Logtalk 3

Reference Manual

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Grammar

The Logtalk grammar is here described using Backus-Naur Form syntax. Non-terminal symbols in *italics* have the definition found in the ISO Prolog Standard. Terminal symbols are represented in a `fixed width font` and between double-quotes.

Entities

entity ::=
    object |
    category |
    protocol

Object definition

object ::=
    begin_object_directive [object_directives] [clauses] end_object_directive.

begin_object_directive ::=
    "`:- object(`" object_identifier ["`,`" object_relations] "`).`"

end_object_directive ::=
    "`:- end_object.`"

object_relations ::=
    prototype_relations |
    non_prototype_relations

prototype_relations ::=
    prototype_relation |
    prototype_relation "`,`" prototype_relations

prototype_relation ::=
    implements_protocols |
    imports_categories |
    extends_objects

non_prototype_relations ::=
    non_prototype_relation |
    non_prototype_relation "`,`" non_prototype_relations

non_prototype_relation ::=
    implements_protocols |

imports_categories |
instantiates_classes |
specializes_classes

Category definition

category ::=
begin_category_directive [category_directives] [clauses] end_category_directive.

begin_category_directive ::=
":- category(" category_identifier ["," category_relations] ")."

end_category_directive ::=
":- end_category."

category_relations ::=
category_relation |
category_relation "," category_relations

category_relation ::=
implements_protocols |
extends_categories |
complements_objects

Protocol definition

protocol ::=
begin_protocol_directive [protocol_directives] end_protocol_directive.

begin_protocol_directive ::=
":- protocol(" protocol_identifier ["," extends_protocols] ")."

end_protocol_directive ::=
":- end_protocol."

Entity relations

extends_protocols ::=
"extends(" extended_protocols ")"

extends_objects ::=
"extends(" extended_objects ")"

extends_categories ::=
"extends(" extended_categories ")"

implements_protocols ::=
"implements(" implemented_protocols ")"

imports_categories ::=
"imports(" imported_categories ")"

instantiates_classes ::=
"instantiates(" instantiated_objects ")"

specializes_classes ::=
"specializes(" specialized_objects ")"

complements_objects ::=
"complements(" complemented_objects ")"

Implemented protocols

implemented_protocols ::=
implemented_protocol |
implemented_protocol_sequence |
implemented_protocol_list

implemented_protocol ::=
protocol_identifier |
scope "::" protocol_identifier

implemented_protocol_sequence ::=
implemented_protocol |
implemented_protocol "," implemented_protocol_sequence

implemented_protocol_list ::=
"[" implemented_protocol_sequence "]"

Extended protocols

extended_protocols ::=
extended_protocol |
extended_protocol_sequence |
extended_protocol_list

extended_protocol ::=
protocol_identifier |

scope "::" protocol_identifier

extended_protocol_sequence ::=
    extended_protocol |
    extended_protocol "," extended_protocol_sequence

extended_protocol_list ::=
    "[" extended_protocol_sequence "]"

Imported categories

imported_categories ::=
    imported_category |
    imported_category_sequence |
    imported_category_list

imported_category ::=
    category_identifier |
    scope "::" category_identifier

imported_category_sequence ::=
    imported_category |
    imported_category "," imported_category_sequence

imported_category_list ::=
    "[" imported_category_sequence "]"

Extended objects

extended_objects ::=
    extended_object |
    extended_object_sequence |
    extended_object_list

extended_object ::=
    object_identifier |
    scope "::" object_identifier

extended_object_sequence ::=
    extended_object |
    extended_object "," extended_object_sequence

extended_object_list ::=
    "[" extended_object_sequence "]"

Extended categories

extended_categories ::=
    extended_category |
    extended_category_sequence |
    extended_category_list

extended_category ::=
    category_identifier |

scope "::" category_identifier

extended_category_sequence ::=
extended_category |
extended_category "," extended_category_sequence

extended_category_list ::=
"[" extended_category_sequence "]"

Instantiated objects

instantiated_objects ::=
instantiated_object |
instantiated_object_sequence |
instantiated_object_list

instantiated_object ::=
object_identifier |
scope "::" object_identifier

instantiated_object_sequence ::=
instantiated_object
instantiated_object "," instantiated_object_sequence |

instantiated_object_list ::=
"[" instantiated_object_sequence "]"

Specialized objects

specialized_objects ::=
specialized_object |
specialized_object_sequence |
specialized_object_list

specialized_object ::=
object_identifier |
scope "::" object_identifier

specialized_object_sequence ::=
specialized_object |
specialized_object "," specialized_object_sequence

specialized_object_list ::=
"[" specialized_object_sequence "]"

Complemented objects

complemented_objects ::=
object_identifier |
complemented_object_sequence |
complemented_object_list

complemented_object_sequence ::=
object_identifier |

object_identifier "," complemented_object_sequence

complemented_object_list ::=
"[" complemented_object_sequence "]"

Entity and predicate scope

scope ::=
"public" |
"protected" |
"private"

Entity identifiers

entity_identifiers ::=
entity_identifier |
entity_identifier_sequence |
entity_identifier_list

entity_identifier ::=
object_identifier |
protocol_identifier |
category_identifier

entity_identifier_sequence ::=
entity_identifier |
entity_identifier "," entity_identifier_sequence

entity_identifier_list ::=
"[" entity_identifier_sequence "]"

Object identifiers

object_identifiers ::=
object_identifier |
object_identifier_sequence |
object_identifier_list

object_identifier ::=
atom |
compound

object_identifier_sequence ::=
object_identifier |
object_identifier "," object_identifier_sequence

object_identifier_list ::=
"[" object_identifier_sequence "]"

Category identifiers

category_identifiers ::=
category_identifier |

category_identifier_sequence |
category_identifier_list

category_identifier ::=
atom |
compound

category_identifier_sequence ::=
category_identifier |
category_identifier "," category_identifier_sequence

category_identifier_list ::=
"[" category_identifier_sequence "]"

Protocol identifiers

protocol_identifiers ::=
protocol_identifier |
protocol_identifier_sequence |
protocol_identifier_list

protocol_identifier ::=
atom

protocol_identifier_sequence ::=
protocol_identifier |
protocol_identifier "," protocol_identifier_sequence

protocol_identifier_list ::=
"[" protocol_identifier_sequence "]"

Module identifiers

module_identifier ::=
atom

Source file names

source_file_names ::=
source_file_name |
source_file_name_list

source_file_name ::=
atom |
library_source_file_name

library_source_file_name ::=
library_name "(" *atom* ")"

library_name ::=
atom

source_file_name_sequence ::=
source_file_name |

source_file_name "," source_file_name_sequence

source_file_name_list ::=
"[" source_file_name_sequence "]"

Directives

Source file directives

source_file_directives ::=
source_file_directive |
source_file_directive source_file_directives

source_file_directive ::=
":- encoding(" *atom* ")." |
":- set_logtalk_flag(" *atom* "," *nonvar* ")." |
Prolog directives

Conditional compilation directives

conditional_compilation_directives ::=
conditional_compilation_directive |
conditional_compilation_directive conditional_compilation_directives

conditional_compilation_directive ::=
":- if(" *callable* ")." |
":- elif(" *callable* ")." |
":- else." |
":- endif."

Object directives

object_directives ::=
object_directive |
object_directive object_directives

object_directive ::=
initialization_directive |
":- built_in." |
":- threaded." |
":- dynamic." |
":- uses(" object_identifier ")." |
":- use_module(" module_identifier "," module_predicate_indicator_alias_list ")." |
":- calls(" protocol_identifiers ")." |
":- info(" entity_info_list ")." |
":- set_logtalk_flag(" *atom* "," *nonvar* ")." |
predicate_directives

Category directives

category_directives ::=
category_directive |

category_directive category_directives

category_directive ::=
initialization_directive |
":- built_in." |
":- dynamic." |
":- uses(" object_identifier ")." |
":- use_module(" module_identifier "," predicate_indicator_alias_list ")." |
":- calls(" protocol_identifiers ")." |
":- info(" entity_info_list ")." |
":- set_logtalk_flag(" *atom* "," *nonvar* ")." |
predicate_directives

Protocol directives

protocol_directives ::=
protocol_directive |
protocol_directive protocol_directives

protocol_directive ::=
initialization_directive |
":- built_in." |
":- dynamic." |
":- info(" entity_info_list ")." |
":- set_logtalk_flag(" *atom* "," *nonvar* ")." |
predicate_directives

Predicate directives

predicate_directives ::=
predicate_directive |
predicate_directive predicate_directives

predicate_directive ::=
alias_directive |
synchronized_directive |
uses_directive |
scope_directive |
mode_directive |
meta_predicate_directive |
meta_non_terminal_directive |
info_directive |
dynamic_directive |
discontiguous_directive |
multifile_directive |
coinductive_directive |
operator_directive

alias_directive ::=
":- alias(" entity_identifier "," predicate_indicator_alias_list ")." |

```
        ":- alias(" entity_identifier "," non_terminal_indicator_alias_list ")."

synchronized_directive ::=
        ":- synchronized(" predicate_indicator ")." |
        ":- synchronized(" non_terminal_indicator ")."

uses_directive ::=
        ":- uses(" object_identifier "," predicate_indicator_alias_list ")."

scope_directive ::=
        ":- public(" predicate_indicator_term | non_terminal_indicator_term ")." |
        ":- protected(" predicate_indicator_term | non_terminal_indicator_term ")." |
        ":- private(" predicate_indicator_term | non_terminal_indicator_term ")."

mode_directive ::=
        ":- mode(" predicate_mode_term | non_terminal_mode_term "," number_of_proofs ")."

meta_predicate_directive ::=
        ":- meta_predicate(" meta_predicate_template_term ")."

meta_non_terminal_directive ::=
        ":- meta_non_terminal(" meta_non_terminal_template_term ")."

info_directive ::=
        ":- info(" predicate_indicator | non_terminal_indicator "," predicate_info_list ")."

dynamic_directive ::=
        ":- dynamic(" predicate_indicator_term | non_terminal_indicator_term ")."

discontiguous_directive ::=
        ":- discontiguous(" predicate_indicator_term | non_terminal_indicator_term ")."

multifile_directive ::=
        ":- multifile(" predicate_indicator_term ")."

coinductive_directive ::=
        ":- coinductive(" predicate_indicator_term | coinductive_predicate_template_term ")."

predicate_indicator_term ::=
        predicate_indicator |
        predicate_indicator_sequence |
        predicate_indicator_list

predicate_indicator_sequence ::=
        predicate_indicator |
        predicate_indicator "," predicate_indicator_sequence

predicate_indicator_list ::=
        "[" predicate_indicator_sequence "]"

predicate_indicator_alias ::=
        predicate_indicator |
        predicate_indicator "as" predicate_indicator |
        predicate_indicator "::" predicate_indicator |
```

predicate_indicator ":" *predicate_indicator*

predicate_indicator_alias_sequence ::=
predicate_indicator_alias |
predicate_indicator_alias "," predicate_indicator_alias_sequence

predicate_indicator_alias_list ::=
"[" predicate_indicator_alias_sequence "]"

module_predicate_indicator_alias ::=
predicate_indicator |
predicate_indicator "as" *predicate_indicator* |
predicate_indicator ":" *predicate_indicator*

module_predicate_indicator_alias_sequence ::=
module_predicate_indicator_alias |
module_predicate_indicator_alias "," module_predicate_indicator_alias_sequence

module_predicate_indicator_alias_list ::=
"[" module_predicate_indicator_alias_sequence "]"

non_terminal_indicator_term ::=
non_terminal_indicator |
non_terminal_indicator_sequence |
non_terminal_indicator_list

non_terminal_indicator_sequence ::=
non_terminal_indicator |
non_terminal_indicator "," non_terminal_indicator_sequence

non_terminal_indicator_list ::=
"[" non_terminal_indicator_sequence "]"

non_terminal_indicator ::=
functor "//" *arity*

non_terminal_indicator_alias ::=
non_terminal_indicator |
non_terminal_indicator "as" *non_terminal_indicator*
non_terminal_indicator "::" *non_terminal_indicator*

non_terminal_indicator_alias_sequence ::=
non_terminal_indicator_alias |
non_terminal_indicator_alias "," non_terminal_indicator_alias_sequence

non_terminal_indicator_alias_list ::=
"[" non_terminal_indicator_alias_sequence "]"

coinductive_predicate_template_term ::=
coinductive_predicate_template |
coinductive_predicate_template_sequence |
coinductive_predicate_template_list

coinductive_predicate_template_sequence ::=
coinductive_predicate_template |

coinductive_predicate_template "," coinductive_predicate_template_sequence

coinductive_predicate_template_list ::=
"[" coinductive_predicate_template_sequence "]"

coinductive_predicate_template ::=
atom "(" coinductive_mode_terms ")"

coinductive_mode_terms ::=
coinductive_mode_term |
coinductive_mode_terms "," coinductive_mode_terms

coinductive_mode_term ::=
"+" | "-"

predicate_mode_term ::=
atom "(" mode_terms ")"

non_terminal_mode_term ::=
atom "(" mode_terms ")"

mode_terms ::=
mode_term |
mode_term "," mode_terms

mode_term ::=
"@" [type] | "+" [type] | "-" [type] | "?" [type]

type ::=
prolog_type | logtalk_type | user_defined_type

prolog_type ::=
"term" | "nonvar" | "var" |
"compound" | "ground" | "callable" | "list" |
"atomic" | "atom" |
"number" | "integer" | "float"

logtalk_type ::=
"object" | "category" | "protocol" |
"event"

user_defined_type ::=
atom |
compound

number_of_proofs ::=
"zero" | "zero_or_one" | "zero_or_more" | "one" | "one_or_more" | "error"

meta_predicate_template_term ::=
meta_predicate_template |
meta_predicate_template_sequence |
meta_predicate_template_list

meta_predicate_template_sequence ::=
meta_predicate_template |

meta_predicate_template "," meta_predicate_template_sequence

meta_predicate_template_list ::=
"[" meta_predicate_template_sequence "]"

meta_predicate_template ::=
object_identifier "::" *atom* "(" meta_predicate_specifiers ")" |
category_identifier "::" *atom* "(" meta_predicate_specifiers ")" |
atom "(" meta_predicate_specifiers ")"

meta_predicate_specifiers ::=
meta_predicate_specifier |
meta_predicate_specifier "," meta_predicate_specifiers

meta_predicate_specifier ::=
non-negative integer | "::" | "^" |
"*"

meta_non_terminal_template_term ::=
meta_predicate_template_term

entity_info_list ::=
"[]" |
"[" entity_info_item "is" *nonvar* "|" entity_info_list "]"

entity_info_item ::=
"comment" | "remarks" |
"author" | "version" | "date" |
"copyright" | "license" |
"parameters" | "parnames" |
atom

predicate_info_list ::=
"[]" |
"[" predicate_info_item "is" *nonvar* "|" predicate_info_list "]"

predicate_info_item ::=
"comment" |
"arguments" | "argnames" |
"redefinition" | "allocation" |
"examples" | "exceptions" |
atom

Clauses and goals

clause ::=
object_identifier "::" *head* ":-" *body* |
head :- *body* |
fact

goal ::=
message_sending |
super_call |

external_call |
context_switching_call |
callable

message_sending ::=
message_to_object |
message_delegation |
message_to_self

message_to_object ::=
receiver "::" messages

message_delegation ::=
"[" message_to_object "]"

message_to_self ::=
"::" messages

super_call ::=
"^^" message

messages ::=
message |
"(" message "," messages ")" |
"(" message ";" messages ")" |
"(" message "->" messages ")"

message ::=
callable |
variable

receiver ::=
"{" *callable* "}" |
object_identifier |
variable

external_call ::=
"{" *callable* "}"

context_switching_call ::=
object_identifier "<<" *goal*

Lambda expressions

lambda_expression ::=
lambda_free_variables "/" lambda_parameters ">>" *callable* |
lambda_free_variables "/" *callable* |
lambda_parameters ">>" *callable*

lambda_free_variables ::=
"{" *conjunction of variables* "}" |
"{" *variable* "}" |

"{}"

lambda_parameters ::=
list of terms |
"[]"

