Preprocessing

Some preprocessing capabilities are included in **PlantUML**, and available for *all* diagrams.

Those functionalities are very similar to the C language preprocessor, except that the speci
been changed to the exclamation mark `!`.

Variable definition [=, ?=]

Although this is not mandatory, we highly suggest that variable names start with a `$`.

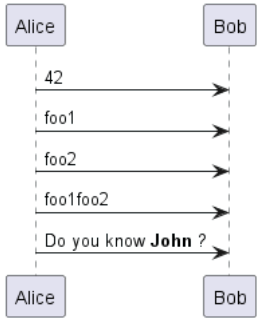
There are three types of data:

- **Integer number***(int)*;
- **String***(str)* - these must be surrounded by single quote or double quote;
- **JSON**(JSON) - these must be surrounded by curly brackets.

(for JSON variable definition and usage, see more details on Preprocessing-JSON page)

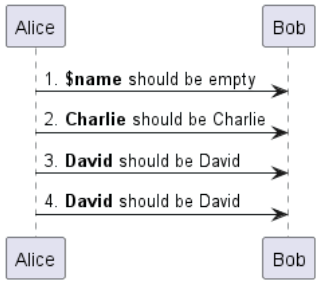
Variables created outside function are **global**, that is you can access them from everywhere
functions). You can emphasize this by using the optional `global` keyword when defining a

```
@startuml
!$a  = 42
!$ab = "foo1"
!$cd = "foo2"
!$ef = $ab + $cd
!$foo = { "name": "John", "age" : 30 }

Alice -> Bob : $a
Alice -> Bob : $ab
Alice -> Bob : $cd
Alice -> Bob : $ef
Alice -> Bob : Do you know **$foo.name** ?
@enduml
```



You can also assign a value to a variable, only if it is not already defined, with the syntax: `!$`

```
@startuml
Alice -> Bob : 1. **$name** should be empty

!$name ?= "Charlie"
Alice -> Bob : 2. **$name** should be Charlie

!$name = "David"
Alice -> Bob : 3. **$name** should be David

!$name ?= "Ethan"
Alice -> Bob : 4. **$name** should be David
@enduml
```



Boolean expression

Boolean representation [0 is false]

There is not real boolean type, but PlantUML use this integer convention:

[Ref. QA-9702]

Boolean operation and operator [&&, ||, ()]

You can use boolean expression, in the test, with :

- *parenthesis* `()` ;
- *and operator* `&&` ;
- *or operator* `||` .

(See next example, within `if` test.)

Boolean builtin functions [%false(), %true(), %not(<exp>)]

For convenience, you can use those boolean builtin functions:

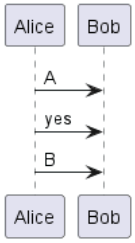
- `%false()`
- `%true()`
- `%not(<exp>)`

[See also Builtin functions]

Conditions [!if, !else, !elseif, !endif]

- You can use expression in condition.
- *else* and *elseif* are also implemented

```
@startuml
!$a = 10
!$ijk = "foo"
Alice -> Bob : A
!if ($ijk == "foo") && ($a+10>=4)
Alice -> Bob : yes
!else
Alice -> Bob : This should not appear
!endif
Alice -> Bob : B
@enduml
```

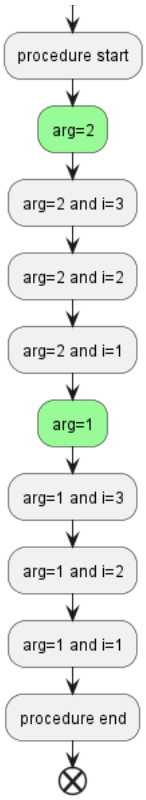


While loop [!while, !endwhile]

You can use `!while` and `!endwhile` keywords to have repeat loops.

