Polylib : A Library for Computations on Polyhedra

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Outline

- Introduction
  - What is a Polylib ?
  - Where is it used ?
- Previous Work on Polylib
- Basic Features
  - Some definitions on Polyhedra
  - Z-Polyhedra and Lattices
  - Ehrhart Polynomials
- Current Work and Progress
- Future development of Polylib

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Polylib Introduction

- A library for doing operations on unions of Polyhedra
- Useful for doing program restructuring transformations in parallelizing compilers
- Used for defining domains of variables in SARE
- Allows computation of useful information in a loop nest
- A tool to study polyhedra and other related mathematical objects

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Previous Work on Polylib

- First developed at IRISA in connection with the ALPHA project in 1993
- Two independent versions : IRISA Polylib & Strasbourg Polylib
- Another Similar Library - NewPolka - developed at VERIMAG

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Basic Features

- Mathematical objects: Polyhedra, Matrices, Vectors
- Polyhedral operations : Union, Intersection, Difference, Simplify, Image and PreImage, etc . . .
- Parametric Polyhedra Representation
- Ehrhart Polynomial Computations
- Z-Polyhedra and Lattices
- Options to support 32/64 bits or multi-precision integers

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Few Definitions on Polyhedra

- Dual representation of Polyhedra

  $\{ X \mid AX = b, CX \leq d \} \equiv \{ X \mid X = L\,\lambda + R\mu + V\vartheta \}$

- Computation of Dual representations
  - Chernikova Algorithm

- Parametrized Polyhedra Representation

  $\{ X \mid AX \leq BN + C \} \equiv \{ X \mid X = L\,\lambda + R\mu + V\vartheta \}$

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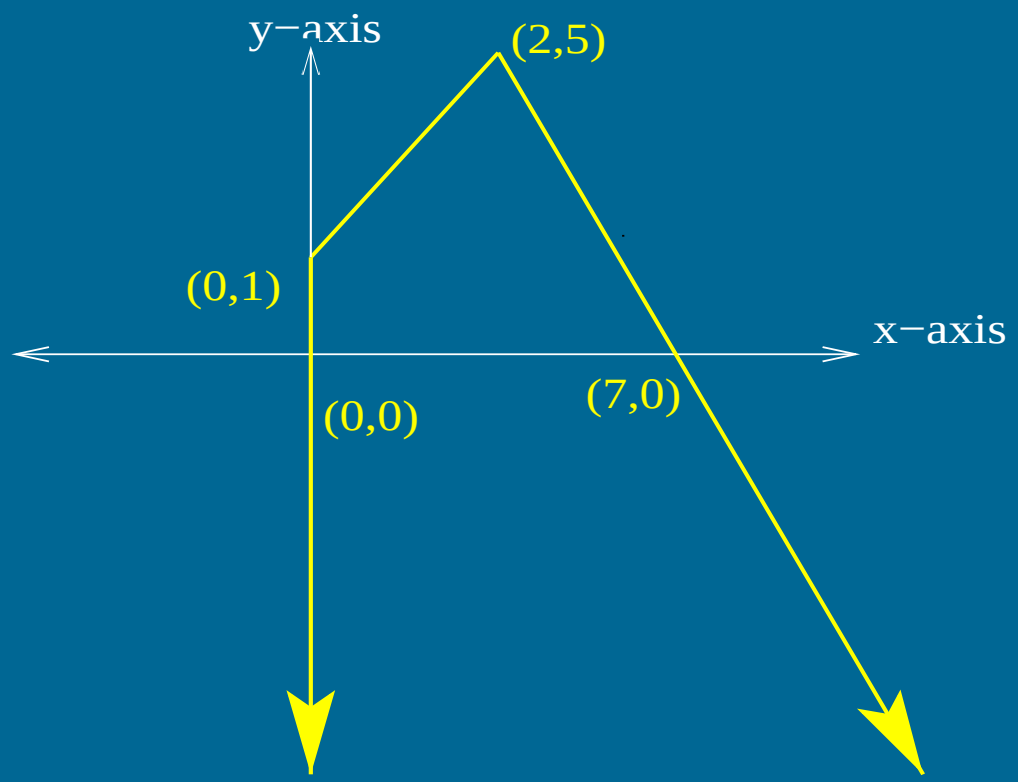
Example



A Polyhedron described by

Vertex Set: {(0,1), (2,5)}
Uni−directional Ray set: {(0,−1), (1,−1)}

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Lattices and Z-polyhedron

- Lattice - A set consisting of all the linear integral combinations of basis vectors. That is,
  $L(A) = \{ Y \in R^m \mid Y = AX, A \in Q^{m \times n}, X \in Z^n \}$
- Z-Polyhderon - An intersection of a polyhderon and an integral full dimensional lattice.

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Ehrhart Polynomials

- Used in the enumeration of lattice points in a Polyhedron
- Useful in analyzing nested loops to derive efficient parallel proograms
- Definitions :

  - Periodic Number: $[n_1, n_2, \ldots, n_q]_N$

  Example: $(-1)^n = [1, -1]_n$

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Current Work and Progress

- Unifying the two independent versions into a single new Polylib
- To support options for 32 bits, 64 bits and multi-precision integers
- Merging Ehrhart and Z-polyhedron part into the new version
- Assisting in the integration of Polylib with MMALPHA
- Extending the portability of Polylib to Win 2000/NT

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Future development of Polylib

- A large set of test suits
- A user friendly/graphical interface
- Options to support 32 bits, 64 bits and multi precision integers in MMALPHA

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Thank You

back to main