The Parma Polyhedra Library
Java Language Interface
User's Manual*
(version 0.10.2)

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1 Main Page

The Parma Polyhedra Library comes equipped with an interface for the Java language. The Java interface provides access to the numerical abstractions (convex polyhedra, BD shapes, octagonal shapes, etc.) implemented by the PPL library. A general introduction to the numerical abstractions, their representation in the PPL and the operations provided by the PPL is given in the main *PPL user manual*. Here we just describe those aspects that are specific to the Java interface. In the sequel, `prefix` is the path prefix under which the library has been installed (typically `/usr` or `/usr/local`).

Overview

Here is a list of notes with general information and advice on the use of the Java interface.

- The numerical abstract domains available to the Java user as Java classes consist of the *simple* domains, *powersets* of a simple domain and *products* of simple domains. Note that the default configuration will only enable a subset of these domains (if you need a different set of domains, see configuration option `-enable-instantiations`).
  - The simple domains are:
    - convex polyhedra, which consist of C_Polyhedron and NNC_Polyhedron;
    - weakly relational, which consist of BD_Shape_N and Octagonal_Shape_N where N is one of the numeric types signed_char, short, int, long, long_long, mpz_class, mpq_class;
    - boxes which consist of Int8_Box, Int16_Box, Int32_Box, Int64_Box, Uint8_Box, Uint16_Box, Uint32_Box, Uint64_Box, Float_Box, Double_Box, Long_Double_Box, Z_Box, Rational_Box; and
    - the Grid domain.
  - The powerset domains are Pointset_Powerset_S where S is a simple domain.
  - The product domains consist of Direct_Product_S_T, Smash_Product_S_T and Constraints_-Product_S_T where S and T are simple domains.

- In the following, any of the above numerical abstract domains is called a PPL *domain* and any element of a PPL domain is called a *PPL object*.

- The Java interface files are all installed in the directory `prefix/lib/ppl`. Since this includes shared and dynamically loaded libraries, you must make your dynamic linker/loader aware of this fact. If you use a GNU/Linux system, try the commands `man ld.so` and `man ldconfig` for more information.

- A Java program can create a new object for a PPL domain by using the constructors for the class corresponding to the domain.

- For a PPL object with space dimension `k`, the identifiers used for the PPL variables must lie between 0 and $k-1$ and correspond to the indices of the associated Cartesian axes. For example, when using methods that combine PPL polyhedra or add constraints or generators to a representation of a PPL polyhedron, the polyhedra referenced and any constraints or generators in the call should follow all the (space) dimension-compatibility rules stated in Section *Representations of Convex Polyhedra* of the main PPL user manual.

- As explained above, a polyhedron has a fixed topology C or NNC, that is determined at the time of its initialization. All subsequent operations on the polyhedron must respect all the topological compatibility rules stated in Section *Representations of Convex Polyhedra* of the main PPL user manual.

- Any application using the PPL should make sure that only the intended version(s) of the library are ever used.
- When the Parma Polyhedra Library is configured, it will automatically test for the existence of the Java system (unless configuration options are passed to disable the build of the Java interface; see configuration option `-enable-interfaces`). If Java is correctly installed in a standard location, things will be arranged so that the Java interface is built and installed (see configuration option `-with-java` if you need to specify a non-standard location for the Java system).

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4 Module Index

4.1 Modules

Here is a list of all modules:

5 Namespace Index

5.1 Namespace List

Here is a list of all documented namespaces with brief descriptions:

6 Class Index

6.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

7 Class Index

7.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

8 Module Documentation

8.1 Java Language Interface

Classes

- class parma_polyhedra_library::By_Reference< T >
  An utility class implementing mutable and non-mutable call-by-reference.
- class parma_polyhedra_library::Coefficient
  A PPL coefficient.
- class parma_polyhedra_library::Congruence
  A linear congruence.
- class parma_polyhedra_library::Congruence_System
  A system of congruences.
- class parma_polyhedra_library::Constraint
  A linear equality or inequality.
- class parma_polyhedra_library::Constraint_System
  A system of constraints.
- class parma_polyhedra_library::Domain_Error_Exception
  Exceptions caused by domain errors.
- class parma_polyhedra_library::Polyhedron
  The Java base class for (C and NNC) convex polyhedra.
- class parma_polyhedra_library::C_Polyhedron
  A topologically closed convex polyhedron.
- class parma_polyhedra_library::Pointset_Powerset_C_Polyhedron
  A powerset of C_Polyhedron objects.
- class parma_polyhedra_library::Pointset_Powerset_C_Polyhedron_Iterator
  An iterator class for the disjuncts of a Pointset_Powerset_C_Polyhedron.
- class parma_polyhedra_library::Generator
  A line, ray, point or closure point.
- class parma_polyhedra_library::Generator_System
  A system of generators.

- class parma_polyhedra_library::Grid_Generator
  A grid line, parameter or grid point.
- class parma_polyhedra_library::Grid_Generator_System
  A system of grid generators.
- class parma_polyhedra_library::Invalid_Argument_Exception
  Exceptions caused by invalid arguments.
- class parma_polyhedra_library::IO
  A class collecting I/O functions.
- class parma_polyhedra_library::Length_Error_Exception
  Exceptions caused by too big length/size values.
- class parma_polyhedra_library::Linear_Expression
  A linear expression.
- class parma_polyhedra_library::Linear_Expression_Coefficient
  A linear expression built from a coefficient.
- class parma_polyhedra_library::Linear_Expression_Difference
  The difference of two linear expressions.
- class parma_polyhedra_library::Linear_Expression_Sum
  The sum of two linear expressions.
- class parma_polyhedra_library::Linear_Expression_Times
  The product of a linear expression and a coefficient.
- class parma_polyhedra_library::Linear_Expression_Unary_Minus
  The negation of a linear expression.
- class parma_polyhedra_library::Linear_Expression_Variable
  A linear expression built from a variable.
- class parma_polyhedra_library::Logic_Error_Exception
  Exceptions due to errors in low-level routines.
- class parma_polyhedra_library::MIP_Problem
  A Mixed Integer (linear) Programming problem.
- class parma_polyhedra_library::Overflow_Error_Exception
  Exceptions due to overflow errors.
- class parma_polyhedra_library::Pair< K, V >
  A pair of values of type K and V.
- class parma_polyhedra_library::Parma_Polyhedra_Library
  A class collecting library-level functions.

- interface parma_polyhedra_library::Partial_Function

  A partial function on space dimension indices.

- class parma_polyhedra_library::Poly_Con_Relation

  The relation between a polyhedron and a constraint.

- class parma_polyhedra_library::Variable

  A dimension of the vector space.

Namespaces

- namespace parma_polyhedra_library

  The PPL Java interface package.

Enumerations

- enum parma_polyhedra_library::Complexity_Class { parma_polyhedra_library::POLYNOMIAL_COMPLEXITY, parma_polyhedra_library::SIMPLEX_COMPLEXITY, parma_polyhedra_library::ANY_COMPLEXITY }

  Possible Complexities.

- enum parma_polyhedra_library::Control_Parameter_Name { parma_polyhedra_library::PRICING }

  Names of MIP problems' control parameters.

- enum parma_polyhedra_library::Control_Parameter_Value { parma_polyhedra_library::PRICING_STEEPEST_EDGE_FLOAT, parma_polyhedra_library::PRICING_STEEPEST_EDGE_EXACT, parma_polyhedra_library::PRICING_TEXTBOOK }

  Possible values for MIP problem's control parameters.

- enum parma_polyhedra_library::Degenerate_Element { parma_polyhedra_library::UNIVERSE, parma_polyhedra_library::EMPTY }

  Kinds of degenerate abstract elements.

- enum parma_polyhedra_library::Generator_Type { parma_polyhedra_library::LINE, parma_polyhedra_library::RAY, parma_polyhedra_library::POINT, parma_polyhedra_library::CLOSURE_POINT }

  The generator type.

- enum parma_polyhedra_library::Grid_Generator_Type { parma_polyhedra_library::LINE, parma_polyhedra_library::PARAMETER, parma_polyhedra_library::POINT }

  The grid generator type.

- enum parma_polyhedra_library::MIP_Problem_Status { parma_polyhedra_library::UNFEASIBLE_MIP_PROBLEM, parma_polyhedra_library::UNBOUNDED_MIP_PROBLEM, parma_polyhedra_library::OPTIMIZED_MIP_PROBLEM }

  Possible outcomes of the MIP_Problem solver.

- enum parma_polyhedra_library::Optimization_Mode { parma_polyhedra_library::MINIMIZATION, parma_polyhedra_library::MAXIMIZATION }

  Possible optimization modes.

- enum parma_polyhedra_library::Relation_Symbol {

  parma_polyhedra_library::LESS_THAN, parma_polyhedra_library::LESS_OR_EQUAL, parma_polyhedra_library::EQUAL, parma_polyhedra_library::GREATER_OR_EQUAL,

  parma_polyhedra_library::GREATER_THAN }

  Relation symbols.

8.1.1 Detailed Description

The Parma Polyhedra Library comes equipped with an interface for the Java language.

8.1.2 Enumeration Type Documentation

8.1.2.1 enum parma_polyhedra_library::Complexity_Class

Possible Complexities.

Enumerator:

POLYNOMIAL_COMPLEXITY Worst-case polynomial complexity.

SIMPLEX_COMPLEXITY Worst-case exponential complexity but typically polynomial behavior.

ANY_COMPLEXITY Any complexity.

8.1.2.2 enum parma_polyhedra_library::Control_Parameter_Name

Names of MIP problems' control parameters.

Enumerator:

PRICING The pricing rule.

8.1.2.3 enum parma_polyhedra_library::Control_Parameter_Value

Possible values for MIP problem's control parameters.

Enumerator:

PRICING_STEEPEST_EDGE_FLOAT Steepest edge pricing method, using floating points (default).

PRICING_STEEPEST_EDGE_EXACT Steepest edge pricing method, using Coefficient.

PRICING_TEXTBOOK Textbook pricing method.

8.1.2.4 enum parma_polyhedra_library::Degenerate_Element

Kinds of degenerate abstract elements.

Enumerator:

UNIVERSE The universe element, i.e., the whole vector space.

EMPTY The empty element, i.e., the empty set.

8.1.2.5 enum parma_polyhedra_library::Generator_Type

The generator type.

Enumerator:

LINE The generator is a line.

RAY The generator is a ray.

POINT The generator is a point.

CLOSURE_POINT The generator is a closure point.

8.1.2.6 enum parma_polyhedra_library::Grid_Generator_Type

The grid generator type.

Enumerator:

LINE The generator is a line.

PARAMETER The generator is a parameter.

POINT The generator is a point.

8.1.2.7 enum parma_polyhedra_library::MIP_Problem_Status

Possible outcomes of the MIP_Problem solver.

Enumerator:

UNFEASIBLE_MIP_PROBLEM The problem is unfeasible.

UNBOUNDED_MIP_PROBLEM The problem is unbounded.

OPTIMIZED_MIP_PROBLEM The problem has an optimal solution.

8.1.2.8 enum parma_polyhedra_library::Optimization_Mode

Possible optimization modes.

Enumerator:

MINIMIZATION Minimization is requested.

MAXIMIZATION Maximization is requested.

8.1.2.9 enum parma_polyhedra_library::Relation_Symbol

Relation symbols.

Enumerator:

LESS_THAN Less than.

LESS_OR_EQUAL Less than or equal to.

EQUAL Equal to.

GREATER_OR_EQUAL Greater than or equal to.

GREATER_THAN Greater than.

9 Namespace Documentation

9.1 parma_polyhedra_library Namespace Reference

The PPL Java interface package.

Classes

- class By_Reference< T >
  An utility class implementing mutable and non-mutable call-by-reference.
- class Coefficient
  A PPL coefficient.
- class Congruence
  A linear congruence.
- class Congruence_System
  A system of congruences.
- class Constraint
  A linear equality or inequality.
- class Constraint_System
  A system of constraints.
- class Domain_Error_Exception
  Exceptions caused by domain errors.
- class Polyhedron
  The Java base class for (C and NNC) convex polyhedra.
- class C_Polyhedron
  A topologically closed convex polyhedron.
- class Pointset_Powerset_C_Polyhedron
  A powerset of C_Polyhedron objects.

- class Pointset_Powerset_C_Polyhedron_Iterator

  An iterator class for the disjuncts of a Pointset_Powerset_C_Polyhedron.