While loop (on Activity diagram)

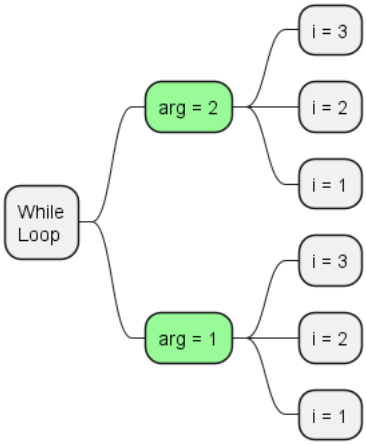
```
!procedure $foo($arg)
  :procedure start;
  !while $arg!=0
    !$i=3
    #palegreen:arg=$arg;
    !while $i!=0
      :arg=$arg and i=$i;
      !$i = $i - 1
    !endwhile
    !$arg = $arg - 1
  !endwhile
  :procedure end;
!endprocedure

start
$foo(2)
end
@enduml
```



[Adapted from QA-10838]

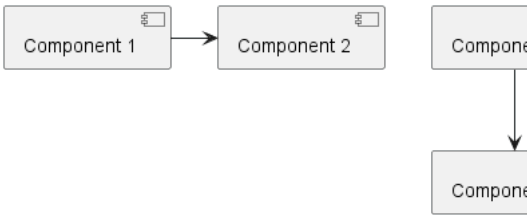
While loop (on Mindmap diagram)

```
@startmindmap
!procedure $foo($arg)
  !while $arg!=0
    !$i=3
    **[#palegreen] arg = $arg
    !while $i!=0
      *** i = $i
      !$i = $i - 1
    !endwhile
    !$arg = $arg - 1
  !endwhile
!endprocedure

*:While
Loop;
$foo(2)
@endmindmap
```



While loop (on Component/Deployment diagram)

```
@startuml
!procedure $foo($arg)
  !while $arg!=0
    [Component $arg] as $arg
    !$arg = $arg - 1
  !endwhile
!endprocedure

$foo(4)

1->2
3-->4
@enduml
```



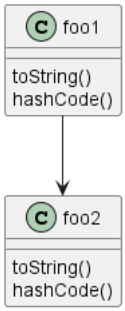
[Ref. QA-14088]

Procedure [!procedure, !endprocedure]

- Procedure names *should* start with a `$`
- Argument names *should* start with a `$`
- Procedures can call other procedures

Example:

```
@startuml
!procedure $msg($source, $destination)
  $source --> $destination
!endprocedure

!procedure $init_class($name)
  class $name {
    $addCommonMethod()
  }
!endprocedure


!procedure $addCommonMethod()
  toString()
  hashCode()
!endprocedure


$init_class("foo1")
$init_class("foo2")
$msg("foo1", "foo2")
@enduml
```



Variables defined in procedures are **local**. It means that the variable is destroyed when the

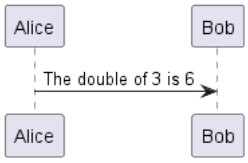
Return function [!function, !endfunction]

A return function does not output any text. It just define a function that you can call:

- directly in variable definition or in diagram text
- from other return functions
- from procedures

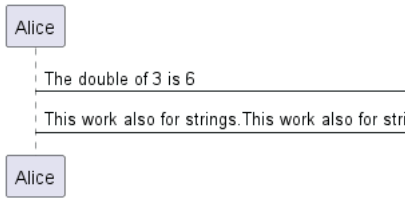
- Function name *should* start with a `$`
- Argument names *should* start with a `$`

```
@startuml
!function $double($a)
!return $a + $a
!endfunction

Alice -> Bob : The double of 3 is $double(3)
@enduml
```



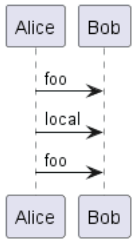
It is possible to shorten simple function definition in one line:

```
!function $double($a) !return $a + $a

Alice -> Bob : The double of 3 is $double(3)
Alice -> Bob : $double("This work also for strings.")
@enduml
```



As in procedure (void function), variable are local by default (they are destroyed when the fu
However, you can access to global variables from function. However, you can use the `local`
local variable if ever a global variable exists with the same name.