Entity properties

category_property ::=
"static" |
"dynamic" |
"built_in" |
"file(" *atom* "," *atom* ")" |
"lines(" *integer* "," *integer* ")" |
"events" |
"public(" predicate_indicator_list ")" |
"protected(" predicate_indicator_list ")" |
"private(" predicate_indicator_list ")" |
"declares(" predicate_indicator "," predicate_declaration_property_list ")" |
"defines(" predicate_indicator "," predicate_definition_property_list ")" |
"includes(" predicate_indicator "," object_identifier | category_identifier "," predicate_definition_property_list ")" |
"provides(" predicate_indicator "," object_identifier | category_identifier "," predicate_definition_property_list ")" |
"calls(" predicate_called "," predicate_call_property_list ")" |
"number_of_clauses(" *integer* ")" |
"number_of_user_clauses(" *integer* ")"

object_property ::=
"static" |
"dynamic" |
"built_in" |
"threaded" |
"file(" *atom* "," *atom* ")" |
"lines(" *integer* "," *integer* ")" |
"context_switching_calls" |
"dynamic_declarations" |
"events" |
"complements(" "allow" | "restrict" ")" |
"complements" |
"public(" predicate_indicator_list ")" |
"protected(" predicate_indicator_list ")" |
"private(" predicate_indicator_list ")" |
"declares(" predicate_indicator "," predicate_declaration_property_list ")" |
"defines(" predicate_indicator "," predicate_definition_property_list ")" |
"includes(" predicate_indicator "," object_identifier | category_identifier "," predicate_definition_property_list ")" |
"provides(" predicate_indicator "," object_identifier | category_identifier "," predicate_definition_property_list ")"
"calls(" predicate_called "," predicate_call_property_list ")" |

```
        "number_of_clauses(" integer ")" |
        "number_of_user_clauses(" integer ")"

    protocol_property ::=
        "static" |
        "dynamic" |
        "built_in" |
        "file(" atom "," atom ")" |
        "lines(" integer "," integer ")" |
        "public(" predicate_indicator_list ")" |
        "protected(" predicate_indicator_list ")" |
        "private(" predicate_indicator_list ")" |
        "declares(" predicate_indicator "," predicate_declaration_property_list ")" |
        "calls(" predicate_called "," predicate_call_property_list ")" |
        "number_of_clauses(" integer ")" |
        "number_of_user_clauses(" integer ")"

    predicate_declaration_property_list ::=
        "[" predicate_declaration_property_sequence "]"

    predicate_declaration_property_sequence ::=
        predicate_declaration_property |
        predicate_declaration_property "," predicate_declaration_property_sequence

    predicate_declaration_property ::=
        "static" | "dynamic" |
        "scope(" scope ")" |
        "private" | "protected" | "public" |
        "coinductive" |
        "multifile" |
        "synchronized" |
        "meta_predicate(" meta_predicate_template ")" |
        "coinductive(" coinductive_predicate_template ")" |
        "non_terminal(" non_terminal_indicator ")" |
        "line_count(" integer ")" |
        "mode(" predicate_mode_term | non_terminal_mode_term "," number_of_proofs ")" |
        "info(" list ")"

    predicate_definition_property_list ::=
        "[" predicate_definition_property_sequence "]"

    predicate_definition_property_sequence ::=
        predicate_definition_property |
        predicate_definition_property "," predicate_definition_property_sequence

    predicate_definition_property ::=
        "auxiliary" |
        "non_terminal(" non_terminal_indicator ")" |
        "line_count(" integer ")" |
```

"number_of_clauses(" *integer* ")"

predicate_called ::=
predicate_indicator |
"^^" predicate_indicator |
"::" predicate_indicator |
variable "::" predicate_indicator |
object_identifier "::" predicate_indicator |
variable ":" predicate_indicator |
module_identifier ":" predicate_indicator

predicate_call_property_list ::=
"[" predicate_call_property_sequence "]"

predicate_call_property_sequence ::=
predicate_call_property |
predicate_call_property "," predicate_call_property_sequence

predicate_call_property ::=
"caller(" predicate_indicator ")" |
"line_count(" *integer* ")" |
"as(" predicate_indicator ")"

Predicate properties

predicate_property ::=
"static" | "dynamic" |
"scope(" scope ")" |
"private" | "protected" | "public" |
"logtalk" | "prolog" | "foreign" |
"coinductive(" coinductive_predicate_template ")" |
"multifile" |
"synchronized" |
"built_in" |
"declared_in(" entity_identifier ")" |
"defined_in(" object_identifier | category_identifier ")" |
"redefined_from(" object_identifier | category_identifier ")" |
"meta_predicate(" meta_predicate_template ")" |
"alias_of(" callable ")" |
"non_terminal(" non_terminal_indicator ")" |
"mode(" predicate_mode_term | non_terminal_mode_term "," number_of_proofs ")" |
"info(" *list* ")" |
"number_of_clauses(" *integer* ")"
"declared_in(" entity_identifier "," *integer* ")" |
"defined_in(" object_identifier | category_identifier "," *integer*")" |
"redefined_from(" object_identifier | category_identifier "," *integer*")"

Compiler options

compiler_option ::=
flag(flag_value)

Directives

encoding/1

Description

```
encoding(Encoding)
```

Declares the source file text encoding. This is an **experimental** source file directive, which is only supported on some back-end Prolog compilers. When used, this directive must be the first term in the source file. Currently recognized encodings values include `'US-ASCII'`, `'ISO-8859-1'`, `'ISO-8859-2'`, `'ISO-8859-15'`, `'UCS-2'`, `'UCS-2LE'`, `'UCS-2BE'`, `'UTF-8'`, `'UTF-16'`, `'UTF-16LE'`, `'UTF-16BE'`, `'UTF-32'`, `'UTF-32LE'`, `'UTF-32BE'`, `'Shift_JIS'`, and `'EUC-JP'`. Be sure to use an encoding supported by the chosen back-end Prolog compiler (whose adapter file must define a table that translates between the Logtalk and Prolog-specific atoms that represent each supported encoding). When writing portable code that cannot be expressed using ASCII, `'UTF-8'` is usually the best choice.

Template and modes

```
encoding(+atom)
```

Examples

```
:- encoding('UTF-8').
```

set_logtalk_flag/2

Description

```
set_logtalk_flag(Flag, Value)
```

Sets Logtalk flag values. The scope of this directive is the entity containing it or the source file being compiled. For global scope, use the corresponding `set_logtalk_flag/2` built-in predicate within an `initialization/1` directive.

Template and modes

```
set_logtalk_flag(+atom, +nonvar)
```

Errors

Flag is a variable:
    `instantiation_error`
Value is a variable:
    `instantiation_error`
Flag is not an atom:
    `type_error(atom, Flag)`
Flag is neither a variable nor a valid flag:
    `domain_error(flag, Flag)`
Value is not a valid value for flag Flag:
    `domain_error(flag_value, Flag + Value)`
Flag is a read-only flag:
    `permission_error(modify, flag, Flag)`

Examples

```
:- set_logtalk_flag(unknown_entities, silent).
```

if/1

Description

```
if(Goal)
```

Starts conditional compilation. The code following the directive is compiled if `Goal` is true. The goal is subjected to goal expansion before execution.

Template and modes

```
if(@callable)
```

Examples

```
:- if(current_prolog_flag(double_quotes, atom)).
```

elif/1

Description

```
elif(Goal)
```

Supports embedded conditionals when performing conditional compilation. The code following the directive is compiled if `Goal` is true. The goal is subjected to goal expansion before execution.

Template and modes

```
elif(@callable)
```

Examples

```
:- elif(predicate_property(callable(_), built_in)).
```

`else/0`

Description

```
else
```

Starts a *else* branch when performing conditional compilation.

Template and modes

```
else
```

Examples

```
:- else.
```

endif/0

Description

```
endif
```

Ends conditional compilation.

Template and modes

```
endif
```

Examples

```
:- endif.
```

built_in/0

Description

```
built_in
```

Declares an entity as built-in. Built-in entities cannot be redefined.

Template and modes

```
built_in
```

Examples

```
:- built_in.
```

category/1-3

Description

```
category(Category)

category(Category,
    implements(Protocols))

category(Category,
    extends(Categories))

category(Category,
    complements(Objects))

category(Category,
    implements(Protocols),
    extends(Categories),
    complements(Objects))
```

Starting category directive.

Template and modes

```
category(+category_identifier)

category(+category_identifier,
    implements(+implemented_protocols))

category(+category_identifier,
    extends(+extended_categories))

category(+category_identifier,
    complements(+complemented_objects))

category(+category_identifier,
    implements(+implemented_protocols),
    extends(+extended_categories),
    complements(+complemented_objects))
```

Examples

```
:- category(monitoring).

:- category(monitoring,
    implements(monitoringp)).

:- category(attributes,
    implements(protected::variables)).

:- category(extended,
    extends(minimal)).

:- category(logging,
    implements(monitoring),
    complements(employee)).
```

dynamic/0

Description

```
dynamic
```

Declares an entity and its contents as dynamic. Dynamic entities can be abolished at runtime.

Template and modes

```
dynamic
```

Examples

```
:- dynamic.
```

end_category/0

Description

```
end_category
```

Ending category directive.

Template and modes

```
end_category
```

Examples

```
:- end_category.
```

end_object/0

Description

```
end_object
```

Ending object directive.

Template and modes

```
end_object
```

Examples

```
:- end_object.
```

end_protocol/0

Description

```
end_protocol
```

Ending protocol directive.

Template and modes

```
end_protocol
```

Examples

```
:- end_protocol.
```

include/1

Description

```
include(File)
```

Includes a file contents, which must be valid terms, at the place of occurrence of the directive. The file can be specified as a relative path, an absolute path, or using library notation. If the file name have an extension, it must not be omitted.

This directive can be used as either a file directive or an entity directive. As an entity directive, it can be used both in entities defined in source files and with the entity creation built-in predicates.

Template and modes

```
include(@source_file_name)
```

Examples

```
:- include(data('raw_1.txt')).

:- include('factbase.pl').

:- include('/home/me/databases/cities.pl').

?- create_object(cities, [], [public(city/4), include('/home/me/databases/cities.pl')], []).
```

info/1

Description

```
info(List)
```

Documentation directive for objects, protocols, and categories. The directive argument is a list of pairs using the format *Key is Value*. See the documenting Logtalk programs section for a description of the valid keys.

Template and modes

```
info(+entity_info_list)
```

Examples

```
:- info([
    version is 1.0,
    author is 'Paulo Moura',
    date is 2000/4/20,
    comment is 'List protocol.'
]).
```

initialization/1

Description

```
initialization(Goal)
```

When used within an object, this directive defines a goal to be called immediately after the object has been loaded into memory. When used at a global level within a source file, this directive defines a goal to be called immediately after the compiled source file is loaded into memory.

Template and modes

```
initialization(@callable)
```

Examples

```
:- initialization(init).
```

multifile/1

Description

```
multifile(Functor/Arity)
multifile((Functor1/Arity1, Functor2/Arity2, ...))
multifile([Functor1/Arity1, Functor2/Arity2, ...])

multifile(Entity::Functor/Arity)
multifile((Entity1::Functor1/Arity1, Entity2::Functor2/Arity2, ...))
multifile([Entity1::Functor1/Arity1, Entity2::Functor2/Arity2, ...])

multifile(Functor//Arity)
multifile((Functor1//Arity1, Functor2//Arity2, ...))
multifile([Functor1//Arity1, Functor2//Arity2, ...])

multifile(Entity::Functor//Arity)
multifile((Entity1::Functor1//Arity1, Entity2::Functor2//Arity2, ...))
multifile([Entity1::Functor1//Arity1, Entity2::Functor2//Arity2, ...])
```

Declares multifile predicates and multifile grammar rule non-terminals. The predicate (or non-terminal) must also be declared public in the object (or category) holding its *primary declaration* (i.e. the declaration without the `Entity::` prefix). Protocols cannot declare multifile predicates as protocols cannot contain predicate definitions.

Template and modes

```
multifile(+predicate_indicator_term)
multifile(+non_terminal_indicator_term)

multifile(+object_identifier::+predicate_indicator_term)
multifile(+object_identifier::+non_terminal_indicator_term)

multifile(+category_identifier::+predicate_indicator_term)
multifile(+category_identifier::+non_terminal_indicator_term)
```

Examples

```
:- multifile(table/3).
:- multifile(user::hook/2).
```

object/1-5

Description

Stand-alone objects (prototypes)

```
object(Object)

object(Object,
    implements(Protocols))

object(Object,
    imports(Categories))

object(Object,
    implements(Protocols),
    imports(Categories))
```

Prototype extensions

```
object(Object,
    extends(Objects))

object(Object,
    implements(Protocols),
    extends(Objects))

object(Object,
    imports(Categories),
    extends(Objects))

object(Object,
    implements(Protocols),
    imports(Categories),
    extends(Objects))
```

Class instances

```
object(Object,
    instantiates(Classes))

object(Object,
    implements(Protocols),
    instantiates(Classes))

object(Object,
    imports(Categories),
    instantiates(Classes))

object(Object,
    implements(Protocols),
    imports(Categories),
    instantiates(Classes))
```

Classes

```
object(Object,
    specializes(Classes))

object(Object,
    implements(Protocols),
    specializes(Classes))

object(Object,
    imports(Categories),
    specializes(Classes))

object(Object,
    implements(Protocols),
    imports(Categories),
    specializes(Classes))
```

Classes with metaclasses

```
object(Object,
    instantiates(Classes),
    specializes(Classes))

object(Object,
    implements(Protocols),
    instantiates(Classes),
    specializes(Classes))

object(Object,
    imports(Categories),
    instantiates(Classes),
    specializes(Classes))

object(Object,
    implements(Protocols),
    imports(Categories),
    instantiates(Classes),
    specializes(Classes))
```

Starting object directive.

Template and modes

Stand-alone objects (prototypes)

```
object(+object_identifier)

object(+object_identifier,
    implements(+implemented_protocols))

object(+object_identifier,
    imports(+imported_categories))

object(+object_identifier,
    implements(+implemented_protocols),
    imports(+imported_categories))
```

Prototype extensions

```
object(+object_identifier,
    extends(+extended_objects))

object(+object_identifier,
    implements(+implemented_protocols),
    extends(+extended_objects))

object(+object_identifier,
    imports(+imported_categories),
    extends(+extended_objects))

object(+object_identifier,
    implements(+implemented_protocols),
    imports(+imported_categories),
    extends(+extended_objects))
```

Class instances

```
object(+object_identifier,
    instantiates(+instantiated_objects))

object(+object_identifier,
    implements(+implemented_protocols),
    instantiates(+instantiated_objects))

object(+object_identifier,
    imports(+imported_categories),
    instantiates(+instantiated_objects))

object(+object_identifier,
    implements(+implemented_protocols),
    imports(+imported_categories),
    instantiates(+instantiated_objects))
```

Classes

```
object(+object_identifier,
    specializes(+specialized_objects))

object(+object_identifier,
    implements(+implemented_protocols),
    specializes(+specialized_objects))

object(+object_identifier,
    imports(+imported_categories),
    specializes(+specialized_objects))

object(+object_identifier,
    implements(+implemented_protocols),
    imports(+imported_categories),
    specializes(+specialized_objects))
```

Class with metaclasses

```
object(+object_identifier,
    instantiates(+instantiated_objects),
    specializes(+specialized_objects))

object(+object_identifier,
    implements(+implemented_protocols),
    instantiates(+instantiated_objects),
    specializes(+specialized_objects))

object(+object_identifier,
    imports(+imported_categories),
    instantiates(+instantiated_objects),
    specializes(+specialized_objects))

object(+object_identifier,
    implements(+implemented_protocols),
    imports(+imported_categories),
    instantiates(+instantiated_objects),
    specializes(+specialized_objects))
```

Examples

```
:- object(list).

:- object(list,
    implements(listp)).

:- object(list,
    extends(compound)).

:- object(list,
    implements(listp),
    extends(compound)).

:- object(object,
    imports(initialization),
    instantiates(class)).

:- object(abstract_class,
    instantiates(class),
    specializes(object)).

:- object(agent,
    imports(private::attributes)).
```

protocol/1-2

Description

```
protocol(Protocol)

protocol(Protocol,
    extends(Protocols))
```

Starting protocol directive.

Template and modes

```
protocol(+protocol_identifier)

protocol(+protocol_identifier,
    extends(+extended_protocols))
```

Examples

```
:- protocol(listp).

:- protocol(listp,
    extends(compoundp)).

:- protocol(queuep,
    extends(protected::listp)).
```

threaded/0

Description

```
threaded
```

Declares that an object supports concurrent calls and asynchronous messages. Any object containing calls to the built-in multi-threading predicates (or importing a category that contains such calls) must include this directive.

Template and modes

```
threaded
```

Examples

```
:- threaded.
```

alias/2

Description

```
alias(Entity, PredicateAliases)
alias(Entity, NonTerminalAliases)
```

Declares predicate and grammar rule non-terminal aliases. A predicate (non-terminal) alias is an alternative name for a predicate (non-terminal) declared or defined in an extended protocol, an implemented protocol, an extended category, an imported category, an extended prototype, an instantiated class, or a specialized class. Predicate aliases may be used to solve conflicts between imported or inherited predicates. It may also be used to give a predicate (non-terminal) a name more appropriated in its usage context. This directive may be used in objects, protocols, and categories.

Predicate (and non-terminal) aliases are specified using (preferably) the notation `Functor/Arity as Alias/Arity` or, in alternative, the notation `Functor/Arity::Alias/Arity`.

