**NAME**

aldebaran – minimization and comparison of labelled transitions systems

**IMPORTANT NOTICE**

As of July 2008, **aldebaran** is a deprecated tool of CADP. Instead of **aldebaran** it is highly recommended to invoke the following tools of CADP (either directly or indirectly using SVL):

- **bcg_cmp**(LOCAL)
- **bcg_info**(LOCAL)
- **bcg_io**(LOCAL)
- **bcg_labels**(LOCAL)
- **bcg_min**(LOCAL)
- **bcg_open**(LOCAL)
- **bisimulator**(LOCAL)
- **caesar_hide_1**(LOCAL)
- **caesar_rename_1**(LOCAL)
- **evaluator**(LOCAL)
- **exp.open**(LOCAL)
- **exhibitor**(LOCAL)
- **generator**(LOCAL)
- **reductor**(LOCAL)

From version 1.0 (January 1990) to version 6.6 (October 2005), **aldebaran** has been a binary executable (located in "$CADP/bin.‘arch‘/aldebaran" and later in "$CADP/bin.‘arch‘/aldebaran.old"). It performed minimizations and comparisons of labelled transition systems, using the Paige & Tarjan algorithm, the Fernandez & Mounier on-the-fly algorithm, the Minimal Model Generation algorithm, and algorithms based on Binary Decision Diagrams (BDD for short). Because **aldebaran** was no longer maintained by its authors and was known to contain bugs (including false verdicts about equivalence or preorder comparisons), it was marked as deprecated in CADP 2006. In July 2008, it was eventually removed from CADP because it would no longer compile using gcc/g++ 3.4.∗ and no one volunteered to port it to 64-bit platforms.

Version 7.∗ of **aldebaran** is a shell-script (located in file "$CADP/com/aldebaran") that has been introduced in October 2005. This shell-script invokes the CADP tools mentioned above and does not rely on **aldebaran** 6.6. It provides extensive backward compatibility with previous versions of **aldebaran** by supporting all their commands/options but **-dequ**. It also removes many limitations that existed in the previous versions of **aldebaran**.

**SYNOPSIS**

**aldebaran** *command* [*options*]
**aldebaran** *command* [*options*] *filename1*
**aldebaran** *command* [*options*] *filename1 filename2*

where *filename* can be either a file in Aldebaran format (with suffix **.aut**), a file in BCG format (with suffix **.bcg**), or a file describing a system of communicating automata (with suffix **.exp**).

**DESCRIPTION**

**aldebaran** allows the minimization or comparison of Labelled Transitions Systems (LTS for short) with respect to various equivalence and preorder relations. It can be applied:

- either to completely generated LTSs, which are usually contained in files with the **.aut** or **.bcg** suffix. See the **aut**(LOCAL) and **bcg**(LOCAL) manual pages for a description of the **.aut** and **.bcg** formats. **aldebaran** also accepts other LTSs formats (such as **.fc2** or **.seq** files): in such case, the **bcg_io** tool is used to perform silently the translation of these other formats into the BCG format.
- or to networks of communicating LTSs, which are contained in files with the **.exp** suffix. See the **exp**(LOCAL) manual page for a description of this format.

**COMMANDS**

The followings *command*s are currently available:

**-dead**

Print the set of deadlock states (sinks) for a LTS or a network of communicating LTSs.

**-det** Determinize a LTS and display the result as a new LTS.

**-help**

Display the help file and stop.

**-info**

Print various graph structure information for the LTS contained in *filename1***.(aut,bcg)** or the network of communicating LTSs contained in *filename1***.exp**. See also the **bcg_info**(LOCAL) tool, which provides more complete structure information on a BCG graph.

**-live**

Check whether there are livelock states (tau circuits) in the LTS or network of communicating LTSs stored in *filename1***.(aut,bcg,exp)**. If so, generate in file **aldebaran.bcg** a diagnostic, which is a subgraph of *filename1* that exhibits both a livelock and a path to the livelock, starting from the initial state.

**-output** *filename*[**.aut**|**.bcg**]

Specify the name (either *filename***.aut** or *filename***.bcg**) and the format (either ALDEBARAN format or BCG format) of the output file in which **aldebaran** will display its results (for those **aldebaran** commands that produce an LTS). By default, if no **-output** command is given, the result is printed on the standard output in ALDEBARAN format.

**-path** *nb*

Compute in a LTS a path from the initial state to the state *nb*. Display the result on the standard output as an LTS encoded in the **seq**(LOCAL) format (see the DIAGNOSTICS section below).

**-sort**

Sort the LTS. Sorting is done with the source state of transitions as primary key, and the label as secondary key. The LTS descriptor remains at the beginning of the file.

**-version**

Display the current version number of the software and stop.

The remaining commands have the following syntax:

**-**<*relation*><*action*>

where <*relation*> is a one-character string, either **b**, **i**, **o**, **p**, or **s**:

* **'b'** : use the strong bisimulation equivalence [Park-81] or the corresponding preorder
* **'i'** : use the tau*.a bisimulation [Fernandez-Mounier-90] or the corresponding preorder (tau is written i in LOTOS)
* **'o'** : use the observational relation [Milner-80]
* **'p'** : use the branching bisimulation [R.J. Van Glabbeek and W.P. Weijland]
* **'s'** : use the safety relation [Rodriguez-88] [Bouajjani-Fernandez-Graf-Rodriguez-Sifakis-91] or the corresponding preorder

and where <*action*> is a character string, either **min**, **cla**, **equ** or **ord**:

* **'min'** : minimize the LTS contained in *filename1***.(aut,bcg)**, or the network of communicating LTSs represented by *filename1***.exp**, with respect to <*relation*> and display the minimized LTS
* **'cla'** : same as above, but display the equivalence classes on the standard output (instead of the reduced LTS)
* **'equ'** : compare both LTSs contained in *filename1***.(aut,bcg)** and *filename2***.(aut,bcg)**, or the network of communicating LTSs *filename1***.exp** to the LTS *filename2***.(aut,bcg)**, or the network of communicating LTSs *filename2***.exp** to LTS *filename1***.(aut,bcg)**, with respect to <*relation*>, using *algorithm*. The result can be either **TRUE** (both LTSs are equivalent) or **FALSE**; in the latter case, **aldebaran** issues a diagnostic consisting either of a set of discriminating sequences displayed on standard output (see the DIAGNOSTICS section below), or of an acyclic BCG graph stored in file **aldebaran.bcg** (see the **-diag** options of **bcg_cmp**(LOCAL) and **bisimulator**(LOCAL) for details about diagnostics in the BCG format).
* **'ord'** : same as **equ**, but use a preorder relation instead of the equivalence relation

In version 7.* of **aldebaran**, the method is selected automatically as follows:

- As regards tau*.a and safety minimizations (**-imin**, **-icla**, **-pmin**, and **-pcla** options), the LTS is first pre-reduced on the fly using **reductor**, then minimized modulo strong bisimulation following the standard method using **bcg_min**.
- As regards strong and branching minimizations (**-bmin**, **-bcla**, **-pmin**, **-pcla**), the LTS is first generated (if needed) using **generator** and then minimized following the standard method using **bcg_min**.
- As regards comparisons modulo strong, branching, observational, tau*.a, and safety equivalences (**-bequ**, **-bord**, **-pequ**, **-pord**, **-oequ**, **-oord**, **-iequ**, **-iord**, **-sequ**, and **-sord** options), they are performed using **bcg_cmp** or, if not possible, using **bisimulator**.

Note: options **-iord** and **-sord** are identical, since both compute the same preorder relation.

**OPTIONS**

The following *options* are currently available:

**-stat**

Print various statistics.

**-hide** *filename*

Use the hiding rules defined in *filename* to hide the labels contained in files

*filename1*.**(aut,bcg,exp)** and possibly *filename2*.**(aut,bcg,exp)**. See the **caesar_hide_1**(LOCAL) manual page for a detailed description of the appropriate format for *filename*. There is no required extension for *filename*; however, extensions "**.hid**" or "**.hide**" are recommended for using the SVL compiler and the EUCALYPTUS graphical user-interface.

**-rename** *filename*
Use the renaming rules defined in *filename* to rename the labels contained in files *filename1*.**(aut,bcg,exp)** and possibly *filename2*.**(aut,bcg,exp)**. See the **caesar_rename_1**(LOCAL) manual page for a description of the appropriate format for *filename*. There is no required extension for *filename*; however, extensions "**.ren**" or "**.rename**" are recommended for using the SVL compiler and the EUCALYPTUS graphical user-interface.

Renaming and hiding patterns are applied in the order in which they occur on the command line.

## DIAGNOSTICS

**aldebaran** produces diagnostics to explain why two LTSs are not related (**equ** or **ord** commands). In the general case, these diagnostics are directed acyclic subgraphs (encoded in the BCG format) containing all sequences that, when executed simultaneously in the two LTSs, lead to non-equivalent states. In the particular case where diagnostics are just a single sequence, **aldebaran** displays this sequence using the **seq**(LOCAL) format, in the same way as **bcg_cmp**(LOCAL) and **bisimulator**(LOCAL) do.

## EXIT STATUS

When the source is erroneous, error messages are issued. Exit status is 0 if everything is alright, 1 otherwise.

## AUTHORS

Versions up to 6.6 of **aldebaran** have been developed by Jean-Claude Fernandez, Laurent Mounier, Alain Kerbrat, and Aline Senart (IMAG), with various bug fixes by Marc Herbert, Hubert Garavel, and Frederic Lang (INRIA Rhone-Alpes).

Version 7.∗ of **aldebaran** was developed by Frederic Lang (INRIA Rhone-Alpes).

## OPERANDS

| | |
|---|---|
| *filename*.**aut** | LTS in the Aldebaran format (input or output) |
| *filename*.**bcg** | LTS in the BCG format (input or output) |
| *filename*.**exp** | network of communicating LTSs (input) |
| *filename*.**hide** | list of labels to hide (input) |
| *filename*.**rename** | list of labels to rename (input) |

## FILES

| | |
|---|---|
| **$CADP/LICENSE** | license file |
| **$CADP/com/aldebaran** | shell-script (version 7.∗) |
| **aldebaran.bcg** | diagnostic file |

## SEE ALSO

ALDEBARAN Reference Manual, **aut**(LOCAL), **bcg**(LOCAL), **bcg_cmp**(LOCAL), **bcg_info**(LOCAL), **bcg_io**(LOCAL), **bcg_labels**(LOCAL), **bcg_min**(LOCAL), **bcg_open**(LOCAL), **bisimulator**(LOCAL), **caesar_hide_1**(LOCAL), **caesar_rename_1**(LOCAL), **evaluator**(LOCAL), **exp**(LOCAL), **exp.open**(LOCAL), **exhibitor**(LOCAL), **generator**(LOCAL), **reductor**(LOCAL), **seq**(LOCAL)

Additional information is available from the CADP Web page located at http://cadp.inria.fr

Directives for installation are given in files **$CADP/INSTALLATION_*.**

Recent changes and improvements to this software are reported and commented in file **$CADP/HISTORY.**

**BUGS**

Please report any bug to cadp@inria.fr