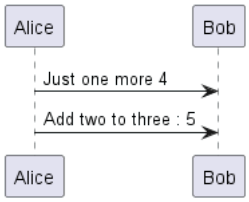
```
@startuml
!function $dummy()
!local $ijk = "local"
!return "Alice -> Bob : " + $ijk
!endfunction

!global $ijk = "foo"

Alice -> Bob : $ijk
$dummy()
Alice -> Bob : $ijk
@enduml
```



Default argument value

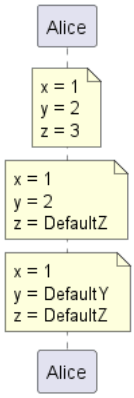
In both procedure and return functions, you can define default values for arguments.

```
@startuml
!function $inc($value, $step=1)
!return $value + $step
!endfunction

Alice -> Bob : Just one more $inc(3)
Alice -> Bob : Add two to three : $inc(3, 2)
@enduml
```



Only arguments at the end of the parameter list can have default values.

```
@startuml
!procedure defaulttest($x, $y="DefaultY", $z="DefaultZ")
note over Alice
  x = $x
  y = $y
  z = $z
end note
!endprocedure

defaulttest(1, 2, 3)
defaulttest(1, 2)
defaulttest(1)
@enduml
```



By default, you have to put quotes when you call a function or a procedure. It is possible to
keyword to indicate that a function or a procedure does not require quotes for its argumer

```
@startuml
!unquoted function id($text1, $text2="FOO") !return $text1 + $text2

alice -> bob : id(aa)
alice -> bob : id(ab,cd)
@enduml
```

Keywords arguments

Like in Python, you can use keywords arguments :

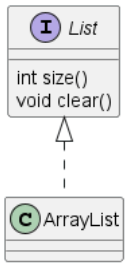
```
@startuml

!unquoted procedure $element($alias, $description="", $label="", $technolo
rectangle $alias as "
<color:$colour><<$alias>></color>
==$label==
//<size:$size>[$technology]</size>//

  $description"
!endprocedure

$element(myalias, "This description is %newline()on several lines", $size=
@enduml
```

Including files or URL [!include, !include_many, !incl

Use the `!include` directive to include file in your diagram. Using URL, you can also include f
Internet/Intranet. Protected Internet resources can also be accessed, this is described in UR

Imagine you have the very same class that appears in many diagrams. Instead of duplicatin
this class, you can define a file that contains the description.

```
@startuml

interface List
List : int size()
List : void clear()
List <|.. ArrayList
@enduml
```



File List.iuml

```
List : int size()
List : void clear()
```

The file `List.iuml` can be included in many diagrams, and any modification in this file will c that include it.

You can also put several `@startuml/@enduml` text block in an included file and then specify w to include adding `!0` where `0` is the block number. The `!0` notation denotes the first diag

For example, if you use `!include foo.txt!1`, the second `@startuml/@enduml` block within `fo` included.

You can also put an id to some `@startuml/@enduml` text block in an included file using `@star` syntax and then include the block adding `!MY_OWN_ID` when including the file, so using som `foo.txt!MY_OWN_ID`.

By default, a file can only be included once. You can use `!include_many` instead of `!include` include some file several times. Note that there is also a `!include_once` directive that raises included several times.

Including Subpart [!startsub, !endsub, !includesub]

You can also use `!startsub NAME` and `!endsub` to indicate sections of text to include from c `!includesub`. For example:

file1.puml:

```
@startuml

A -> A : stuff1
!startsub BASIC
B -> B : stuff2
!endsub
C -> C : stuff3
!startsub BASIC
D -> D : stuff4
!endsub
@enduml
```

file1.puml would be rendered exactly as if it were:

```
@startuml

A -> A : stuff1
B -> B : stuff2
C -> C : stuff3
D -> D : stuff4
@enduml
```

However, this would also allow you to have another file2.puml like this:

file2.puml

```
@startuml

title this contains only B and D
!includesub file1.puml!BASIC
@enduml
```