Template and modes

```
alias(@entity_identifier, +list(predicate_indicator_alias))
alias(@entity_identifier, +list(non_terminal_indicator_alias))
```

Examples

```
:- alias(list, [member/2 as list_member/2]).
:- alias(set,  [member/2 as set_member/2]).

:- alias(words, [singular//0 as peculiar//0]).
```

coinductive/1

Description

```
coinductive(Functor/Arity)
coinductive((Functor1/Arity1, Functor2/Arity2, ...))
coinductive([Functor1/Arity1, Functor2/Arity2, ...])

coinductive(Template)
coinductive((Template1, Template2, ...))
coinductive([Template1, Template2, ...])
```

This is an **experimental** directive, used for declaring coinductive predicates. Requires a back-end Prolog compiler with minimal support for cyclic terms. The current implementation of coinduction allows the generation of only the *basic cycles* but all valid solutions should be recognized. Use a predicate indicator as argument when all the coinductive predicate arguments are relevant for coinductive success. Use a template when only some coinductive predicate arguments (represented by a "`+`") should be considered when testing for coinductive success (represent the arguments that should be disregarded by a "`-`"). It's possible to define local `coinductive_success_hook/2` or `coinductive_success_hook/1` predicates that are automatically called with the coinductive predicate term resulting from a successful unification with an ancestor goal as first argument. The second argument, when present, is the coinductive hypothesis (i.e. the ancestor goal) used. These hook predicates can provide an alternative to the use of tabling when defining some coinductive predicates. There is no overhead when these hook predicates are not defined.

This directive must precede any calls to the declared coinductive predicates.

Template and modes

```
coinductive(+predicate_indicator_term)
coinductive(+coinductive_predicate_template_term)
```

Examples

```
:- coinductive(comember/2).
:- coinductive(controller(+,+,+,-,-)).
```

discontiguous/1

Description

```
discontiguous(Functor/Arity)
discontiguous((Functor1/Arity1, Functor2/Arity2, ...))
discontiguous([Functor1/Arity1, Functor2/Arity2, ...])

discontiguous(Functor//Arity)
discontiguous((Functor1//Arity1, Functor2//Arity2, ...))
discontiguous([Functor1//Arity1, Functor2//Arity2, ...])
```

Declares discontiguous predicates and discontiguous grammar rule non-terminals. The use of this directive should be avoided as not all Prolog compilers support discontiguous predicates.

Template and modes

```
discontiguous(+predicate_indicator_term)
discontiguous(+non_terminal_indicator_term)
```

Examples

```
:- discontiguous(counter/1).

:- discontiguous((lives/2, works/2)).

:- discontiguous([db/4, key/2, file/3]).
```

dynamic/1

Description

```
dynamic(Functor/Arity)
dynamic((Functor1/Arity1, Functor2/Arity2, ...))
dynamic([Functor1/Arity1, Functor2/Arity2, ...])

dynamic(Entity::Functor/Arity)
dynamic((Entity1::Functor1/Arity1, Entity2::Functor2/Arity2, ...))
dynamic([Entity1::Functor1/Arity1, Entity2::Functor2/Arity2, ...])

dynamic(Functor//Arity)
dynamic((Functor1//Arity1, Functor2//Arity2, ...))
dynamic([Functor1//Arity1, Functor2//Arity2, ...])

dynamic(Entity::Functor//Arity)
dynamic((Entity1::Functor1//Arity1, Entity2::Functor2//Arity2, ...))
dynamic([Entity1::Functor1//Arity1, Entity2::Functor2//Arity2, ...])
```

Declares dynamic predicates and dynamic grammar rule non-terminals. Note that an object can be static and have both static and dynamic predicates/non-terminals. Dynamic predicates cannot be declared as synchronized. When the dynamic predicates are local to an object, declaring them also as private predicates allows the Logtalk compiler to generated optimized code for asserting and retracting predicate clauses. Categories can also contain dynamic predicate directives but cannot contain clauses for dynamic predicates.

The predicate indicators (non-terminal indicators) can be explicitly qualified with an object identifier or a category identifier when the predicates (non-terminals) are also declared multifile.

Template and modes

```
dynamic(+predicate_indicator_term)
dynamic(+non_terminal_indicator_term)

dynamic(+object_identifier::+predicate_indicator_term)
dynamic(+object_identifier::+non_terminal_indicator_term)

dynamic(+category_identifier::+predicate_indicator_term)
dynamic(+category_identifier::+non_terminal_indicator_term)
```

Examples

```
:- dynamic(counter/1).

:- dynamic((lives/2, works/2)).

:- dynamic([db/4, key/2, file/3]).
```

info/2

Description

```
info(Functor/Arity, List)
info(Functor//Arity, List)
```

Documentation directive for predicates and grammar rule non-terminals. The first argument is either a predicate indicator or a grammar rule non-terminal indicator. The second argument is a list of pairs using the format *Key is Value*. See the documenting Logtalk programs section for a description of the valid keys.

Template and modes

```
info(+predicate_indicator, +predicate_info_list)
info(+non_terminal_indicator, +predicate_info_list)
```

Examples

```
:- info(empty/1, [
    comment is 'True if the argument is an empty list.',
    argnames is ['List']
]).

:- info(sentence//0, [
    comment is 'Rewrites a sentence into a noun phrase and a verb phrase.'
]).
```

meta_predicate/1

Description

```
meta_predicate(MetaPredicateTemplate)
meta_predicate((MetaPredicateTemplate1, MetaPredicateTemplate2, ...))
meta_predicate([MetaPredicateTemplate1, MetaPredicateTemplate2, ...])

meta_predicate(Entity::MetaPredicateTemplate)
meta_predicate((Entity1::MetaPredicateTemplate1, Entity2::MetaPredicateTemplate2, ...))
meta_predicate([Entity1::MetaPredicateTemplate1, Entity2::MetaPredicateTemplate2, ...])

meta_predicate(Module:MetaPredicateTemplate)
meta_predicate((Module1:MetaPredicateTemplate1, Module2:MetaPredicateTemplate2, ...))
meta_predicate([Module1:MetaPredicateTemplate1, Module2:MetaPredicateTemplate2, ...])
```

Declares meta-predicates, i.e., predicates that have arguments that will be called as goals. An argument may also be a *closure* instead of a goal if the meta-predicate uses the `call/N` Logtalk built-in methods to construct and call the actual goal from the closure and the additional arguments.

Meta-arguments which are goals are represented by the integer `0`. Meta-arguments which are closures are represented by a positive integer, `N`, representing the number of additional arguments that will be appended to the closure in order to construct the corresponding meta-call. Normal arguments are represented by the atom `*`. Meta-arguments are always called in the meta-predicate calling context, not in the meta-predicate definition context.

Logtalk allows the use of this directive to override the original meta-predicate directive. This is sometimes necessary when calling Prolog module meta-predicates due to the lack of standardization of the syntax of the meta-predicate templates.

Template and modes

```
meta_predicate(+meta_predicate_template_term)

meta_predicate(+object_identifier::+meta_predicate_template_term)
meta_predicate(+category_identifier::+meta_predicate_template_term)

meta_predicate(+module_identifier:+meta_predicate_template_term)
```

Examples

```
:- meta_predicate(findall(*, 0, *)).

:- meta_predicate(forall(0, 0)).

:- meta_predicate(maplist(2, *, *)).
```

meta_non_terminal/1

Description

```
meta_non_terminal(MetaNonTerminalTemplate)
meta_non_terminal((MetaNonTerminalTemplate1, MetaNonTerminalTemplate2, ...))
meta_non_terminal([MetaNonTerminalTemplate1, MetaNonTerminalTemplate2, ...])

meta_non_terminal(Entity::MetaNonTerminalTemplate)
meta_non_terminal((Entity1::MetaNonTerminalTemplate1, Entity2::MetaNonTerminalTemplate2, ...))
meta_non_terminal([Entity1::MetaNonTerminalTemplate1, Entity2::MetaNonTerminalTemplate2, ...])

meta_non_terminal(Module:MetaNonTerminalTemplate)
meta_non_terminal((Module1:MetaNonTerminalTemplate1, Module2:MetaNonTerminalTemplate2, ...))
meta_non_terminal([Module1:MetaNonTerminalTemplate1, Module2:MetaNonTerminalTemplate2, ...])
```

Declares meta-non-terminals, i.e., non-terminals that have arguments that will be called as non-terminals (or grammar rule bodies). An argument may also be a *closure* instead of a goal if the non-terminal uses the `call//1-N` Logtalk built-in methods to construct and call the actual non-terminal from the closure and the additional arguments.

Meta-arguments which are non-terminals are represented by the integer `0`. Meta-arguments which are closures are represented by a positive integer, `N`, representing the number of additional arguments that will be appended to the closure in order to construct the corresponding meta-call. Normal arguments are represented by the atom `*`. Meta-arguments are always called in the meta-non-terminal calling context, not in the meta-non-terminal definition context.

Logtalk allows the use of this directive to override the original meta-non-terminal directive. This is sometimes necessary when calling Prolog module meta-non-terminals due to the lack of standardization of the syntax of the meta-non-terminal templates.

Template and modes

```
meta_non_terminal(+meta_non_terminal_template_term)

meta_non_terminal(+object_identifier::+meta_non_terminal_template_term)
meta_non_terminal(+category_identifier::+meta_non_terminal_template_term)

meta_non_terminal(+module_identifier:+meta_non_terminal_template_term)
```

Examples

```
:- meta_non_terminal(findall(*, 0, *)).

:- meta_non_terminal(forall(0, 0)).

:- meta_non_terminal(maplist(2, *, *)).
```

mode/2

Description

```
mode(Mode, NumberOfProofs)
```

Most predicates can be used with several instantiations modes. This directive enables the specification of each instantiation mode and the corresponding number of proofs (not necessarily distinct solutions). You may also use this directive for documenting grammar rule non-terminals. Multiple directives may be used to specify the same predicate or grammar rule non-terminal.

Template and modes

```
mode(+predicate_mode_term, +number_of_proofs)
mode(+non_terminal_mode_term, +number_of_proofs)
```

Examples

```
:- mode(atom_concat(-atom, -atom, +atom), one_or_more).
:- mode(atom_concat(+atom, +atom, -atom), one).

:- mode(var(@term), zero_or_one).

:- mode(solve(+callable, -list(atom)), zero_or_one).
```

op/3

Description

```
op(Precedence, Associativity, Operator)
```

Declares operators. Operators declared inside objects and categories have local scope. Global operators can be declared inside a source file by writing the respective directives before the entity opening directives.

Template and modes

```
op(+integer, +associativity, +atom_or_atom_list)
```

Examples

```
:- op(950, fx, +).
:- op(950, fx, ?).
:- op(950, fx, @).
:- op(950, fx, -).
```

private/1

Description

```
private(Functor/Arity)
private((Functor1/Arity1, Functor2/Arity2, ...))
private([Functor1/Arity1, Functor2/Arity2, ...])

private(Functor//Arity)
private((Functor1//Arity1, Functor2//Arity2, ...))
private([Functor1//Arity1, Functor2//Arity2, ...])

private(op(Precedence, Associativity, Operator))
```

Declares private predicates, private grammar rule non-terminals, and private operators. A private predicate can only be called from the object containing the private directive. A private non-terminal can only be used in a call of the `phrase/2` and `phrase/3` methods from the object containing the private directive.

Template and modes

```
private(+predicate_indicator_term)
private(+non_terminal_indicator_term)
private(+operator_declaration)
```

Examples

```
:- private(counter/1).

:- private((init/1, free/1)).

:- private([data/3, key/1, keys/1]).
```

protected/1

Description

```
protected(Functor/Arity)
protected((Functor1/Arity1, Functor2/Arity2, ...))
protected([Functor1/Arity1, Functor2/Arity2, ...])

protected(Functor//Arity)
protected((Functor1//Arity1, Functor2//Arity2, ...))
protected([Functor1//Arity1, Functor2//Arity2, ...])

protected(op(Precedence, Associativity, Operator))
```

Declares protected predicates, protected grammar rule non-terminals, and protected operators. A protected predicate can only be called from the object containing the directive or from an object that inherits the directive. A protected non-terminal can only be used as an argument in a `phrase/2` and `phrase/3` messages sent from the object containing the directive or from an object that inherits the directive. Protected operators are not inherited but declaring them provides useful information for defining descendant objects.

Template and modes

```
protected(+predicate_indicator_term)
protected(+non_terminal_indicator_term)
protected(+operator_declaration)
```

Examples

```
:- protected(init/1).

:- protected((print/2, convert/4)).

:- protected([load/1, save/3]).
```

public/1

Description

```
public(Functor/Arity)
public((Functor1/Arity1, Functor2/Arity2, ...))
public([Functor1/Arity1, Functor2/Arity2, ...])

public(Functor//Arity)
public((Functor1//Arity1, Functor2//Arity2, ...))
public([Functor1//Arity1, Functor2//Arity2, ...])

public(op(Precedence, Associativity, Operator))
```

Declares public predicates, public grammar rule non-terminals, and public operators. A public predicate can be called from any object. A public non-terminal can be used as an argument in `phrase/2` and `phrase/3` messages sent from any object. Public operators are not exported but declaring them provides useful information for defining client objects.

Template and modes

```
public(+predicate_indicator_term)
public(+non_terminal_indicator_term)
public(+operator_declaration)
```

Examples

```
:- public(ancestor/1).

:- public((instance/1, instances/1)).

:- public([leaf/1, leaves/1]).
```

synchronized/1

Description

```
synchronized(Functor/Arity)
synchronized((Functor1/Arity1, Functor2/Arity2, ...))
synchronized([Functor1/Arity1, Functor2/Arity2, ...])

synchronized(Functor//Arity)
synchronized((Functor1//Arity1, Functor2//Arity2, ...))
synchronized([Functor1//Arity1, Functor2//Arity2, ...])
```

Declares synchronized predicates and synchronized grammar rule non-terminals. A synchronized predicate (or synchronized non-terminal) is protected by a mutex in order to allow for thread synchronization when proving a call to the predicate (or non-terminal). All predicates declared in the same synchronized directive share the same mutex. In order to use a separate mutex for each predicate (so that they are independently synchronized), a per-predicate synchronized directive must be used.

Declaring a predicate synchronized implicitly makes it deterministic. When using a single-threaded back-end Prolog compiler, calls to synchronized predicates behave as wrapped by the standard `once/1` meta-predicate.

Note that synchronized predicates cannot be declared dynamic (when necessary, declare the predicates updating the dynamic predicates as synchronized).

Template and modes

```
synchronized(+predicate_indicator_term)
synchronized(+non_terminal_indicator_term)
```

Examples

```
:- synchronized(db_update/1).

:- synchronized((write_stream/2, read_stream/2)).

:- synchronized([add_to_queue/2, remove_from_queue/2]).
```

uses/2

Description

```
uses(Object, Predicates)
uses(Object, PredicatesAndAliases)
```

```
uses(Object, NonTerminals)
uses(Object, NonTerminalsAndAliases)
```

Declares that all calls (made from predicates defined in the category or object containing the directive) to the specified predicates are to be interpreted as messages to the specified object. Thus, this directive may be used to simplify writing of predicate definitions by allowing the programmer to omit the `Object::` prefix when using the predicates listed in the directive (as long as the predicate calls do not occur as arguments for non-standard Prolog meta-predicates not declared on the adapter files). It is also possible to include operator declarations, `op(Precedence, Associativity, Operator)`, in the second argument.

This directive is also used when compiling calls to the database and reflection built-in methods by looking into these methods predicate arguments.

It is possible to specify a predicate alias using the notation `Functor/Arity as Alias/Arity` or, in alternative, the notation `Functor/Arity::Alias/Arity`. Aliases may be used either for avoiding conflicts between predicates specified in `use_module/2` and `uses/2` directives or for giving more meaningful names considering the using context of the predicates.

Template and modes

```
uses(+object_identifier, +predicate_indicator_list)
uses(+object_identifier, +predicate_indicator_alias_list)
```

```
uses(+object_identifier, +non_terminal_indicator_list)
uses(+object_identifier, +non_terminal_indicator_alias_list)
```

Examples

```
:- uses(list, [append/3, member/2]).
:- uses(store, [data/2]).

foo :-
    ...,
    findall(X, member(X, L), A),    % the same as findall(X, list::member(X, L), A)
    append(A, B, C),                % the same as list::append(A, B, C)
    assertz(data(X, C)),            % the same as store::assertz(data(X, C))
    ...
```

Another example, using the extended notation that allows us to define predicate aliases:

```
:- uses(btrees, [new/1::new_btree/1]).
:- uses(queues, [new/1::new_queue/1]).

btree_to_queue :-
    ...,
    new_btree(Tree),     % the same as btrees::new(Tree)
    new_queue(Queue),    % the same as queues::new(Queue)
    ...
```

use_module/2

Description

```
use_module(Module, Predicates)
```

This directive is supported only when using a back-end Prolog compiler that supports modules. It declares that all calls (made from predicates defined in the category or object containing the directive) to the specified predicates are to be interpreted as calls to explicitly-qualified module predicates. Thus, this directive may be used to simplify writing of predicate definitions by allowing the programmer to omit the `Module:` prefix when using the predicates listed in the directive (as long as the predicate calls do not occur as arguments for non-standard Prolog meta-predicates not declared on the adapter files). It is also possible to include operator declarations, `op(Precedence, Associativity, Operator)`, in the second argument.

This directive is also used when compiling calls to the database and reflection built-in methods by examining these methods predicate arguments.

It is possible to specify a predicate alias using the notation `Functor/Arity as Alias/Arity` or, in alternative, the notation `Functor/Arity:Alias/Arity`. Aliases may be used either for avoiding conflicts between predicates specified in `use_module/2` and `uses/2` directives or for giving more meaningful names considering the using context of the predicates.

