

JNORMALIZ 1.5

VINICIUS ALMENDRA AND BOGDAN ICHIM

ABSTRACT. This is the release of the version 1.5 of `jNormaliz`, a graphical interface for `Normaliz` version 2.11. `Normaliz` is a program for the computation of Hilbert bases of rational cones and the normalizations of affine monoids. It may also be used for solving diophantine linear systems of inequalities, equations and congruences.

1. INTRODUCTION

`jNormaliz` 1.5 [1] is a graphical interface for `Normaliz` compatible with version 2.11. The program `Normaliz` [5] is mainly a tool for computing Hilbert bases. It may also be used for solving diophantine linear systems of inequalities, equations and congruences.

Several related computations are also integrated. Using `Normaliz`, one may compute the following:

- (1) the Hilbert basis and the support hyperplanes of a rational cone. The cone may be given by:
 - (i) a system of generators;
 - (ii) a linear system of inequalities, equations and congruences;
 - (iii) the binomial equations of the (monoid) generators.
- (2) the lattice points and the support hyperplanes of an integral polytope;
- (3) the generators of the integral closure of the Rees algebra of a monomial ideal $I \subseteq K[X_1, \dots, X_n]$ and the generators of the integral closure of I .

If the associated monoid is homogeneous in a certain sense or a specific grading is added to the input file, then one may also compute the Hilbert series and the Hilbert quasipolynomial of the monoid.

The graphical interface `jNormaliz` offers a text editor for the input files, visualization of the output files and facilities to run or stop `Normaliz` without having to deal with the command-line details. The software also allows keeping track of how computation evolves, through a console where the verbose output of `Normaliz` is displayed, a timer and a memory gauge. The interface is written in Java. That allowed us to combine the

Date: April 27, 2014.

Acknowledgement: B. Ichim was partially supported by project PN-II-RU-TE-2012-3-0161, granted by the Romanian National Authority for Scientific Research, CNCS - UEFISCDI, during the development of `jNormaliz` 1.5.

good portability (on different operating systems) of the graphical elements provided by Java with the computational advantages of the C++ implementation of **Normaliz**.

For the algorithms implemented by **Normaliz** see [8] (starting with version 1.0), [3] (introduced in version 2.0), [2] (describing changes in version 2.5) and [7] (the additions in version 2.8). A full description of the user interface (version 2.2) is contained in [4] and the changes to version 2.5 are available in [6].

2. INSTALLATION AND SYSTEM REQUIREMENTS

jNormaliz should work on all platforms where Java can run. It has been tested on Windows, Linux and MacOS. To run **jNormaliz**, it is necessary to have Java runtime version 1.6.0 (or a newer version). If the operating system architecture is 64 bits, the Java runtime used should also be 64 bits; otherwise, the information about the memory usage might be displayed incorrectly. Notice that **jNormaliz** requires an installed reader of PDF files in order to view the associated documentation files.

If you intend to use **jNormaliz** 1.5, you should also have installed **Normaliz** version 2.11.

jNormaliz should be installed over an existing installation of **Normaliz**, unzipping the contents of the file `jnormaliz.zip` inside the directory where **Normaliz** is installed. **jNormaliz** depends on this, as it assumes that the executable files are in the same directory where the file `jnormaliz.jar` is.

jNormaliz is composed by a Java executable (the file `jnormaliz.jar`), some third-party libraries (in the folder `lib/`), the source files (in the folder `source/jNormaliz`) and this documentation (in the folder `doc/`).