This file would be rendered exactly as if:

```
@startuml

title this contains only B and D
B -> B : stuff2
D -> D : stuff4
@enduml
```

Builtin functions [%]

Some functions are defined by default. Their name starts by `%`

Name	Description	Example
`%chr`	Return a character from a give Unicode value	`%chr(65)`
`%darken`	Return a darken color of a given color with some ratio	`%darken("red", 20)`
`%date`	Retrieve current date. You can provide an optional format for the date	`%date("yyyy.MM.dd' at 'HH:mm")`
	You can provide another optional time (on epoch format)	`%date("YYYY-MM-dd", %now() + 1*24*3600)`
`%dec2hex`	Return the hexadecimal string (String) of a decimal value (Int)	`%dec2hex(12)`
`%dirpath`	Retrieve current dirpath	`%dirpath()`
`%feature`	Check if some feature is available in the current PlantUML running version	`%feature("theme")`
`%false`	Return always `false`	`%false()`
`%file_exists`	Check if a file exists on the local filesystem	`%file_exists("c:/foo/dummy.txt")`
`%filename`	Retrieve current filename	`%filename()`
`%function_exists`	Check if a function exists	`%function_exists("$some_function")`
`%get_variable_value`	Retrieve some variable value	`%get_variable_value("$my_variable")`

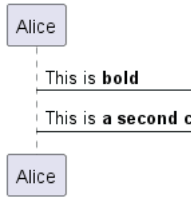
`%getenv`	environment variable value	`%getenv("OS")`
`%hex2dec`	Return the decimal value (Int) of a hexadecimal string (String)	`%hex2dec("d")` or `%hex2dec(d)`
`%hsl_color`	Return the RGBa color from a HSL color `%hsl_color(h, s, l)` or `%hsl_color(h, s, l, a)`	`%hsl_color(120, 100, 50)`
`%intval`	Convert a String to Int	`%intval("42")`
`%is_dark`	Check if a color is a dark one	`%is_dark("#000000")`
`%is_light`	Check if a color is a light one	`%is_light("#000000")`
`%lighten`	Return a lighten color of a given color with some ratio	`%lighten("red", 20)`
`%load_json`	Load JSON data from local file or external URL	`%load_json("http://localhost:7778/management/he`
`%lower`	Return a lowercase string	`%lower("Hello")`
`%newline`	Return a newline	`%newline()`
`%not`	Return the logical negation of an expression	`%not(2+2==4)`
`%now`	Return the current epoch time	`%now()`
`%ord`	Return a Unicode value from a given character	`%ord("A")`
`%lighten`	Return a lighten color of a given color with some ratio	`%lighten("red", 20)`
`%reverse_color`	Reverse a color using RGB	`%reverse_color("#FF7700")`
`%reverse_hsluv_color`	Reverse a color using HSLuv	`%reverse_hsluv_color("#FF7700")`

	variable	
`%size`	Return the size of any string or JSON structure	`%size("foo")`
`%string`	Convert an expression to String	`%string(1 + 2)`
`%strlen`	Calculate the length of a String	`%strlen("foo")`
`%strpos`	Search a substring in a string	`%strpos("abcdef", "ef")`
`%substr`	Extract a substring. Takes 2 or 3 arguments	`%substr("abcdef", 3, 2)`
`%true`	Return always `true`	`%true()`
`%upper`	Return an uppercase string	`%upper("Hello")`
`%variable_exists`	Check if a variable exists	`%variable_exists("$my_variable")`
`%version`	Return PlantUML current version	`%version()`

Logging [!log]

You can use `!log` to add some log output when generating the diagram. This has no impac
diagram itself. However, those logs are printed in the command line's output stream. This c
debug purpose.