Note that this directive differs from the directive with the same name found on some Prolog implementations by requiring the first argument to be a module name (an atom) instead of a file specification. As a consequence, this directive doesn't automatically load the module. Loading the module file is dependent of the used backend Prolog compiler and should be done separately (e.g. using a source file `use_module/1` or `use_module/2` directive in the entity file or in the application loader file). Also note that the name of the module may differ from the name of the module file.

Template and modes

```
use_module(+module_identifier, +predicate_indicator_list)
```

Examples

```
:- use_module(lists, [append/3, member/2]).
:- use_module(store, [data/2]).

foo :-
    ...,
    findall(X, member(X, L), A),    % the same as findall(X, lists:member(X, L), A)
    append(A, B, C),                % the same as lists:append(A, B, C)
    assertz(data(X, C)),            % the same as assertz(store:data(X, C))
    ...
```

Built-in predicates

current_category/1

Description

```
current_category(Category)
```

Enumerates, by backtracking, all currently defined categories. All categories are found, either static, dynamic, or built-in.

Template and modes

```
current_category(?category_identifier)
```

Errors

Category is neither a variable nor a valid category identifier:
`type_error(category_identifier, Category)`

Examples

```
| ?- current_category(monitoring).
```

current_object/1

Description

```
current_object(Object)
```

Enumerates, by backtracking, all currently defined objects. All objects are found, either static, dynamic or built-in.

Template and modes

```
current_object(?object_identifier)
```

Errors

Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`

Examples

```
| ?- current_object(list).
```

current_protocol/1

Description

```
current_protocol(Protocol)
```

Enumerates, by backtracking, all currently defined protocols. All protocols are found, either static, dynamic, or built-in.

Template and modes

```
current_protocol(?protocol_identifier)
```

Errors

Protocol is neither a variable nor a valid protocol identifier:
`type_error(protocol_identifier, Protocol)`

Examples

```
| ?- current_protocol(listp).
```

category_property/2

Description

```
category_property(Category, Property)
```

Enumerates, by backtracking, the properties associated with the defined categories. The valid category properties are listed in the language grammar.

Template and modes

```
category_property(?category_identifier, ?category_property)
```

Errors

Category is neither a variable nor a valid category identifier:
`type_error(category_identifier, Category)`
Property is neither a variable nor a callable term:
`type_error(callable, Property)`
Property is a callable term but not a valid category property:
`domain_error(category_property, Property)`

Examples

```
| ?- category_property(Category, dynamic).
```

object_property/2

Description

```
object_property(Object, Property)
```

Enumerates, by backtracking, the properties associated with the defined objects. The valid object properties are listed in the language grammar.

Template and modes

```
object_property(?object_identifier, ?object_property)
```

Errors

Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`
Property is neither a variable nor a callable term:
`type_error(callable, Property)`
Property is a callable term but not a valid object property:
`domain_error(object_property, Property)`

Examples

```
| ?- object_property(list, Property).
```

protocol_property/2

Description

```
protocol_property(Protocol, Property)
```

Enumerates, by backtracking, the properties associated with the currently defined protocols. The valid protocol properties are listed in the language grammar.

Template and modes

```
protocol_property(?protocol_identifier, ?protocol_property)
```

Errors

Protocol is neither a variable nor a valid protocol identifier:
`type_error(protocol_identifier, Protocol)`
Property is neither a variable nor a callable term:
`type_error(callable, Property)`
Property is a callable term but not a valid protocol property:
`domain_error(protocol_property, Property)`

Examples

```
| ?- protocol_property(listp, Property).
```

create_category/4

Description

```
create_category(Identifier, Relations, Directives, Clauses)
```

Creates a new, dynamic category. This predicate is often used as a primitive to implement high-level category creation methods.

When using Logtalk multi-threading features, predicates calling this built-in predicate may need to be declared synchronized in order to avoid race conditions.

Template and modes

```
create_category(?category_identifier, +list, +list, +list)
```

Errors

Relations, Directives, or Clauses is a variable:
`instantiation_error`
Identifier is neither a variable nor a valid category identifier:
`type_error(category_identifier, Identifier)`
Identifier is already in use:
`permission_error(replace, category, Identifier)`
`permission_error(replace, object, Identifier)`
`permission_error(replace, protocol, Identifier)`
Relations is neither a variable nor a proper list:
`type_error(list, Relations)`
Directives is neither a variable nor a proper list:
`type_error(list, Directives)`
Clauses is neither a variable nor a proper list:
`type_error(list, Clauses)`

Examples

```
| ?- create_category(
       tolerances,
       [implements(comparing)],
       [],
       [epsilon(1e-15), (equal(X, Y) :- epsilon(E), abs(X-Y) =< E)]
    ).
```

create_object/4

Description

```
create_object(Identifier, Relations, Directives, Clauses)
```

Creates a new, dynamic object. The word *object* is used here as a generic term. This predicate can be used to create new prototypes, instances, and classes. This predicate is often used as a primitive to implement high-level object creation methods.

When using Logtalk multi-threading features, predicates calling this built-in predicate may need to be declared synchronized in order to avoid race conditions.

Template and modes

```
create_object(?object_identifier, +list, +list, +list)
```

Errors

Relations, Directives, or Clauses is a variable:
`instantiation_error`
Identifier is neither a variable nor a valid object identifier:
`type_error(object_identifier, Identifier)`
Identifier is already in use:
`permission_error(replace, category, Identifier)`
`permission_error(replace, object, Identifier)`
`permission_error(replace, protocol, Identifier)`
Relations is neither a variable nor a proper list:
`type_error(list, Relations)`
Directives is neither a variable nor a proper list:
`type_error(list, Directives)`
Clauses is neither a variable nor a proper list:
`type_error(list, Clauses)`

Examples

Creating a simple, stand-alone object (a prototype):

```
| ?- create_object(translator, [], [public(int/2)], [int(0, zero)]).
```

Creating a new prototype derived from a parent prototype:

```
| ?- create_object(mickey, [extends(mouse)], [public(alias/1)], [alias(mortimer)]).
```

Creating a new class instance:

```
| ?- create_object(p1, [instantiates(person)], [], [name('Paulo Moura'), age(42)]).
```

Creating a new class as a specialization of another class:

```
| ?- create_object(hovercraft, [specializes(vehicle)], [public([propeller/2,
fan/2])], []).
```

Creating a new object and defining its initialization goal:

```
| ?- create_object(runner, [instantiates(runners)], [initialization(start)],
[length(22), time(60)]).
```

Creating a new empty object with dynamic predicate declarations support:

```
| ?- create_object(database, [], [set_logtalk_flag(dynamic_declarations, allow)],
[]).
```

create_protocol/3

Description

```
create_protocol(Identifier, Relations, Directives)
```

Creates a new, dynamic protocol. This predicate is often used as a primitive to implement high-level protocol creation methods.

When using Logtalk multi-threading features, predicates calling this built-in predicate may need to be declared synchronized in order to avoid race conditions.

Template and modes

```
create_protocol(?protocol_identifier, +list, +list)
```

Errors

Either Relations or Directives is a variable:
`instantiation_error`
Identifier is neither a variable nor a valid protocol identifier:
`type_error(protocol_identifier, Identifier)`
Identifier is already in use:
`permission_error(replace, category, Identifier)`
`permission_error(replace, object, Identifier)`
`permission_error(replace, protocol, Identifier)`
Relations is neither a variable nor a proper list:
`type_error(list, Relations)`
Directives is neither a variable nor a proper list:
`type_error(list, Directives)`

Examples

```
| ?- create_protocol(
       logging,
       [extends(monitoring)],
       [public([log_file/1, log_on/0, log_off/0])]
    ).
```

abolish_category/1

Description

```
abolish_category(Category)
```

Removes from the database a dynamic category.

Template and modes

```
abolish_category(@category_identifier)
```

Errors

Category is a variable:
`instantiation_error`
Category is neither a variable nor a valid category identifier:
`type_error(category_identifier, Category)`
Category is an identifier of a static category:
`permission_error(modify, static_category, Category)`
Category does not exist:
`existence_error(category, Category)`

Examples

```
| ?- abolish_category(monitoring).
```

abolish_object/1

Description

```
abolish_object(Object)
```

Removes from the database a dynamic object.

Template and modes

```
abolish_object(@object_identifier)
```

Errors

Object is a variable:
`instantiation_error`
Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`
Object is an identifier of a static object:
`permission_error(modify, static_object, Object)`
Object does not exist:
`existence_error(object, Object)`

Examples

```
| ?- abolish_object(list).
```

abolish_protocol/1

Description

```
abolish_protocol(Protocol)
```

Removes from the database a dynamic protocol.

Template and modes

```
abolish_protocol(@protocol_identifier)
```

Errors

Protocol is a variable:
`instantiation_error`
Protocol is neither a variable nor a valid protocol identifier:
`type_error(protocol_identifier, Protocol)`
Protocol is an identifier of a static protocol:
`permission_error(modify, static_protocol, Protocol)`
Protocol does not exist:
`existence_error(protocol, Protocol)`

Examples

```
| ?- abolish_protocol(listp).
```

extends_object/2-3

Description

```
extends_object(Prototype, Parent)
extends_object(Prototype, Parent, Scope)
```

Enumerates, by backtracking, all pairs of objects such that the first one extends the second. The relation scope is represented by the atoms `public`, `protected`, and `private`.

Template and modes

```
extends_object(?object_identifier, ?object_identifier)
extends_object(?object_identifier, ?object_identifier, ?scope)
```

Errors

Prototype is neither a variable nor a valid object identifier:
`type_error(object_identifier, Prototype)`
Parent is neither a variable nor a valid object identifier:
`type_error(object_identifier, Parent)`
Scope is neither a variable nor an atom:
`type_error(atom, Scope)`
Scope is not a valid entity scope:
`domain_error(scope, Scope)`

Examples

```
| ?- extends_object(Object, state_space).

| ?- extends_object(Object, list, public).
```

extends_protocol/2-3

Description

```
extends_protocol(Protocol1, Protocol2)
extends_protocol(Protocol1, Protocol2, Scope)
```

Enumerates, by backtracking, all pairs of protocols such that the first one extends the second. The relation scope is represented by the atoms `public`, `protected`, and `private`.

Template and modes

```
extends_protocol(?protocol_identifier, ?protocol_identifier)
extends_protocol(?protocol_identifier, ?protocol_identifier, ?scope)
```

Errors

Protocol1 is neither a variable nor a valid protocol identifier:
`type_error(protocol_identifier, Protocol1)`
Protocol2 is neither a variable nor a valid protocol identifier:
`type_error(protocol_identifier, Protocol2)`
Scope is neither a variable nor an atom:
`type_error(atom, Scope)`
Scope is not a valid entity scope:
`domain_error(scope, Scope)`

Examples

```
| ?- extends_protocol(listp, Protocol).

| ?- extends_protocol(Protocol, termp, private).
```

extends_category/2-3

Description

```
extends_category(Category1, Category2)
extends_category(Category1, Category2, Scope)
```

Enumerates, by backtracking, all pairs of categories such that the first one extends the second. The relation scope is represented by the atoms `public`, `protected`, and `private`.

Template and modes

```
extends_category(?category_identifier, ?category_identifier)
extends_category(?category_identifier, ?category_identifier, ?scope)
```

Errors

Category1 is neither a variable nor a valid protocol identifier:
`type_error(category_identifier, Category1)`
Category2 is neither a variable nor a valid protocol identifier:
`type_error(category_identifier, Category2)`
Scope is neither a variable nor an atom:
`type_error(atom, Scope)`
Scope is not a valid entity scope:
`domain_error(scope, Scope)`

Examples

```
| ?- extends_category(basic, Category).

| ?- extends_category(Category, extended, private).
```

implements_protocol/2-3

Description

```
implements_protocol(Object, Protocol)
implements_protocol(Category, Protocol)

implements_protocol(Object, Protocol, Scope)
implements_protocol(Category, Protocol, Scope)
```

Enumerates, by backtracking, all pairs of entities such that an object or a category implements a protocol. The relation scope is represented by the atoms `public`, `protected`, and `private`. This predicate only returns direct implementation relations; it does not implement a transitive closure.

Template and modes

```
implements_protocol(?object_identifier, ?protocol_identifier)
implements_protocol(?category_identifier, ?protocol_identifier)

implements_protocol(?object_identifier, ?protocol_identifier, ?scope)
implements_protocol(?category_identifier, ?protocol_identifier, ?scope)
```

Errors

Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`
Category is neither a variable nor a valid category identifier:
`type_error(category_identifier, Category)`
Protocol is neither a variable nor a valid protocol identifier:
`type_error(protocol_identifier, Protocol)`
Scope is neither a variable nor an atom:
`type_error(atom, Scope)`
Scope is not a valid entity scope:
`domain_error(scope, Scope)`

Examples

```
| ?- implements_protocol(list, listp).

| ?- implements_protocol(list, listp, public).
```

imports_category/2-3

Description

```
imports_category(Object, Category)

imports_category(Object, Category, Scope)
```

Enumerates, by backtracking, importation relations between objects and categories. The relation scope is represented by the atoms `public`, `protected`, and `private`.

Template and modes

```
imports_category(?object_identifier, ?category_identifier)

imports_category(?object_identifier, ?category_identifier, ?scope)
```

Errors

Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`
Category is neither a variable nor a valid category identifier:
`type_error(category_identifier, Category)`
Scope is neither a variable nor an atom:
`type_error(atom, Scope)`
Scope is not a valid entity scope:
`domain_error(scope, Scope)`

Examples

```
| ?- imports_category(debugger, monitoring).

| ?- imports_category(Object, monitoring, protected).
```

instantiates_class/2-3

Description

```
instantiates_class(Instance, Class)
instantiates_class(Instance, Class, Scope)
```

Enumerates, by backtracking, all pairs of objects such that the first one instantiates the second. The relation scope is represented by the atoms `public`, `protected`, and `private`.

Template and modes

```
instantiates_class(?object_identifier, ?object_identifier)
instantiates_class(?object_identifier, ?object_identifier, ?scope)
```

Errors

Instance is neither a variable nor a valid object identifier:
`type_error(object_identifier, Instance)`
Class is neither a variable nor a valid object identifier:
`type_error(object_identifier, Class)`
Scope is neither a variable nor an atom:
`type_error(atom, Scope)`
Scope is not a valid entity scope:
`domain_error(scope, Scope)`

Examples

```
| ?- instantiates_class(water_jug, state_space).

| ?- instantiates_class(Space, state_space, public).
```

specializes_class/2-3

Description

```
specializes_class(Class, Superclass)
specializes_class(Class, Superclass, Scope)
```

Enumerates, by backtracking, all pairs of objects such that the first one specializes the second. The relation scope is represented by the atoms `public`, `protected`, and `private`.

Template and modes

```
specializes_class(?object_identifier, ?object_identifier)
specializes_class(?object_identifier, ?object_identifier, ?scope)
```

Errors

Class is neither a variable nor a valid object identifier:
`type_error(object_identifier, Class)`
Superclass is neither a variable nor a valid object identifier:
`type_error(object_identifier, Superclass)`
Scope is neither a variable nor an atom:
`type_error(atom, Scope)`
Scope is not a valid entity scope:
`domain_error(scope, Scope)`

Examples

```
| ?- specializes_class(Subclass, state_space).

| ?- specializes_class(Subclass, state_space, public).
```

complements_object/2

Description

```
complements_object(Category, Object)
```

Enumerates, by backtracking, all category–object pairs such that the category explicitly complements the object.

Template and modes

```
complements_object(?category_identifier, ?object_identifier)
```

Errors

Category is neither a variable nor a valid category identifier:
`type_error(category_identifier, Prototype)`
Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Parent)`

Examples

```
| ?- complements_object(logging, employee).
```

conforms_to_protocol/2-3

Description

```
conforms_to_protocol(Object, Protocol)
conforms_to_protocol(Category, Protocol)

conforms_to_protocol(Object, Protocol, Scope)
conforms_to_protocol(Category, Protocol, Scope)
```

Enumerates, by backtracking, all pairs of entities such that an object or a category conforms to a protocol. The relation scope is represented by the atoms `public`, `protected`, and `private`. This predicate implements a transitive closure for the protocol implementation relation.

Template and modes

```
conforms_to_protocol(?object_identifier, ?protocol_identifier)
conforms_to_protocol(?category_identifier, ?protocol_identifier)

conforms_to_protocol(?object_identifier, ?protocol_identifier, ?scope)
conforms_to_protocol(?category_identifier, ?protocol_identifier, ?scope)
```

Errors

Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`
Category is neither a variable nor a valid category identifier:
`type_error(category_identifier, Category)`
Protocol is neither a variable nor a valid protocol identifier:
`type_error(protocol_identifier, Protocol)`
Scope is neither a variable nor an atom:
`type_error(atom, Scope)`
Scope is not a valid entity scope:
`domain_error(scope, Scope)`

Examples

```
| ?- conforms_to_protocol(list, listp).

| ?- conforms_to_protocol(list, listp, public).
```

abolish_events/5

Description

```
abolish_events(Event, Object, Message, Sender, Monitor)
```

Abolishes all matching events. The two types of events are represented by the atoms `before` and `after`.

