The Algol 68 Jargon File

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This file provides definitions for many terms used in the context of the Algol 68 programming language and associated technologies. You can find this file in other formats along with the sources at `https://jemarch.net`.

1 Introduction

As C. H. Lindsey puts it in his legendary Informal Introduction to Algol 68, a language in which fundamental concepts combine in an orthogonal way requires very precise terminology. Algol 68 is the orthogonal programming language for antonomasia, and it for sure introduces a rich set of very precise terminology.

Furthermore, when the language got introduced the IFIP WG-2.1 took great care of using new terms for concepts that had their rough similar equivalences in other programming languages, instead of using the most common terms. Such is the case of *assignation*, which is similar but not exactly the same than the *assignment* of other programming languages. Many of the new terms are neologisms created for the occasion, also for good reasons as discussed below.

This all means that the Algol 68 programmers, implementors and aficionados need to get familiar with a very precise and somewhat extensive terminology. That may be quite confusing to the uninitiated.

As with most things related to Algol 68, mastering the terminology requires a little bit of effort and time, but believe me, it pays back in spades. Watching two Algol 68 programmers discussing about their programs is like watching two well greased machines: the terms they use are precise, and they can use terms referring to domain-specific concepts that would require the usage of a (probably not very well constructed on the fly) metaphor or analogy in other programming languages, and very little if anything is lost in translation. The communication is fast, rich and precise. It is also fun.

This jargon file is an attempt to gather and summarize this terminology for the benefit of anyone introducing herself in the enthralling world of algorithmic languages.

How to use this file

Each entry in the file describes the meaning of one particular term, including a more or less extensive description of the entity or concept described by the term. This usually involves programming examples, but note that the purpose of this file is *not* to be an Algol 68 manual. Usage examples *of the term* are shown in the form of hypothetical lines of dialogues. When applicable, the syntax of the concept associated with the term will be also explained as simplified syntactic rules from the Report. Finally, references to other entries or to the bibliography are included in the entries.

So how to look for a term in this file?

If you are reading this document in an *info* reader, then you can press `m` and introduce the term you are looking for. Your info reader shall be nice enough to provide auto-complete. References can then be followed the same way.

If you are reading this document as a man-page, then you will find references to all the entries of the jargon file in the `SEE ALSO` section below.

If you are reading this document as a PDF, then you can use either the table of contents or the concepts index you can found in the appendices. Depending on how nice your PDF reader is, and assuming you are not reading a printed document, you can probably follow the references by clicking on them.

If you are reading this document as an HTML in some website, then you can follow the hyperlinks in table of contents and indexes.

Bibliography

- The Revised Report on the Algorithmic Language Algol 68 By A. van Wijngaarden, B.J. Mailloux, J.E.L Peck, C.H.A. Koster, M. Sintzoff, C.H. Lindsey, L.G.L.T. Meertens and R.G. Fisker.

  Referenced by marks like [RR *section*].

- The Report on the Standard Hardware Representation for ALGOL 68 By Wilfred J. Hansen and Hendrik Boom.

  Referenced by marks like [SHR *section*].
- The Informal Introduction to Algol68 By C.H. Lindsey and V.D. Meulen.

  Referenced by marks like [II *section*]

2 Representation

2.1 Pseudo Comment

Meaning

The chapter 10 of the Algol 68 Revised Report describes the standard environment in which programs run. This chapter includes many code snippets with declarations and other entities that describe the interface provided by the standard preludes. However, code for the preludes is not given in full, suitable to be compiled form: many details are abstracted. Furthermore, the code that is actually provided in more detail is intended to serve as reference algorithms and is not necessarily the most efficient or even convenient way to encode the expressed logic.

In addition to regular comments, the code snippets in this part of the Report use *pseudo-comments*, which are delimited by a pair of bold tags **c**, and represent either a declarer or a closed-clause, as suggested by the contents of the pseudo-comment.

An example of the usage of pseudo-comments from the report:

```
op round = (real a) int:
     c An integral value, if one exists, which is
       widenable to a real value differing by not more
       than one-half from the value of 'a'
     c;
```

Many other texts, articles and books in the Algol 68 sphere make use of pseudo-comments.

It may be even possible to add support to compilers so they recognize them and compile them into some appropriate run-time diagnostic, which could be helpful in top-level programming.

See Also

- See Section 3.2 [Comment], page 5,
- [RR 10.1.3.step7]

2.2 Taggle

Meaning

The Standard Hardware Representation defines a *taggle* as a nonempty sequence of letters and digits. Taggles are the constituents of tags. For example, in:

```
int age of retirement = 65;
```

The tag `age of retirement` is composed by three taggles: `age`, `of` and `retirement`. Note how typographical display features (space characters in this case) can appear between taggles in a tag.

See Also

- [RR 9.4.2.2.a]
- [SHR 1]

3 Language

3.1 Actual Parameter

Meaning

An *actual parameter* is the right hand side of an identity declaration, and consists of an unit whose context is strong. The value yielded by this unit, after strong coercion if necessary, shall be of the same mode than the one specified by the formal declarer. The value is ascribed to the defining identifier in the identity declaration.

For example, in the following identity declaration the actual parameter is `0`, which is in a strong context, and therefore gets widening to match the mode specified by the formal declarer **real**:

real **ratio** `= 0;`

Actual parameters also appear in routine calls, where they define the values passed to a procedure or an operator. This highlights that in Algol 68 the mechanism of associating formal parameters with actual parameters is the identity declaration: during a function call the internal values provided in the call get ascribed to the formal parameters. For example, in the following routine call:

```
multiply vectors ((10, 20), (1, 2));
```

The actual parameters are `(10, 20)` and `(1, 2)`, which are row displays of some **vector** mode.

