

# POLYVEST 1.0

Cunjing Ge  
Institute of Software  
Chinese Academy of Sciences  
gecj@ios.ac.cn

February 29, 2016

PolyVest is an efficient tool to estimate the Volume of a convex polytope. It can handle instances with dozens of dimensions with high accuracy. It is mainly based on a Multiphase Monte-Carlo algorithm. For further details about the algorithm, refer to [1].

## 1 Installation

This PolyVest package consists of the files listed in Table 1.

Table 1: Files in the PolyVest distribution

<code>examples/</code>	Some examples of input instances
<code>main.cpp</code>	The main program
<code>makefile</code>	
<code>README</code>	
<code>vol.cpp</code>	Implementation of volume estimation and rounding procedure
<code>vol.h</code>	The header file defines <code>polytope</code> class

### 1.1 Step 1:

The functionality of PolyVest is dependent on other libraries: `glpk`, `GFortran`, `LAPACK`, `BLAS`, `Armadillo`.

On Ubuntu or Debian, you can simply use ‘`apt-cache search`’ and ‘`apt-get install`’ to search and install the above libraries.

Library	Http site
glpk	<a href="http://www.gnu.org/software/glpk/">http://www.gnu.org/software/glpk/</a>
GFortran	<a href="http://gcc.gnu.org/fortran/">http://gcc.gnu.org/fortran/</a>
LAPACK	<a href="http://www.netlib.org/lapack/">http://www.netlib.org/lapack/</a>
BLAS	<a href="http://www.netlib.org/blas/index.html">http://www.netlib.org/blas/index.html</a>
Armadillo	<a href="http://arma.sourceforge.net/">http://arma.sourceforge.net/</a>

## 1.2 Step 2:

If you use `g++` to compile you should just type

```
% make
```

and the executable `PolyVest` will be created. Otherwise edit the `makefile` and replace in the line `CXX=g++` the word `g++` by the name of your `c++` compiler.

## 2 PolyVest input format

### 2.1 Description

The input of `PolyVest` is a convex polytope defined as the bounded intersection of finitely many halfspaces (linear inequalities). To describe the polytope  $\{x \in \mathbb{R}^N : b \geq Ax\}$ , where  $b$  is an  $M \times 1$  vector, and  $A$  is an  $M \times N$  matrix, the corresponding input file is given by a total of  $2 + M \times (N + 1)$  numbers.

The first two numbers in the input file must be:

$$M \ N$$

Every  $N+1$  following numbers define an inequality in  $b \geq Ax$ . For example, the  $i$ th inequality appears in the input as follows:

$$b_i - a_{i1} - a_{i2} \dots - a_{iN}$$

`PolyVest` supports both floating point numbers and integers in the input. Note that `PolyVest` does not identify LF (line feed) or NL (new line) characters, so it is fine that you put all numbers in a line.

## 2.2 Example

To illustrate the file format, let us consider the simple example of the square  $\{(x, y) \in \mathbb{R}^2 : -1 \leq x, y \leq 1\}$ . The file `cube_2` is given by:

```

4  2
1  1  0
1  0  1
1  0 -1
1 -1  0

```

You can also write the file like this:

```

4 2 1 1 0 1 0 1 1 0 -1 1 -1 0

```

## 3 Invoking PolyVest

In the command line, you may run PolyVest as follows:

```
% PolyVest <input-file> <step-size-coef> [output-file]
```

Parameter	Remark
<code>input-file</code>	The location of input file in the format as described above.
<code>step-size-coef</code>	A parameter that controls the sample size of <b>PolyVest</b> . The larger <code>step-size-coef</code> , the larger sample size and longer execution time. Usually, we choose 1600.
<code>output-file</code>	The location of output file. This parameter is optional. <b>PolyVest</b> will append the result to file ' <code>PolyVest.result</code> ' by default.

If you want to estimate the volume of `cube_2` above, type:

```
% PolyVest examples/cube_2 1600 out_c2
```

and you can find the result in file `out_c2`.

## References

- [1] Cunjing Ge, Feifei Ma. A Fast and Practical Method to Estimate Volumes of Convex Polytopes. *FAW 2015*: 52-65.