Template and modes

```
abolish_events(@event, @object_identifier, @callable, @object_identifier, @object_identifier)
```

Errors

Event is neither a variable nor a valid event identifier:
`type_error(event, Event)`
Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`
Message is neither a variable nor a callable term:
`type_error(callable, Message)`
Sender is neither a variable nor a valid object identifier:
`type_error(object_identifier, Sender)`
Monitor is neither a variable nor a valid object identifier:
`type_error(object_identifier, Monitor)`

Examples

```
| ?- abolish_events(_, list, _, _, debugger).
```

current_event/5

Description

```
current_event(Event, Object, Message, Sender, Monitor)
```

Enumerates, by backtracking, all defined events. The two types of events are represented by the atoms `before` and `after`.

Template and modes

```
current_event(?event, ?object_identifier, ?callable, ?object_identifier, ?object_identifier)
```

Errors

Event is neither a variable nor a valid event identifier:
`type_error(event, Event)`
Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`
Message is neither a variable nor a callable term:
`type_error(callable, Message)`
Sender is neither a variable nor a valid object identifier:
`type_error(object_identifier, Sender)`
Monitor is neither a variable nor a valid object identifier:
`type_error(object_identifier, Monitor)`

Examples

```
| ?- current_event(Event, Object, Message, Sender, debugger).
```

define_events/5

Description

```
define_events(Event, Object, Message, Sender, Monitor)
```

Defines a new set of events. The two types of events are represented by the atoms `before` and `after` The object `Monitor` must define the event handler methods required by the `Event` argument.

Template and modes

```
define_events(@event, @object_identifier, @callable, @object_identifier, +object_identifier)
```

Errors

Event is neither a variable nor a valid event identifier:
`type_error(event, Event)`
Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`
Message is neither a variable nor a callable term:
`type_error(callable, Message)`
Sender is neither a variable nor a valid object identifier:
`type_error(object_identifier, Sender)`
Monitor is a variable:
`instantiation_error`
Monitor is neither a variable nor a valid object identifier:
`existence_error(object_identifier, Monitor)`
Monitor does not define the required `before/3` method:
`existence_error(procedure, before/3)`
Monitor does not define the required `after/3` method:
`existence_error(procedure, after/3)`

Examples

```
| ?- define_events(_, list, member(_, _), _ , debugger).
```

threaded/1

Description

```
threaded(Goals)

threaded(Conjunction)
threaded(Disjunction)
```

Proves each goal in a conjunction (disjunction) of goals in its own thread. This predicate is deterministic and opaque to cuts. The predicate argument is **not** flattened.

When the argument is a conjunction of goals, a call to this predicate blocks until either all goals succeed, one of the goals fail, or one of the goals generate an exception; the failure of one of the goals or an exception on the execution of one of the goals results in the termination of the remaining threads. The predicate call is true *iff* all goals are true.

When the argument is a disjunction of goals, a call to this predicate blocks until either one of the goals succeeds, all the goals fail, or one of the goals generate an exception; the success of one of the goals or an exception on the execution of one of the goals results in the termination of the remaining threads. The predicate call is true *iff* one of the goals is true.

When the predicate argument is neither a conjunction not a disjunction of goals, no threads are used. In this case, the predicate call is equivalent to a `once/1` predicate call.

Template and modes

```
threaded(+callable)
```

Errors

Goals is a variable:
`instantiation_error`
A goal in Goals is a variable:
`instantiation_error`
Goals is neither a variable nor a callable term:
`type_error(callable, Goals)`
A goal Goal in Goals is neither a variable nor a callable term:
`type_error(callable, Goal)`

Examples

Prove a conjunction of goals, each one in its own thread:
`threaded((Goal, Goals))`
Prove a disjunction of goals, each one in its own thread:
`threaded((Goal; Goals))`

threaded_call/1-2

Description

```
threaded_call(Goal)
threaded_call(Goal, Tag)
```

Proves `Goal` asynchronously using a new thread. The argument can be a message sending goal. Calls to this predicate always succeeds and return immediately. The results (success, failure, or exception) are sent back to the message queue of the object containing the call (*this*); they can be retrieved by calling the `threaded_exit/1` predicate.

The variant `threaded_call/2` returns a threaded call identifier tag that can be used with the `threaded_exit/2` predicate. Tags shall be regarded as an opaque term; users shall not rely on its type.

Template and modes

```
threaded_call(@callable)
threaded_call(@callable, -nonvar)
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`
Tag is not a variable:
`type_error(variable, Goal)`

Examples

Prove `Goal` asynchronously in a new thread:
`threaded_call(Goal)`
Prove `::Message` asynchronously in a new thread:
`threaded_call(::Message)`
Prove `Object::Message` asynchronously in a new thread:
`threaded_call(Object::Message)`

threaded_once/1-2

Description

```
threaded_once(Goal)
threaded_once(Goal, Tag)
```

Proves `Goal` asynchronously using a new thread. Only the first goal solution is found. The argument can be a message sending goal. This call always succeeds. The result (success, failure, or exception) is sent back to the message queue of the object containing the call (*this*).

The variant `threaded_once/2` returns a threaded call identifier tag that can be used with the `threaded_exit/2` predicate. Tags shall be regarded as an opaque term; users shall not rely on its type.

Template and modes

```
threaded_once(@callable)
threaded_once(@callable, -nonvar)
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`
Tag is not a variable:
`type_error(variable, Goal)`

Examples

Prove `Goal` asynchronously in a new thread:
`threaded_once(Goal)`
Prove `::Message` asynchronously in a new thread:
`threaded_once(::Message)`
Prove `Object::Message` asynchronously in a new thread:
`threaded_once(Object::Message)`

threaded_ignore/1

Description

```
threaded_ignore(Goal)
```

Proves `Goal` asynchronously using a new thread. Only the first goal solution is found. The argument can be a message sending goal. This call always succeeds, independently of the result (success, failure, or exception), which is simply discarded instead of being sent back to the message queue of the object containing the call (*this*).

Template and modes

```
threaded_ignore(@callable)
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`

Examples

Prove `Goal` asynchronously in a new thread:
`threaded_ignore(Goal)`
Prove `::Message` asynchronously in a new thread:
`threaded_ignore(::Message)`
Prove `Object::Message` asynchronously in a new thread:
`threaded_ignore(Object::Message)`

threaded_exit/1-2

Description

```
threaded_exit(Goal)
threaded_exit(Goal, Tag)
```

Retrieves the result of proving `Goal` in a new thread. This predicate blocks execution until the reply is sent to the *this* message queue by the thread executing the goal. When there is no thread proving the goal, the predicate generates an exception. This predicate is non-deterministic, providing access to any alternative solutions of its argument.

The argument of this predicate should be a *variant* of the argument of the corresponding `threaded_call/1` call. When the predicate argument is subsumed by the `threaded_call/1` call argument, the `threaded_exit/1` call will succeed iff its argument is a solution of the (more general) goal.

The variant `threaded_exit/2` accepts a threaded call identifier tag generated by the calls to the `threaded_call/2` and `threaded_once/2` predicates. Tags shall be regarded as an opaque term; users shall not rely on its type.

Template and modes

```
threaded_exit(+callable)
threaded_exit(+callable, +nonvar)
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`
no thread is running for proving Goal:
`existence_error(goal_thread, Goal)`
Tag is a variable:
`instantiation_error`

Examples

To retrieve an asynchronous goal proof result:
`threaded_exit(Goal)`
To retrieve an asynchronous message to *self* result:
`threaded_exit(::Goal)`
To retrieve an asynchronous message result:
`threaded_exit(Object::Goal)`

threaded_peek/1-2

Description

```
threaded_peek(Goal)
threaded_peek(Goal, Tag)
```

Checks if the result of proving `Goal` in a new thread is already available. This call succeeds or fails without blocking execution waiting for a reply to be available.

The argument of this predicate should be a *variant* of the argument of the corresponding `threaded_call/1` call. When the predicate argument is subsumed by the `threaded_call/1` call argument, the `threaded_peek/1` call will succeed iff its argument unifies with an already available solution of the (more general) goal.

The variant `threaded_peek/2` accepts a threaded call identifier tag generated by the calls to the `threaded_call/2` and `threaded_once/2` predicates. Tags shall be regarded as an opaque term; users shall not rely on its type.

Template and modes

```
threaded_peek(+callable)
threaded_peek(+callable, +nonvar)
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`
Tag is a variable:
`instantiation_error`

Examples

To check for an asynchronous goal proof result:
`threaded_peek(Goal)`
To check for an asynchronous message to *self* result:
`threaded_peek(::Goal)`
To check for an asynchronous message result:
`threaded_peek(Object::Goal)`

threaded_wait/1

Description

```
threaded_wait(Term)
threaded_wait([Term| Terms])
```

Suspends the thread making the call until a notification is received that unifies with `Term`. The call must be made within the same object (*this*) containing the calls to the `threaded_notify/1` predicate that will eventually send the notification. The argument may also be a list of notifications, `[Term| Terms]`. In this case, the thread making the call will suspend until all notifications in the list are received.

Template and modes

```
threaded_wait(?term)
threaded_wait(+list(term))
```

Errors

`(none)`

Examples

Wait until the `data_available` notification is received:

```
threaded_wait(data_available)
```

threaded_notify/1

Description

```
threaded_notify(Term)
threaded_notify([Term| Terms])
```

Sends `Term` as a notification to any thread suspended waiting for it in order to proceed. The call must be made within the same object (*this*) containing the calls to the `threaded_wait/1` predicate waiting for the notification. The argument may also be a list of notifications, `[Term| Terms]`. In this case, all notifications in the list will be sent to any threads suspended waiting for them in order to proceed.

Template and modes

```
threaded_notify(@term)
threaded_notify(@list(term))
```

Errors

`(none)`

Examples

Send the notification `data_available`:

```
threaded_notify(data_available)
```

logtalk_compile/1

Description

```
logtalk_compile(File)
logtalk_compile(Files)
```

Compiles to disk a source file or a list of source files using the default compiler flags specified in the Logtalk adapter file. The Logtalk source file name extension (by default, `.lgt`) can be omitted. Source file paths can be absolute, relative to the current directory, or use library notation. This predicate can also be used to compile Prolog source files as Logtalk source code. When no recognized Logtalk or Prolog extension is specified, the compiler tries first to append a Logtalk source file extension and then a Prolog source file extension. If that fails, the compiler tries to use the file name as-is.

Note that only the errors related to problems in the predicate argument are listed below. This predicate fails when errors are found during compilation of a source file.

Template and modes

```
logtalk_compile(@source_file_name)
logtalk_compile(@list(source_file_name))
```

Errors

File is a variable:
`instantiation_error`
Files is a variable or a list with an element which is a variable:
`instantiation_error`
File, or an element File of the Files list, is neither a variable nor a source file:
`type_error(source_file_name, File)`
File, or an element File of the Files list, uses library notation but the library does not exist:
`existence_error(library, Library)`
File or an element File of the Files list does not exist:
`existence_error(file, File)`

Examples

```
| ?- logtalk_compile(set).

| ?- logtalk_load(types(tree)).

| ?- logtalk_compile([listp, list]).
```

logtalk_compile/2

Description

```
logtalk_compile(File, Options)
logtalk_compile(Files, Options)
```

Compiles to disk a source file or a list of source files using a list of compiler options. The Logtalk source file name extension (by default, `.lgt`) can be omitted. Source file paths can be absolute, relative to the current directory, or use library notation. This predicate can also be used to compile Prolog source files as Logtalk source code. When no recognized Logtalk or Prolog extension is specified, the compiler tries first to append a Logtalk source file extension and then a Prolog source file extension. If that fails, the compiler tries to use the file name as-is. Compiler option are represented as *flag(value)*. For a description of the available compiler flags, please consult the User Manual.

Note that only the errors related to problems in the predicate argument are listed below. This predicate fails when errors are found during compilation of a source file.

Template and modes

```
logtalk_compile(@source_file_name, @list(compiler_option))
logtalk_compile(@list(source_file_name), @list(compiler_option))
```

Errors

File is a variable:
`instantiation_error`
Files is a variable or a list with an element which is a variable:
`instantiation_error`
File, or an element File of the Files list, is neither a variable nor a source file name:
`type_error(source_file_name, File)`
File, or an element File of the Files list, uses library notation but the library does not exist:
`existence_error(library, Library)`
File or an element File of the Files list, does not exist:
`existence_error(file, File)`
Options is a variable or a list with an element which is a variable:
`instantiation_error`
Options is neither a Options nor a proper list:
`type_error(list, Flags)`
An element Option of the Options list is not a valid compiler option:
`type_error(compiler_option, Option)`
An element Option of the Options list defines a value for a read-only compiler flag:
`permission_error(modify, flag, Flag)`
An element Option of the Options list defines an invalid value for a flag:
`domain_error(flag_value, Flag+Value)`

Examples

```
| ?- logtalk_compile_1(list, []).

| ?- logtalk_compile_1(types(tree)).

| ?- logtalk_compile_1([listp, list], [source_data(off), portability(silent)]).
```

logtalk_load/1

Description

```
logtalk_load(File)
logtalk_load(Files)
```

Compiles to disk and then loads to memory a source file or a list of source files using the default compiler flags specified in the Logtalk adapter file. The Logtalk source file name extension (by default, `.lgt`) can be omitted. Source file paths can be absolute, relative to the current directory, or use library notation. This predicate can also be used to compile Prolog source files as Logtalk source code. When no recognized Logtalk or Prolog extension is specified, the compiler tries first to append a Logtalk source file extension and then a Prolog source file extension. If that fails, the compiler tries to use the file name as-is.

Note that only the errors related to problems in the predicate argument are listed below. This predicate fails when errors are found during compilation of a source file.

Depending on the back-end Prolog compiler, the notation `{File}` may be used in alternative (check the adapter files for its availability).

Template and modes

```
logtalk_load(@source_file_name)
logtalk_load(@list(source_file_name))
```

Errors

File is a variable:
`instantiation_error`
Files is a variable or a list with an element which is a variable:
`instantiation_error`
File, or an element File of the Files list, is neither a variable nor a source file name:
`type_error(source_file_name, File)`
File, or an element File of the Files list, uses library notation but the library does not exist:
`existence_error(library, Library)`
File or an element File of the Files list, does not exist:
`existence_error(file, File)`

Examples

```
| ?- logtalk_load(set).

| ?- logtalk_load(types(tree)).

| ?- logtalk_load([listp, list]).
```

logtalk_load/2

Description

```
logtalk_load(File, Options)
logtalk_load(Files, Options)
```

Compiles to disk and then loads to memory a source file or a list of source files using a list of compiler options. The Logtalk source file name extension (by default, `.lgt`) can be omitted. Compiler option are represented as *flag(value)*. This predicate can also be used to compile Prolog source files as Logtalk source code. When no recognized Logtalk or Prolog extension is specified, the compiler tries first to append a Logtalk source file extension and then a Prolog source file extension. If that fails, the compiler tries to use the file name as-is. For a description of the available compiler flags, please consult the User Manual. Source file paths can be absolute, relative to the current directory, or use library notation.

Note that only the errors related to problems in the predicate argument are listed below. This predicate fails when errors are found during compilation of a source file.

Template and modes

```
logtalk_load(@source_file_name, @list(compiler_option))
logtalk_load(@list(source_file_name), @list(compiler_option))
```

Errors

File is a variable:
`instantiation_error`
Files is a variable or a list with an element which is a variable:
`instantiation_error`
File, or an element File of the Files list, is neither a variable nor a source file name:
`type_error(source_file_name, File)`
File, or an element File of the Files list, uses library notation but the library does not exist:
`existence_error(library, Library)`
File or an element File of the Files list, does not exist:
`existence_error(file, File)`
Options is a variable or a list with an element which is a variable:
`instantiation_error`
Options is neither a Options nor a proper list:
`type_error(list, Options)`
An element Option of the Options list is not a valid compiler option:
`type_error(compiler_option, Option)`
An element Option of the Options list defines a value for a read-only compiler flag:
`permission_error(modify, flag, Flag)`
An element Option of the Options list defines an invalid value for a flag:
`domain_error(flag_value, Flag+Value)`

Examples

```
| ?- logtalk_load(list, []).

| ?- logtalk_load(types(tree)).

| ?- logtalk_load([listp, list], [source_data(off), portability(silent)]).
```

`logtalk_make/0`

Description

```
logtalk_make
```

Reloads all Logtalk source files that have been modified since the time they are last loaded.

There are some caveats when using this built-in predicate, however. First, only source files loaded using the `logtalk_load/1-2` predicates are reloaded. Second, when a source file have not been modified since last loaded, it will not be reloaded if the same explicit compiler options are being used and there are no changes to the `debug/1` and `optimize/1` options (i.e. there is no change to the file compilation mode). No check is made for other implicit compiler options that may have changed between loads.

Template and modes

```
logtalk_make
```

Errors

`(none)`

Examples

```
| ?- logtalk_make.
```

logtalk_make/1

Description

```
logtalk_make(Target)
```

Allows reloading all Logtalk source files that have been modified since the time they are last loaded when called with the argument `all` and deleting all intermediate files generated by the compilation of Logtalk source files when called with the argument `clean`.

There are some caveats, however, when using this built-in predicate with the `all` target. First, only source files loaded using the `logtalk_load/1-2` predicates are reloaded. Second, when a source file have not been modified since last loaded, it will not be reloaded if the same explicit compiler options are being used and there are no changes to the `debug/1` and `optimize/1` options (i.e. there is no change to the file compilation mode). No check is made for other implicit compiler options that may have changed between loads.

Template and modes

```
logtalk_make(+atom)
```

Errors

`(none)`

Examples

```
| ?- logtalk_make(clean).
```

logtalk_library_path/2

Description

```
logtalk_library_path(Library, Path)
```

Dynamic and multifile user-defined predicate, allowing the declaration of aliases to library paths. Library aliases may also be used on the second argument (using the notation *alias(path)*). Paths must always end with the path directory separator character ("/").

Relative paths (e.g. `'../'` or `'./'`) should only be used within the *alias(path)*) notation so that library paths can always be expanded to absolute paths independently of the (usually unpredictable) current directory at the time the `logtalk_library_path/2` predicate is called.

When working with a relocatable application, the actual application installation directory can be retrieved by calling the `logtalk_load_context/2` predicate with the `directory` key and using the returned value to define the `logtalk_library_path/2` predicate. On a settings file, simply use an `initialization/1` directive to wrap the call to the `logtalk_load_context/2` predicate and the assert of the `logtalk_library_path/2` fact.

Template and modes

```
logtalk_library_path(?atom, -atom)
logtalk_library_path(?atom, -compound)
```

Errors

(none)

Examples

```
| ?- logtalk_library_path(viewpoints, Path).