Syntax

Simplified [RR 4.4.1.A,d]:

```
A) MODINE :: MODE ; routine.

d) MODE source for MODINE:
     where (MODINE) is (MODE), MODE source;
     where (MODINE) is (routine), MODE routine text.
```

Simplified [RR 5.2.1.1.c]:

```
c) MODE source:
     strong MODE unit.
```

We are not including here the rules for `routine text` but these can be found in [RR 5.4.1.a,b].

See Also

- Section 3.10 [Formal Parameter], page 12,
- Section 3.9 [Formal Declarer], page 11,
- [II 2.2.1]
- [RR 4.4.1.d]

3.2 Comment

Meaning

Like in other programming languages, comments in Algol 68 programs are intended to document the program and their contents are ignored by the compiler: they are stripped out by the lexer. There are three styles of comments, that differ only by the delimiters used to begin and end the comment.

The first style uses **comment** to delimit the comment contents:

```
comment
  This program does foo and bar.
  Written by John Doe.
comment
```

The second style uses **co** to delimit the comment contents:

```
if not ok
then co This happens rarely co
     abort
fi
```

The third style uses # to delimit the comment contents:

```
print (whatever) # XXX remove trace #
```

Comments of different styles can be nested. Therefore up to three nesting levels is supported, which must be more than enough.

3.3 Contraction

Meaning

Certain language constructions which can be cumbersome for the programmer to write can be "contracted" into equivalent forms. The resulting shorter form is called a *contraction*. The constructions that can be contracted are:

- Collateral variable declarations.
- Collateral identity declarations (constant declarations).
- Identity declarations of routine modes.
- Priority declarations.

See for example the following collateral declaration of several variables of the same name, followed by it's corresponding contraction:

```
int size, int offset, int value := 1024;
int size, offset, value := 1024;
```

In the contracted form above, the same actual declarer (**int**) is shared among all the declared variables. The elaboration is still collateral, as implied by the comma separator.

The same can be applied to identity declarations. If we turn the variables above into constants, we have:

```
int size = 0, int offset = 0, int value = 1024;
int size = 0, offset = 0, value = 1024;
```

Note that you cannot mix variable declarations and constant declarations in the same contraction. If you tried to do:

```
int alignment = 1, int value := 1024;
int alignment = 1, value := 1024; # BAD #
```

The first collateral declaration is perfectly valid, but the resulting contraction is not. The reason is that in the variable declaration for `value` the mode at the left is an actual declarer that generates a new name to hold the value, whereas the mode at the left in the identity declaration for `alignment` is a formal declarer. This becomes more clear if we explicit the generator in the variable declaration:

```
int alignment = 1, loc int value := 1024;
int alignment = 1, value := 1024; # BAD #
```

Identity declarations of routines can become clunky:

```
proc([]real,real)real waverage = ([]real numbers, real weight) real:
begin
  ...
end
```

The corresponding contracted form, where the actual declarer is shortened to **proc**, would be:

```
proc waverage = ([]real numbers, real weight) real:
begin
  ...
end
```

Note however that the contraction form of a routine declaration is less expressive than the uncontracted form. In the contracted form it is required for the right hand side to be a routine text. That is not the case in the uncontracted form, in which the right hand side can be any unit yielding a routine of the expected mode, like in:

```
proc(int,int) transformer = (op = add
                             | int(int a, int b)int: a + b
                             | int(int a, int b)int: a * b);
```

Finally, collateral declarations of the priority of operators can also be contracted in the expected way:

```
prio isoneof = 6, prio ismanyof = 6;
prio isoneof = 6, ismanyof = 6;
```

Syntax

Simplified [RR 4.1.1.b:c]:

```
b) COMMON joined definition of PROPS:
     COMMON joined definition of PROPS, and also token, joined definition of PROP.
c) COMMON joined definition of PROP:
     COMMON definition of PROP.
```

Note that `and also token` is the comma symbol in most representations.

The rules above are used in the syntax of all the constructs mentioned in this article. For example the following simplified rule [RR 4.3.1.a] implements priority declarations:

```
a) priority declaration of DECS:
     priority token, priority joined definition of DECS.
```

Where `priority` plays the role of `COMMON` and `DECS` of `PROPS`. The rules for the other constructions are built the same way, so we are not including them here.

See Also

- [II 1.1.3,2.1.2,4.2.2.1]
- [RR 4.1.1.b:c]

3.4 Development

Meaning

Development is the process of replacing a mode indication by its actual declarer. For example, given the following mode declaration:

```
mode tree_node = struct (int payload, ref tree_node left, right);
```

In the example below, which denotes a variable declaration, the occurrence of the mode indication **tree_node** is developed into the full structure mode definition:

```
tree_node top = (0, nil);
```

Which is then equivalent to:

```
struct (int payload, ref tree_node left, right) top = (0, nil);
```

The term "development" is not to be confused with "elaboration". The first applies to modes, the second to phrases and clauses. The first happens at compile-time, the second at run-time. It doesn't make sense to elaborate a mode, nor to develop a formula for example.

Usage

- *"The mode node develops into a structure"*

See Also

- [II 1.3.3.1]

3.5 Enquiry Clause

Meaning

An *enquiry clause* is a serial clause in a meek context that doesn't immediately contain labels, and therefore nor completers. Serial clauses that appear in the enquiry clause can feature labels and completers on their own.

Enquiry clauses (or just "enquiries") can be found in the following constructions:

– In conditional clauses, the if-part is an enquiry clause that must yield an **int**.
– In case clauses, the in-part is an enquiry clause that must yield an **int**.
– In loop clauses, if present, the while-part is an enquiry clause that must yield a **bool**.
– In conformity clauses, the case-part' is an enquiry clause that must yield an union.