- class Generator

  A line, ray, point or closure point.

- class Generator_System

  A system of generators.

- class Grid_Generator

  A grid line, parameter or grid point.

- class Grid_Generator_System

  A system of grid generators.

- class Invalid_Argument_Exception

  Exceptions caused by invalid arguments.

- class IO

  A class collecting I/O functions.

- class Length_Error_Exception

  Exceptions caused by too big length/size values.

- class Linear_Expression

  A linear expression.

- class Linear_Expression_Coefficient

  A linear expression built from a coefficient.

- class Linear_Expression_Difference

  The difference of two linear expressions.

- class Linear_Expression_Sum

  The sum of two linear expressions.

- class Linear_Expression_Times

  The product of a linear expression and a coefficient.

- class Linear_Expression_Unary_Minus

  The negation of a linear expression.

- class Linear_Expression_Variable

  A linear expression built from a variable.

- class Logic_Error_Exception

  Exceptions due to errors in low-level routines.

- class MIP_Problem

A Mixed Integer (linear) Programming problem.

- class Overflow_Error_Exception

  Exceptions due to overflow errors.

- class Pair< K, V >

  A pair of values of type K and V.

- class Parma_Polyhedra_Library

  A class collecting library-level functions.

- interface Partial_Function

  A partial function on space dimension indices.

- class Poly_Con_Relation

  The relation between a polyhedron and a constraint.

- class Poly_Gen_Relation

  The relation between a polyhedron and a generator.

- class Variable

  A dimension of the vector space.

- class Variables_Set

  A java.util.TreeSet of variables' indexes.

Enumerations

- enum Complexity_Class { POLYNOMIAL_COMPLEXITY, SIMPLEX_COMPLEXITY, ANY_-COMPLEXITY }

  Possible Complexities.

- enum Control_Parameter_Name { PRICING }

  Names of MIP problems' control parameters.

- enum Control_Parameter_Value { PRICING_STEEPEST_EDGE_FLOAT, PRICING_-STEEPEST_EDGE_EXACT, PRICING_TEXTBOOK }

  Possible values for MIP problem's control parameters.

- enum Degenerate_Element { UNIVERSE, EMPTY }

  Kinds of degenerate abstract elements.

- enum Generator_Type { LINE, RAY, POINT, CLOSURE_POINT }

  The generator type.

- enum Grid_Generator_Type { LINE, PARAMETER, POINT }

  The grid generator type.

- enum MIP_Problem_Status { UNFEASIBLE_MIP_PROBLEM, UNBOUNDED_MIP_PROBLEM, OPTIMIZED_MIP_PROBLEM }

  Possible outcomes of the MIP_Problem solver.

- enum Optimization_Mode { MINIMIZATION, MAXIMIZATION }

  Possible optimization modes.

- enum Relation_Symbol {
  LESS_THAN, LESS_OR_EQUAL, EQUAL, GREATER_OR_EQUAL,
  GREATER_THAN }

  Relation symbols.

9.1.1 Detailed Description

The PPL Java interface package.

All classes, interfaces and enums related to the Parma Polyhedra Library Java interface are included in this package.

10 Class Documentation

10.1 parma_polyhedra_library::By_Reference< T > Class Reference

An utility class implementing mutable and non-mutable call-by-reference.

Public Member Functions

- By_Reference (T object_value)

  Builds an object encapsulating `object_value`.

- void set (T y)

  Set an object to value `object_value`.

- T get ()

  Returns the value held by `this`.

Package Attributes

- T obj

  Stores the object.

10.1.1 Detailed Description

An utility class implementing mutable and non-mutable call-by-reference.

The documentation for this class was generated from the following file:

- By_Reference.java

10.2 parma_polyhedra_library::C_Polyhedron Class Reference

A topologically closed convex polyhedron.

Inherits parma_polyhedra_library::Polyhedron.

Public Member Functions

Standard Constructors and Destructor

- C_Polyhedron (long d, Degenerate_Element kind)
  Builds a new C polyhedron of dimension `d`.
- C_Polyhedron (C_Polyhedron y)
  Builds a new C polyhedron that is copy of `y`.
- C_Polyhedron (C_Polyhedron y, Complexity_Class complexity)
  Builds a new C polyhedron that is a copy of `ph`.
- C_Polyhedron (Constraint_System cs)
  Builds a new C polyhedron from the system of constraints `cs`.
- C_Polyhedron (Congruence_System cgs)
  Builds a new C polyhedron from the system of congruences `cgs`.
- native void free ()
  Releases all resources managed by `this`*, also resetting it to a null reference.*

Constructors Behaving as Conversion Operators

Besides the conversions listed here below, the library also provides conversion operators that build a semantic geometric description starting from **any** *other semantic geometric description (e.g.,* `Grid(C_Polyhedron y)`*,* `C_Polyhedron(BD_Shape_mpq_class y)`*, etc.). Clearly, the conversion operators are only available if both the source and the target semantic geometric descriptions have been enabled when configuring the library. The conversions also taking as argument a complexity class sometimes provide non-trivial precision/efficiency trade-offs.*

- C_Polyhedron (NNC_Polyhedron y)
  Builds a C polyhedron that is a copy of the topological closure of the NNC polyhedron `y`.
- C_Polyhedron (NNC_Polyhedron y, Complexity_Class complexity)
  Builds a C polyhedron that is a copy of the topological closure of the NNC polyhedron `y`.
- C_Polyhedron (Generator_System gs)
  Builds a new C polyhedron from the system of generators `gs`.

Other Methods

- native boolean upper_bound_assign_if_exact (C_Polyhedron y)

  If the upper bound of `this` *and* `y` *is exact it is assigned to* `this` *and* `true` *is returned; otherwise* `false` *is returned.*

Static Public Member Functions

- static native Pair< C_Polyhedron, Pointset_Powerset_NNC_Polyhedron > linear_partition (C_Polyhedron p, C_Polyhedron q)

  Partitions `q` *with respect to* `p`.

Protected Member Functions

- native void finalize ()

  Releases all resources managed by `this`.

10.2.1 Detailed Description

A topologically closed convex polyhedron.

10.2.2 Constructor & Destructor Documentation

10.2.2.1 parma_polyhedra_library::C_Polyhedron::C_Polyhedron (long *d*, Degenerate_Element *kind*)

Builds a new C polyhedron of dimension `d`.

If `kind` is `EMPTY`, the newly created polyhedron will be empty; otherwise, it will be a universe polyhedron.

10.2.2.2 parma_polyhedra_library::C_Polyhedron::C_Polyhedron (C_Polyhedron *y*, Complexity_Class *complexity*)

Builds a new C polyhedron that is a copy of `ph`.

The complexity argument is ignored.

10.2.2.3 parma_polyhedra_library::C_Polyhedron::C_Polyhedron (Constraint_System *cs*)

Builds a new C polyhedron from the system of constraints `cs`.

The new polyhedron will inherit the space dimension of `cs`.

10.2.2.4 parma_polyhedra_library::C_Polyhedron::C_Polyhedron (Congruence_System *cgs*)

Builds a new C polyhedron from the system of congruences `cgs`.

The new polyhedron will inherit the space dimension of `cgs`.

10.2.2.5 parma_polyhedra_library::C_Polyhedron::C_Polyhedron (NNC_Polyhedron *y*, Complexity_Class *complexity*)

Builds a C polyhedron that is a copy of the topological closure of the NNC polyhedron `y`.

The complexity argument is ignored, since the exact constructor has polynomial complexity.

10.2.2.6 parma_polyhedra_library::C_Polyhedron::C_Polyhedron (Generator_System *gs*)

Builds a new C polyhedron from the system of generators `gs`.

The new polyhedron will inherit the space dimension of `gs`.

10.2.3 Member Function Documentation

10.2.3.1 native boolean parma_polyhedra_library::C_Polyhedron::upper_bound_assign_if_exact (C_Polyhedron *y*)

If the upper bound of `this` and `y` is exact it is assigned to `this` and `true` is returned; otherwise `false` is returned.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are dimension-incompatible.

10.2.3.2 static native Pair<C_Polyhedron, Pointset_Powerset_NNC_Polyhedron> parma_polyhedra_library::C_Polyhedron::linear_partition (C_Polyhedron *p*, C_Polyhedron *q*) [static]

Partitions `q` with respect to `p`.

Let `p` and `q` be two polyhedra. The function returns a pair object `r` such that

- `r.first` is the intersection of `p` and `q`;
- `r.second` has the property that all its elements are pairwise disjoint and disjoint from `p`;
- the set-theoretical union of `r.first` with all the elements of `r.second` gives `q` (i.e., `r` is the representation of a partition of `q`).

The documentation for this class was generated from the following file:

- Fake_Class_for_Doxygen.java

10.3 parma_polyhedra_library::Coefficient Class Reference

A PPL coefficient.

Public Member Functions

- Coefficient (int i)

  Builds a coefficient values `i`.

- Coefficient (long l)

Builds a coefficient valued `l`.

- Coefficient (BigInteger bi)

  Builds a coefficient valued `bi`.

- Coefficient (String s)

  Builds a coefficient from the decimal representation in `s`.

- Coefficient (Coefficient c)

  Builds a copy of `c`.

- BigInteger getBigInteger ()

  Returns the value held by `this`.

10.3.1 Detailed Description

A PPL coefficient.

Objects of type Coefficient are used to implement the integral valued coefficients occurring in linear expressions, constraints, generators and so on.

10.3.2 Constructor & Destructor Documentation

10.3.2.1 parma_polyhedra_library::Coefficient::Coefficient (String *s*) [inline]

Builds a coefficient from the decimal representation in `s`.

Exceptions:

java.lang.NumberFormatException Thrown if `s` does not contain a valid decimal representation.

The documentation for this class was generated from the following file:

- Coefficient.java

10.4 parma_polyhedra_library::Congruence Class Reference

A linear congruence.

Public Member Functions

- Congruence (Linear_Expression e1, Linear_Expression e2, Coefficient m)

  Returns the congruence `e1` $=$ `e2` $\pmod{\texttt{m}}$.

- native String ascii_dump ()

  Returns an ascii formatted internal representation of `this`.

- native String toString ()

  Returns a string representation of `this`.

Protected Attributes

- Coefficient modulus

  The modulus of the congruence.

Package Attributes

- Linear_Expression lhs

  The value of the left hand side of `this`.

- Linear_Expression rhs

  The value of the right hand side of `this`.

10.4.1 Detailed Description

A linear congruence.

An object of the class Congruence is an object represeting a congruence:

- $\mathrm{cg} = \sum_{i=0}^{n-1} a_i x_i + b = 0 \pmod{m}$

where n is the dimension of the space, a_i is the integer coefficient of variable x_i, b is the integer inhomogeneous term and m is the integer modulus; if $m = 0$, then cg represents the equality congruence $\sum_{i=0}^{n-1} a_i x_i + b = 0$ and, if $m \neq 0$, then the congruence cg is said to be a proper congruence.

The documentation for this class was generated from the following file:

- Congruence.java

10.5 parma_polyhedra_library::Congruence_System Class Reference

A system of congruences.

Public Member Functions

- Congruence_System ()

  Default constructor: builds an empty system of congruences.

- native String ascii_dump ()

  Returns an ascii formatted internal representation of `this`.

- native String toString ()

  Returns a string representation of `this`.

10.5.1 Detailed Description

A system of congruences.

An object of the class Congruence_System is a system of congruences, i.e., a multiset of objects of the class Congruence.

The documentation for this class was generated from the following file:

- Congruence_System.java

10.6 parma_polyhedra_library::Constraint Class Reference

A linear equality or inequality.

Public Member Functions

- Constraint (Linear_Expression le1, Relation_Symbol rel_sym, Linear_Expression le2)
  Builds a constraint from two linear expressions with a specified relation symbol.
- Linear_Expression left_hand_side ()
  Returns the left hand side of `this`.
- Linear_Expression right_hand_side ()
  Returns the right hand side of `this`.
- Relation_Symbol kind ()
  Returns the relation symbol of `this`.
- native String ascii_dump ()
  Returns an ascii formatted internal representation of `this`.
- native String toString ()
  Returns a string representation of `this`.

10.6.1 Detailed Description

A linear equality or inequality.

An object of the class Constraint is either:

- a linear equality;
- a non-strict linear inequality;
- a strict linear inequality.