Path = examples('viewpoints/')
yes

| ?- logtalk_library_path(Library, Path).

Library = lgtuser
Path = '$LOGTALKUSER/' ;

Library = library
Path = lgtuser('library/') ;

Library = examples
Path = lgtuser('examples/') ;

Library = viewpoints
Path = examples('viewpoints/')
yes
```

logtalk_load_context/2

Description

```
logtalk_load_context(Key, Value)
```

Provides access to the Logtalk compilation/loading context. The following keys are currently supported: `entity_identifier`, `entity_prefix`, `entity_type`, `source`, `file` (same as `source`), `basename`, `directory`, `stream`, `target` (the full path of the intermediate Prolog file), `term_position` (`Start-End`), and `variable_names` (`[Name1=Variable1, ...]`). The `term_position` key is only supported in back-end Prolog compilers that provide the start and end lines of a read term.

The `source`, `file`, `basename`, `directory`, and `target` keys can also be used in calls to the `logtalk_load_context/2` predicate wrapped in `initialization/1` directives.

Using the `variable_names` key requires calling the standard built-in predicate `term_variables/2` on the term read and unifying the term variables with the variables in the names list. This, however, rises portability issues with those Prolog compilers that don't return the variables in the same order for the `term_variables/2` predicate and the option `variable_names/1` of the `read_term/3` built-in predicate, which is used by the Logtalk compiler to read source files.

Template and modes

```
logtalk_load_context(?atom, -nonvar)
```

Errors

`(none)`

Examples

```
| ?- logtalk_load_context(entity_identifier, Name).

Name = list
yes

| ?- logtalk_load_context(source, Source).

Source = '/Users/me/project/library/list.lgt'

| ?- logtalk_load_context(basename, Basename).

Basename = 'list.lgt'

| ?- logtalk_load_context(directory, Directory).

Directory = '/Users/me/project/library/'
yes
```

current_logtalk_flag/2

Description

```
current_logtalk_flag(Flag, Value)
```

Enumerates, by backtracking, the current Logtalk flag values.

Template and modes

```
current_logtalk_flag(?atom, ?atom)
```

Errors

Flag is neither a variable nor an atom:
`type_error(atom, Flag)`
Flag is not a valid flag:
`domain_error(flag, Value)`

Examples

```
| ?- current_logtalk_flag(xml, Value).
```

set_logtalk_flag/2

Description

```
set_logtalk_flag(Flag, Value)
```

Sets Logtalk default, global, flag values. For local flag scope, use the corresponding `set_logtalk_flag/2` directive. To set a global flag value when compiling and loading a source file, wrap the calls to this built-in predicate with an `initialization/1` directive.

Template and modes

```
set_logtalk_flag(+atom, +nonvar)
```

Errors

Flag is a variable:
`instantiation_error`
Value is a variable:
`instantiation_error`
Flag is not an atom:
`type_error(atom, Flag)`
Flag is neither a variable nor a valid flag:
`domain_error(flag, Flag)`
Value is not a valid value for flag Flag:
`domain_error(flag_value, Flag + Value)`
Flag is a read-only flag:
`permission_error(modify, flag, Flag)`

Examples

```
| ?- set_logtalk_flag(unknown_entities, silent).
```

Built-in methods

parameter/2

Description

```
parameter(Number, Term)
```

Used in parametric objects (and parametric categories), this private method provides runtime access to the parameter values of the entity that contains the predicate clause whose body is being executed by using the argument number in the entity identifier. This predicate is implemented as a unification between its second argument and the corresponding implicit execution-context argument in the predicate containing the call. This unification occurs at the clause head when the second argument is not instantiated (the most common case). When the second argument is instantiated, the unification must be delayed to runtime and thus occurs at the clause body. See also `this/1`.

Template and modes

```
parameter(+integer, ?term)
```

Errors

Number is a variable:
`instantiation_error`
Number is neither a variable nor an integer value:
`type_error(integer, Number)`
Number is smaller than one or greater than the parametric entity identifier arity:
`domain_error(out_of_range, Number)`
Entity identifier is not a compound term:
`type_error(compound, Entity)`

Examples

```
:- object(box(_Color, _Weight)).

    ...

    color(Color) :-             % this clause is translated into a fact
        parameter(1, Color).    % upon compilation

    heavy :-
        parameter(2, Weight),   % after compilation, the >/2 call will be
        Weight > 10.            % the first condition on the clause body

    ...
```

self/1

Description

```
self(Self)
```

Returns the object that has received the message under processing. This private method is translated to a unification between its argument and the corresponding implicit context argument in the predicate containing the call. This unification occurs at the clause head, not at the clause body.

Template and modes

```
self(?object_identifier)
```

Errors

(none)

Examples

```
test :-
    self(Self),                                 % after compilation, the write/1
    write('executing a method in behalf of '),  % call will be the first goal on
    writeq(Self), nl.                           % the clause body
```

sender/1

Description

```
sender(Sender)
```

Returns the object that has sent the message under processing. This private method is translated into a unification between its argument and the corresponding implicit context argument in the predicate containing the call. This unification occurs at the clause head, not at the clause body.

Template and modes

```
sender(?object_identifier)
```

Errors

(none)

Examples

```
% after compilation, the write/1 call will be the first goal on the clause body:

test :-
    sender(Sender),
    write('executing a method to answer a message sent by '),
    writeq(Sender), nl.
```

this/1

Description

```
this(This)
```

Unifies its argument with the identifier of the object for which the predicate clause whose body is being executed is defined (or the object importing the category that contains the predicate clause). This private method is implemented as a unification between its argument and the corresponding implicit execution-context argument in the predicate containing the call. This unification occurs at the clause head, not at the clause body. This method is useful for avoiding hard-coding references to an object identifier or for retrieving all object parameters with a single call when using parametric objects. See also `parameter/2`.

Template and modes

```
this(?object_identifier)
```

Errors

(none)

Examples

```
% after compilation, the write/1 call will be the first goal on the clause body:

test :-
    this(This),
    write('executing a definition contained in '),
    writeq(This), nl.
```

current_op/3

Description

```
current_op(Priority, Specifier, Operator)
```

Enumerates, by backtracking, the visible operators declared for an object. Operators not declared using a scope directive are not found.

Template and modes

```
current_op(?operator_priority, ?operator_specifier, ?atom)
```

Errors

Priority is neither a variable nor an integer:
`type_error(integer, Priority)`
Priority is an integer but not a valid operator priority:
`domain_error(operator_priority, Priority)`
Specifier is neither a variable nor an atom:
`type_error(atom, Specifier)`
Specifier is an atom but not a valid operator specifier:
`domain_error(operator_specifier, Specifier)`
Operator is neither a variable nor an atom:
`type_error(atom, Operator)`

Examples

To enumerate, by backtracking, the operators visible in *this*:
`current_op(Priority, Specifier, Operator)`
To enumerate, by backtracking, the public and protected operators visible in *self*:
`::current_op(Priority, Specifier, Operator)`
To enumerate, by backtracking, the public operators visible for an explicit object:
`Object::current_op(Priority, Specifier, Operator)`

current_predicate/1

Description

```
current_predicate(Predicate)
```

Enumerates, by backtracking, the visible user predicates for an object.

Template and modes

```
current_predicate(?predicate_indicator)
```

Errors

Predicate is neither a variable nor a valid predicate indicator:
`type_error(predicate_indicator, Predicate)`
Predicate is a Functor/Arity term but Functor is neither a variable nor an atom:
`type_error(atom, Name)`
Predicate is a Functor/Arity term but Arity is neither a variable nor an integer:
`type_error(integer, Arity)`
Predicate is a Functor/Arity term but Arity is a negative integer:
`domain_error(not_less_than_zero, Arity)`

Examples

To enumerate, by backtracking, the user predicates visible in *this*:
`current_predicate(Predicate)`
To enumerate, by backtracking, the public and protected user predicates visible in *self*:
`::current_predicate(Predicate)`
To enumerate, by backtracking, the public user predicates visible for an explicit object:
`Object::current_predicate(Predicate)`

predicate_property/2

Description

```
predicate_property(Predicate, Property)
```

Enumerates, by backtracking, the properties of a visible predicate. The valid predicate properties are listed in the language grammar.

Template and modes

```
predicate_property(+callable, ?predicate_property)
```

Errors

Predicate is a variable:
`instantiation_error`
Predicate is neither a variable nor a callable term:
`type_error(callable, Predicate)`
Property is neither a variable nor a valid predicate property:
`domain_error(predicate_property, Property)`

Examples

To enumerate, by backtracking, the properties of a predicate visible in *this*:
`predicate_property(foo(_), Property)`
To enumerate, by backtracking, the properties of a public or protected predicate visible in *self*:
`::predicate_property(foo(_), Property)`
To enumerate, by backtracking, the properties of a public predicate visible in an explicit object:
`Object::predicate_property(foo(_), Property)`

abolish/1

Description

```
abolish(Predicate)
abolish(Functor/Arity)
```

Removes a runtime declared dynamic predicate or a local dynamic predicate from an object database.

Template and modes

```
abolish(+predicate_indicator)
```

Errors

Predicate is a variable:
`instantiation_error`
Functor is a variable:
`instantiation_error`
Arity is a variable:
`instantiation_error`
Predicate is neither a variable nor a valid predicate indicator:
`type_error(predicate_indicator, Predicate)`
Functor is neither a variable nor an atom:
`type_error(atom, Functor)`
Arity is neither a variable nor an integer:
`type_error(integer, Arity)`
Predicate is statically declared:
`permission_error(modify, predicate_declaration, Functor/Arity)`
Predicate is a private predicate:
`permission_error(modify, private_predicate, Functor/Arity)`
Predicate is a protected predicate:
`permission_error(modify, protected_predicate, Functor/Arity)`
Predicate is a static predicate:
`permission_error(modify, static_predicate, Functor/Arity)`
Predicate is not declared for the object receiving the message:
`existence_error(predicate_declaration, Functor/Arity)`

Examples

To abolish any dynamic predicate in *this*:
`abolish(Predicate)`
To abolish a public or protected dynamic predicate in *self*:
`::abolish(Predicate)`
To abolish a public dynamic predicate in an explicit object:
`Object::abolish(Predicate)`

asserta/1

Description

```
asserta(Head)
asserta((Head:-Body))
```

Asserts a clause as the first one for an object's dynamic predicate. If the predicate is not already declared, then a dynamic predicate declaration is added to the object (assuming that we are asserting locally or that the compiler option `dynamic_declarations` was switched on when the object was created or compiled).

This method may be used to assert clauses for predicates that are not declared dynamic for dynamic objects provided that the predicates are declared in *this*. This allows easy initialization of dynamically created objects when writing constructors.

Template and modes

```
asserta(+clause)
```

Errors

Head is a variable:
`instantiation_error`
Head is a neither a variable nor a callable term:
`type_error(callable, Head)`
Body cannot be converted to a goal:
`type_error(callable, Body)`
The predicate indicator of Head, Functor/Arity, is that of a private predicate:
`permission_error(modify, private_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a protected predicate:
`permission_error(modify, protected_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a static predicate:
`permission_error(modify, static_predicate, Functor/Arity)`
Target object was created/compiled with support for dynamic declaration of predicates turned off:
`permission_error(create, predicate_declaration, Functor/Arity)`

Examples

To assert a clause as the first one for any dynamic predicate in *this*:
`asserta(Clause)`
To assert a clause as the first one for any public or protected dynamic predicate in *self*:
`::asserta(Clause)`
To assert a clause as the first one for any public dynamic predicate in an explicit object:
`Object::asserta(Clause)`

assertz/1

Description

```
assertz(Head)
assertz((Head:-Body))
```

Asserts a clause as the last one for an object's dynamic predicate. If the predicate is not already declared, then a dynamic predicate declaration is added to the object (assuming that we are asserting locally or that the compiler option `dynamic_declarations` was switched on when the object was created or compiled).

This method may be used to assert clauses for predicates that are not declared dynamic for dynamic objects provided that the predicates are declared in *this*. This allows easy initialization of dynamically created objects when writing constructors.

Template and modes

```
assertz(+clause)
```

Errors

Head is a variable:
`instantiation_error`
Head is a neither a variable nor a callable term:
`type_error(callable, Head)`
Body cannot be converted to a goal:
`type_error(callable, Body)`
The predicate indicator of Head, Functor/Arity, is that of a private predicate:
`permission_error(modify, private_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a protected predicate:
`permission_error(modify, protected_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a static predicate:
`permission_error(modify, static_predicate, Functor/Arity)`
Target object was created/compiled with support for dynamic declaration of predicates turned off:
`permission_error(create, predicate_declaration, Functor/Arity)`

Examples

To assert a clause as the last one for any dynamic predicate in *this*:
`assertz(Clause)`
To assert a clause as the last one for any public or protected dynamic predicate in *self*:
`::assertz(Clause)`
To assert a clause as the last one for any public dynamic predicate in an explicit object:
`Object::assertz(Clause)`

clause/2

Description

```
clause(Head, Body)
```

Enumerates, by backtracking, the clauses of an object's dynamic predicates.

This method may be used to enumerate clauses for predicates that are not declared dynamic for dynamic objects provided that the predicates are declared in *this*.

Template and modes

```
clause(+callable, ?body)
```

Errors

Head is a variable:
`instantiation_error`
Head is a neither a variable nor a callable term:
`type_error(callable, Head)`
Body is a neither a variable nor a callable term:
`type_error(callable, Body)`
The predicate indicator of Head, Functor/Arity, is that of a private predicate:
`permission_error(access, private_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a protected predicate:
`permission_error(access, protected_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a static predicate:
`permission_error(access, static_predicate, Functor/Arity)`
Head is not a declared predicate:
`existence_error(predicate_declaration, Functor/Arity)`

Examples

To retrieve a matching clause of any dynamic predicate in *this*:
`clause(Head, Body)`
To retrieve a matching clause of a public or protected dynamic predicate in *self*:
`::clause(Head, Body)`
To retrieve a matching clause of a public dynamic predicate in an explicit object:
`Object::clause(Head, Body)`

retract/1

Description

```
retract(Head)
retract((Head:-Body))
```

Retracts a dynamic clause from an object.

This method may be used to retract clauses for predicates that are not declared dynamic for dynamic objects provided that the predicates are declared in *this*.

Template and modes

```
retract(+clause)
```

Errors

Head is a variable:
`instantiation_error`
Head is neither a variable nor a callable term:
`type_error(callable, Head)`
The predicate indicator of Head, Functor/Arity, is that of a private predicate:
`permission_error(modify, private_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a protected predicate:
`permission_error(modify, protected_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a static predicate:
`permission_error(modify, static_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is not declared:
`existence_error(predicate_declaration, Functor/Arity)`

Examples

To retract a matching clause of a dynamic predicate in *this*:
`retract(Clause)`
To retract a matching clause of a public or protected dynamic predicate in *self*:
`::retract(Clause)`
To retract a matching clause of a public dynamic predicate in an explicit object:
`Object::retract(Clause)`

retractall/1

Description

```
retractall(Head)
```

Retracts all matching predicates from an object.

This method may be used to retract clauses for predicates that are not declared dynamic for dynamic objects provided that the predicates are declared in *this*.

Template and modes

```
retractall(+callable)
```

Errors

Head is a variable:
`instantiation_error`
Head is neither a variable nor a callable term:
`type_error(callable, Head)`
The predicate indicator of Head, Functor/Arity, is that of a private predicate:
`permission_error(modify, private_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a protected predicate:
`permission_error(modify, protected_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is that of a static predicate:
`permission_error(modify, static_predicate, Functor/Arity)`
The predicate indicator of Head, Functor/Arity, is not declared:
`existence_error(predicate_declaration, Functor/Arity)`

Examples

To retract all matching predicate definitions in *this*:
`retractall(Head)`
To retract all matching public or protected predicate definitions in *self*:
`::retractall(Head)`
To retract all matching public predicate definitions in an explicit object:
`Object::retractall(Head)`

call/1-N

Description

```
call(Goal)
call(Closure, Arg1, ...)
call(Object::Closure, Arg1, ...)
call(::Closure, Arg1, ...)
```

Calls a goal, which might be constructed by appending additional arguments to a closure. The upper limit for `N` depends on the upper limit for the arity of a compound term of the back-end Prolog compiler. This built-in meta-predicate is declared as a private method and thus cannot be used as a message to an object. When using a back-end Prolog compiler supporting a module system, calls in the format `call(Module:Closure, Arg1, ...)` may also be used.

Note that `::Closure` closures are only supported for local meta-calls. Passing this kind of closure as an argument of a meta-predicate called using message sending is not supported and always fails as the value of *self* is lost in the round-trip to the object defining the meta-predicate. The workaround is to simply call the `self(Self)` built-in method and use the returned value with a `Self::Closure` closure instead.

Template and modes

```
call(+callable)
call(+callable, ?term)
call(+callable, ?term, ?term)
...
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`
Closure is a variable:
`instantiation_error`
Closure is neither a variable nor a callable term:
`type_error(callable, Closure)`

Examples

Call a goal, constructed by appending additional arguments to a closure, in the context of the object or category containing the call:
`call(Closure, Arg1, Arg2, ...)`
To send a goal, constructed by appending additional arguments to a closure, as a message to *self*:
`call(::Closure, Arg1, Arg2, ...)`
To send a goal, constructed by appending additional arguments to a closure, as a message to an explicit object:
`call(Object::Closure, Arg1, Arg2, ...)`

ignore/1

Description

```
ignore(Goal)
```

This predicate succeeds weather its argument succeeds or fails and it is not re-executable. This built-in meta-predicate is declared as a private method and thus cannot be used as a message to an object.