Early drafts of the language used regular serial clauses in these contexts, which led to an unexpected problem. Consider the following conditional clause:

```
if int i := x + 10; xxx: i = 0
then ...
else ... i := 0; go to xxx ...
fi
```

In conditional clauses the if-part introduces a range that is visible in the rest of the clause. In the example above, if `x` is not zero when the clause is elaborated the `else` part gets elaborated and jumps back to the if-part. Similar situations happen in case, loop and conformity clauses. To avoid these difficulties, enquiry clauses got introduced with the restrictions explained above.

See Also

- Conditional Clause
- Loop Clause
- Enquiry Clause
- Conformity Clause
- [II 3.2.4.2]
- [II 3.2.4.3]
- [II 3.5.2]
- [II 3.6]

3.6 Environment Enquiry

Meaning

An *environment enquiry* is a kind of procedure defined in the standard prelude whose purpose is to provide information about the properties of the particular implementation used to compile the program.

Procedures implementing environment enquiries do not take any argument and yield a value of some appropriate mode. For example, the `max int` environment enquiry yields a value of mode **int**, whereas `null character` yields a value of mode **char**.

The section 10.2.1 of the Revised Report defines the environment enquiries that a conforming implementation must provide. These are:

int `int lenghts`
: 1 plus the number of extra lenghts of integers. This determines how many **long** entries in a longsety preceding **int** are meaningful in the implementation.

int `int shorts`
: 1 plus the number of extra shorts of integers. This determines how many **short** entries in a shorsety preceding **int** are meaningful in the implementation.

sizety int *`sizety`* `max int`
: The largest *sizety* integral value.

int `real lengths`
: 1 plus the number of extra lenghts of real numbers. This determines how many **long** entries in a longsety preceding **real** are meaningful in the implementation.

int `real shorts`
: 1 plus the number of extra shorts of real numbers. This determines how many **short** entries preceding **real** in a shortsety are meaningful in the implementation.

sizety real *`sizety`* `max real`
: The largest *sizety* real value.

sizety real *`sizety`* `small real`
: The smallest *sizety* real value such that both **sizety** `1 +` *`sizety`* `small real >` **sizety** `1` and **sizety** `1 -` *`sizety`* `small real <` **sizety** `1`.

int `bit lengths`
: 1 plus the number of extra longs of bits. This determines how many **long** entries in a longsety preceding **bits** are meaningful in the implementation.

bin `bit shorts`
: 1 plus the number of extra shorts of bits. This determines how many **short** entries in a shortsety preceding **bits** are meaningful in the implementation.

int *`sizety`* `bits width`
: The number of elements in a value of mode **sizety bits**.

int `bytes lenghts`
: 1 plus the number of extra longs of bytes. This determines how many **long** entries in a longsety preceding **bytes** are meaningful in the implementation.

int `bytes shorts`
: 1 plus the number of extra shorts of bytes. This determines how many **short** entries in a shortsety preceding **bytes** are meaningful in the implementation.

int *`sizety`* `bytes width`
: The number of elements in a value of mode **sizety bytes**.

op abs = (**char** `a`) **int**
: The integral equivalent of the character `a`.

op repr = (**int** `a`) **char**
: That character `x`, if it exists, for hich **abs** `x = a`.

int `max abs char`
: The largest integral equivalent of a character.

char `null character`
: Some character.

char `flip` The character used to represent **true** during transput.

char `flop` The character used to represent **false** during transput.

char `errorchar`
: The character used to represent unconvertible arithmetic values.

char `blank`
: The blank character.

See Also

- [RR 10.2.1]
- Section 3.8 [Flip and Flop], page 11,

3.7 Field Selector

Meaning

Structure modes consist on one or more fields, each of which have a mode on their own and a name. For example, this is how we would declare a mode for a node in a linked list:

node = **struct** (**int** `id`, **real** `weight`, **ref node** `next`);

The names of the fields in the structure, `id`, `weight` and `next`, are known as *field selectors* of the structure mode. Field selectors look like identifiers and are formed using the same rules, but they are not identifiers: they cannot be used on their own, and can only appear in a program text as part of a *selection*, like in `next` **of** `node`.

Note that the field selectors are integral part of the structure mode. The two structure modes **struct** (**int** `a`, **int** `b`) and **struct** (**int** `x`, **int** `y`) are different modes, since the field selectors of their fields are different. All the fields in a structure mode must feature a field selector: there is no provision in the language for "anonymous" fields.

Syntax

Simplified [RR 4.6.1.d]:

```
d) structured with FIELDS mode declarator:
     structure token, FIELDS portrayer of FIELDS brief pack.
```

Simplified [RR 1.2.1.I:J]:

```
I) FIELDS :: FIELD ; FIELDS FIELD.
J) FIELD :: MODE field TAG.
```

Note that `TAG` is the metanotion that produces identifier tokens.

See Also

- [II 2.4.1]
- [RR 4.6.1.d,1.2.1.I:J]

3.8 Flip and Flop

Meaning

During transput, the boolean values **true** and **false** are represented by two characters known as *flip* and *flop* respectively. The particular characters used for flip and flop are provided by two enviroment enquiries. Most implementation have used the character `T` for flip and `F` for flop.

See Also

- [RR 10.2.1]
- Section 3.6 [Environment Enquiry], page 9,

3.9 Formal Declarer

Meaning

A *formal declarer* specifies the mode of the value being ascribed in an identity declaration. It appears on the left hand side of an identity declaration, before the defining identifier. For example, in the following identity declaration the formal declarer is the mode indication **real**:

```
real pi = 3.141592;
```

Formal declarers also appear in routine texts as the modes of formal parameters, which shouldn't be surprising, since the mechanism of associating formal parameters with actual parameters in a routine call is the identity declaration: during a function call the internal values provided in the call get ascribed to the formal parameters. For example, in the following routine the mode indications **ref tree** and `[]`**int** are formal declarers:

```
proc set tree weights = (ref tree node, []int weights) void:
begin
   ...
end
```

The mode specified in a cast is also a formal declarer. In the following example, where a cast is used in the firm context of an operator, the formal declarer is **real**:

```
c := real (2) * pi * r;
```

Note that (unlike actual declarers) formal declarers of row modes do not include bounds. If bounds are provided they are ignored, although some implementation may offer checking the bounds at run-time as a security measure. This could be particularly useful in formal parameters, where the run-time check would make sure multiples of the expected bounds get passed to the routine.