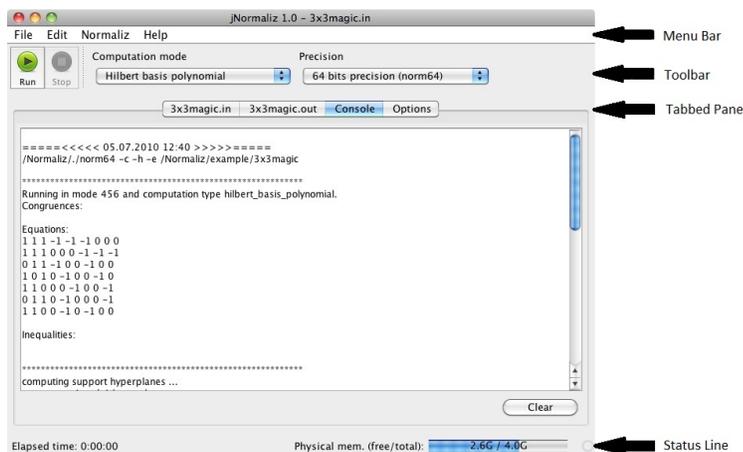


FIGURE 1. Interface with input file loaded

3. OVERVIEW OF THE GRAPHICAL INTERFACE

The interface **jNormaliz** (see Fig. 1) is divided into four main areas: the menu bar, the toolbar, the tabbed panel and the status line. Follows a brief description of each element.

The **menu bar** contains the following submenus.

- (i) The **File** menu presents to the user the next options.
 - (a) *Open*. Opens an existing input file. If the user tries to open a file without the extension `.in` (that is a input file for **Normaliz**), **jNormaliz** will refuse it and will display an error message.
 - (b) *New*. Creates a new input file and loads it in **jNormaliz**. Associated with this option there is a *New file dialog* (Fig. 2) which allows the user to specify the name of the new file, the dimensions of the input matrix and the *mode* (see also the **Normaliz** manual for information on the available modes). The generated input file will contain a matrix in the specified dimensions filled up with zeros.

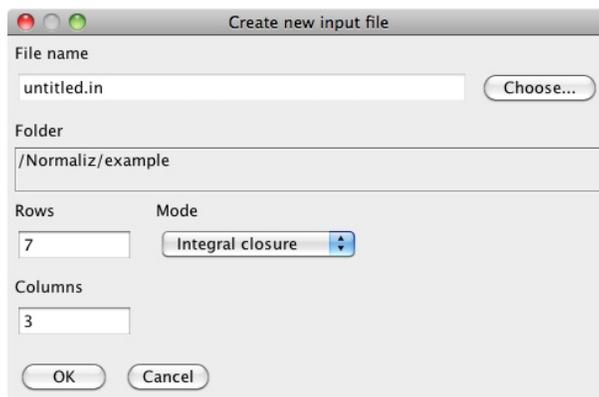


FIGURE 2. The new file dialog

- (c) *Close*. Closes the currently opened input file, interrupting ongoing calculations.
- (d) *Save*. Saves the input file. Notice that this option will only be available if the input file has been modified. Also remark that when a file suffers any modification in the editor, **jNormaliz** appends a `*` to its name in the title bar.
- (e) *Save as*. Allows saving the currently opened input file under another name.
- (f) *Print*. Prints the contents of the currently selected tab in the tabbed panel (input file, output file or console).
- (g) *Exit*. Exits the application, offering the option of interrupting ongoing calculations.

- (ii) The **Edit** menu contains standard functions for editing text files.
 - (a) *Undo*. Undoes the most recent editing operation in the input file.
 - (b) *Cut*. Cuts the selected text from the input file.
 - (c) *Copy*. Copies the selected text into the clipboard. It is active on input files, output files and on the console.
 - (d) *Paste*. Pastes the text from the clipboard into the input file.
- (iii) The **Normaliz** menu has just two commands used for starting (*Run*) and interrupting (*Stop*) computations with **Normaliz**. The same commands are also available in the toolbar.
- (iv) The **Help** menu gives the user fast access to the documentation distributed together with **Normaliz**.
 - (a) *Help*. Opens this file.
 - (b) *Open Normaliz manual*. Opens the PDF file containing the full user documentation of **Normaliz**.
 - (c) *Open Normaliz website*. Opens the **Normaliz** homepage in the default web browser.
 - (d) *Mathematical background*. Opens a dialog containing a short description and a link to some of the articles describing the algorithms used by **Normaliz**.
 - (e) *About*. Displays a box containing information about **jNormaliz**.

The **toolbar** gives the user fast access to the most used commands.

- (i) **Run** button. Starts computations on the currently opened input file. After a successful execution, the content of the output file is updated with the results.
- (ii) **Stop** button. Interrupts computations.
- (iii) **Algorithm** box. Allows choosing which algorithm will be used the next time **Normaliz** will run. For details, see **Normaliz** manual (available from the Help menu).