Template and modes

```
ignore(+callable)
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`

Examples

Call a goal and succeeding even if it fails:
`ignore(Goal)`
To send a goal as a non-backtracable message to *self*:
`ignore(::Goal)`
To send a goal as a non-backtracable message to an explicit object:
`ignore(Object::Goal)`

once/1

Description

```
once(Goal)
```

This predicate behaves as `call(Goal)` but it is not re-executable. This built-in meta-predicate is declared as a private method and thus cannot be used as a message to an object.

Template and modes

```
once(+callable)
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`

Examples

Call a goal deterministically in the context of the object or category containing the call:
`once(Goal)`
To send a goal as a non-backtracable message to *self*:
`once(::Goal)`
To send a goal as a non-backtracable message to an explicit object:
`once(Object::Goal)`

\+/1

Description

```
\+ Goal
```

Not-provable meta-predicate. True iff `call(Goal)` is false. This built-in meta-predicate cannot be used as a message to an object.

Template and modes

```
\+ +callable
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`

Examples

Not-provable goal in the context of the object or category containing the call:
`\+ Goal`
Not-provable goal sent as a message to *self*:
`\+ ::Goal`
Not-provable goal sent as a message to an explicit object:
`\+ Object::Goal`

catch/3

Description

```
catch(Goal, Catcher, Recovery)
```

Catches exceptions thrown by a goal. See the Prolog ISO standard definition. This built-in meta-predicate is declared as a private method and thus cannot be used as a message to an object.

Template and modes

```
catch(?callable, ?term, ?term)
```

Errors

Goal is a variable:
`instantiation_error`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`

Examples

`(none)`

throw/1

Description

```
throw(Exception)
```

Throws an exception. This built-in predicate is declared as a private method and thus cannot be used as a message to an object.

Template and modes

```
throw(+nonvar)
```

Errors

Exception is a variable:
`instantiation_error`
Exception does not unify with the second argument of any call of `catch/3`:
`system_error`

Examples

`(none)`

bagof/3

Description

```
bagof(Term, Goal, List)
```

See the Prolog ISO standard definition. This built-in meta-predicate is declared as a private method and thus cannot be used as a message to an object.

Template and modes

```
bagof(@term, +callable, -list)
```

Errors

(see the Prolog ISO standard)

Examples

To find all solutions in the context of the object or category containing the call:

```
bagof(Term, Goal, List)
```

To find all solutions by sending the goal as a message to *self*:

```
bagof(Term, ::Goal, List)
```

To find all solutions by sending the goal as a message to an explicit object:

```
bagof(Term, Object::Goal, List)
```

findall/3

Description

```
findall(Term, Goal, List)
```

See the Prolog ISO standard definition. This built-in meta-predicate is declared as a private method and thus cannot be used as a message to an object.

Template and modes

```
findall(?term, +callable, ?list)
```

Errors

(see the Prolog ISO standard)

Examples

To find all solutions in the context of the object or category containing the call:

```
findall(Term, Goal, List)
```

To find all solutions by sending the goal as a message to *self*:

```
findall(Term, ::Goal, List)
```

To find all solutions by sending the goal as a message to an explicit object:

```
findall(Term, Object::Goal, List)
```

findall/4

Description

```
findall(Term, Goal, List, Tail)
```

Variant of the standard `findall/3` that allows passing the tail of the results list. This built-in meta-predicate is declared as a private method and thus cannot be used as a message to an object.

Template and modes

```
findall(?term, +callable, ?list, +list)
```

Errors

(same as the standard `findall/3` predicate)

Examples

To find all solutions in the context of the object or category containing the call:

```
findall(Term, Goal, List, Tail)
```

To find all solutions by sending the goal as a message to *self*:

```
findall(Term, ::Goal, List, Tail)
```

To find all solutions by sending the goal as a message to an explicit object:

```
findall(Term, Object::Goal, List, Tail)
```

forall/2

Description

```
forall(Generator, Test)
```

For all solutions of `Generator`, `Test` is true. This built-in meta-predicate is declared as a private method and thus cannot be used as a message to an object.

Template and modes

```
forall(+callable, +callable)
```

Errors

Either Generator or Test is a variable:
`instantiation_error`
Generator is neither a variable nor a callable term:
`type_error(callable, Generator)`
Test is neither a variable nor a callable term:
`type_error(callable, Test)`

Examples

To call both goals in the context of the object or category containing the call:
`forall(Generator, Test)`
To send both goals as messages to *self*:
`forall(::Generator, ::Test)`
To send both goals as messages to explicit objects:
`forall(Object1::Generator, Object2::Test)`

setof/3

Description

```
setof(Term, Goal, List)
```

See the Prolog ISO standard definition. This built-in meta-predicate is declared as a private method and thus cannot be used as a message to an object.

Template and modes

```
setof(@term, +callable, -list)
```

Errors

(see the Prolog ISO standard)

Examples

To find all solutions in the context of the object or category containing the call:

```
setof(Term, Goal, List)
```

To find all solutions by sending the goal as a message to *self*:

```
setof(Term, ::Goal, List)
```

To find all solutions by sending the goal as a message to an explicit object:

```
setof(Term, Object::Goal, List)
```

before/3

Description

```
before(Object, Message, Sender)
```

User-defined method for handling `before` events. This method is declared in the `monitoring` built-in protocol as a public predicate. Note that you can make its scope protected or private by using, respectively, protected or private implementation of the `monitoring` protocol.

Template and modes

```
before(?object_identifier, ?callable, ?object_identifier)
```

Errors

(none)

Examples

```
:- object(...,
    implements(monitoring),
    ...).

    before(Object, Message, Sender) :-
        writeq(Object), write('::'), writeq(Message),
        write(' from '), writeq(Sender), nl.
```

after/3

Description

```
after(Object, Message, Sender)
```

User-defined method for handling `after` events. This method is declared in the `monitoring` built-in protocol as a public predicate. Note that you can make its scope protected or private by using, respectively, protected or private implementation of the `monitoring` protocol.

Template and modes

```
after(?object_identifier, ?callable, ?object_identifier)
```

Errors

(none)

Examples

```
:- object(...,
    implements(monitoring),
    ...).

    after(Object, Message, Sender) :-
        writeq(Object), write('::'), writeq(Message),
        write(' from '), writeq(Sender), nl.
```

forward/1

Description

```
forward(Message)
```

User-defined method for forwarding unknown messages sent to an object (using the `::/2` control construct), automatically called the runtime when defined. This method is declared in the `forwarding` built-in protocol as a public predicate. Note that you can make its scope protected or private by using, respectively, protected or private implementation of the `forwarding` protocol.

Template and modes

```
forward(+callable)
```

Errors

(none)

Examples

```
:- object(proxy,
    implements(forwarding),
    ...).

    forward(Message) :-
        % delegate the unknown message to other object
        [real::Message].
```

call//1-N

Description

```
call(Closure)
call(Closure, Arg1, ...)
call(Object::Closure, Arg1, ...)
call(::Closure, Arg1, ...)
```

This non-terminal takes a closure and is processed by appending the input list of tokens and the list of remaining tokens to the arguments of the closure. This built-in non-terminal is interpreted as a private non-terminal and thus cannot be used as a message to an object. When using a back-end Prolog compiler supporting a module system, calls in the format `call(Module:Closure)` may also be used. By using as argument a lambda expression, this built-in non-terminal provides controlled access to the input list of tokens and to the list of the remaining tokens processed by the grammar rule containing the call.

Template and modes

```
call(+callable)
call(+callable, ?term)
call(+callable, ?term, ?term)
...
```

Errors

Closure is a variable:

```
instantiation_error
```

Closure is neither a variable nor a callable term:

```
type_error(callable, Closure)
```

Examples

Calls a goal, constructed by appending the input list of tokens and the list of remaining tokens to the arguments of the closure, in the context of the object or category containing the call:

```
call(Closure)
```

To send a goal, constructed by appending the input list of tokens and the list of remaining tokens to the arguments of the closure, as a message to *self*:

```
call(::Closure)
```

To send a goal, constructed by appending the input list of tokens and the list of remaining tokens to the arguments of the closure, as a message to an explicit object:

```
call(Object::Closure)
```

phrase//1

Description

```
phrase(NonTerminal)
```

This non-terminal takes a non-terminal or a grammar rule body and parses it using the current implicit list of tokens. A common use is to wrap what otherwise would be a naked variable in a grammar rule body.

Template and modes

```
phrase(+callable)
```

Errors

NonTerminal is a variable:
`instantiation_error`
NonTerminal is neither a variable nor a callable term:
`type_error(callable, NonTerminal)`

Examples

phrase/2

Description

```
phrase(GrammarRuleBody, Input)
phrase(::GrammarRuleBody, Input)
phrase(Object::GrammarRuleBody, Input)
```

True when the `GrammarRuleBody` grammar rule body can be applied to the `Input` list of tokens. In the most common case, `GrammarRuleBody` is a non-terminal defined by a grammar rule. This built-in method is declared private and thus cannot be used as a message to an object. When using a back-end Prolog compiler supporting a module system, calls in the format `phrase(Module:GrammarRuleBody, Input)` may also be used.

This method is opaque to cuts in the first argument. When the first argument is sufficiently instantiated at compile time, the method call is compiled in order to eliminate the implicit overheads of converting the grammar rule body into a goal and meta-calling it. For performance reasons, the second argument is only type-checked at compile time.

Template and modes

```
phrase(+callable, ?list)
```

Errors

NonTerminal is a variable:
`instantiation_error`
NonTerminal is neither a variable nor a callable term:
`type_error(callable, NonTerminal)`

Examples

To parse a list of tokens using a local non-terminal:
`phrase(NonTerminal, Input)`
To parse a list of tokens using a non-terminal within the scope of *self*:
`phrase(::NonTerminal, Input)`
To parse a list of tokens using a public non-terminal of an explicit object:
`phrase(Object::NonTerminal, Input)`

phrase/3

Description

```
phrase(GrammarRuleBody, Input, Rest)
phrase(::GrammarRuleBody, Input, Rest)
phrase(Object::GrammarRuleBody, Input, Rest)
```

True when the `GrammarRuleBody` grammar rule body can be applied to the `Input-Rest` difference list of tokens. In the most common case, `GrammarRuleBody` is a non-terminal defined by a grammar rule. This built-in method is declared private and thus cannot be used as a message to an object. When using a back-end Prolog compiler supporting a module system, calls in the format `phrase(Module:GrammarRuleBody, Input, Rest)` may also be used.

This method is opaque to cuts in the first argument. When the first argument is sufficiently instantiated at compile time, the method call is compiled in order to eliminate the implicit overheads of converting the grammar rule body into a goal and meta-calling it. For performance reasons, the second and third arguments are only type-checked at compile time.

Template and modes

```
phrase(+callable, ?list, ?list)
```

Errors

NonTerminal is a variable:
`instantiation_error`
NonTerminal is neither a variable nor a callable term:
`type_error(callable, NonTerminal)`

Examples

To parse a list of tokens using a local non-terminal:
`phrase(NonTerminal, Input, Rest)`
To parse a list of tokens using a non-terminal within the scope of *self*:
`phrase(::NonTerminal, Input, Rest)`
To parse a list of tokens using a public non-terminal of an explicit object:
`phrase(Object::NonTerminal, Input, Rest)`

expand_term/2

Description

```
expand_term(Term, Expansion)
```

Expands a term. The most common use is to expand a grammar rule into a clause. Users may override the default Logtalk grammar rule translator by defining clauses for the predicate `term_expansion/2`.

The expansion works as follows: if the first argument is a variable, then it is unified with the second argument; if the first argument is not a variable and clauses for the `term_expansion/2` predicate are within scope, then this predicate is called to provide an expansion that is then unified with the second argument; if the `term_expansion/2` predicate is not used and the first argument is a compound term with functor `-->/2` then the default Logtalk grammar rule translator is used, with the resulting clause being unified with the second argument; when the translator is not used, the two arguments are unified. The `expand_term/2` predicate may return a single term or a list of terms.

This built-in method may be used to expand a grammar rule into a clause for use with the built-in database methods.

Term expansion is only performed by by Logtalk at compile time (to expand terms read from a source file). This predicate can be used by the user to perform term expansion at runtime (for example, to convert a grammar rule into a clause).

Template and modes

```
expand_term(?term, ?term)
```

Errors

(none)

Examples

(none)

term_expansion/2

Description

```
term_expansion(Term, Expansion)
```

Defines an expansion for a term. This predicate, when defined, is automatically called by the `expand_term/2` method. Use of this predicate by the `expand_term/2` method may be restricted by changing its default public scope. The `term_expansion/2` clauses are only used by the `expand_term/2` method if they are within the scope of the *sender*. When that is not the case, the `expand_term/2` method only uses the default expansions. The `term_expansion/2` predicate may return a list of terms.

Term expansion may be also be applied when compiling source files by defining the object providing access to the `term_expansion/2` clauses as a *hook object*. Clauses for the `term_expansion/2` predicate defined within an object or a category are **never** used in the compilation of the object or the category itself. Moreover, terms wrapped using the `{}/1` compiler bypass control construct are not expanded and any expanded term wrapped in this control construct will not be further expanded.

Objects and categories implementing this predicate should declare that they implement the `expanding` protocol. This protocol implementation relation can be declared as either protected or private to restrict the scope of this predicate.

Template and modes

```
term_expansion(+nonvar, -nonvar)
term_expansion(+nonvar, -list(nonvar))
```

Errors

`(none)`

Examples

```
term_expansion((:- license(default)), (:- license(gplv3))).
term_expansion(data(Millimeters), data(Meters)) :- Meters is Millimeters / 1000.
```

expand_goal/2

Description

```
expand_goal(Goal, ExpandedGoal)
```

Expands a goal.

The expansion works as follows: if the first argument is a variable, then it is unified with the second argument; if the first argument is not a variable and clauses for the `goal_expansion/2` predicate are within scope, then this predicate is recursively called until a fixed-point is reached to provide an expansion that is then unified with the second argument; if the call to the `goal_expansion/2` predicate fails, the two arguments are unified.

Goal expansion is only performed by Logtalk at compile time (to expand the body of clauses and meta-directives read from a source file). This predicate can be used by the user to perform goal expansion at runtime (for example, before asserting a clause).

Template and modes

```
expand_goal(?term, ?term)
```

Errors

(none)

Examples

(none)

goal_expansion/2

Description

```
goal_expansion(Goal, ExpandedGoal)
```

Defines an expansion for a goal. The first argument is the goal to be expanded. The expanded goal is returned in the second argument. This predicate is called recursively on the expanded goal until there are no changes. Thus, care must be taken to avoid compilation loops. This predicate, when defined, is automatically called by the `expand_goal/2` method. Use of this predicate by the `expand_goal/2` method may be restricted by changing its default public scope.

Goal expansion may be also be applied when compiling source files by defining the object providing access to the `goal_expansion/2` clauses as a *hook object*. Clauses for the `goal_expansion/2` predicate defined within an object or a category are **never** used in the compilation of the object or the category itself. Moreover, goals wrapped using the `{}/1` compiler bypass control construct are not expanded and any expanded goal wrapped in this control construct will not be further expanded.

Objects and categories implementing this predicate should declare that they implement the `expanding` protocol. This protocol implementation relation can be declared as either protected or private to restrict the scope of this predicate.

Template and modes

```
goal_expansion(+callable, -callable)
```

Errors

`(none)`

Examples

```
goal_expansion(write(Term), (write_term(Term, []), nl)).
goal_expansion(read(Term), (write('Input: '), {read(Term)})).
```

print_message/3

Description

```
print_message(Kind, Component, Term)
```

Built-in method for printing a message represented by a term, which is converted to the message text using the `logtalk::message_tokens(Term, Component)` hook predicate. This method is declared in the `logtalk` built-in object as a public predicate. The line prefix and the output stream used for each `Kind-Component` pair can be found using the `logtalk::message_prefix_stream(Kind, Component, Prefix, Stream)` hook predicate.

This predicate starts by converting the message term to a list of tokens and by calling the `logtalk::message_hook(Message, Kind, Component, Tokens)` hook predicate. If this predicate succeeds, the `print_message/3` predicate assumes that the message have been successfully printed.

Template and modes

```
print_message(+nonvar, +atom, +nonvar)
```

Errors

`(none)`

Examples

```
..., logtalk::print_message(information, core, redefining_entity(object, foo)), ...
```

message_tokens//2

Description

```
message_tokens(Message, Component)
```

User-defined non-terminal hook used to rewrite a message term into a list of tokens and declared in the `logtalk` built-in object as a public, multifile, and dynamic non-terminal. The list of tokens can be printed by calling the `print_message_tokens/3` method. This non-terminal hook is automatically called by the `print_message/3` method.

Template and modes

```
message_tokens(+nonvar, +atom)
```

Errors

(none)

Examples

```
:- multifile(logtalk::message_tokens//2).
:- dynamic(logtalk::message_tokens//2).

logtalk::message_tokens(redefining_entity(Type, Entity), core) -->
    ['Redefining ~w ~q'-[Type, Entity], nl].
```

message_hook/4

Description

```
message_hook(Message, Kind, Component, Tokens)
```

User-defined hook method for intercepting printing of a message, declared in the `logtalk` built-in object as a public, multifile, and dynamic predicate. This hook method is automatically called by the `print_message/3` method. When the call succeeds, the `print_message/3` method assumes that the message have been successfully printed.

Template and modes

```
message_hook(@callable, @callable, @callable, @list(nonvar))
```

Errors

(none)

Examples

```
:- multifile(logtalk::message_hook/4).
:- dynamic(logtalk::message_hook/4).