The documentation for this class was generated from the following file:

- Constraint.java

10.7 parma_polyhedra_library::Constraint_System Class Reference

A system of constraints.

Public Member Functions

- Constraint_System ()

  Default constructor: builds an empty system of constraints.

- native String ascii_dump ()

  Returns an ascii formatted internal representation of `this`.

- native String toString ()

  Returns a string representation of `this`.

10.7.1 Detailed Description

A system of constraints.

An object of the class Constraint_System is a system of constraints, i.e., a multiset of objects of the class Constraint.

The documentation for this class was generated from the following file:

- Constraint_System.java

10.8 parma_polyhedra_library::Domain_Error_Exception Class Reference

Exceptions caused by domain errors.

Public Member Functions

- Domain_Error_Exception (String s)

  Constructor.

10.8.1 Detailed Description

Exceptions caused by domain errors.

The documentation for this class was generated from the following file:

- Domain_Error_Exception.java

10.9 parma_polyhedra_library::Generator Class Reference

A line, ray, point or closure point.

Public Member Functions

- Coefficient divisor ()

  If `this` *is either a point or a closure point, returns its divisor.*

- native String ascii_dump ()

  Returns an ascii formatted internal representation of `this`.

- native String toString ()

  Returns a string representation of `this`.

Static Public Member Functions

- static Generator closure_point (Linear_Expression e, Coefficient c)

  Returns the closure point at `e` / `d`.

- static Generator line (Linear_Expression le)

  Returns the line of direction `e`.

- static Generator point (Linear_Expression le, Coefficient d)

  Returns the point at `e` / `d`.

- static Generator ray (Linear_Expression le)

  Returns the ray of direction `e`.

10.9.1 Detailed Description

A line, ray, point or closure point.

An object of the class Generator is one of the following:

- a line;
- a ray;
- a point;
- a closure point.

10.9.2 Member Function Documentation

10.9.2.1 static Generator parma_polyhedra_library::Generator::closure_point (Linear_Expression *e*, Coefficient *c*) [inline, static]

Returns the closure point at `e` / `d`.

Exceptions:

RuntimeErrorException Thrown if `d` is zero.

10.9.2.2 static Generator parma_polyhedra_library::Generator::line (Linear_Expression *le*) [inline, static]

Returns the line of direction `e`.

Exceptions:

RuntimeErrorException Thrown if the homogeneous part of `e` represents the origin of the vector space.

10.9.2.3 static Generator parma_polyhedra_library::Generator::point (Linear_Expression *le*, Coefficient *d*) [inline, static]

Returns the point at `e` / `d`.

Exceptions:

RuntimeErrorException Thrown if `d` is zero.

10.9.2.4 static Generator parma_polyhedra_library::Generator::ray (Linear_Expression *le*) [inline, static]

Returns the ray of direction `e`.

Exceptions:

RuntimeErrorException Thrown if the homogeneous part of `e` represents the origin of the vector space.

10.9.2.5 Coefficient parma_polyhedra_library::Generator::divisor () [inline]

If `this` is either a point or a closure point, returns its divisor.

Exceptions:

RuntimeErrorException Thrown if `this` is neither a point nor a closure point.

The documentation for this class was generated from the following file:

- Generator.java

10.10 parma_polyhedra_library::Generator_System Class Reference

A system of generators.

Public Member Functions

- Generator_System ()

  Default constructor: builds an empty system of generators.

- native String ascii_dump ()

  Returns an ascii formatted internal representation of `this`.

- native String toString ()

  Returns a string representation of `this`.

10.10.1 Detailed Description

A system of generators.

An object of the class Generator_System is a system of generators, i.e., a multiset of objects of the class Generator (lines, rays, points and closure points).

The documentation for this class was generated from the following file:

- Generator_System.java

10.11 parma_polyhedra_library::Grid_Generator Class Reference

A grid line, parameter or grid point.

Public Member Functions

- native String ascii_dump ()

  Returns an ascii formatted internal representation of `this`.

- native String toString ()

  Returns a string representation of `this`.

Static Public Member Functions

- static Grid_Generator grid_line (Linear_Expression e)

  Returns the line of direction `e`.

- static Grid_Generator parameter (Linear_Expression e, Coefficient c)

  Returns the parameter of direction `e` *and size* `e/d`.

- static Grid_Generator grid_point (Linear_Expression e, Coefficient c)

  Returns the point at `e / d`.

10.11.1 Detailed Description

A grid line, parameter or grid point.

An object of the class Grid_Generator is one of the following:

- a grid_line;

- a parameter;
- a grid_point.

10.11.2 Member Function Documentation

10.11.2.1 static Grid_Generator parma_polyhedra_library::Grid_Generator::grid_line (Linear_Expression *e*) [inline, static]

Returns the line of direction `e`.

Exceptions:

RuntimeErrorException Thrown if the homogeneous part of `e` represents the origin of the vector space.

10.11.2.2 static Grid_Generator parma_polyhedra_library::Grid_Generator::parameter (Linear_Expression *e*, Coefficient *c*) [inline, static]

Returns the parameter of direction `e` and size `e/d`.

Both `e` and `d` are optional arguments, with default values Linear_Expression::zero() and Coefficient_one(), respectively.

Exceptions:

RuntimeErrorException Thrown if `d` is zero.

10.11.2.3 static Grid_Generator parma_polyhedra_library::Grid_Generator::grid_point (Linear_Expression *e*, Coefficient *c*) [inline, static]

Returns the point at `e` / `d`.

Both `e` and `d` are optional arguments, with default values Linear_Expression::zero() and Coefficient_one(), respectively.

Exceptions:

RuntimeErrorException Thrown if `d` is zero.

The documentation for this class was generated from the following file:

- Grid_Generator.java

10.12 parma_polyhedra_library::Grid_Generator_System Class Reference

A system of grid generators.

Public Member Functions

- Grid_Generator_System ()

  Default constructor: builds an empty system of grid generators.

- native String ascii_dump ()

  Returns an ascii formatted internal representation of `this`.

- native String toString ()

  Returns a string representation of `this`.

10.12.1 Detailed Description

A system of grid generators.

An object of the class Grid_Generator_System is a system of grid generators, i.e., a multiset of objects of the class Grid_Generator.

The documentation for this class was generated from the following file:

- Grid_Generator_System.java

10.13 parma_polyhedra_library::Invalid_Argument_Exception Class Reference

Exceptions caused by invalid arguments.

Public Member Functions

- Invalid_Argument_Exception (String s)

  Constructor.

10.13.1 Detailed Description

Exceptions caused by invalid arguments.

The documentation for this class was generated from the following file:

- Invalid_Argument_Exception.java

10.14 parma_polyhedra_library::IO Class Reference

A class collecting I/O functions.

Static Public Member Functions

- static native String wrap_string (String str, int indent_depth, int preferred_first_line_length, int preferred_line_length)

  Utility function for the wrapping of lines of text.

10.14.1 Detailed Description

A class collecting I/O functions.

10.14.2 Member Function Documentation

10.14.2.1 static native String parma_polyhedra_library::IO::wrap_string (String *str*, int *indent_depth*, int *preferred_first_line_length*, int *preferred_line_length*) [static]

Utility function for the wrapping of lines of text.

Parameters:

str The source string holding the lines to wrap.

indent_depth The indentation depth.

preferred_first_line_length The preferred length for the first line of text.

preferred_line_length The preferred length for all the lines but the first one.

Returns:

The wrapped string.

The documentation for this class was generated from the following file:

- IO.java

10.15 parma_polyhedra_library::Length_Error_Exception Class Reference

Exceptions caused by too big length/size values.

Public Member Functions

- Length_Error_Exception (String s)
  Constructor.

10.15.1 Detailed Description

Exceptions caused by too big length/size values.

The documentation for this class was generated from the following file:

- Length_Error_Exception.java

10.16 parma_polyhedra_library::Linear_Expression Class Reference

A linear expression.

Inherited by parma_polyhedra_library::Linear_Expression_Coefficient, parma_polyhedra_library::Linear_Expression_Difference, parma_polyhedra_library::Linear_Expression_Sum, parma_polyhedra_library::Linear_Expression_Times, parma_polyhedra_library::Linear_Expression_Unary_Minus, and parma_polyhedra_library::Linear_Expression_Variable.

Public Member Functions

- Linear_Expression sum (Linear_Expression y)
  Returns the sum of `this` *and* `y`.
- Linear_Expression subtract (Linear_Expression y)
  Returns the difference of `this` *and* `y`.
- Linear_Expression times (Coefficient c)
  Returns the product of `this` *times* `c`.
- Linear_Expression unary_minus ()
  Returns the negation of `this`.
- abstract Linear_Expression clone ()
  Returns a copy of the linear expression.
- native String ascii_dump ()
  Returns an ascii formatted internal representation of `this`.
- native String toString ()
  Returns a string representation of `this`.

10.16.1 Detailed Description

A linear expression.

An object of the class Linear_Expression represents a linear expression that can be built from a Linear_Expression_Variable, Linear_Expression_Coefficient, Linear_Expression_Sum, Linear_Expression_Difference, Linear_Expression_Unary_Minus.

The documentation for this class was generated from the following file:

- Linear_Expression.java

10.17 parma_polyhedra_library::Linear_Expression_Coefficient Class Reference

A linear expression built from a coefficient.

Inherits parma_polyhedra_library::Linear_Expression.

Public Member Functions

- Linear_Expression_Coefficient (Coefficient c)
  Builds the object corresponding to a copy of the coefficient `c`.
- Coefficient argument ()
  Returns coefficient representing the linear expression.
- Linear_Expression_Coefficient clone ()
  Builds a copy of this.

Protected Attributes

- Coefficient coeff

  The coefficient representing the linear expression.

10.17.1 Detailed Description

A linear expression built from a coefficient.

The documentation for this class was generated from the following file:

- Linear_Expression_Coefficient.java

10.18 parma_polyhedra_library::Linear_Expression_Difference Class Reference

The difference of two linear expressions.

Inherits parma_polyhedra_library::Linear_Expression.

Public Member Functions

- Linear_Expression_Difference (Linear_Expression x, Linear_Expression y)

  Builds an object that represents the difference of the copy `x` *and* `y`.

- Linear_Expression left_hand_side ()

  Returns the left hand side of `this`.

- Linear_Expression right_hand_side ()

  Returns the left hand side of `this`.

- Linear_Expression_Difference clone ()

  Builds a copy of this.

Protected Attributes

- Linear_Expression lhs

  The value of the left hand side of `this`.

- Linear_Expression rhs

  The value of the right hand side of `this`.

10.18.1 Detailed Description

The difference of two linear expressions.

The documentation for this class was generated from the following file:

- Linear_Expression_Difference.java

10.19 parma_polyhedra_library::Linear_Expression_Sum Class Reference

The sum of two linear expressions.

Inherits parma_polyhedra_library::Linear_Expression.

Public Member Functions

- Linear_Expression_Sum (Linear_Expression x, Linear_Expression y)
  Builds an object that represents the sum of the copy of `x` *and* `y`.
- Linear_Expression left_hand_side ()
  Returns the left hand side of `this`.
- Linear_Expression right_hand_side ()
  Returns the right hand side of `this`.
- Linear_Expression_Sum clone ()
  Builds a copy of this.

Protected Attributes

- Linear_Expression lhs
  The value of the left hand side of `this`.
- Linear_Expression rhs
  The value of the right hand side of `this`.

10.19.1 Detailed Description

The sum of two linear expressions.

The documentation for this class was generated from the following file:

- Linear_Expression_Sum.java

10.20 parma_polyhedra_library::Linear_Expression_Times Class Reference

The product of a linear expression and a coefficient.

Inherits parma_polyhedra_library::Linear_Expression.

Public Member Functions

- Linear_Expression_Times (Linear_Expression l, Coefficient c)
  Builds an object cloning the input arguments.
- Linear_Expression left_hand_side ()

Returns the left hand side of `this`.

- Linear_Expression right_hand_side ()

  Returns the right hand side of `this`.

- Linear_Expression_Times clone ()

  Builds a copy of this.

Protected Attributes

- Linear_Expression_Coefficient lhs

  The value of the left hand side of `this`.

- Linear_Expression rhs

  The value of the left hand side of `this`.

10.20.1 Detailed Description

The product of a linear expression and a coefficient.

