>
       <FintConstant>0</FintConstant>
     </logGTExpr>
   </condition>
  <body>
    <FassignStatement">
      <FarrayRef>
        <varRef>
          <Var>ix</Var>
        </varRef>
        <arrayIndex>
          <Var>i</Var>
        </arrayIndex>
        <arrayIndex>
          <Var>j</Var>
        </arrayIndex>
      </FarrayRef>
      <FintConstant>0</FintConstant>
    </FassignStatement>
  </body>
</FdoStatement>
```

6.33 `FdoConcurrentStatement` element

The `FdoConcurrentStatement` element represents a `do concurrent` statement.

Contents model

```
((var, indexRange)+, condition?, body?)
```

Child elements

name	description	R/O
var	Specifies the do variable.	R
indexRange	Specifies the value range of the do variable.	R
condition	Specifies the masking condition.	O
body	Specifies the content statements.	O

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
type	text	Specifies the type identifier if the type is specified.	O
construct_name	text	Specifies the construct name.	O

6.34 selectTypeStatement element

The selectTypeStatement element represents a select type construct.

Contents model

```
(id, typeGuard*)
```

Child elements

name	description	R/O
id	Specifies the variable or the expression (and its associate name) to test the type.	R
typeGuard	Specifies the type guard statement in the construct.	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
construct_name	text	Specifies the construct name.	O

Example

The selectTypeStatement element for the select type construct below is as follows:

Fortran 2008

```
class(t) x
...
select type(p=>x)
type is(t1)
  ...
type is(t2)
  ...
```

```
class is(t3)
  ...
type default
  ...
end select
```

XcodeML/Fortran

```
<selectTypeStatement>
  <id>
    <name>p</name>
    <value>
       <Var>x</Var>
    </value>
  </id>
  <typeGuard kind="TYPE_IS" type="TYPE_ID_OF_T1">
    <body>
      ...
    </body>
  </typeGuard>
  <typeGuard kind="TYPE_IS" type="TYPE_ID_OF_T2">
    <body>
      ...
    </body>
  </typeGuard>
  <typeGuard kind="CLASS_IS" type="TYPE_ID_OF_T3">
    <body>
      ...
    </body>
  </typeGuard>
  <typeGuard kind="TYPE_DEFAULT">
    <body>
      ...
    </body>
  </typeGuard>
</selectTypeStatement>
```

6.35 `typeGuard` element

The `typeGuard` element represents a `type guard` statement in the `select type` construct.

Contents model

`(body)`

Child elements

name	description	R/O
`body`	Specifies the content statements.	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
kind	text	Specifies "TYPE_IS", "CLASS_IS" or "TYPE_DEFAULT" as the kind of the type guard.	R
type	text	Specifies the type identifier to test.	O

6.36 syncAllStatement element

The syncAllStatement element represents a sync all statement.

Contents model

(syncStat*)

Child elements

name	description	R/O
syncStat	Specifies the stat specifiers.	O

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.37 syncImagesStatement element

The syncImagesStatement element represents a sync image statement.

Contents model

(expModer?, syncStat*)

Child elements

name	description	R/O
exprModel	Specifies the expression representing the image. Omitted if '*' is specified.	O
syncStat	Specifies the stat specifiers.	O

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.38 syncMemoryStatement element

The syncMemoryStatement element represents a sync memory statement.

Contents model

`(syncStat*)`

Child elements

name	description	R/O
`syncStat`	Specifies the stat specifiers.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.39 `lock/unlockStatement` element

The `lock/unlockStatement` element represents a `lock/unlock` statement.

Contents model

`(Var?, syncStat*)`

Child elements

name	description	R/O
`Var`	Specifies the lock variable.	O
`syncStat`	Specifies the stat specifiers.	O

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-

6.40 `syncStat` element

The `syncStat` element represents a `stat` specifier.

Contents model

`(Var)`

Child elements

name	description	R/O
`Var`	Specifies the variable.	O

Attributes

name	type	description	R/O
`kind`	text	Specifies "`STAT`", "`ERRMSG`" or "`ACQUIRED_LOCK`" as the kind of the stat speficier.	R

6.41 criticalStatement element

The criticalStatement element represents a critical construct.

Contents model

(body)

Child elements

name	description	R/O
body	Specifies the content statements.	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
construct_name	text	Specifies the construct name.	O

6.42 associateStatement element

The associateStatement element represents a associate construct.

Contents model

(symbols, body)

Child elements

name	description	R/O
symbols	Specifies the bindings within the construct.	R
body	Specifies the content statements.	R

Attributes

name	type	description	R/O
common attributes	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
construct_name	text	Specifies the construct name.	O

Example

The associateStatement element for the associate statement below is as follows:

Fortran 2008