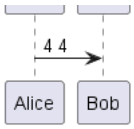
```
@startuml
!function bold($text)
!$result = "<b>"+ $text +"</b>"
!log Calling bold function with $text. The result is $result
!return $result
!endfunction

Alice -> Bob : This is bold("bold")
Alice -> Bob : This is bold("a second call")
@enduml
```



Memory dump [!dump_memory]

You can use `!dump_memory` to dump the full content of the memory when generating the di
string can be put after `!dump_memory`. This has no impact at all on the diagram itself. This co
debug purpose.

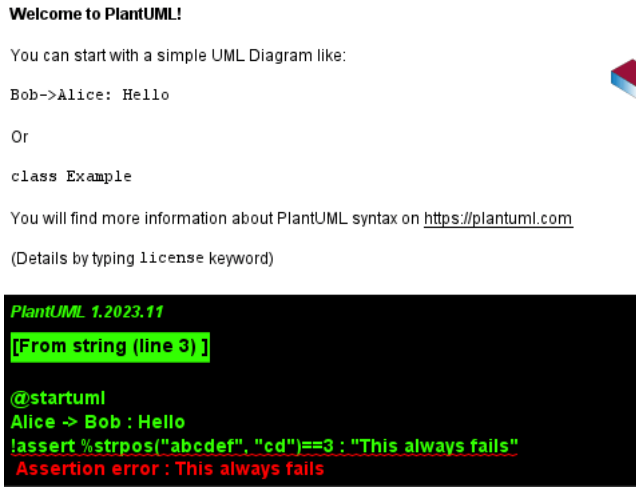
```
!function $inc($string)
!$val = %intval($string)
!log value is $val
!dump_memory
!return $val+1
!endfunction

Alice -> Bob : 4 $inc("3")
!unused = "foo"
!dump_memory EOF
@enduml
```



Assertion [!assert]

You can put assertions in your diagram.

```
@startuml
Alice -> Bob : Hello
!assert %strpos("abcdef", "cd")==3 : "This always fails"
@enduml
```



Building custom library [!import, !include]

It's possible to package a set of included files into a single .zip or .jar archive. This single zip imported into your diagram using `!import` directive.

Once the library has been imported, you can `!include` file from this single zip/jar.

Example:

```
@startuml

!import /path/to/customLibrary.zip
' This just adds "customLibrary.zip" in the search path

!include myFolder/myFile.iuml
' Assuming that myFolder/myFile.iuml is located somewhere
' either inside "customLibrary.zip" or on the local filesystem

...
```

You can specify the java property `plantuml.include.path` in the command line.

For example:

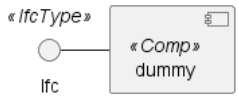
```
java -Dplantuml.include.path="c:/mydir" -jar plantuml.jar atest1.txt
```

Note the this -D option has to put before the -jar option. -D options after the -jar option will constants within plantuml preprocessor.

Argument concatenation [##]

It is possible to append text to a macro argument using the `##` syntax.

```
@startuml
!unquoted procedure COMP_TEXTGENCOMP(name)
[name] << Comp >>
interface Ifc << IfcType >> AS name##Ifc
name##Ifc - [name]
!endprocedure
COMP_TEXTGENCOMP(dummy)
@enduml
```

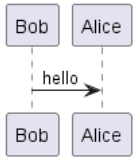


Dynamic invocation [`%invoke_procedure()`, `%call_use`

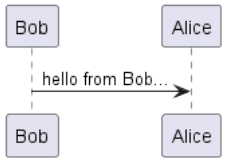
You can dynamically invoke a procedure using the special `%invoke_procedure()` procedure. as first argument the name of the actual procedure to be called. The optional following arg the called procedure.