The documentation for this class was generated from the following file:

- Linear_Expression_Times.java

10.21 parma_polyhedra_library::Linear_Expression_Unary_Minus Class Reference

The negation of a linear expression.

Inherits parma_polyhedra_library::Linear_Expression.

Public Member Functions

- Linear_Expression_Unary_Minus (Linear_Expression x)

  Builds an object that represents the negation of the copy `x`.

- Linear_Expression argument ()

  Returns the value that `this` *negates.*

- Linear_Expression_Unary_Minus clone ()

  Builds a copy of this.

Protected Attributes

- Linear_Expression arg

  The value that `this` *negates.*

10.21.1 Detailed Description

The negation of a linear expression.

The documentation for this class was generated from the following file:

- Linear_Expression_Unary_Minus.java

10.22 parma_polyhedra_library::Linear_Expression_Variable Class Reference

A linear expression built from a variable.

Inherits parma_polyhedra_library::Linear_Expression.

Public Member Functions

- Linear_Expression_Variable (Variable v)
  Builds the object associated to the copy of v.
- Variable argument ()
  Returns the variable representing the linear expression.
- Linear_Expression_Variable clone ()
  Builds a copy of this.

10.22.1 Detailed Description

A linear expression built from a variable.

The documentation for this class was generated from the following file:

- Linear_Expression_Variable.java

10.23 parma_polyhedra_library::Logic_Error_Exception Class Reference

Exceptions due to errors in low-level routines.

Public Member Functions

- Logic_Error_Exception (String s)
  Constructor.

10.23.1 Detailed Description

Exceptions due to errors in low-level routines.

These exceptions may be generated, for instance, by the inability of querying/controlling the FPU behavior with respect to rounding modes.

The documentation for this class was generated from the following file:

- Logic_Error_Exception.java

10.24 parma_polyhedra_library::MIP_Problem Class Reference

A Mixed Integer (linear) Programming problem.

Inherits parma_polyhedra_library::PPL_Object.

Constructors and Destructor

- MIP_Problem (long dim)

  Builds a trivial MIP problem.

- MIP_Problem (long dim, Constraint_System cs, Linear_Expression obj, Optimization_Mode mode)

  Builds an MIP problem having space dimension `dim` *from the constraint system* `cs`*, the objective function* `obj` *and optimization mode* `mode`*.*

- MIP_Problem (MIP_Problem y)

  Builds a copy of `y`*.*

- native void free ()

  Releases all resources managed by `this`*, also resetting it to a null reference.*

- native void finalize ()

  Releases all resources managed by `this`*.*

Public Member Functions

Functions that Do Not Modify the MIP_Problem

- native long max_space_dimension ()

  Returns the maximum space dimension an MIP_Problem can handle.

- native long space_dimension ()

  Returns the space dimension of the MIP problem.

- native Variables_Set integer_space_dimensions ()

  Returns a set containing all the variables' indexes constrained to be integral.

- native Constraint_System constraints ()

  Returns the constraints .

- native Linear_Expression objective_function ()

  Returns the objective function.

- native Optimization_Mode optimization_mode ()

  Returns the optimization mode.

- native String ascii_dump ()

Returns an ascii formatted internal representation of `this`.

- native String toString ()
  Returns a string representation of `this`.
- native long total_memory_in_bytes ()
  Returns the total size in bytes of the memory occupied by the underlying C++ object.
- native boolean OK ()
  Checks if all the invariants are satisfied.

Functions that May Modify the MIP_Problem

- native void clear ()
  Resets `this` *to be equal to the trivial MIP problem.*
- native void add_space_dimensions_and_embed (long m)
  Adds `m` *new space dimensions and embeds the old MIP problem in the new vector space.*
- native void add_to_integer_space_dimensions (Variables_Set i_vars)
  Sets the variables whose indexes are in set `i_vars` *to be integer space dimensions.*
- native void add_constraint (Constraint c)
  Adds a copy of constraint `c` *to the MIP problem.*
- native void add_constraints (Constraint_System cs)
  Adds a copy of the constraints in `cs` *to the MIP problem.*
- native void set_objective_function (Linear_Expression obj)
  Sets the objective function to `obj`.
- native void set_optimization_mode (Optimization_Mode mode)
  Sets the optimization mode to `mode`.

Computing the Solution of the MIP_Problem

- native boolean is_satisfiable ()
  Checks satisfiability of `*this`.
- native MIP_Problem_Status solve ()
  Optimizes the MIP problem.
- native void evaluate_objective_function (Generator evaluating_point, Coefficient num, Coefficient den)
  Sets `num` *and* `den` *so that* $\frac{num}{den}$ *is the result of evaluating the objective function on* `evaluating_point`.
- native Generator feasible_point ()
  Returns a feasible point for `*this`*, if it exists.*
- native Generator optimizing_point ()
  Returns an optimal point for `this`*, if it exists.*

- native void optimal_value (Coefficient num, Coefficient den)
  Sets `num` *and* `den` *so that* $\frac{num}{den}$ *is the solution of the optimization problem.*

Querying/Setting Control Parameters

- native Control_Parameter_Value get_control_parameter (Control_Parameter_Name name)
  Returns the value of control parameter `name`.
- native void set_control_parameter (Control_Parameter_Value value)
  Sets control parameter `value`.

10.24.1 Detailed Description

A Mixed Integer (linear) Programming problem.

An object of this class encodes a mixed integer (linear) programming problem. The MIP problem is specified by providing:

- the dimension of the vector space;
- the feasible region, by means of a finite set of linear equality and non-strict inequality constraints;
- the subset of the unknown variables that range over the integers (the other variables implicitly ranging over the reals);
- the objective function, described by a Linear_Expression;
- the optimization mode (either maximization or minimization).

The class provides support for the (incremental) solution of the MIP problem based on variations of the revised simplex method and on branch-and-bound techniques. The result of the resolution process is expressed in terms of an enumeration, encoding the feasibility and the unboundedness of the optimization problem. The class supports simple feasibility tests (i.e., no optimization), as well as the extraction of an optimal (resp., feasible) point, provided the MIP_Problem is optimizable (resp., feasible).

By exploiting the incremental nature of the solver, it is possible to reuse part of the computational work already done when solving variants of a given MIP_Problem: currently, incremental resolution supports the addition of space dimensions, the addition of constraints, the change of objective function and the change of optimization mode.

10.24.2 Constructor & Destructor Documentation

10.24.2.1 parma_polyhedra_library::MIP_Problem::MIP_Problem (long *dim*) [inline]

Builds a trivial MIP problem.

A trivial MIP problem requires to maximize the objective function 0 on a vector space under no constraints at all: the origin of the vector space is an optimal solution.

Parameters:

dim The dimension of the vector space enclosing `this`.

Exceptions:

std::length_error Thrown if `dim` exceeds `max_space_dimension()`.

10.24.2.2 parma_polyhedra_library::MIP_Problem::MIP_Problem (long *dim*, Constraint_System *cs*, Linear_Expression *obj*, Optimization_Mode *mode*) [inline]

Builds an MIP problem having space dimension `dim` from the constraint system `cs`, the objective function `obj` and optimization mode `mode`.

Parameters:

dim The dimension of the vector space enclosing `this`.

cs The constraint system defining the feasible region.

obj The objective function.

mode The optimization mode.

Exceptions:

std::length_error Thrown if `dim` exceeds `max_space_dimension()`.

std::invalid_argument Thrown if the constraint system contains any strict inequality or if the space dimension of the constraint system (resp., the objective function) is strictly greater than `dim`.

10.24.3 Member Function Documentation

10.24.3.1 native void parma_polyhedra_library::MIP_Problem::clear ()

Resets `this` to be equal to the trivial MIP problem.

The space dimension is reset to 0.

10.24.3.2 native void parma_polyhedra_library::MIP_Problem::add_space_dimensions_and_embed (long *m*)

Adds `m` new space dimensions and embeds the old MIP problem in the new vector space.

Parameters:

m The number of dimensions to add.

Exceptions:

std::length_error Thrown if adding `m` new space dimensions would cause the vector space to exceed dimension `max_space_dimension()`.

The new space dimensions will be those having the highest indexes in the new MIP problem; they are initially unconstrained.

10.24.3.3 native void parma_polyhedra_library::MIP_Problem::add_to_integer_space_dimensions (Variables_Set *i_vars*)

Sets the variables whose indexes are in set `i_vars` to be integer space dimensions.

Exceptions:

std::invalid_argument Thrown if some index in `i_vars` does not correspond to a space dimension in `this`.

10.24.3.4 native void parma_polyhedra_library::MIP_Problem::add_constraint (Constraint *c*)

Adds a copy of constraint `c` to the MIP problem.

Exceptions:

std::invalid_argument Thrown if the constraint `c` is a strict inequality or if its space dimension is strictly greater than the space dimension of `this`.

10.24.3.5 native void parma_polyhedra_library::MIP_Problem::add_constraints (Constraint_System *cs*)

Adds a copy of the constraints in `cs` to the MIP problem.

Exceptions:

std::invalid_argument Thrown if the constraint system `cs` contains any strict inequality or if its space dimension is strictly greater than the space dimension of `*this`.

10.24.3.6 native void parma_polyhedra_library::MIP_Problem::set_objective_function (Linear_Expression *obj*)

Sets the objective function to `obj`.

Exceptions:

std::invalid_argument Thrown if the space dimension of `obj` is strictly greater than the space dimension of `this`.

10.24.3.7 native boolean parma_polyhedra_library::MIP_Problem::is_satisfiable ()

Checks satisfiability of `*this`.

Returns:

`true` if and only if the MIP problem is satisfiable.

10.24.3.8 native MIP_Problem_Status parma_polyhedra_library::MIP_Problem::solve ()

Optimizes the MIP problem.

Returns:

An MIP_Problem_Status flag indicating the outcome of the optimization attempt (unfeasible, unbounded or optimized problem).

10.24.3.9 native void parma_polyhedra_library::MIP_Problem::evaluate_objective_function (Generator *evaluating_point*, Coefficient *num*, Coefficient *den*)

Sets `num` and `den` so that $\frac{num}{den}$ is the result of evaluating the objective function on `evaluating_point`.

Parameters:

evaluating_point The point on which the objective function will be evaluated.

num On exit will contain the numerator of the evaluated value.

den On exit will contain the denominator of the evaluated value.

Exceptions:

std::invalid_argument Thrown if `this` and `evaluating_point` are dimension-incompatible or if the generator `evaluating_point` is not a point.

10.24.3.10 native Generator parma_polyhedra_library::MIP_Problem::feasible_point ()

Returns a feasible point for `*this`, if it exists.

Exceptions:

std::domain_error Thrown if the MIP problem is not satisfiable.

10.24.3.11 native Generator parma_polyhedra_library::MIP_Problem::optimizing_point ()

Returns an optimal point for `this`, if it exists.

Exceptions:

std::domain_error Thrown if `this` doesn't not have an optimizing point, i.e., if the MIP problem is unbounded or not satisfiable.

10.24.3.12 native void parma_polyhedra_library::MIP_Problem::optimal_value (Coefficient *num*, Coefficient *den*)

Sets `num` and `den` so that $\frac{num}{den}$ is the solution of the optimization problem.

Exceptions:

std::domain_error Thrown if `*this` doesn't not have an optimizing point, i.e., if the MIP problem is unbounded or not satisfiable.

The documentation for this class was generated from the following file:

- MIP_Problem.java

10.25 parma_polyhedra_library::Overflow_Error_Exception Class Reference

Exceptions due to overflow errors.

Public Member Functions

- Overflow_Error_Exception (String s)

  Constructor.

10.25.1 Detailed Description

Exceptions due to overflow errors.

These exceptions can be obtained when the library has been configured to use integer coefficients having bounded size.

The documentation for this class was generated from the following file:

- Overflow_Error_Exception.java

10.26 parma_polyhedra_library::Pair< K, V > Class Reference

A pair of values of type K and V.

Public Member Functions

- K getFirst ()
  Returns the object of type K.
- V getSecond ()
  Returns the object of type V.

10.26.1 Detailed Description

A pair of values of type K and V.

An object of this class holds an ordered pair of values of type K and V.

The documentation for this class was generated from the following file:

- Pair.java

10.27 parma_polyhedra_library::Parma_Polyhedra_Library Class Reference

A class collecting library-level functions.