```
associate(x=>... , y=>...)
 ... = x
 ... = y
end associate
```

XcodeML/Fortran

```
<associateStatement>
  <symbols>
    <id>
      <name>x</name>
      <value>
        ...
      </value>
    </id>
    <id>
      <name>y</name>
      <value>
        ...
      </value>
    </id>
  </symbols>
  <body>
     ...
  </body>
</associateStatement>
```

6.43 `blockStatement` element

The `blockStatement` element represents a `block` construct.

Contents model

`(symbols?, declarations?, body)`

Child elements

name	description	R/O
`symbols`	Specifies the symbols included in the element.	O
`declarations`	Specifies the declarations included in the block construct.	O
`body`	Specifies the content statements.	R

Attributes

name	type	description	R/O
`common attributes`	-	Refer to "9.2 Common attributes of the definition / declaration / statement element".	-
`construct_name`	text	Specifies the construct name.	O

Example

The `blockStatement` element for the `block` construct below is as follows:

Fortran 2008

```
block
 integer i
 real x
```

```
  ...
end block
```

XcodeML/Fortran

```
<blockStatement>
  <symbols>
     <id type="Fint" sclass="flocal">
       <name>i</name>
     </id>
     <id type="Freal" sclass="flocal">
       <name>a</name>
     </id>
   </symbols>
   <declarations>
     <varDecl>
       <name type="Fint">i</name>
     </varDecl>
     <varDecl>
       <name type="Freal">a</name>
     </varDecl>
  </declarations>
  <body>
     ...
  </body>
</blockStatement>
```

7 Expression element

This chapter describes the XML elements corresponding to the syntax elements for expressions in Fortran. Each element has a `type` element attached, which can be used to extract the data type information of the expression.

7.1 Constant element

The elements representing constants are described below.

7.1.1 `FintConstant`, `FrealConstant`, `FcharacterConstant`, `FlogicalConstant` element

The `FintConstant`, `FrealConstant`, `FcharacterConstant` and `FlogicalConstant` element represents a constant of the `integer`, `real`, `character` and `logical` type respectively.

The contents of the elements are shown below.

element	format of the content
`FintConstant`	Specifies a constant that has an integer value; a decimal or hexadecimal (starting with "`0x`") number.
`FrealConstant`	32bit hexadeciaml(starting with 0x) two numbers representing an IEEE754 floating-point number.
`FcharacterConstant`	A character string.
`FlogicalConstant`	`1`(or `true`) representing true of the logical value, or `0`(or `false`) representing false.

Contents model

```
(#PCDATA)
```

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O
`kind`	text	Specifies the kind parameter of the type element.	O

7.1.2 `FcomplexContant` element

The `FcomplexContant` element represents a constant of the `complex` type.

Contents model

```
(FrealConstant, FrealConstant)
```

Child elements

name	description	R/O
`FrealConstant`	Specifies a couple of a constant of the `Freal` type.	R

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O

7.2 Array constructor element

7.2.1 `FarrayConstructor` element

The `FarrayConstructor` element represents an array constructor.

Contents model

```
(exprModel)*
```

Child elements

name	description	R/O
`exprModel`	Specifies the expression of the value of the array element. Refer to "9.4 exprModel".	O

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O

7.3 Structure constructor element

7.3.1 `Constant` element

The `FstructConstructor` element represents a structure constructor.

Contents model

```
(typeParamValues?, (exprModel)*)
```

Child elements

name	description	R/O
`typeParamValues`	Specifies the value of the type parameter.	O
`exprModel`	Specifies the expressions representing the values of the structure components. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O

Example

The `FstructConstructor` element for the type `S` below is as follows:

Fortran 2008

```
type S(alen,blen,clen)
real,length:: alen,blen,clen
real::a(alen) = 0.0
real::b(blen) = 0.0
real::b(clen) = 0.0
end type
... = S(100,100,100)(b=1.0,c=2.0)
```

XcodeML/Fortran