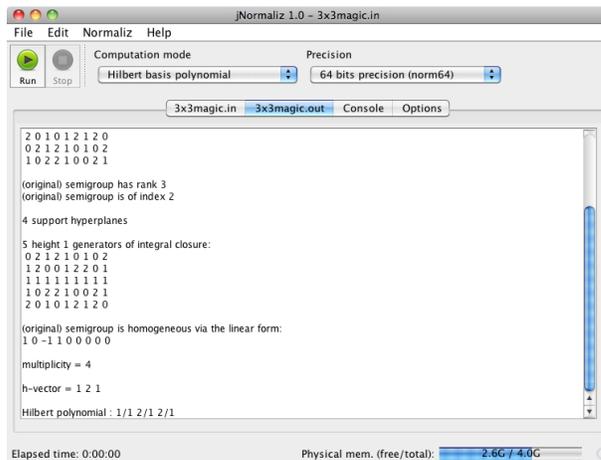


FIGURE 3. Output file tab

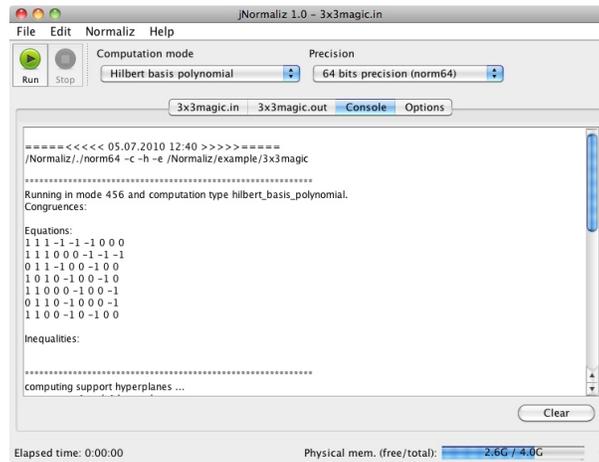


FIGURE 4. Console tab

- (iv) **Computational mode** box. Allows choosing which computations will be performed the next time **Normaliz** will run. For details, see **Normaliz** manual (available from the Help menu).
- (v) **Precision** box. Allows choosing the arithmetic precision to be used while running **Normaliz** (64 bits or infinite precision). For details on arithmetic limitations, see **Normaliz** manual (available from the Help menu).

The **tabbed panel** presents the user the following four tabs.

- (i) **Input** tab (Fig. 1). It shows the currently open input file. Notice that this tab is only shown when there is an open input file.
- (ii) **Output** tab (Fig. 3). Contains the output file (if available).
- (iii) **Console** tab (Fig. 4). This tab shows the console output of **Normaliz**, together with some extra information (the command line commands, the date and time of each **Normaliz** call). With this tab is possible to track **Normaliz** execution, as it is updated in real-time. The user can also select and copy the contents of the console to some other application.
- (iv) **Options** tab (Fig. 5). This tab groups some options regarding **Normaliz**, **jNormaliz** and **NmzIntegrate**.
 - (a) *Output options*. This group controls which output files are generated by **Normaliz**. Notice that only the .out file is displayed by **jNormaliz**. For more details about this group of options consult **Normaliz** manual.
 - (b) *Run tests for arithmetic overflow*. When checked, **Normaliz** will try to detect arithmetic errors (see **Normaliz** manual).
 - (c) *Control the number of parallel threads*. When checked, the user controls the maximum number of parallel threads generated by **Normaliz**. When not, **Normaliz** will generate the maximum number (depending on the particular

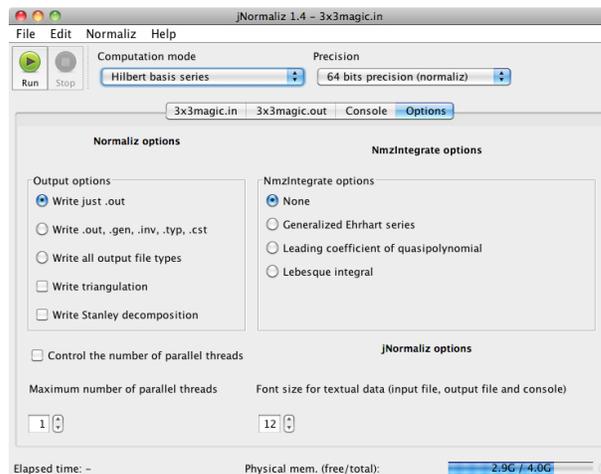


FIGURE 5. Options tab

system where it is running). The maximum number of parallel threads allowed can be set in the box below.