Static Public Member Functions

Version Checking

- static native int version_major ()
  Returns the major number of the PPL version.
- static native int version_minor ()
  Returns the minor number of the PPL version.
- static native int version_revision ()
  Returns the revision number of the PPL version.
- static native int version_beta ()

Returns the beta number of the PPL version.

- static native String version ()
  Returns a string containing the PPL version.
- static native String banner ()
  Returns a string containing the PPL banner.

(Re-) Setting floating-point rounding mode.

- static native void set_rounding_for_PPL ()
  Sets the FPU rounding mode so that the PPL abstractions based on floating point numbers work correctly.
- static native void restore_pre_PPL_rounding ()
  Sets the FPU rounding mode as it was before initialization of the PPL.

10.27.1 Detailed Description

A class collecting library-level functions.

10.27.2 Member Function Documentation

10.27.2.1 static native String parma_polyhedra_library::Parma_Polyhedra_Library::banner () [static]

Returns a string containing the PPL banner.

The banner provides information about the PPL version, the licensing, the lack of any warranty whatsoever, the C++ compiler used to build the library, where to report bugs and where to look for further information.

10.27.2.2 static native void parma_polyhedra_library::Parma_Polyhedra_Library::set_rounding_for_PPL () [static]

Sets the FPU rounding mode so that the PPL abstractions based on floating point numbers work correctly.

This is performed automatically at initialization-time. Calling this function is needed only if restore_pre_PPL_rounding() has been previously called.

10.27.2.3 static native void parma_polyhedra_library::Parma_Polyhedra_Library::restore_pre_PPL_rounding () [static]

Sets the FPU rounding mode as it was before initialization of the PPL.

After calling this function it is absolutely necessary to call set_rounding_for_PPL() before using any PPL abstractions based on floating point numbers. This is performed automatically at finalization-time.

The documentation for this class was generated from the following file:

- Parma_Polyhedra_Library.java

10.28 parma_polyhedra_library::Partial_Function Interface Reference

A partial function on space dimension indices.

Public Member Functions

- long max_in_codomain ()

  Returns the maximum value that belongs to the codomain of the partial function.

- boolean maps (Long i, By_Reference< Long > j)

  Sets `j` *to the value (if any) of the partial function on index* `i`.

Package Functions

- boolean has_empty_codomain ()

  Returns `true` *if and only if the partial function has an empty codomain (i.e., it is always undefined).*

10.28.1 Detailed Description

A partial function on space dimension indices.

In order to specify how space dimensions should be mapped by methods named `map_space_dimensions`, the user should implement this interface.

Note:

An example of implementation can be found in the PPL test file `interfaces/Java/tests/Test_Partial_Function.java`.

10.28.2 Member Function Documentation

10.28.2.1 boolean parma_polyhedra_library::Partial_Function::has_empty_codomain () [package]

Returns `true` if and only if the partial function has an empty codomain (i.e., it is always undefined).

This method will always be called before the other methods of the interface. Moreover, if `true` is returned, then none of the other interface methods will be called.

10.28.2.2 boolean parma_polyhedra_library::Partial_Function::maps (Long *i*, By_Reference< Long > *j*)

Sets `j` to the value (if any) of the partial function on index `i`.

The function returns `true` if and only if the partial function is defined on domain value `i`.

The documentation for this interface was generated from the following file:

- Partial_Function.java

10.29 parma_polyhedra_library::Pointset_Powerset_C_Polyhedron Class Reference

A powerset of C_Polyhedron objects.

Inherits parma_polyhedra_library::PPL_Object.

Public Member Functions

Ad Hoc Functions for Pointset_Powerset domains

- native void omega_reduce ()
  Drops from the sequence of disjuncts in `this` *all the non-maximal elements, so that a non-redundant powerset if obtained.*
- native long size ()
  Returns the number of disjuncts.
- native boolean geometrically_covers (Pointset_Powerset_C_Polyhedron y)
  Returns `true` *if and only if* `this` *geometrically covers* `y`.
- native boolean geometrically_equals (Pointset_Powerset_C_Polyhedron y)
  Returns `true` *if and only if* `this` *is geometrically equal to* `y`.
- native Pointset_Powerset_C_Polyhedron_Iterator begin_iterator ()
  Returns an iterator referring to the beginning of the sequence of disjuncts of `this`.
- native Pointset_Powerset_C_Polyhedron_Iterator end_iterator ()
  Returns an iterator referring to past the end of the sequence of disjuncts of `this`.
- native void add_disjunct (C_Polyhedron d)
  Adds to `this` *a copy of disjunct* `d`.
- native void drop_disjunct (Pointset_Powerset_C_Polyhedron_Iterator iter)
  Drops from `this` *the disjunct referred by* `iter`*; returns an iterator referring to the disjunct following the dropped one.*
- native void drop_disjuncts (Pointset_Powerset_C_Polyhedron_Iterator first, Pointset_Powerset_C_Polyhedron_Iterator last)
  Drops from `this` *all the disjuncts from* `first` *to* `last` *(excluded).*
- native void pairwise_reduce ()
  Modifies `this` *by (recursively) merging together the pairs of disjuncts whose upper-bound is the same as their set-theoretical union.*

10.29.1 Detailed Description

A powerset of C_Polyhedron objects.

The powerset domains can be instantiated by taking as a base domain any fixed semantic geometric description (C and NNC polyhedra, BD and octagonal shapes, boxes and grids). An element of the powerset domain represents a disjunctive collection of base objects (its disjuncts), all having the same space dimension.

Besides the methods that are available in all semantic geometric descriptions (whose documentation is not repeated here), the powerset domain also provides several ad hoc methods. In particular, the iterator types allow for the examination and manipulation of the collection of disjuncts.

10.29.2 Member Function Documentation

10.29.2.1 native long parma_polyhedra_library::Pointset_Powerset_C_Polyhedron::size ()

Returns the number of disjuncts.

If present, Omega-redundant elements will be counted too.

The documentation for this class was generated from the following file:

- Fake_Class_for_Doxygen.java

10.30 parma_polyhedra_library::Pointset_Powerset_C_Polyhedron_Iterator Class Reference

An iterator class for the disjuncts of a Pointset_Powerset_C_Polyhedron.

Inherits parma_polyhedra_library::PPL_Object.

Public Member Functions

- Pointset_Powerset_C_Polyhedron_Iterator (Pointset_Powerset_C_Polyhedron_Iterator y)

  Builds a copy of iterator `y`.

- native boolean equals (Pointset_Powerset_C_Polyhedron_Iterator itr)

  Returns `true` *if and only if* `this` *and* `itr` *are equal.*

- native void next ()

  Modifies `this` *so that it refers to the next disjunct.*

- native void prev ()

  Modifies `this` *so that it refers to the previous disjunct.*

- native C_Polyhedron get_disjunct ()

  Returns the disjunct referenced by `this`.

- native void free ()

  Releases resources and resets `this` *to a null reference.*

Protected Member Functions

- native void finalize ()

  Releases the resources managed by `this`.

10.30.1 Detailed Description

An iterator class for the disjuncts of a Pointset_Powerset_C_Polyhedron.

10.30.2 Member Function Documentation

10.30.2.1 native C_Polyhedron parma_polyhedra_library::Pointset_Powerset_C_Polyhedron_Iterator::get_disjunct ()

Returns the disjunct referenced by `this`.

Warning:

> On exit, the C_Polyhedron disjunct is still owned by the powerset object: any function call on the owning powerset object may invalidate it. Moreover, the disjunct is meant to be immutable and should not be modified in any way (its resources will be released when deleting the owning powerset). If really needed, the disjunct may be copied into a new object, which will be under control of the user.

The documentation for this class was generated from the following file:

- Fake_Class_for_Doxygen.java

10.31 parma_polyhedra_library::Poly_Con_Relation Class Reference

The relation between a polyhedron and a constraint.

Public Member Functions

- Poly_Con_Relation (int val)
  Constructs from a integer value.
- boolean implies (Poly_Con_Relation y)
  True if and only if `*this` *implies* `y`.

Static Public Member Functions

- static Poly_Con_Relation nothing ()
  The assertion that says nothing.
- static Poly_Con_Relation is_disjoint ()
  The polyhedron and the set of points satisfying the constraint are disjoint.
- static Poly_Con_Relation strictly_intersects ()
  The polyhedron intersects the set of points satisfying the constraint, but it is not included in it.
- static Poly_Con_Relation is_included ()
  The polyhedron is included in the set of points satisfying the constraint.
- static Poly_Con_Relation saturates ()
  The polyhedron is included in the set of points saturating the constraint.

10.31.1 Detailed Description

The relation between a polyhedron and a constraint.

This class implements conjunctions of assertions on the relation between a polyhedron and a constraint.

The documentation for this class was generated from the following file:

- Poly_Con_Relation.java

10.32 parma_polyhedra_library::Poly_Gen_Relation Class Reference

The relation between a polyhedron and a generator.

Public Member Functions

- Poly_Gen_Relation (int val)
  Constructs from a integer value.
- boolean implies (Poly_Gen_Relation y)
  True if and only if `*this` *implies* `y`.

Static Public Member Functions

- static Poly_Gen_Relation nothing ()
  The assertion that says nothing.
- static Poly_Gen_Relation subsumes ()
  Adding the generator would not change the polyhedron.

10.32.1 Detailed Description

The relation between a polyhedron and a generator.

This class implements conjunctions of assertions on the relation between a polyhedron and a generator.

The documentation for this class was generated from the following file:

- Poly_Gen_Relation.java

10.33 parma_polyhedra_library::Polyhedron Class Reference

The Java base class for (C and NNC) convex polyhedra.

Inherits parma_polyhedra_library::PPL_Object.

Inherited by parma_polyhedra_library::C_Polyhedron.

Public Member Functions

Member Functions that Do Not Modify the Polyhedron

- native long space_dimension ()
  Returns the dimension of the vector space enclosing `this`.
- native long affine_dimension ()
  Returns 0, *if* `this` *is empty; otherwise, returns the* affine dimension *of* `this`.
- native Constraint_System constraints ()
  Returns the system of constraints.
- native Congruence_System congruences ()
  Returns a system of (equality) congruences satisfied by `this`.
- native Constraint_System minimized_constraints ()
  Returns the system of constraints, with no redundant constraint.
- native Congruence_System minimized_congruences ()
  Returns a system of (equality) congruences satisfied by `this`, *with no redundant congruences and having the same affine dimension as* `this`.
- native boolean is_empty ()
  Returns `true` *if and only if* `this` *is an empty polyhedron.*
- native boolean is_universe ()
  Returns `true` *if and only if* `this` *is a universe polyhedron.*
- native boolean is_bounded ()
  Returns `true` *if and only if* `this` *is a bounded polyhedron.*
- native boolean is_discrete ()
  Returns `true` *if and only if* `this` *is discrete.*
- native boolean is_topologically_closed ()
  Returns `true` *if and only if* `this` *is a topologically closed subset of the vector space.*
- native boolean contains_integer_point ()
  Returns `true` *if and only if* `this` *contains at least one integer point.*
- native boolean constrains (Variable var)
  Returns `true` *if and only if* `var` *is constrained in* `this`.
- native boolean bounds_from_above (Linear_Expression expr)
  Returns `true` *if and only if* `expr` *is bounded from above in* `this`.
- native boolean bounds_from_below (Linear_Expression expr)
  Returns `true` *if and only if* `expr` *is bounded from below in* `this`.
- native boolean maximize (Linear_Expression expr, Coefficient sup_n, Coefficient sup_d, By_Reference< Boolean > maximum)
  Returns `true` *if and only if* `this` *is not empty and* `expr` *is bounded from above in* `this`, *in which case the supremum value is computed.*

- native boolean minimize (Linear_Expression expr, Coefficient inf_n, Coefficient inf_d, By_-Reference< Boolean > minimum)

  Returns `true` *if and only if* `this` *is not empty and* `expr` *is bounded from below in* `this`*, in which case the infimum value is computed.*

- native boolean maximize (Linear_Expression expr, Coefficient sup_n, Coefficient sup_d, By_-Reference< Boolean > maximum, Generator g)

  Returns `true` *if and only if* `this` *is not empty and* `expr` *is bounded from above in* `this`*, in which case the supremum value and a point where* `expr` *reaches it are computed.*

- native boolean minimize (Linear_Expression expr, Coefficient inf_n, Coefficient inf_d, By_-Reference< Boolean > minimum, Generator g)

  Returns `true` *if and only if* `this` *is not empty and* `expr` *is bounded from below in* `this`*, in which case the infimum value and a point where* `expr` *reaches it are computed.*

- native Poly_Con_Relation relation_with (Constraint c)

  Returns the relations holding between the polyhedron `this` *and the constraint* `c`*.*

- native Poly_Gen_Relation relation_with (Generator c)

  Returns the relations holding between the polyhedron `this` *and the generator* `g`*.*

- native Poly_Con_Relation relation_with (Congruence c)

  Returns the relations holding between the polyhedron `this` *and the congruence* `c`*.*

- native boolean contains (Polyhedron y)

  Returns `true` *if and only if* `this` *contains* `y`*.*

- native boolean strictly_contains (Polyhedron y)

  Returns `true` *if and only if* `this` *strictly contains* `y`*.*

- native boolean is_disjoint_from (Polyhedron y)

  Returns `true` *if and only if* `this` *and* `y` *are disjoint.*

- native boolean equals (Polyhedron y)

  Returns `true` *if and only if* `this` *and* `y` *are equal.*

- boolean equals (Object y)

  Returns `true` *if and only if* `this` *and* `y` *are equal.*

- native int hashCode ()

  Returns a hash code for `this`*.*

- native long external_memory_in_bytes ()

  Returns the size in bytes of the memory managed by `this`*.*

- native long total_memory_in_bytes ()

  Returns the total size in bytes of the memory occupied by `this`*.*

- native String toString ()

  Returns a string representing `this`*.*

- native String ascii_dump ()

  Returns a string containing a low-level representation of `this`*.*

- native boolean OK ()
  Checks if all the invariants are satisfied.