```
<FstructConstructor type="TYPE_ID_OF_S">
<typeParamValues>
  <FintConstant type="Fint">100</FintConstant>
<FintConstant type="Fint">100</FintConstant>
<FintConstant type="Fint">100</FintConstant>
```

```
  </typeParamValues>
  <namedValue name="b">
     <FrealConstant>1.0</FrealConstant>
  </namedValue>
  <namedValue name="c">
     <FrealConstant>2.0</FrealConstant>
  </namedValue>
</FstructConstructor>
```

7.4 Elements referencing variables

The elements representing a reference to a variable are described below.

7.4.1 `Var` element

The `Var` element represents a name of the variable. Specifies the name of the variable as the content.

Contents model

`(#PCDATA)`

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O
`scope`	text	Specifies one of "`local`" for a local variable, "`global`" for a global variable, "`param`" for a dummy argument. Note: "`global`" is not used in XcodeML/Fortran, however.	R

7.4.2 `FmemberRef` element

The `FmemberRef` element represents a reference to a structure component.

Contents model

`(varRef)`

Child elements

name	description	R/O
`varRef`	Specifies the reference to the structure.	R

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O
`member`	text	Specifies the name of the component.	R
`is_complex_part`	bool	`true` if refering to the `complex` type partially. In this case, the member name(the value of the `member` attribute) is either "`RE`" or "`IM`".	O

7.4.3 `FcoArrayRef` element

The `FcoArrayRef` element represents a reference to a coarray.

Contents model

```
(varRef, (arrayIndex)+)
```

Child elements

name	description	R/O
`varRef`	Specifies the coindexed named object.	R
`arrayIndex`	Specifies the image selector.	R

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier corresponding to the referenced coarray in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O

7.4.4 `FarrayRef` element

The `FarrayRef` element represents a reference to an array section or an array element. In the case representing a reference to an array element, specifies all of the index elements by the `arrayIndex` element.

Contents model

```
(varRef, (arrayIndex | indexRange | FarrayConstructor | FarrayRef)*)
```

Child elements

name	description	R/O
`varRef`	Specifies the reference to the array.	R
`arrayIndex`	Specified if the element list of the array section is expressed by the subscripts. Can be repeated the number of the dimension times together with other elements.	O
`indexRange`	Specified if the element list of the array section is expressed by the upper and lower bounds. Can be repeated the number of the dimension times together with other elements.	O
`FarrayConstructor`	Specified if the element list of the array section is expressed by the vector subscript by the array constructor. Can be repeated the number of the dimension times together with other elements.	O
`FarrayRef`	Specified if the element list of the array section is expressed by the vector subscript by the array section. Can be repeated the number of the dimension times together with other elements.	O

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O

7.4.5 `FcharacterRef` element

The `FcharacterRef` element represents a reference to a character substring.

Contents model

```
(varRef, indexRange?)
```

Child elements

name	description	R/O
`varRef`	Specifies the reference to the character variable.	R
`indexRange`	Specifies the element list of the character string by the upper and lower bounds.	O

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O

7.4.6 `varRef` element

The `varRef` element represents a reference to a variable.

Contents model

```
(Var | FmemberRef | FarrayRef | FcharacterRef | FcoArrayRef)
```

Child elements

name	description	R/O
`Var`	Specifid if the element references the variable.	R
`FmemberRef`	Specifid if the element references the structure component.	R
`FarrayRef`	Specifid if the element references the array section of the array.	R
`FcharacterRef`	Specifid if the element references the character substring of the character string.	R
`FcoArrayRef`	Specifid if the element references the coarray.	R

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O

7.5 Function call

7.5.1 `functionCall` element

The `functionCall` element represents a function / subroutine call.

Contents model

```
((name|FmemberRef), arguments?)
```

Child elements

name	description	R/O
`name`	Specifies the name of the function or subroutine.	R
`FmemberRef`	Specifies the name of the function or subroutine (in the case of the component of the structure or the type bound procedure).	R
`arguments`	Specifies the expressions of the arguments.	O

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O
`is_intrinsic`	bool	Specifies if the intrinsic function / subroutine call.	O

7.5.2 `arguments` element

Contents model