Syntax

Simplified [RR 4.4.1.c] (formal declarer in identity declaration):

```
A) MODINE :: MODE ; routine.

c) identity definition of MODE TAG:
     MODE defining identifier with TAG, is defined as token,
     source for MODINE.
```

Simplified [RR 4.6.1.r] (formal declarer in formal parameter):

```
r) MODE parameter joined declarer:
     formal MODE declarer.
```

Simplified [RR 5.5.1.a] (formal declarer in cast):

```
a) MOID cast:
```

```
        formal MOID declarer, strong MOID ENCLOSED clause.
```

In `4.4.1.c` the formal declarer is the `MODE` before the `defining identifier`.

Note that `is defined as token` is the equal sign character in the standard representation.

See Also

- [II 2.2.1]
- [RR 4.4.1.c,4.6.1.r,5.5.1.a]

3.10 Formal Parameter

Meaning

A *formal parameter* is the left hand side of an identity declaration, and consists of a formal declarer, which indicates the mode of the internal object being ascribed in the identity declaration, followed by a defining identifier to which the value will be ascribed. In the identity declaration:

```
real ratio = 2.71828;
```

The formal parameter is **real** `ratio`, the formal declarer is the mode indication **real** and the defining identifier is `ratio`.

Formal parameters also appear in routine texts, where they define which values are accepted as parameters by the routine when it is called. This highlights that in Algol 68 the mechanism of associating formal parameters with actual parameters is the identity declaration: during a function call the internal values provided in the call get ascribed to the formal parameters. For example, in the following routine:

```
proc multiply vectors = (vector a, vector b) vector:
begin
   ...
end
```

The formal parameters are **vector** `a` and **vector** `b`.

Note that formal parameters may appear "distributed" in the case of contracted definitions. In the following example:

```
real x, y, z;
```

There are three formal parameters, which are **real** `x`, **real** `y` and **real** `z`.

Syntax

Simplified [RR 4.4.1.a:c]

```
A) MODINE :: MODE ; routine.

a) MODINE identity declaration of DECS:
     formal MODINE declarer, identity joined definition of DECS.

b) routine declarer: procedure token.

c) identity definition of MODE TAG:
     MODE defining identifier with TAG, is defined as token, MODE source for MODINE.
```

Note that `is defined as token` is the equal sign character in the standard representation.

See Also

- See Section 3.9 [Formal Declarer], page 11,
- [II 2.2.1]
- [RR 4.4.1.a:c]

3.11 Go-On Symbol

Meaning

The *go-on symbol* separates the phrases (declarations and units) in serial clauses. The concrete syntax for the go-on symbol is almost always the semicolon character `;`.

Consider for example the following closed clause, that consists on a serial clause with a declaration, a statement (voided assignation) and a final expression that determines the value of the serial clause:

```
(int t := x; x := y; t)
```

In Algol 68 the go-on symbol always implies serial elaboration. In the example above, the declaration is elaborated first, then the assignation and finally the final expression.

Strictly speaking, it is not legal to put extra go-on symbols after the sequence of phrases: unlike in ALGOL 60, Algol 68 doesn't support the notion of "empty statement" (**skip** is used for that purpose instead) so the following code is invalid:

```
begin foo;
      bar;
      baz;
end
```

However, some implementations are lenient and just emit a warning about the superfluous go-on symbol. That is the case of both GNU Algol 68 and Algol68 Genie.

Syntax

Simplified [RR 3.2.1.b]:

```
b) SOID series:
     strong void unit, go on token, SOID series;
     declaration of DECS, go on token, SOID series LABSETY;
     label definition of LAB, series with LABSETY;
     completion token, label definition of LAB, series with LABSETY;
     SOID unit.
```

See Also

- [RR 3.2.1.b]

3.12 Incestuous Union

Meaning

An *incestuous union* is an union that contains two or more alternatives whose modes are firmly related. Two modes M1 and M2 are firmly related if it would be possible to coerce a value of mode M1 to a value of mode M2 in a firm context, or to vice versa.

Consider the following union mode definition:

```
mode datum = union (int,ref int,proc int);
```

This union is incestuous, as both **ref int** and **proc int** values can be coerced to **int** in a firm context, by dereferencing and deproceduring respectively. If allowed in the language, this would lead to an ambiguity. After the assignation in the following example, the value stored in the union variable `mydatum` may either an **int** or a **ref int**:

```
int var;
datum mydatum := var;
```

To avoid these ambiguities incestuous unions are not allowed by the language and should be reported in compile-time errors by Algol 68 compilers.

Syntax

[RR 4.7.1.a]:

```
f) WHETHER MOODSETY1 with MOODSETY2 incestuous:
     where (MOODSETY2) is (MOOD MOODSETY3),
       WHETHER MOODSETY1 MOOD with MOODSETY3 incestuous
         or MOOD is firm union of MOODSETY1 MOODSETY3 mode;
```

See Also

- [RR 4.7.1.f]
- Firmly Related

3.13 Indicator

Meaning

An *indicator* is either an identifier, a mode indication or an operator. In all cases it specifies or denotes some other entity: identifiers specify the internal objects ascribed to them in identity declarations, mode indications specify modes associated to them in mode declarations, and operators specify routines ascribed to them in operation declarations.