Space Dimension Preserving Member Functions that May Modify the Polyhedron

- native void add_constraint (Constraint c)
  Adds a copy of constraint `c` *to the system of constraints of* `this` *(without minimizing the result).*
- native void add_congruence (Congruence cg)
  Adds a copy of congruence `cg` *to* `this`*, if* `cg` *can be exactly represented by a polyhedron.*
- native void add_constraints (Constraint_System cs)
  Adds a copy of the constraints in `cs` *to the system of constraints of* `this` *(without minimizing the result).*
- native void add_congruences (Congruence_System cgs)
  Adds a copy of the congruences in `cgs` *to* `this`*, if all the congruences can be exactly represented by a polyhedron.*
- native void refine_with_constraint (Constraint c)
  Uses a copy of constraint `c` *to refine* `this`.
- native void refine_with_congruence (Congruence cg)
  Uses a copy of congruence `cg` *to refine* `this`.
- native void refine_with_constraints (Constraint_System cs)
  Uses a copy of the constraints in `cs` *to refine* `this`.
- native void refine_with_congruences (Congruence_System cgs)
  Uses a copy of the congruences in `cgs` *to refine* `this`.
- native void intersection_assign (Polyhedron y)
  Assigns to `this` *the intersection of* `this` *and* `y`*. The result is not guaranteed to be minimized.*
- native void upper_bound_assign (Polyhedron y)
  Assigns to `this` *the upper bound of* `this` *and* `y`.
- native void difference_assign (Polyhedron y)
  Assigns to `this` *the* poly-difference *of* `this` *and* `y`*. The result is not guaranteed to be minimized.*
- native void time_elapse_assign (Polyhedron y)
  Assigns to `this` *the result of computing the* time-elapse *between* `this` *and* `y`.
- native void topological_closure_assign ()
  Assigns to `this` *its topological closure.*
- native boolean simplify_using_context_assign (Polyhedron y)
  Assigns to `this` *a* meet-preserving simplification *of* `this` *with respect to* `y`*. If* `false` *is returned, then the intersection is empty.*
- native void affine_image (Variable var, Linear_Expression expr, Coefficient denominator)
  Assigns to `this` *the* affine image *of* `this` *under the function mapping variable* `var` *to the affine expression specified by* `expr` *and* `denominator`.
- native void affine_preimage (Variable var, Linear_Expression expr, Coefficient denominator)

Assigns to `this` *the* affine preimage *of* `this` *under the function mapping variable* `var` *to the affine expression specified by* `expr` *and* `denominator`.

- native void bounded_affine_image (Variable var, Linear_Expression lb_expr, Linear_Expression ub_expr, Coefficient denominator)

  Assigns to `this` *the image of* `this` *with respect to the* bounded affine relation $\frac{\text{lb\_expr}}{\text{denominator}} \leq \text{var}' \leq \frac{\text{ub\_expr}}{\text{denominator}}$.

- native void bounded_affine_preimage (Variable var, Linear_Expression lb_expr, Linear_Expression ub_expr, Coefficient denominator)

  Assigns to `this` *the preimage of* `this` *with respect to the* bounded affine relation $\frac{\text{lb\_expr}}{\text{denominator}} \leq \text{var}' \leq \frac{\text{ub\_expr}}{\text{denominator}}$.

- native void generalized_affine_image (Variable var, Relation_Symbol relsym, Linear_Expression expr, Coefficient denominator)

  Assigns to `this` *the image of* `this` *with respect to the* generalized affine relation $\text{var}' \bowtie \frac{\text{expr}}{\text{denominator}}$, *where* $\bowtie$ *is the relation symbol encoded by* `relsym`.

- native void generalized_affine_preimage (Variable var, Relation_Symbol relsym, Linear_Expression expr, Coefficient denominator)

  Assigns to `this` *the preimage of* `this` *with respect to the* generalized affine relation $\text{var}' \bowtie \frac{\text{expr}}{\text{denominator}}$, *where* $\bowtie$ *is the relation symbol encoded by* `relsym`.

- native void generalized_affine_image (Linear_Expression lhs, Relation_Symbol relsym, Linear_Expression rhs)

  Assigns to `this` *the image of* `this` *with respect to the* generalized affine relation $\text{lhs}' \bowtie \text{rhs}$, *where* $\bowtie$ *is the relation symbol encoded by* `relsym`.

- native void generalized_affine_preimage (Linear_Expression lhs, Relation_Symbol relsym, Linear_Expression rhs)

  Assigns to `this` *the preimage of* `this` *with respect to the* generalized affine relation $\text{lhs}' \bowtie \text{rhs}$, *where* $\bowtie$ *is the relation symbol encoded by* `relsym`.

- native void unconstrain_space_dimension (Variable var)

  Computes the cylindrification *of* `this` *with respect to space dimension* `var`, *assigning the result to* `this`.

- native void unconstrain_space_dimensions (Variables_Set to_be_unconstrained)

  Computes the cylindrification *of* `this` *with respect to the set of space dimensions* `to_be_unconstrained`, *assigning the result to* `this`.

- native void widening_assign (Polyhedron y, By_Reference< Integer > tp)

  Assigns to `this` *the result of computing the* H79-widening *between* `this` *and* `y`.

Member Functions that May Modify the Dimension of the Vector Space

- native void swap (Polyhedron y)

  Swaps `this` *with polyhedron* `y`. *(*`this` *and* `y` *can be dimension-incompatible.).*

- native void add_space_dimensions_and_embed (long m)

  Adds `m` *new space dimensions and embeds the old polyhedron in the new vector space.*

- native void add_space_dimensions_and_project (long m)

  Adds `m` *new space dimensions to the polyhedron and does not embed it in the new vector space.*

- native void concatenate_assign (Polyhedron y)
  Assigns to `this` *the* concatenation *of* `this` *and* `y`*, taken in this order.*
- native void remove_space_dimensions (Variables_Set to_be_removed)
  Removes all the specified dimensions from the vector space.
- native void remove_higher_space_dimensions (long new_dimension)
  Removes the higher dimensions of the vector space so that the resulting space will have dimension `new_dimension`.
- native void expand_space_dimension (Variable var, long m)
  Creates `m` *copies of the space dimension corresponding to* `var`.
- native void fold_space_dimensions (Variables_Set to_be_folded, Variable var)
  Folds the space dimensions in `to_be_folded` *into* `var`.
- native void map_space_dimensions (Partial_Function pfunc)
  Remaps the dimensions of the vector space according to a partial function.

Ad Hoc Functions for (C or NNC) Polyhedra

The functions listed here below, being specific of the polyhedron domains, do not have a correspondence in other semantic geometric descriptions.

- native Generator_System generators ()
  Returns the system of generators.
- native Generator_System minimized_generators ()
  Returns the system of generators, with no redundant generator.
- native void add_generator (Generator g)
  Adds a copy of generator `g` *to the system of generators of* `this` *(without minimizing the result).*
- native void add_generators (Generator_System gs)
  Adds a copy of the generators in `gs` *to the system of generators of* `this` *(without minimizing the result).*
- native void poly_hull_assign (Polyhedron y)
  Same as upper_bound_assign.
- native void poly_difference_assign (Polyhedron y)
  Same as difference_assign.
- native void BHRZ03_widening_assign (Polyhedron y, By_Reference< Integer > tp)
  Assigns to `this` *the result of computing the* BHRZ03-widening *between* `this` *and* `y`.
- native void H79_widening_assign (Polyhedron y, By_Reference< Integer > tp)
  Assigns to `this` *the result of computing the* H79-widening *between* `this` *and* `y`.
- native void limited_BHRZ03_extrapolation_assign (Polyhedron y, Constraint_System cs, By_Reference< Integer > tp)
  Improves the result of the BHRZ03-widening *computation by also enforcing those constraints in* `cs` *that are satisfied by all the points of* `this`.

- native void limited_H79_extrapolation_assign (Polyhedron y, Constraint_System cs, By_-Reference< Integer > tp)

  Improves the result of the H79-widening *computation by also enforcing those constraints in* `cs` *that are satisfied by all the points of* `this`.

- native void bounded_BHRZ03_extrapolation_assign (Polyhedron y, Constraint_System cs, By_-Reference< Integer > tp)

  Improves the result of the BHRZ03-widening *computation by also enforcing those constraints in* `cs` *that are satisfied by all the points of* `this`*, plus all the constraints of the form* $\pm x \leq r$ *and* $\pm x < r$*, with* $r \in \mathbb{Q}$*, that are satisfied by all the points of* `this`.

- native void bounded_H79_extrapolation_assign (Polyhedron y, Constraint_System cs, By_-Reference< Integer > tp)

  Improves the result of the H79-widening *computation by also enforcing those constraints in* `cs` *that are satisfied by all the points of* `this`*, plus all the constraints of the form* $\pm x \leq r$ *and* $\pm x < r$*, with* $r \in \mathbb{Q}$*, that are satisfied by all the points of* `this`.

10.33.1 Detailed Description

The Java base class for (C and NNC) convex polyhedra.

The base class Polyhedron provides declarations for most of the methods common to classes C_Polyhedron and NNC_Polyhedron. Note that the user should always use the derived classes. Moreover, C and NNC polyhedra can not be freely interchanged: as specified in the main manual, most library functions require their arguments to be topologically compatible.

10.33.2 Member Function Documentation

10.33.2.1 native boolean parma_polyhedra_library::Polyhedron::constrains (Variable *var*)

Returns `true` if and only if `var` is constrained in `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `var` is not a space dimension of `this`.

10.33.2.2 native boolean parma_polyhedra_library::Polyhedron::bounds_from_above (Linear_-Expression *expr*)

Returns `true` if and only if `expr` is bounded from above in `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `expr` and `this` are dimension-incompatible.

10.33.2.3 native boolean parma_polyhedra_library::Polyhedron::bounds_from_below (Linear_-Expression *expr*)

Returns `true` if and only if `expr` is bounded from below in `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `expr` and `this` are dimension-incompatible.

10.33.2.4 native boolean parma_polyhedra_library::Polyhedron::maximize (Linear_Expression *expr*, Coefficient *sup_n*, Coefficient *sup_d*, By_Reference< Boolean > *maximum*)

Returns `true` if and only if `this` is not empty and `expr` is bounded from above in `this`, in which case the supremum value is computed.

Parameters:

expr The linear expression to be maximized subject to `this`;

sup_n The numerator of the supremum value;

sup_d The denominator of the supremum value;

maximum `true` if and only if the supremum is also the maximum value.

Exceptions:

Invalid_Argument_Exception Thrown if `expr` and `this` are dimension-incompatible.

If `this` is empty or `expr` is not bounded from above, `false` is returned and `sup_n`, `sup_d` and `maximum` are left untouched.