```
(exprModel)*
```

Child elements

name	description	R/O
`exprModel`	Specifies the expressions of the arguments. Refer to "9.4 exprModel".	O

Attributes

name	type	description	R/O
-	-	-	-

7.6 Binary operation element

The elements representing the binary operators are described below.

element	operator	operation
`plusExpr`	+	addition
`minusExpr`	-	subtraction
`mulExpr`	*	multiplication
`divExpr`	/	division
`FpowerExpr`	**	exponentiation
`FconcatExpr`	//	concatenation
`logEQExpr`	== .EQ.	equal
`logNEQExpr`	/= .NE.	not equal
`logGEExpr`	>= .GE.	greater than or equal
`logGTExpr`	> .GT.	greater than
`logLEExpr`	<= .LE.	less than or equal
`logLTExpr`	< .LT.	less than
`logAndExpr`	.AND.	logical intersection
`logOrExpr`	.OR.	logical union
`logEQVExpr`	.EQV.	logical equivalence
`logNEQVExpr`	.NEQV.	logical non-equivalence
`userBinaryExpr`	arbitrary	depends on the interface.

Contents model

`(exprModel, exprModel)`

Child elements

name	description	R/O
`exprModel`	Specifies the left-hand expression as the first operand, the right-hand expression as the second operand. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O

7.7 Unary operation element

The elements representing the unary operators are described below. No element is prepared for the unary operator '+' because it is omitted by the canonicalization.

element	operator	operation
`unaryMinusExpr`	-	sign inversion
`logNotExpr`	.NOT.	logical complement
`userUnaryExpr`	arbitrary	depends on the interface.

Contents model

```
(exprModel)
```

Child elements

name	description	R/O
`exprModel`	Specifies the operand expression. Refer to "9.4 exprModel.	R

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	O

8 General element

8.1 `kind` element

The `kind` element represents a `kind` parameter of the type.

Contents model

```
(#PCDATA)
```

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
-	-	-	-

8.2 `id` element

The `id` element represents an identifier of the name of the variable, array, structure component, dummy argument of the function or subroutine, etc.

Contents model

```
(name)
```

Child elements

name	description	R/O
`name`	Specifies the name of the identifier(the name of the variable if the identifier corresponds to a variable etc.).	R

Attributes

name	type	description	R/O
`sclass`	text	Specifies the storage class, one of '`auto`', '`param`', '`extern`', '`extern_def`', '`label`', '`tagname`'.	R
`type`	text	Specifies the type name identifier in XcodeML/Fortran. Refer to "9.1 The data type name identifier".	R

Example

The symbol table entry of the variable "`xyz`" in "`integer xyz`" is as follows:

XcodeML/Fortran
```
<id sclass="extern_def" type="Fint">
  <name>xyz</name>
</id>
```

The symbol table entry of the function "`foo`" in "`function foo`" is as follows: Here, "`F06f168`" is the `type_id` of the data type of "`foo`".

XcodeML/Fortran
```
<id sclass="extern_def" type="F06f168">
  <name>foo</name>
</id>
```

8.3 `name` element

The `name` element specifies the name of a variable or a type name etc.

Contents model

`(#PCDATA)`

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`type`	text	Specifies the type name identifier in XcodeML/Fortran.	R

8.4 `value` element

The `value` element represents an arbitrary value expressed by an expression.

Contents model

(exprModel)

Child elements

name	description	R/O
exprModel	Specifies the expression of the value. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
repeat_count	text	Specifies the repeat count of the element. Valid only in the initialization expression of the data statement.	O

8.5 kind params

The param element represents a dummy argument list of the function or subroutine. The element is also used to represent a statement label list in the go to statement.

Contents model

(name*)

Child elements

name	description	R/O
name	Specifies the names of the dummy arguments or the statement labels. In the case of the statement labels, the type attribute of the name element must be 'Fint'.	O

Attributes

name	type	description	R/O
-	-	-	-

8.6 len element

The len element represents an arbitrary length expressed by an expression.

Contents model

(exprModel)

Child elements

name	description	R/O
exprModel	Specifies the expression of the length. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
`is_assumed_shape`	bool	`true` if no length is specified("`(:)`").	O
`is_assume_size`	bool	`true` if the length is the assumed-size.	O

8.7 `body` element

The `body` element represents a block of statements.

Contents model

`(statementModel*)`

Child elements

name	description	R/O
`statementModel`	Specifies arbitrary statements.	O

Attributes

name	type	description	R/O
-	-	-	-

8.8 `rename` element

The `rename` element represents a local name and a name accessed in the `use` statement.

Contents model

`empty`

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
`use_name`	text	Specifies the name accessed.	R
`local_name`	text	Specifies the local name.	R
`is_operator`	bool	`true` if the element represents the rename of the defined operator.	O

8.9 `renamable` element

The `renamable` element represents a local name and a name accessed, which are omissible, in the `use` statement with the only option.

Contents model

`empy`

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
use_name	text	Specifies the name accessed.	R
local_name	text	Specifies the local name.	O
is_operator	bool	true if the element represents the rename of the defined operator.	O

8.10 arrayIndex element

The arrayIndex element represents an arbitrary index value(or size) expressed by an expression.

Contents model

(exprModel)

Child elements

name	description	R/O
exprModel	Specifies the expression of the value. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
-	-	-	-

8.11 indexRange element

The indexRange element represents an arbitrary range of the subscript(or size) expressed by an upper and lower bound and a step. The meaning of the element depends on the kind of the parent element.

Contents model

(lowerBound?, upperBound?, step?)

Child elements

name	description	R/O
lowerBound	Specifies the lower bound. The kind of the parent element determines the default value.	O
upperBound	Specifies the upper bound. The kind of the parent element determines the default value.	O
step	Specifies the step. May be neglected depending on the kind of the parent element.	O

Attributes

name	type	description	R/O
`is_assumed_shape`	bool	`true` in the case of the assumed-shape array.	O
`is_assumed_size`	bool	`true` in the case of the assumed-size array.	O

8.12 `lowerBound` element

The `lowerBound` element represents a lower bound of a range.

Contents model

`(exprModel)`

Child elements

name	description	R/O
`exprModel`	Specifies the expression of the lower bound. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
-	-	-	-

8.13 `upperBound` element

The `upperBound` element represents a upper bound of the range.

Contents model

`(exprModel)`

Child elements

name	description	R/O
`exprModel`	Specifies the expression of the upper bound. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
-	-	-	-

8.14 `step` element

The `step` element represents a stride of a range.

Contents model

`(exprModel)`

Child elements

name	description	R/O
exprModel	Specifies the expression of the stride. Refer to "9.4 exprModel".	R

Attributes

name	type	description	R/O
-	-	-	-

8.15 FdoLoop element

The FdoLoop element represents an implied-do. The element defines all the implied-does in the data statement, the I/O statement and the array constructor.

Contents model