The indicator in the following identity declaration is `pi`:

```
real pi = 3.14;
```

The indicator in the following mode declaration is **tree_node**:

```
mode tree_node = struct (int payload, ref tree_node next);
```

The indicator in the following operation declaration is `+`:

```
op + = (tree_node n1, tree_node n2) tree_node: ...;
```

Syntax

[RR 4.8.1.A,G]:

```
A) INDICATOR :: identifier ; mode indication ; operator.
G) TAX :: TAG ; TAB ; TAD ; TAM.
```

See Also

- Section 3.16 [Mode Indication], page 16,
- [II 1.1.1]
- [RR 4.8.1.A]

3.14 Longsety

Meaning

A *longsety* is a sequence of zero or more **long** bold tags. The term follows the fashion of the Revised Report, where the suffix `-ety` means "or empty".

The Algol 68 modes **int**, **real**, **compl**, **bits** and **bytes** can be prefixed with any number of **long** tag words. The effect of each **long** is to double the precision of the mode.

At some point, however, a "saturation" point is reached where the addition of extra **long** has no further effect on the mode. Where that point resides is up to the particular implementation.

For example, if the precision of **int** is four bytes or 32-bit, the precision of **long int** is 64-bit, and the precision of **long long int** is 128-bit.

A longsety can also be used in an integral denotation in order to specify the mode of the denotation. For example in the formula:

```
long 20 + long 30
```

The denotations **long** 20 and **long** 30 are of mode **long int**, which determines its precision. The reason why it is important to specify the mode in the denotations is that in Algol 68 it is not legal to widen to a mode having a different precision, so the following identity declaration is not legal:

```
long long int number = 100; # BAD #
```

This is because the mode of the denotation `100` is `int` whereas the expected mode is **long long int**. This can be achieved by a longsety in the denotation:

```
long long int number = long long 100;
```

Note that some Algol 68 implementations allow to widen to modes having a different precision.

Syntax

Simplified [RR 1.2.1.E]:

```
E) LONGSETY :: long LONGSETY ; EMPTY.
```

See Also

- Section 3.17 [Shortsety], page 17,
- Section 3.18 [Sizety], page 17,
- [II 2.7.2]
- [RR 1.2.1E]

3.15 Monads and Nomads

Meaning

Algol68 operators, be them predefined or defined by the programmer, can be referred via either bold tags or sequences of certain non-alphabetic symbols. For example, the dyadic operator `+` is defined for many modes to perform addition, the monadic operator **entier** gets a real value and rounds it to an integral value, and the operator `:=:` is the identity relation. Many operators provide both bold tag names and symbols names, like in the case of `:/=:` that can also be written as **isnt**.

Bold tags are lexically well delimited, and if the same tag is used to refer to a monadic operator and to a dyadic operator, no ambiguity can arise. For example in the code:

```
op plus = (int a, b) int: a + b,
   plus = (int a): a;
int val = 2 plus plus 3;
```

It is clear that the second instance of **plus** refers to the monadic operator and the first instance refers to the dyadic operator. If one would write **plusplus**, it would be a third different bold tag.

However, symbols are not lexically delimited as words, and one symbol can appear immediately following another symbol. This can lead to ambiguities. For example, if we were to define a C-like monadic operator `++` like:

```
op ++ = (ref int a) int: (int t = a; a +:=1; t);
```

Then the expression `++a` would be ambiguous: is it `++a` or `+(+a)`?. In a similar way, if we would use `++` as the name of a dyadic operator, an expression like `a++b` could be also interpreted as both `a++b` and `a+(+b)`.

To avoid these problems Algol 68 divides the symbols which are suitable to appear in the name of an operator into two classes: monads and nomads. *Monads* are symbols that can be used as monadic operators. *Nomads* are symbols which can be used as both monadic or dyadic operators.

The Revised Report defines the sets of monads and nomads as metanotions, referring to symbols in an abstract way using symbolical names like "is at most" or "plus i times". These symbols do not always have a clear correspondence in click-able and printable symbols in all computers, so different implementations provide slightly different sets of monads and nomads. For example, in both GNU Algol 68 and Algol 68 Genie the set of monads is `%^&+-~!?` and the set of nomads is `></=*`.

Now that we know about monads and nomads, we can give the precise rules to conform valid operator names in Algol 68:

- A bold tag.
- Any monad.
- A monad followed by a nomad.
- A monad optionally followed by a nomad followed by either `:=` or `=:`, but not by both.

Syntax

Simplified [RR 9.4.2.I,H] defines monads and nomads as metanotions:

```
H) MONAD ::  or; and; ampersand; differs from; is at most; is at least;
             over; percent; indow; floor; ceiling;
             plus i times; not; tilde; down; up;
             plus; minus; style TALLY monad.

I) NOMAD :: is less than; is greater than; divided by;
            equals; times; asterisk.
```

See Also

- [RR 9.4.2.I,H]

3.16 Mode Indication

Meaning

A *mode indication* is a bold word, an external object, that specifies a mode. Examples are **int** and **complex**. It is possible to introduce new mode indications via mode declarations. A mode indication is interchangeable with the mode it denotes within its range, which spans until the end of the current block. For example, the following mode declaration declares a mode indication **tuple**, which is visible until the end of the closed clause:

```
begin
  mode tuple = [2];
  ...
end
```

Mode indications are very often abbreviated and referred to as "MOIDs" or "moids".

Syntax

Simplified [RR 4.8.1.A,a]:

```
A) INDICATOR :: identifier ; mode indication ; operator.
G) TAX :: TAG ; TAB ; TAD ; TAM.

a) QUALITY new defining INDICATOR with TAX:
     TAX token.
```

Note that `TAB` is the meta-notion for a bold tag.

See Also

- [II 2.3]
- [RR 4.8.1.A,a]

3.17 Shortsety

Meaning

A *shortsety* is a sequence of one or more **short** bold tags. The term follows the fashion of the Revised Report, where the suffix `-ety` means "or empty".