10.33.2.5 native boolean parma_polyhedra_library::Polyhedron::minimize (Linear_Expression *expr*, Coefficient *inf_n*, Coefficient *inf_d*, By_Reference< Boolean > *minimum*)

Returns `true` if and only if `this` is not empty and `expr` is bounded from below in `this`, in which case the infimum value is computed.

Parameters:

expr The linear expression to be minimized subject to `this`;

inf_n The numerator of the infimum value;

inf_d The denominator of the infimum value;

minimum `true` if and only if the infimum is also the minimum value.

Exceptions:

Invalid_Argument_Exception Thrown if `expr` and `this` are dimension-incompatible.

If `this` is empty or `expr` is not bounded from below, `false` is returned and `inf_n`, `inf_d` and `minimum` are left untouched.

10.33.2.6 native boolean parma_polyhedra_library::Polyhedron::maximize (Linear_Expression *expr*, Coefficient *sup_n*, Coefficient *sup_d*, By_Reference< Boolean > *maximum*, Generator *g*)

Returns `true` if and only if `this` is not empty and `expr` is bounded from above in `this`, in which case the supremum value and a point where `expr` reaches it are computed.

Parameters:

expr The linear expression to be maximized subject to `this`;

sup_n The numerator of the supremum value;

sup_d The denominator of the supremum value;

maximum `true` if and only if the supremum is also the maximum value;

g When maximization succeeds, will be assigned the point or closure point where `expr` reaches its supremum value.

Exceptions:

Invalid_Argument_Exception Thrown if `expr` and `this` are dimension-incompatible.

If `this` is empty or `expr` is not bounded from above, `false` is returned and `sup_n`, `sup_d`, `maximum` and `g` are left untouched.

10.33.2.7 native boolean parma_polyhedra_library::Polyhedron::minimize (Linear_Expression *expr*, Coefficient *inf_n*, Coefficient *inf_d*, By_Reference< Boolean > *minimum*, Generator *g*)

Returns `true` if and only if `this` is not empty and `expr` is bounded from below in `this`, in which case the infimum value and a point where `expr` reaches it are computed.

Parameters:

expr The linear expression to be minimized subject to `this`;

inf_n The numerator of the infimum value;

inf_d The denominator of the infimum value;

minimum `true` if and only if the infimum is also the minimum value;

g When minimization succeeds, will be assigned a point or closure point where `expr` reaches its infimum value.

Exceptions:

Invalid_Argument_Exception Thrown if `expr` and `this` are dimension-incompatible.

If `this` is empty or `expr` is not bounded from below, `false` is returned and `inf_n`, `inf_d`, `minimum` and `g` are left untouched.

10.33.2.8 native Poly_Con_Relation parma_polyhedra_library::Polyhedron::relation_with (Constraint *c*)

Returns the relations holding between the polyhedron `this` and the constraint `c`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and constraint `c` are dimension-incompatible.

10.33.2.9 native Poly_Gen_Relation parma_polyhedra_library::Polyhedron::relation_with (Generator *c*)

Returns the relations holding between the polyhedron `this` and the generator `g`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and generator `g` are dimension-incompatible.

10.33.2.10 native Poly_Con_Relation parma_polyhedra_library::Polyhedron::relation_with (Congruence *c*)

Returns the relations holding between the polyhedron `this` and the congruence `c`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and congruence `c` are dimension-incompatible.

10.33.2.11 native boolean parma_polyhedra_library::Polyhedron::contains (Polyhedron *y*)

Returns `true` if and only if `this` contains `y`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.12 native boolean parma_polyhedra_library::Polyhedron::strictly_contains (Polyhedron *y*)

Returns `true` if and only if `this` strictly contains `y`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.13 native boolean parma_polyhedra_library::Polyhedron::is_disjoint_from (Polyhedron *y*)

Returns `true` if and only if `this` and `y` are disjoint.

Exceptions:

Invalid_Argument_Exception Thrown if `x` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.14 native int parma_polyhedra_library::Polyhedron::hashCode ()

Returns a hash code for `this`.

If `x` and `y` are such that `x == y`, then `x.hash_code() == y.hash_code()`.

10.33.2.15 native String parma_polyhedra_library::Polyhedron::ascii_dump ()

Returns a string containing a low-level representation of `this`.

Useful for debugging purposes.

10.33.2.16 native void parma_polyhedra_library::Polyhedron::add_constraint (Constraint *c*)

Adds a copy of constraint `c` to the system of constraints of `this` (without minimizing the result).

Parameters:

c The constraint that will be added to the system of constraints of `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and constraint `c` are topology-incompatible or dimension-incompatible.

10.33.2.17 native void parma_polyhedra_library::Polyhedron::add_congruence (Congruence *cg*)

Adds a copy of congruence `cg` to `this`, if `cg` can be exactly represented by a polyhedron.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and congruence `cg` are dimension-incompatible, of if `cg` is a proper congruence which is neither a tautology, nor a contradiction.

10.33.2.18 native void parma_polyhedra_library::Polyhedron::add_constraints (Constraint_System *cs*)

Adds a copy of the constraints in `cs` to the system of constraints of `this` (without minimizing the result).

Parameters:

cs Contains the constraints that will be added to the system of constraints of `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `cs` are topology-incompatible or dimension-incompatible.

10.33.2.19 native void parma_polyhedra_library::Polyhedron::add_congruences (Congruence_System *cgs*)

Adds a copy of the congruences in `cgs` to `this`, if all the congruences can be exactly represented by a polyhedron.

Parameters:

cgs The congruences to be added.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `cgs` are dimension-incompatible, of if there exists in `cgs` a proper congruence which is neither a tautology, nor a contradiction.

10.33.2.20 native void parma_polyhedra_library::Polyhedron::refine_with_constraint (Constraint *c*)

Uses a copy of constraint `c` to refine `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and constraint `c` are dimension-incompatible.

10.33.2.21 native void parma_polyhedra_library::Polyhedron::refine_with_congruence (Congruence *cg*)

Uses a copy of congruence `cg` to refine `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and congruence `cg` are dimension-incompatible.

10.33.2.22 native void parma_polyhedra_library::Polyhedron::refine_with_constraints (Constraint_System *cs*)

Uses a copy of the constraints in `cs` to refine `this`.

Parameters:

cs Contains the constraints used to refine the system of constraints of `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `cs` are dimension-incompatible.

10.33.2.23 native void parma_polyhedra_library::Polyhedron::refine_with_congruences (Congruence_System *cgs*)

Uses a copy of the congruences in `cgs` to refine `this`.

Parameters:

cgs Contains the congruences used to refine the system of constraints of `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `cgs` are dimension-incompatible.

10.33.2.24 native void parma_polyhedra_library::Polyhedron::intersection_assign (Polyhedron *y*)

Assigns to `this` the intersection of `this` and `y`. The result is not guaranteed to be minimized.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.25 native void parma_polyhedra_library::Polyhedron::upper_bound_assign (Polyhedron *y*)

Assigns to `this` the upper bound of `this` and `y`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.26 native void parma_polyhedra_library::Polyhedron::difference_assign (Polyhedron *y*)

Assigns to `this` the *poly-difference* of `this` and `y`. The result is not guaranteed to be minimized.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.27 native void parma_polyhedra_library::Polyhedron::time_elapse_assign (Polyhedron *y*)

Assigns to `this` the result of computing the *time-elapse* between `this` and `y`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.28 native boolean parma_polyhedra_library::Polyhedron::simplify_using_context_assign (Polyhedron *y*)

Assigns to `this` a *meet-preserving simplification* of `this` with respect to `y`. If `false` is returned, then the intersection is empty.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.29 native void parma_polyhedra_library::Polyhedron::affine_image (Variable *var*, Linear_Expression *expr*, Coefficient *denominator*)

Assigns to `this` the *affine image* of `this` under the function mapping variable `var` to the affine expression specified by `expr` and `denominator`.

Parameters:

var The variable to which the affine expression is assigned;

expr The numerator of the affine expression;

denominator The denominator of the affine expression (optional argument with default value 1).

Exceptions:

Invalid_Argument_Exception Thrown if `denominator` is zero or if `expr` and `this` are dimension-incompatible or if `var` is not a space dimension of `this`.

10.33.2.30 native void parma_polyhedra_library::Polyhedron::affine_preimage (Variable *var*, Linear_Expression *expr*, Coefficient *denominator*)

Assigns to `this` the *affine preimage* of `this` under the function mapping variable `var` to the affine expression specified by `expr` and `denominator`.

Parameters:

var The variable to which the affine expression is substituted;

expr The numerator of the affine expression;

denominator The denominator of the affine expression (optional argument with default value 1).

Exceptions:

Invalid_Argument_Exception Thrown if `denominator` is zero or if `expr` and `this` are dimension-incompatible or if `var` is not a space dimension of `this`.

10.33.2.31 native void parma_polyhedra_library::Polyhedron::bounded_affine_image (Variable *var*, Linear_Expression *lb_expr*, Linear_Expression *ub_expr*, Coefficient *denominator*)

Assigns to `this` the image of `this` with respect to the *bounded affine relation* $\frac{\text{lb\_expr}}{\text{denominator}} \leq \text{var}' \leq \frac{\text{ub\_expr}}{\text{denominator}}$.

Parameters:

var The variable updated by the affine relation;

lb_expr The numerator of the lower bounding affine expression;

ub_expr The numerator of the upper bounding affine expression;

denominator The (common) denominator for the lower and upper bounding affine expressions (optional argument with default value 1).

Exceptions:

Invalid_Argument_Exception Thrown if `denominator` is zero or if `lb_expr` (resp., `ub_expr`) and `this` are dimension-incompatible or if `var` is not a space dimension of `this`.

10.33.2.32 native void parma_polyhedra_library::Polyhedron::bounded_affine_preimage (Variable *var*, Linear_Expression *lb_expr*, Linear_Expression *ub_expr*, Coefficient *denominator*)

Assigns to `this` the preimage of `this` with respect to the *bounded affine relation* $\frac{\text{lb\_expr}}{\text{denominator}} \leq \text{var}' \leq \frac{\text{ub\_expr}}{\text{denominator}}$.

Parameters:

var The variable updated by the affine relation;

lb_expr The numerator of the lower bounding affine expression;

ub_expr The numerator of the upper bounding affine expression;

denominator The (common) denominator for the lower and upper bounding affine expressions (optional argument with default value 1).

Exceptions:

Invalid_Argument_Exception Thrown if `denominator` is zero or if `lb_expr` (resp., `ub_expr`) and `this` are dimension-incompatible or if `var` is not a space dimension of `this`.

10.33.2.33 native void parma_polyhedra_library::Polyhedron::generalized_affine_image (Variable *var*, Relation_Symbol *relsym*, Linear_Expression *expr*, Coefficient *denominator*)

Assigns to `this` the image of `this` with respect to the *generalized affine relation* $\mathrm{var}' \bowtie \frac{\mathrm{expr}}{\mathrm{denominator}}$, where $\bowtie$ is the relation symbol encoded by `relsym`.

Parameters:

var The left hand side variable of the generalized affine relation;

relsym The relation symbol;

expr The numerator of the right hand side affine expression;

denominator The denominator of the right hand side affine expression (optional argument with default value 1).

Exceptions:

Invalid_Argument_Exception Thrown if `denominator` is zero or if `expr` and `this` are dimension-incompatible or if `var` is not a space dimension of `this` or if `this` is a C_Polyhedron and `relsym` is a strict relation symbol.

10.33.2.34 native void parma_polyhedra_library::Polyhedron::generalized_affine_preimage (Variable *var*, Relation_Symbol *relsym*, Linear_Expression *expr*, Coefficient *denominator*)

Assigns to `this` the preimage of `this` with respect to the *generalized affine relation* $\mathrm{var}' \bowtie \frac{\mathrm{expr}}{\mathrm{denominator}}$, where $\bowtie$ is the relation symbol encoded by `relsym`.

Parameters:

var The left hand side variable of the generalized affine relation;

relsym The relation symbol;

expr The numerator of the right hand side affine expression;

denominator The denominator of the right hand side affine expression (optional argument with default value 1).

Exceptions:

Invalid_Argument_Exception Thrown if `denominator` is zero or if `expr` and `this` are dimension-incompatible or if `var` is not a space dimension of `this` or if `this` is a C_Polyhedron and `relsym` is a strict relation symbol.