```
(Var, indexRange, value+)
```

Child elements

name	description	R/O
Var	Specifies the do variable.	R
indexRange	Specifies the upper and lower bounds.	R
value	Specifies the expression element for the value of the implied-do.	R

Attributes

name	type	description	R/O
-	-	-	-

8.16 namedValue element

The namedValue element represents a value with a keyword.

Contents model

```
empty
```

Child elements

name	description	R/O
-	-	-

Attributes

name	type	description	R/O
name	text	Specifies the keyword.	R
value	text	Specifies the value.	R

8.17 `namedValueList` element

The `namedValueList` element represents a value list with keywords.

Contents model

```
(namedValue*)
```

Child elements

name	description	R/O
`namedValue`	Specifies the value with the keyword.	O

Attributes

name	type	description	R/O
-	-	-	-

8.18 `valueList` element

The `valueList` element represents a value list expressed by an expression.

Contents model

```
(value*)
```

Child elements

name	description	R/O
`value`	Specifies the expression for the value.	O

Attributes

name	type	description	R/O
-	-	-	-

8.19 `varList` element

The `varList` element represents a list.

Contents model

```
(varRef | FdoLoop)*
```

Child elements

name	description	R/O
`varRef`	Specifies the item expressed by the reference to the variable.	O
`FdoLoop`	Specifies the list of the items expressed by the implied-do.	O

Attributes

name	type	description	R/O
`name`	text	Specifies the `namelist` group name if the parent is the `FnamelistDecl` element.	O

9 Common element

The definitions commonly used in an arbitrary element are shown below.

9.1 The data type name identifier

In the program, the data type is identified by the data name. The name is one of the basic data type names or the derived data type names below.

type name	description
`Fint`	integer type
`Freal`	real type
`Fcomplex`	complex type
`Flogical`	logical type
`Fcharacter`	character type
`Fvoid`	void type; represents the type of the return value of the subroutine.
`others`	derived type; expressed by an arbitrary string consisting of alphabets and numbers different from the names of the basic data types. It must be unique in the program.

9.2 Common attributes of the definition / declaration / statement element

Every definition, declaration and statement elements may have the following attributes.

Attributes

name	type	description	R/O
`lineno`	text	Specifies the line number in the Fortran program.	R
`file`	text	Specifies the source code name of the Fortran program.	R

9.3 `lValueModel` model

The `lValueModel model` is commonly used by the elements which refer to the variable as the lvalue.

Contents model