For example, you can have:

```
@startuml
!procedure $go()
  Bob -> Alice : hello
!endprocedure

!$wrapper = "$go"

%invoke_procedure($wrapper)
@enduml
```

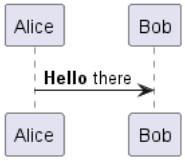



```
@startuml
!procedure $go($txt)
  Bob -> Alice : $txt
!endprocedure

%invoke_procedure("$go", "hello from Bob...")
@enduml
```



For return functions, you can use the corresponding special function `%call_user_func()` :

```
@startuml
!function bold($text)
!return "<b>"+ $text +"</b>"
!endfunction

Alice -> Bob : %call_user_func("bold", "Hello") there
@enduml
```



Evaluation of addition depending of data types [+]

Evaluation of `$a + $b` depending of type of `$a` or `$b`

```
@startuml
title
<#LightBlue>|= |=  $a |=  $b |=  <U+0025>string($a + $b)|
<#LightGray>| type | str | str | str (concatenation) |
| example |= "a" |= "b" |= %string("a" + "b") |
<#LightGray>| type | str | int | str (concatenation) |
| ex.|= "a" |=  2  |= %string("a" + 2)   |
<#LightGray>| type | str | int | str (concatenation) |
| ex.|=  1  |= "b" |= %string(1 + "b")   |
<#LightGray>| type | bool | str | str (concatenation) |
| ex.|= <U+0025>true() |= "b" |= %string(%true() + "b") |
<#LightGray>| type | str | bool | str (concatenation) |
| ex.|= "a" |= <U+0025>false() |= %string("a" + %false()) |
<#LightGray>| type |  int  |  int | int (addition of int) |
| ex.|=  1  |=  2  |= %string(1 + 2)     |
<#LightGray>| type |  bool  |  int | int (addition) |
| ex.|= <U+0025>true() |= 2 |= %string(%true() + 2) |
<#LightGray>| type |  int  |  bool | int (addition) |
| ex.|=  1  |= <U+0025>false() |= %string(1 + %false()) |
<#LightGray>| type |  int  |  int | int (addition) |
| ex.|=  1  |=  <U+0025>intval("2")  |= %string(1 + %intval("2")) |
end title
@enduml
```

	$a	$b	%string($a +
type	str	str	str (concate
example	"a"	"b"	ab
type	str	int	str (concate
ex.	"a"	2	a2
type	str	int	str (concate
ex.	1	"b"	1b
type	bool	str	str (concate
ex.	%true()	"b"	1b
type	str	bool	str (concate
ex.	"a"	%false()	a0
type	int	int	int (addition
ex.	1	2	3
type	bool	int	int (addition)
ex.	%true()	2	3
type	int	bool	int (addition)
ex.	1	%false()	1
type	int	int	int (addition)
ex.	1	%intval("2")	3

Preprocessing JSON

You can extend the functionality of the current Preprocessing with JSON Preprocessing feat

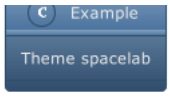
- JSON Variable definition
- Access to JSON data
- Loop over JSON array

(See more details on Preprocessing-JSON page)

Including theme [!theme]

Use the `!theme` directive to change the default theme of your diagram.

```
!theme spacelab
class Example {
  Theme spacelab
}
@enduml
```



You will find more information on the dedicated page.

Migration notes

The current preprocessor is an update from some legacy preprocessor.

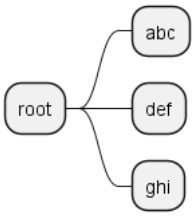
Even if some legacy features are still supported with the actual preprocessor, you should n
more (they might be removed in some long term future).

- You should not use `!define` and `!definelong` anymore. Use `!function` , `!procedure`
  instead.
  - `!define` should be replaced by return `!function`
  - `!definelong` should be replaced by `!procedure` .
- `!include` now allows multiple inclusions : you don't have to use `!include_many` anym
- `!include` now accepts a URL, so you don't need `!includeurl`
- Some features (like `%date%`) have been replaced by builtin functions (for example `%da`
- When calling a legacy `!definelong` macro with no arguments, you do have to use par
  use `my_own_definelong()` because `my_own_definelong` without parenthesis is not recc
  preprocessor.

Please contact us if you have any issues.

`%Splitstr` builtin function

```
@startmindmap
!$list = %splitstr("abc~def~ghi", "~")

* root
!foreach $item in $list
  ** $item
!endfor
@endmindmap
```



[Ref. QA-15374]