10.33.2.35 native void parma_polyhedra_library::Polyhedron::generalized_affine_image (Linear_Expression *lhs*, Relation_Symbol *relsym*, Linear_Expression *rhs*)

Assigns to `this` the image of `this` with respect to the *generalized affine relation* $\mathrm{lhs}' \bowtie \mathrm{rhs}$, where $\bowtie$ is the relation symbol encoded by `relsym`.

Parameters:

lhs The left hand side affine expression;

relsym The relation symbol;

rhs The right hand side affine expression.

Exceptions:

Invalid_Argument_Exception Thrown if `this` is dimension-incompatible with `lhs` or `rhs` or if `this` is a C_Polyhedron and `relsym` is a strict relation symbol.

10.33.2.36 native void parma_polyhedra_library::Polyhedron::generalized_affine_preimage (Linear_Expression *lhs*, Relation_Symbol *relsym*, Linear_Expression *rhs*)

Assigns to `this` the preimage of `this` with respect to the *generalized affine relation* $\mathrm{lhs}' \bowtie \mathrm{rhs}$, where $\bowtie$ is the relation symbol encoded by `relsym`.

Parameters:

lhs The left hand side affine expression;

relsym The relation symbol;

rhs The right hand side affine expression.

Exceptions:

Invalid_Argument_Exception Thrown if `this` is dimension-incompatible with `lhs` or `rhs` or if `this` is a C_Polyhedron and `relsym` is a strict relation symbol.

10.33.2.37 native void parma_polyhedra_library::Polyhedron::unconstrain_space_dimension (Variable *var*)

Computes the *cylindrification* of `this` with respect to space dimension `var`, assigning the result to `this`.

Parameters:

var The space dimension that will be unconstrained.

Exceptions:

Invalid_Argument_Exception Thrown if `var` is not a space dimension of `this`.

10.33.2.38 native void parma_polyhedra_library::Polyhedron::unconstrain_space_dimensions (Variables_Set *to_be_unconstrained*)

Computes the *cylindrification* of `this` with respect to the set of space dimensions `to_be_unconstrained`, assigning the result to `this`.

Parameters:

to_be_unconstrained The set of space dimension that will be unconstrained.

Exceptions:

Invalid_Argument_Exception Thrown if `this` is dimension-incompatible with one of the Variable objects contained in `to_be_removed`.

10.33.2.39 native void parma_polyhedra_library::Polyhedron::widening_assign (Polyhedron *y*, By_Reference< Integer > *tp*)

Assigns to `this` the result of computing the *H79-widening* between `this` and `y`.

Parameters:

y A polyhedron that *must* be contained in `this`;

tp A reference to an unsigned variable storing the number of available tokens (to be used when applying the *widening with tokens* delay technique).

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.40 native void parma_polyhedra_library::Polyhedron::swap (Polyhedron *y*)

Swaps `this` with polyhedron `y`. (`this` and `y` can be dimension-incompatible.).

Exceptions:

Invalid_Argument_Exception Thrown if `x` and `y` are topology-incompatible.

10.33.2.41 native void parma_polyhedra_library::Polyhedron::add_space_dimensions_and_embed (long *m*)

Adds `m` new space dimensions and embeds the old polyhedron in the new vector space.

Parameters:

m The number of dimensions to add.

Exceptions:

Length_Error_Exception Thrown if adding `m` new space dimensions would cause the vector space to exceed dimension `max_space_dimension()`.

10.33.2.42 native void parma_polyhedra_library::Polyhedron::add_space_dimensions_and_project (long *m*)

Adds `m` new space dimensions to the polyhedron and does not embed it in the new vector space.

Parameters:

m The number of space dimensions to add.

Exceptions:

Length_Error_Exception Thrown if adding `m` new space dimensions would cause the vector space to exceed dimension `max_space_dimension()`.

10.33.2.43 native void parma_polyhedra_library::Polyhedron::concatenate_assign (Polyhedron *y*)

Assigns to `this` the *concatenation* of `this` and `y`, taken in this order.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible.

Length_Error_Exception Thrown if the concatenation would cause the vector space to exceed dimension `max_space_dimension()`.

10.33.2.44 native void parma_polyhedra_library::Polyhedron::remove_space_dimensions (Variables_Set *to_be_removed*)

Removes all the specified dimensions from the vector space.

Parameters:

to_be_removed The set of Variable objects corresponding to the space dimensions to be removed.

Exceptions:

Invalid_Argument_Exception Thrown if `this` is dimension-incompatible with one of the Variable objects contained in `to_be_removed`.

10.33.2.45 native void parma_polyhedra_library::Polyhedron::remove_higher_space_dimensions (long *new_dimension*)

Removes the higher dimensions of the vector space so that the resulting space will have dimension `new_dimension`.

Exceptions:

Invalid_Argument_Exception Thrown if `new_dimensions` is greater than the space dimension of `this`.

10.33.2.46 native void parma_polyhedra_library::Polyhedron::expand_space_dimension (Variable *var*, long *m*)

Creates `m` copies of the space dimension corresponding to `var`.

Parameters:

var The variable corresponding to the space dimension to be replicated;

m The number of replicas to be created.

Exceptions:

Invalid_Argument_Exception Thrown if `var` does not correspond to a dimension of the vector space.

Length_Error_Exception Thrown if adding `m` new space dimensions would cause the vector space to exceed dimension `max_space_dimension()`.

10.33.2.47 native void parma_polyhedra_library::Polyhedron::fold_space_dimensions (Variables_Set *to_be_folded*, Variable *var*)

Folds the space dimensions in `to_be_folded` into `var`.

Parameters:

to_be_folded The set of Variable objects corresponding to the space dimensions to be folded;

var The variable corresponding to the space dimension that is the destination of the folding operation.

Exceptions:

Invalid_Argument_Exception Thrown if `this` is dimension-incompatible with `var` or with one of the Variable objects contained in `to_be_folded`. Also thrown if `var` is contained in `to_be_folded`.

10.33.2.48 native void parma_polyhedra_library::Polyhedron::map_space_dimensions (Partial_Function *pfunc*)

Remaps the dimensions of the vector space according to a *partial function*.

Parameters:

pfunc The partial function specifying the destiny of each space dimension.

10.33.2.49 native void parma_polyhedra_library::Polyhedron::add_generator (Generator *g*)

Adds a copy of generator `g` to the system of generators of `this` (without minimizing the result).

Exceptions:

Invalid_Argument_Exception Thrown if `this` and generator `g` are topology-incompatible or dimension-incompatible, or if `this` is an empty polyhedron and `g` is not a point.

10.33.2.50 native void parma_polyhedra_library::Polyhedron::add_generators (Generator_System *gs*)

Adds a copy of the generators in `gs` to the system of generators of `this` (without minimizing the result).

Parameters:

gs Contains the generators that will be added to the system of generators of `this`.

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `gs` are topology-incompatible or dimension-incompatible, or if `this` is empty and the system of generators `gs` is not empty, but has no points.

10.33.2.51 native void parma_polyhedra_library::Polyhedron::BHRZ03_widening_assign (Polyhedron *y*, By_Reference< Integer > *tp*)

Assigns to `this` the result of computing the *BHRZ03-widening* between `this` and `y`.

Parameters:

y A polyhedron that *must* be contained in `this`;

tp A reference to an unsigned variable storing the number of available tokens (to be used when applying the *widening with tokens* delay technique).

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.52 native void parma_polyhedra_library::Polyhedron::H79_widening_assign (Polyhedron *y*, By_Reference< Integer > *tp*)

Assigns to `this` the result of computing the *H79-widening* between `this` and `y`.

Parameters:

y A polyhedron that *must* be contained in `this`;

tp A reference to an unsigned variable storing the number of available tokens (to be used when applying the *widening with tokens* delay technique).

Exceptions:

Invalid_Argument_Exception Thrown if `this` and `y` are topology-incompatible or dimension-incompatible.

10.33.2.53 native void parma_polyhedra_library::Polyhedron::limited_BHRZ03_extrapolation_assign (Polyhedron *y*, Constraint_System *cs*, By_Reference< Integer > *tp*)

Improves the result of the *BHRZ03-widening* computation by also enforcing those constraints in `cs` that are satisfied by all the points of `this`.

Parameters:

y A polyhedron that *must* be contained in `this`;

cs The system of constraints used to improve the widened polyhedron;

tp A reference to an unsigned variable storing the number of available tokens (to be used when applying the *widening with tokens* delay technique).

Exceptions:

Invalid_Argument_Exception Thrown if `this`, `y` and `cs` are topology-incompatible or dimension-incompatible.

10.33.2.54 native void parma_polyhedra_library::Polyhedron::limited_H79_extrapolation_assign (Polyhedron *y*, Constraint_System *cs*, By_Reference< Integer > *tp*)

Improves the result of the *H79-widening* computation by also enforcing those constraints in `cs` that are satisfied by all the points of `this`.

Parameters:

y A polyhedron that *must* be contained in `this`;

cs The system of constraints used to improve the widened polyhedron;

tp A reference to an unsigned variable storing the number of available tokens (to be used when applying the *widening with tokens* delay technique).

Exceptions:

Invalid_Argument_Exception Thrown if `this`, `y` and `cs` are topology-incompatible or dimension-incompatible.

10.33.2.55 native void parma_polyhedra_library::Polyhedron::bounded_BHRZ03_extrapolation_assign (Polyhedron *y*, Constraint_System *cs*, By_Reference< Integer > *tp*)

Improves the result of the *BHRZ03-widening* computation by also enforcing those constraints in `cs` that are satisfied by all the points of `this`, plus all the constraints of the form $\pm x \leq r$ and $\pm x < r$, with $r \in \mathbb{Q}$, that are satisfied by all the points of `this`.

Parameters:

y A polyhedron that *must* be contained in `this`;

cs The system of constraints used to improve the widened polyhedron;

tp A reference to an unsigned variable storing the number of available tokens (to be used when applying the *widening with tokens* delay technique).

Exceptions:

Invalid_Argument_Exception Thrown if `this`, `y` and `cs` are topology-incompatible or dimension-incompatible.

10.33.2.56 native void parma_polyhedra_library::Polyhedron::bounded_H79_extrapolation_assign (Polyhedron *y*, Constraint_System *cs*, By_Reference< Integer > *tp*)

Improves the result of the *H79-widening* computation by also enforcing those constraints in `cs` that are satisfied by all the points of `this`, plus all the constraints of the form $\pm x \leq r$ and $\pm x < r$, with $r \in \mathbb{Q}$, that are satisfied by all the points of `this`.

Parameters:

y A polyhedron that *must* be contained in `this`;

cs The system of constraints used to improve the widened polyhedron;

tp A reference to an unsigned variable storing the number of available tokens (to be used when applying the *widening with tokens* delay technique).

Exceptions:

Invalid_Argument_Exception Thrown if `this`, `y` and `cs` are topology-incompatible or dimension-incompatible.

The documentation for this class was generated from the following file:

- Fake_Class_for_Doxygen.java

10.34 parma_polyhedra_library::Variable Class Reference

A dimension of the vector space.

Public Member Functions

- Variable (int i)

  Builds the variable corresponding to the Cartesian axis of index `i`.

- int id ()

  Returns the index of the Cartesian axis associated to `this`.

- int compareTo (Variable v)

  Returns a negative number if `this` *comes first than* `v`*, a zero if* `this` *equals* `v`*, a positive number if if* `this` *comes first than* `v`.

10.34.1 Detailed Description

A dimension of the vector space.

An object of the class Variable represents a dimension of the space, that is one of the Cartesian axes. Variables are used as basic blocks in order to build more complex linear expressions. Each variable is identified by a non-negative integer, representing the index of the corresponding Cartesian axis (the first axis has index 0).

10.34.2 Constructor & Destructor Documentation

10.34.2.1 parma_polyhedra_library::Variable::Variable (int *i*) `[inline]`

Builds the variable corresponding to the Cartesian axis of index `i`.

Exceptions:

RuntimeErrorException Thrown if `i` is has negative value.

The documentation for this class was generated from the following file:

- Variable.java

10.35 parma_polyhedra_library::Variables_Set Class Reference

A java.util.TreeSet of variables' indexes.

Public Member Functions

- Variables_Set ()

  Builds the empty set of variable indexes.

10.35.1 Detailed Description

A java.util.TreeSet of variables' indexes.

The documentation for this class was generated from the following file:

- Variables_Set.java

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