```
(Var | FarrayRef | FcharacterRef | FmemberRef | FcoArrayRef)
```

Element

Refer to the specification of each element.

9.4 `exprModel` model

The `exprModel` model is commonly used by the elements which refer to the expression.

Contents model

```
(FintConstant | FrealConstant | FcomplexConstant | FcharacterConstant | FlogicalConstant
| FarrayConstructor | FstructConstructor | Var | FarrayRef | FcharacterRef | FmemberRef
| FcoArrayRef | varRef | functionCall | plusExpr | minusExpr | mulExpr | divExpr
| FpowerExpr | FconcatExpr | logEQExpr | logNEQExpr | logGEExpr | logGTExpr | logLEExpr
```

```
| logLTExpr | logAndExpr | logOrExpr | logEQVExpr | logNEQVExpr | unaryMinusExpr
| logNotExpr | userBinaryExpr | userUnaryExpr | FdoLoop)
```

Element

Refer to the specification of each element.

9.5 `statementModel` model

The `statementModel` model is commonly used by the elements which refer to the statement.

Contents model

```
(FassignStatement | exprStatement | FpointerAssignStatement | FifStatement | FdoStatement
| FdoWhileStatement | continueStatement | FcycleStatement | FexitStatement | FreturnStatemer
| gotoStatement | statementLabel | FselectCaseStatement | FcaseLabel | FwhereStatement
| FstopStatement | FreadStatement | FwriteStatement | FprintStatement | FrewindStatement
| FendFileStatement | FbackspaceStatement | FopenStatement | FcloseStatement | FinquireState
| FformatDecl | FdataDecl | FentryDecl | FallocateStatement | FdeallocateStatement
| FnullifyStatement | FpragmaStatement | FcontainsStatement)
```

Element

Refer to the specification of each element.

10 Miscellaneous

10.1 Intrinsic procedures

Intrinsic procedures are treated as external functions or subroutines without `extern` declaration.

10.2 Treatment of comments and pragmas

There is no element which represents comments. However, the pragma elements for the directives of OpenMP 3.0 are kept by the `FpragmaStatement` elements.

10.3 Canonicalization

In this specification of XcodeML/Fortran, codes are assumed to be altered in the actual conversion process by the frontend within the range where the meanings of the codes are not changed. The alterations are made as follows:

- As for the `implicit` statement, declares all the variables explicitly and adds the `implicit none` statement.
- The `parameter` statement, the `dimension` statement, the `allocatable` statement, the `pointer` statement, the `target` statement, the `intent` statement and the `save` statement saving a variable are unified into a type declaration of the variable.
- The `parameter` variable initialized by a constant is replaced by the constant.
- The `statement function` is inlined.
- The unary operator '+' is omitted.

- Any comments other than the directives of OpenMP 3.0 are removed.

Accordingly, some Fortran 90 syntax elements such as the `statement function` have no corresponding elements in XcodeML/Fortran.

10.4 Restrictions

This specification of XcodeML/Fortran does not support the following Fortran 90 syntax because they do not appear in both of NBP and SPEC benchmarks.

- The `block data` statement, the `end block data` statement.
- The `optional` statement within the `module` declaration.
- The binary, octal and hexadecimal integer expression by the BOZ literal.

On the other hand, the following 6 items from the obsolescent features in Fortran 90 are not supported.

- The `do` variable and the expressions of type default real or double precision real, and the shared do-loop termination.
- The `assign` statement, the `assigned go to` statement and the `assigned format`.
- Branching to an `end if` statement.
- The alternate `return` and the `alternate return` statement.
- The `pause` statement.
- The `H edit descriptor`.

11 Bibliography

1. The XcodeML specification(version 0.8J).
2. The report on the usage of Fortran 90/95 features in NBP/SPEC.
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4. The International Standard : ISO/IEC 1539-1991 The Programming Languages FORTRAN
5. The Japanese Industrial Standard : JIS X 3001-1994 Programing Language FORTRAN