The Algol 68 modes **int**, **real**, **compl**, **bits** and **bytes** can be prefixed with any number of **short** tag words. The effect of each **short** is to half the precision of the mode.

At some point, however, a "saturation" point is reached where the addition of extra **short** has no further effect on the mode. Where that point resides is up to the particular implementation.

For example, if the precision of **int** is four bytes or 32-bit, the precision of **short int** is 16-bit, and the precision of **short short int** is 8-bit.

A shortsety can also be used in an integral denotation in order to specify the mode of the denotation. For example in the formula:

short `20 +` **short** `30`

The denotations **short** `20` and **short** `30` are of mode **short int**, which determines its precision. The reason why it is important to specify the mode in the denotations is that in Algol 68 it is not legal to widen to a mode having a different precision, so the following identity declaration is not legal:

short short int `number = 10; # BAD #`

This is because the mode of the denotation `100` is `int` whereas the expected mode is **short short int**. This can be achieved by a shortsety in the denotation:

short short int `number =` **short short** `10;`

Note that some Algol 68 implementations allow to widen to modes having a different precision.

Syntax

Simplified [RR 1.2.1.F]:

```
F) SHORTSETY :: short SHORTSETY ; EMPTY.
```

See Also

- Section 3.14 [Longsety], page 14,
- Section 3.18 [Sizety], page 17,
- [II 2.7.2] [RR 1.2.1.F]

3.18 Sizety

Meaning

A *sizety* is either a *longsety* or a *shortsety*. The term follows the fashion of the Revised Report, where the suffix `-ety` means "or empty".

For example, the sizety of a mode declared as **long long bits** is **long long**.

Usage

This term is useful in order to inquiry the number of size modifiers some particular mode has, like in:

- *"What is the sizety of* **file_size***?"*
- *"The sizety was wrong, I changed it to long long."*

Note that this is not exactly the same than asking for the precision of **FILE_SIZE**. The sizety implies some particular precision, but only indirectly.

Syntax

Simplified [RR 1.2.1.F]:

```
SIZETY :: long LONGSETY ; short SHORTSETY ; EMPTY.
```

See Also

- Section 3.14 [Longsety], page 14,
- Section 3.17 [Shortsety], page 17,
- [II 2.7.2] [RR 1.2.1.F]

3.19 Specification Part

Meaning

Each alternative in a conformity clause is composed by a *specification part*, which determines whether the alternative is chosen, followed by a unit that yields the value to which the clause elaborates in case the alternative is chosen. Each specification part contains a formal declarer followed by an optional defining identifier.

Consider for example the following conformity clause:

```
case datum
in (int i): i + 10,
   (real r): entier r + 10,
   (void): 0
esac
```

The first alternative has a specification part `(`**int** `i):`. It specifies that the alternative is chosen in case the enquiry clause `datum` is an **int**, and ascribes that value to the identifier `r` (which becomes a defining identifier) in the following unit. The second alternative has a similar specification part `(`**real** `r)`. The specification part of the third and last alternative, `(`**void**`)`, doesn't have an identifier.

Syntax

Simplified [RR 3.4.1.j,k]:

```
j) MODE specification defining new MODE TAG:
     declarative defining new MODE TAG brief pack, colon token.
k) MOID specification defining new EMPTY:
     formal MOID declarer brief pack, colon token.
```

See Also

- Conformity Clause
- Section 3.9 [Formal Declarer], page 11,
- [II 3.6]
- [RR 3.4.1.j,k]

3.20 Structure Display

Meaning

When a collateral clause is in a strong context where a primary yielding a structure value is expected, its constituent units are elaborated collaterally as usual, and the resulting values are used to conform the value of the fields of a new structure value of the expected mode. These collateral clauses are called *structure displays*, and play the role of structure denotations in Algol 68, even though they are not truly denotations.

The constituent units of a structure display are known as the *field positions* of the structure display. They are always elaborated in strong context with the mode of the corresponding structure mode field expected. The units are elaborated collaterally.

Consider the following structured mode with a couple of **real** fields and the declaration of a constant of that mode:

```
mode vector = (real x, y);
vector v1 = (3.14, 10)
```

The right hand side of an identity declaration is a strong context, and therefore the required mode is known at compile-time. In this case the mode expected is **vector**. The collateral clause `(3.14, 10)` can then recognized as a structure display of that particular mode, and its constituent units `3.14` and `10` become strong field positions with expected mode **real**. This allows the widening of `10` to `10.0` in this case.

When the context is not strong, however, structure displays cannot be recognized as such. Consider the following operator that adds two **vector**s:

```
op + = (vector a, b) vector:
   (x of a + x of b, y of a + y of b)
```

Again, the structure display in the body of the routine text ascribed to the operator `+` is in a strong context expecting a **vector**, so no problem there. But then consider the following formula that uses the just defined operator:

```
(1, 2) + (3, 4)
```

That is not valid code and a compiler will complain. The operands of a formula are in firm context, and the collateral clauses are recognized as such, which are *void units*. To remedy this we are forced to use casts in order to surround the collateral clauses with a strong context with required mode **vector**:

```
vector (1, 2) +  vector (3, 4)
```

Note that structure displays must have two or more field positions, or certain syntactic ambiguity known as *Yoneda's ambiguity* would arise: given **mode** = **m** (**ref m** `m`); **m** `nobuo, yoneda;` the assignation `nobuo := (yoneda)` is ambiguous. This difficulty can be easily circumvented by using the non-ambiguous `m` **of** `nobuo := yoneda`.

Syntax

Simplified [RR 3.3.1.e:h]:

```
FIELD :: MODE field TAG.

e) strong structured with FIELDS FIELD mode collateral clause:
     FIELDS FIELD portrait.
f) FIELDS FIELD portrait:
     FIELDS portrait, and also token, FIELD portrait.
g) MODE field TAG portrait:
     strong MODE unit;
h) *structure display:
```

```
strong structured with FIELDS FIELD mode collateral clause.
```

Note that `and also token` is the comma symbol in most representations.