- (d) *Font size*. Changes the font size used to show and print the input file, the output file and the console.
- (e) *NmzIntegrate options*. This group controls the option for NmzIntegrate called by Normaliz. For more details about this group of options consult Normaliz manual and NmzIntegrate manual.

Remark that below the text box there is a link for the folder where the input and output files are. Clicking this link opens the folder in the systems default file manager.

The **status line** displays three useful pieces of information.

- (i) **Elapsed time** of the current or last Normaliz execution.
- (ii) A gauge displaying how much **physical memory** is currently available, and also the total physical memory available.
- (iii) An icon indicating that there is a currently **running computation**.

4. LIMITATIONS

Only one input file can be loaded at one time in jNormaliz. However, the user can run other instances of jNormaliz in order to deal with multiple input files simultaneously.

5. INFORMATION FOR DEVELOPERS

jNormaliz was developed using Netbeans version 6.8. It uses the following third-party libraries:

- (1) A modified version of JavaSysMon 0.3.1, from Jez Humble (available at <http://wiki.github.com/jezhumble/javasysmon/>).

(2) Jakarta Commons Exec 1.0.1 (available at <http://commons.apache.org/exec/>)

6. COPYRIGHT

`jNormaliz` is free software licensed under the GNU General Public License, version 3. You can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.

It is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with the program. If not, see <http://www.gnu.org/licenses/>.

`jNormaliz` should always be distributed together with the corresponding version of `Normaliz`. Please refer to `Normaliz` in the following manner in any publication or related work for which it has been used:

W. Bruns, B. Ichim and C. Söger: `Normaliz`. Algorithms for rational cones and affine monoids. Available from <http://www.math.uos.de/normaliz>.

It is now customary to evaluate mathematicians by such data as numbers of publications, citations and impact factors. The data bases on which such dubious evaluations are based do not list mathematical software. Therefore we ask you to cite the article [7] in addition. This is very helpful for the younger members of the team.

REFERENCES

- [1] V. Almendra and B. Ichim: *jNormaliz. A graphical interface for Normaliz*. Available at <http://www.math.uos.de/normaliz>.
- [2] W. Bruns, R. Hemmecke, B. Ichim, M. Köppe, and C. Söger. *Challenging computations of Hilbert bases of cones associated with algebraic statistics*. Exp. Math. **20**, No. 1, (2011), 25–33.
- [3] W. Bruns and B. Ichim. *Normaliz: algorithms for affine monoids and rational cones*. J. Algebra **324**, No. 5, (2010), 1098–1113.
- [4] W. Bruns and B. Ichim. *Introduction to Normaliz 2.2*. In Acta Univ. Apulensis, D. Breaz (ed.) et al., Proceedings of ICTAMI 2009, pp. 113–132.
- [5] W. Bruns, B. Ichim and C. Söger. *Normaliz. Algorithms for rational cones and affine monoids*. Available at <http://www.math.uos.de/normaliz>.
- [6] W. Bruns, B. Ichim and C. Söger. *Introduction to Normaliz 2.5*. LNCS **6327** (2010), , Proceedings of ICMS 2010, pp. 209–212.
- [7] W. Bruns, B. Ichim and C. Söger. *The power of pyramid decompositions in Normaliz*. Preprint arXiv:1206.1916.
- [8] W. Bruns and R. Koch. *Computing the integral closure of an affine semigroup*. Univ. Iagel. Acta Math. **39** (2001), 59–70.

V. ALMENDRA, INSTITUTE OF MATHEMATICS "SIMION STOILOW" OF THE ROMANIAN ACADEMY,
C.P. 1-764, 010702 BUCHAREST, ROMANIA

E-mail address: `vinicius.almendra@gmail.com`

BOGDAN ICHIM, INSTITUTE OF MATHEMATICS "SIMION STOILOW" OF THE ROMANIAN ACADEMY,
C.P. 1-764, 010702 BUCHAREST, ROMANIA

E-mail address: `bogdan.ichim@imar.ro`