% print silent messages instead of discarding them as default
logtalk::message_hook(_, silent, core, Tokens) :-
    logtalk::message_prefix_stream(silent, core, Prefix, Stream),
    logtalk::print_message_tokens(Stream, Prefix, Tokens).
```

message_prefix_stream/4

Description

```
message_prefix_stream(Kind, Component, Prefix, Stream)
```

User-defined hook method for specifying the default prefix and stream for printing a message for a given kind and component. This method is declared in the `logtalk` built-in object as a public, multifile, and dynamic predicate.

Template and modes

```
message_prefix_stream(?nonvar, ?atom, ?atom, ?stream_or_alias)
```

Errors

(none)

Examples

```
:- multifile(logtalk::message_prefix_stream/4).
:- dynamic(logtalk::message_prefix_stream/4).

logtalk::message_prefix_stream(information, core, '% ', user_output).
```

print_message_tokens/3

Description

```
print_message_tokens(Stream, Prefix, Tokens)
```

Built-in method for printing a list of message tokens, declared in the `logtalk` built-in object as a public predicate. This method is automatically called by the `print_message/3` method (assuming that the message was not intercepted by a `message_hook/4` definition) and calls the user-defined hook predicate `print_message_token/4` for each token. When a call to this hook predicate succeeds, the `print_message_tokens/3` predicate assumes that the token have been printed. When the call fails, the `print_message_tokens/3` predicate uses a default printing procedure for the token.

Template and modes

```
print_message_tokens(@stream_or_alias, +atom, @list(nonvar))
```

Errors

(none)

Examples

```
..., logtalk::print_message_tokens(user_output, '% ', ['Redefining ~w ~q'-[object, foo], nl]),
```

print_message_token/4

Description

```
print_message_token(Stream, Prefix, Token, Tokens)
```

User-defined hook method for printing a message token, declared in the `logtalk` built-in object as a public, multifile, and dynamic predicate. It allows the user to intercept the printing of a message token. This hook method is automatically called by the `print_message_tokens/3` built-in method for each token.

Template and modes

```
print_message_token(@stream_or_alias, @atom, @nonvar, @list(nonvar))
```

Errors

(none)

Examples

```
:- multifile(logtalk::print_message_token/4).
:- dynamic(logtalk::print_message_token/4).

% ignore all flush tokens
logtalk::print_message_token(_Stream, _Prefix, flush, _Tokens).
```

ask_question/5

Description

```
ask_question(Question, Kind, Component, Check, Answer)
```

Built-in method for asking a question represented by a term, `Question`, which is converted to the question text using the `logtalk::message_tokens(Question, Component)` hook predicate. This method is declared in the `logtalk` built-in object as a public predicate. The default question prompt and the input stream used for each `Kind-Component` pair can be found using the `logtalk::question_prompt_stream(Kind, Component, Prompt, Stream)` hook predicate. The `Check` argument is a closure that is converted into a checking goal by extending it with the user supplied answer. This predicate implements a read-loop that terminates when the checking predicate succeeds.

This predicate starts by calling the `logtalk::question_hook(Question, Kind, Component, Check, Answer)` hook predicate. If this predicate succeeds, the `ask_question/5` predicate assumes that the question have been successfully asked and replied.

Template and modes

```
ask_question(+nonvar, +atom, +nonvar, +callable, -term)
```

Meta-predicate template

```
ask_question(*, *, *, 1, *)
```

Errors

(none)

Examples

```
..., logtalk::ask_question(enter_context_spy_point(Template), question, debugger, callable, Spy
```

question_hook/5

Description

```
question_hook(Question, Kind, Component, Check, Answer)
```

User-defined hook method for intercepting asking a question, declared in the `logtalk` built-in object as a public, multifile, and dynamic predicate. This hook method is automatically called by the `ask_question/5` method. When the call succeeds, the `ask_question/5` method assumes that the question have been successfully asked and replied.

Template and modes

```
question_hook(+nonvar, +nonvar, +atom, +callable, -term)
```

Meta-predicate template

```
question_hook(*, *, *, 1, *)
```

Errors

(none)

Examples

```
:- multifile(logtalk::question_hook/5).
:- dynamic(logtalk::question_hook/5).

% use a pre-defined answer instead of asking the user
logtalk::question_hook(upper_limit, question, my_app, float, 3.7).
```

question_prompt_stream/4

Description

```
question_prompt_stream(Kind, Component, Prompt, Stream)
```

User-defined hook method for specifying the default prompt and input stream for asking a question for a given kind and component. This method is declared in the `logtalk` built-in object as a public, multifile, and dynamic predicate.

Template and modes

```
question_prompt_stream(?nonvar, ?atom, ?atom, ?stream_or_alias)
```

Errors

(none)

Examples

```
:- multifile(logtalk::question_prompt_stream/4).
:- dynamic(logtalk::question_prompt_stream/4).

logtalk::question_prompt_stream(question, debugger, '    > ', user_input).
```

coinductive_success_hook/1-2

Description

```
coinductive_success_hook(Head, Hypothesis)
coinductive_success_hook(Head)
```

User-defined hook predicates that are automatically called in case of coinductive success when proving a query for a coinductive predicates. The hook predicates are called with the head of the coinductive predicate on coinductive success and, optionally, with the hypothesis used that to reach coinductive success.

When both hook predicates are defined, the `coinductive_success_hook/1` clauses are only used if no `coinductive_success_hook/2` clause applies. The compiler ensures zero performance penalties when defining coinductive predicates without a corresponding definition for the coinductive success hook predicates.

The compiler assumes that these hook predicates are defined as static predicates in order to optimize their use.

Template and modes

```
coinductive_success_hook(+callable, +callable)
coinductive_success_hook(+callable)
```

Errors

(none)

Examples

(none)

Control constructs

::/2

Description

```
Object::Message
{Proxy}::Message
```

Sends a message to an object. The message argument must match a public predicate of the receiver object. When the message corresponds to a protected or private predicate, the call is only valid if the *sender* matches the predicate *scope container*. When the predicate is declared but not defined, the message simply fails (as per the closed-world assumption).

The `{Proxy}::Message` syntax allows simplified access to parametric object *proxies*. Its operational semantics is equivalent to the goal conjunction `(call(Proxy), Proxy::Message)`. I.e. `Proxy` is proved within the context of the pseudo-object `user` and, if successful, the goal term is used as a parametric object identifier. Exceptions thrown when proving `Proxy` are handled by the `::/2` control construct. This syntax construct supports backtracking over the `{Proxy}` goal.

The lookups for the message declaration and the corresponding method are performed using a depth-first strategy. Depending on the value of the `optimize` flag, these lookups are performed at compile time whenever sufficient information is available. When the lookups are performed at runtime, a caching mechanism is used to improve performance in subsequent messages.

Template and modes

```
+object_identifier::+callable
{+object_identifier}::+callable
```

Errors

Either Object or Message is a variable:
`instantiation_error`
Object is not a valid object identifier:
`type_error(object_identifier, Object)`
Message is neither a variable nor a callable term:
`type_error(callable, Message)`
Message, with predicate indicator Functor/Arity, is declared private:
`permission_error(access, private_predicate, Functor/Arity)`
Message, with predicate indicator Functor/Arity, is declared protected:
`permission_error(access, protected_predicate, Functor/Arity)`
Message, with predicate indicator Functor/Arity, is not declared:
`existence_error(predicate_declaration, Functor/Arity)`
Object does not exist:
`existence_error(object, Object)`

Proxy is a variable:
`instantiation_error`
Proxy is not a valid object identifier:
`type_error(object_identifier, Proxy)`

The predicate Proxy does not exist in the *user* pseudo-object:

```
existence_error(procedure, ProxyFunctor/ProxyArity)
```

Examples

```
| ?- list::member(X, [1, 2, 3]).

X = 1 ;
X = 2 ;
X = 3
yes
```

::/1

Description

```
::Message
```

Send a message to *self*. Only used in the body of a predicate definition. The argument should match a public or protected predicate of *self*. It may also match a private predicate if the predicate is within the scope of the object where the method making the call is defined, if imported from a category, if used from inside a category, or when using private inheritance. When the predicate is declared but not defined, the message simply fails (as per the closed-world assumption).

The lookups for the message declaration and the corresponding method are performed using a depth-first strategy. A message to *self* necessarily requires the use of dynamic binding but a caching mechanism is used to improve performance in subsequent messages.

Template and modes

```
::+callable
```

Errors

Message is a variable:
`instantiation_error`
Message is neither a variable nor a callable term:
`type_error(callable, Message)`
Message, with predicate indicator Functor/Arity, is declared private:
`permission_error(access, private_predicate, Functor/Arity)`
Message, with predicate indicator Functor/Arity, is not declared:
`existence_error(predicate_declaration, Functor/Arity)`

Examples

```
area(Area) :-
    ::width(Width),
    ::height(Height),
    Area is Width*Height.
```

^^/1

Description

```
^^Predicate
```

Calls an imported or inherited predicate definition. The call fails if the predicate is declared but there is no imported and no inherited predicate definition. This control construct may be used within objects or categories in the body of a predicate definition. When used within a category, the predicate definition lookup is restricted to the extended categories.

The called predicate should be declared public or protected. It may also be declared private if within the scope of the entity where the method making the call is defined. When the predicate is declared but not defined, the message simply fails (as per the closed-world assumption).

This control construct is a generalization of the Smalltalk *super* keyword to take into account Logtalk support for prototypes and categories besides classes. The lookup for the predicate definition starts at the imported categories, if any. If an imported predicate definition is not found, the lookup proceeds to the ancestor objects.

The lookups for the predicate declaration and the predicate definition are performed using a depth-first strategy. Depending on the value of the `optimize` flag, these lookups are performed at compile time whenever sufficient information is available. When the lookups are performed at runtime, a caching mechanism is used to improve performance in subsequent calls.

Template and modes

```
^^+callable
```

Errors

Predicate is a variable:
```
instantiation_error
```
Predicate is neither a variable nor a callable term:
```
type_error(callable, Predicate)
```
Predicate, with predicate indicator Functor/Arity, is declared private:
```
permission_error(access, private_predicate, Functor/Arity)
```
Predicate, with predicate indicator Functor/Arity, is not declared:
```
existence_error(predicate_declaration, Functor/Arity)
```

Examples

```
init :-
    assertz(counter(0)),
    ^^init.
```

[]/1

Description

```
[Object::Message]
[{Proxy}::Message]
```

This control construct allows the programmer to send a message to an object while preserving the original sender. It is mainly used in the definition of object handlers for unknown messages. This functionality is usually know as *delegation* but be aware that this is an overloaded word that can mean different things in different object-oriented programming languages.

To prevent using of this control construct to break object encapsulation, an attempt to delegate a message to same object as the original sender results in an error. The remaining error conditions are the same as the `::/2` control construct.

Note that, despite the correct functor for this control construct being (traditionally) `'.'/2`, we refer to it as `[]/1` simply to emphasize that the syntax is a list with a single element.

Template and modes

```
[+object_identifier::+callable]
[{+object_identifier}::+callable]
```

Errors

Object and the original sender are the same object:
`permission_error(access, object, Sender)`

Either Object or Message is a variable:
`instantiation_error`
Object is not a valid object identifier:
`type_error(object_identifier, Object)`
Message is neither a variable nor a callable term:
`type_error(callable, Message)`
Message, with predicate indicator Functor/Arity, is declared private:
`permission_error(access, private_predicate, Functor/Arity)`
Message, with predicate indicator Functor/Arity, is declared protected:
`permission_error(access, protected_predicate, Functor/Arity)`
Message, with predicate indicator Functor/Arity, is not declared:
`existence_error(predicate_declaration, Functor/Arity)`
Object does not exist:
`existence_error(object, Object)`

Proxy is a variable:
`instantiation_error`
Proxy is not a valid object identifier:
`type_error(object_identifier, Proxy)`
The predicate Proxy does not exist in the *user* pseudo-object:
`existence_error(procedure, ProxyFunctor/ProxyArity)`

Examples

```
forward(Message) :-
    [Object::Message].
```

{}/1

Description

```
{Term}
{Goal}
```

This control construct allows the programmer to bypass the Logtalk compiler. It can be used to wrap a source file term or a goal. It can also be used as a message to any object. In the case of a goal, it is opaque to cuts and the argument is called within the context of the pseudo-object user. It is also possible to use `{Closure}` as the first argument of `call/2-N` calls. In this case, `Closure` will be extended with the remaining arguments of the `call/2-N` call in order to construct a goal that will be called within the context of `user`.

This control construct may also be used in place of an object identifier when sending a message. In this case, the result of proving its argument as a goal (within the context of the pseudo-object `user`) is used as an object identifier in the message sending call.

Template and modes

```
{+callable}
```

Errors

Term or Goal is a variable:
    `instantiation_error`
Term or Goal is neither a variable nor a callable term:
    `type_error(callable, Goal)`

Examples

```
{:- load_foreign_resource(file)}.

N1/D1 < N2/D2 :-
    {N1*D2 < N2*D1}.

call_in_user(F, X, Y, Z) :-
    call({F}, X, Y, Z).

| ?- {circle(Id, Radius, Color)}::area(Area).
...

| ?- logtalk::{write('Hello world!'), nl}.
Hello world!
yes
```

<</2

Description

```
Object<<Message
{Proxy}<<Message
```

Calls a goal within the context of the specified object. Goal is called with the execution context (*sender*, *this*, and *self*) set to Object. Goal may need to be written within brackets to avoid parsing errors due to operator clashes. This control construct should only be used for debugging or for writing unit tests. This control construct can only be used for objects compiled with the compiler option `context_switching_calls` set to `allow`. Set this compiler option to `deny` to disable this control construct and thus preventing using it to break encapsulation.

The `{Proxy}<<Message` syntax allows simplified access to parametric object *proxies*. Its operational semantics is equivalent to the goal conjunction `(call(Proxy), Proxy<<Message)`. I.e. `Proxy` is proved within the context of the pseudo-object `user` and, if successful, the goal term is used as a parametric object identifier. Exceptions thrown when proving `Proxy` are handled by the `<<2` control construct. This syntax construct supports backtracking over the `{Proxy}` goal.

Caveat: although the goal argument is fully compiled before calling, some of the necessary information for the second compiler pass may not be available at runtime.

Template and modes

```
+object_identifier<<+callable
{+object_identifier}<<+callable
```

Errors

Either Object or Goal is a variable:
`instantiation_error`
Object is neither a variable nor a valid object identifier:
`type_error(object_identifier, Object)`
Goal is neither a variable nor a callable term:
`type_error(callable, Goal)`
Object does not contain a local definition for the Goal predicate:
`existence_error(procedure, Goal)`
Object does not exist:
`existence_error(object, Object)`
Object was created/compiled with support for context switching calls turned off:
`permission_error(access, database, Goal)`

Examples

```
test(member) :-
    list << member(1, [1]).
```