Note how the structure mode in `e` has at least two fields.

See Also

- [II 3.4]
- [RR 3.3.1.e:h]

3.21 Subname

Meaning

Selecting a name of a structure value results in another name, which is known as a *sub-name*. For example, given the following structure mode:

```
mode node = struct (int data, ref int next);
```

And a name of a value of mode **node**:

```
node anode := (0, nil);
```

Then selecting the field `data` of the structure name yields a sub-name with mode **ref int**:

```
data of anode := 100;
print ((data of anode))
```

It is said that the mode **ref node** is *"endowed with sub-names"*.

See Also

- [II 1.4.1.2]

3.22 Subscript

Meaning

A *subscript* is used to refer to some particular entry in a multiple's dimension while slicing. For example, in the slice:

```
foo[1,2,3]
```

The subscript `1` refers to the entry in the first dimension of the multiple with index `1`. This doesn't necessarily means the first element: it depends on the bounds of the dimension. Likewise, the subscripts `2` and `3` refer to the values with indexes `2` and `3` in the second and third dimensions of the multiple. The action of applying a subscript is known as *subscripting*.

When subscripts are provided for all the dimensions of a multiple the result of the slice is an element from the multiple.

Syntax

Simplified [RR 5.3.2.e]:

```
e) subscript : meek integral unit.
```

See Also

- [II 1.5.2]
- [RR 5.3.2.e]

3.23 Trimmer

Meaning

A *trimmer* is used to refer to a subset of values in a multiple's dimension while slicing. For example, in the slice:slice

```
foo[1:5]
```

The trimmer `1:5` refers to the values with index `1` to `5` in the only dimension of the multiple `foo`. The action of applying a trimmer is known as *trimming*, and it always yields a slice.

The multiple resulting from the slice above will have lower bound `1` an upper bound `5`, but it is possible to "rebound" the result of trimming by using *revised bounds*. Consider:

```
[]int foo = (1, 2, 3, 4, 5, 6, 7, 8, 9, 10);
[]int trim1 = foo[6:10];
[]int trim2 = foo[6:10 at 1];
[]int trim3 = foo[6:10 @ 1];
```

Where `trim1` has lower bound `6` and upper bound `10`, and both `trim2` and `trim3` have lower bound `1` and upper bound `5`. All `trim1`, `trim2` and `trim3` contain values `6, 7, 8, 9, 10`. Note that **at** and **@** are alternative representations of the "at token".

All components of a trimmer are optional. If the lower bound of the trimmer is omitted (as in `[:5]`) then it defaults to the lower bound of the multiple's dimension. If the upper bound of the trimmer is omitted (as in `[1:]`) then it defaults to the upper bound of the multiple's dimension. Both bounds can be omitted, resulting in `:` or simply an empty string, such as in the slice `foo[2,]`. If the lower bound revision part is omitted, the bounds of the resulting multiple are the same than the bounds specified in the trimmer (or implied by the trimmer.)

Syntax

Simplified [RR 5.3.2.f,g]:

```
f) trimmer : lower bound option, up to token, upper bound option,
             revised lower bound option.
g) revised lower bound : at token, lower bound.
```

See Also

- [II 1.5.2]
- [RR 5.3.2.f,g]

3.24 Vacuum

Meaning

Row displays contain zero, two or more constituent units. A row display that contains no units is known as a *vacuum*. The vacuum yields an empty multiple when evaluated, with whatever number of dimensions required by the appropriate row mode. Each dimension has a lower bound of one and an upper bound of zero.

The following example shows an identity declaration that ascribes a multiple that contains no elements to the identifier `empty`:

```
[]int empty = ();
```

The empty collateral clause `()` is in a strong context where a multiple of mode `[]int` is required, and therefore constitutes a row display. The following holds for the created multiple:

```
assert (lwb empty = 1);
assert (upb empty = 0);
```

```
assert (elems empty = 0);
```

The following example shows a similar identity declaration, but this time the row mode has three dimensions:

```
[,,]int empty cube = ();
```

Note how the vacuum is sill a single empty row display, i.e. it is not written `((()))`. All dimensions of the multiple have the same bounds:

```
assert (1 lwb empty = 1);
assert (1 upb empty = 0);
assert (1 elems empty = 0);
assert (2 lwb empty = 1);
assert (2 upb empty = 0);
assert (2 elems empty = 0);
assert (3 lwb empty = 1);
assert (3 upb empty = 0);
assert (3 elems empty = 0);
```

Syntax

[RR 3.3.1.k]:

```
k) *vacuum : EMPTY PACK.
```

See Also

- Row Display
- [II 3.5.1]
- [RR 3.3.1.k]

3.25 Well-Formedness

Meaning

As is usual in modern programming languages Algol 68 supports an infinity of user defined modes, which are derived from the primitive modes[1]. There are two ways a programmer could shoot herself in the foot while defining modes:

- Values of the specified mode may require infinite memory.
- The mode may introduce ambiguities if values of that mode may be strongly coerced into themselves.

The first problem arises in modes that somehow include themselves. This can happen both directly, when a structure mode has a field of its own mode, or indirectly like in the following example:

```
mode thunk = struct (int content, thunk_extra extra);
mode thunk_extra = struct (char ext code, thunk extra thunk);
```

The second problem is more difficult to find in practice. The following rather artificial example is taken from II:

```
mode itself = ref itself;
ref itself who = loc itself;
```

If some particular mode is free of these problems, it is said that the mode is *well formed*.

Note how the root cause of non-well formed modes is in all cases some sort of recursion. Structural recursion can be avoided by what is known as *shielding*: a **ref** or a **proc** "shields" the

[1] In fact Algol 68 was the first language that seriously introduced the concept

referred or procedured mode that follows from causing recursion. For example, the following mode is well formed and actually quite useful:

```
mode tree node = struct (int data, ref tree node left, right);
```

The well-formedness of modes can always be detected at compile-time using a method known as the *ying-yang algorithm* that is specified in the Revised Report as a predicate grammar (see below).

Syntax

[RR 7.1.1.A]:

```
A) PREF :: procedure yielding ; REF to.
```

[RR 7.4.1.a:d]:

```
a) WHETHER (NOTION) shields SAFE to SAFE:
     where (NOTION) is (PLAIN)
        or (NOTION) is (FLEXETY ROWS of)
        or (NOTION) is (union of) or (NOTION) is (void),
     WHETHER true.

b) WHETHER (PREF) shields SAFE to yin SAFE:
     WHETHER true.

c) WHETHER (structured with) sheilds SAFE to yang SAFE:
     WHETHER true.

d) WHETHER (procedure with) shields SAFE to ying yang SAFE:
     WHETHER true.
```

See Also

- [II 2.4.3]
- [RR 7.1.1.A,7.4,7.4.1.a:d]

3.26 Widening

Meaning

Widening is one of the six coercions. It is allowed in strong syntactic positions. This coercion transforms:

- Integers to real numbers of the same longsety.
- Real numbers to complex numbers of the same longsety.
- A **bits** value to an unpacked row of booleans.
- A **bytes** value to an unpacked row of characters.

Some implementations (like Algol 68 Genie) extend the meaning of widening by allowing transformations from, say, **int** to **long int** or from **long real** to **long long real**, but this is not allowed in the strict language, which requires using the **leng** and **shorten** operators instead.

Syntax

Simplified [RR 6.5.1.a:d]:

```
a) widened to SIZETY real FORM:
     MEEK SIZETY integral FORM.
b) widened to structured with SIZETY real field re
```

```
                                SIZETY real field im mode FORM:
          MEEK SIZETY real FORM;
          widened to SIZETY real FORM.
     c) widened to row of boolean FORM:
          MEEK BITS FORM.
     d) widened to row of character FORM:
          MEEK BYTES FORM.
```

See Also

- Coercion
- [RR 6.5]

4 Implementation

5 Other

5.1 Orthogonal

Meaning

Adriaan van Wijngaarden championed the notion of *orthogonal programming language* and applied the notion in all its strength in the design of Algol 68. An orthogonal programming language is one such that it comprises a number of primitive independent concepts which are then applied in an orthogonal way. This makes the language very expressive, reduces the number of arbitrary rules (which the programmer has to remember) and avoids redundancy.

There are many examples of orthogonality in Algol 68. In fact, what is seldom found are arbitrary rules! One nice example is: take the notions of the comma separator `,` (in the Report that symbol is known as the *and also token*), collateral clauses, parallel clauses, declarations, multiple sub-scripting, actual argument passing, row display and structure display. These concepts are all independent. Now let's establish a rule: the comma separator implies collateral elaboration. Then let's apply this rule "orthogonally" by combining the concepts above.

Starting with the most obvious example, the units in the following collateral clause are elaborated collaterally, no surprise there:

```
(x * 2, y / 2)
```

If the following parallel clause there is still collateral elaboration, and it would be expected:

```
par begin generate data (), consume data () end
```

But then the indexes in the following multiple subscripting are also elaborated collaterally:

```
play voice ((monster at[get x (current map), get y (current map)]))
```

The actual parameters in the following procedure call are elaborated... collaterally!:

```
encrypt buffer (str, get random (seed))
```

The following contracted identity declarations are elaborated, surprise surprise, collaterally:

```
[]real randoms1 = get random (seed), randoms2 = get random (seed)
```

The field positions in the following structure display are also elaborated collaterally:

```
maintainer maint = (default name,
                    default url,
                    get last package (packages))
```

You get the point: there is no Algol 68 code where a comma separator doesn't imply collateral elaboration. Out of strings, comments and pragmats that's it. The programmer is only required to remember a number of N+M concepts (like the ones enumerated above) instead of the effect of combining them in N*M different combinations.

Algol 68 is not absolutely orthogonal, it has rules that introduce exceptions. An example is: "sizety modifiers can be applied to **int real**, **complex**, **bits**, **bytes** modes, but not to structured or rowed modes".

Usage

- "Algol 68 is an orthogonal programming language".
- "In this language concepts are applied orthogonally".
- "That rule you mention is not orthogonal".

See Also

- [RR 0.1.2]

5.2 Uninitiated Reader

Meaning

The original Report on the Algorithmic Language Algol 68, accepted in December 1968, was notoriously difficult to read, not only because of the usage of the two-level grammars and formal representation, but also because it lacked pragmatic descriptions.

The Revised Report, accepted at the end of 1973, incorporated many improvements in the described language, but also added many pragmatic descriptions to improve the readability. It also acknowledged the reported difficulties in the following famous paragraph in [RR 0.1.1]:

> "The Group wishes to contribute to the solution of the problems of describing a language clearly and completely. The method adopted in this Report is based upon a formalized two-level grammar, with the semantics expressed in natural language, but making use of some carefully and precisely defined terms and concepts. **It is recognized, however, that this method may be difficult for the uninitiated reader**."

It is to note that, although the readability problems were in their most part fixed by the Revised Report, which was a way more accessible document than the original report, the bad reputation of the later persisted and contributed to create FUD and the false impression that the described language (as opposed to the method of representation) was very difficult to learn.

Usage

The *uninitiated reader* or simply the *uninitiated* is sometimes used to refer to inexperienced programmers or users.

C. H. Lindsey dedicated his Informal Introduction to ALGOL 68 "To the Uninitiated Reader".

See Also

- [RR 0.1.1]

Concept Index

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