

OpenXM/Risa/Asir-Contrib

OpenXM/Risa/Asir-Contrib User's Manual (English Edition)
Edition 1.3.1 for OpenXM/Asir2000
February 2010

by OpenXM Developing Team

1 Introduction

The computer algebra system `asir` can use servers, which support the `OpenXM` protocols (Open message eXchange for Mathematics, <http://www.openxm.org>), as components. The interface functions to call these servers are loaded by loading the file `'OpenXM/rc/asirrc'`. This file is automatically loaded in "Risa/Asir(OpenXM distribution)", which we call `OpenXM/Risa/Asir` in this document. This document explains these interface functions for `asir` and several mathematical and utility functions written in the user languages of Risa/Asir. These mathematical and utility functions are outcome of the Asir-contrib project.

As to technical details on the `OpenXM` protocols, see `'openxm-en.tex'` at `'$(OpenXM_HOME)/doc/OpenXM-specs'`.

Enjoy mathematics on your computer.

List of contributors:

- Maekawa, Masahide (Oct., 1999 – : CVS server)
- Noro, Masayuki (Jan., 1996 – : OpenXM Protocol OXRFC-100, asir2000)
- Ohara, Katsuyoshi (Jan., 1998 – : ox_math, oxc OXRFC-101)
- Takayama, Nobuki (Jan., 1996 – : OpenXM Protocol OXRFC-100, kan/sm1, asir-contrib)
- Tamura, Yasushi (Nov., 1998 – : OpenMath proxy, tfb)
- Fujimoto, Mitsushi (Windows)
- Iwane, Hidenao (Knapsack factorizer)
- Nakayama, Hiromasa (Gaussian elimination)
- Okutani, Yukio (Oct., 1999 – Feb., 2000 : matrix, diff, ...)
- Stillman, Mike (Macaulay 2 client and server)
- Tsai, Harrison (Macaulay 2 client and server)

See `OpenXM/Copyright` for the copyright notice.

2 How to load Asir/Contrib

With loading ‘OpenXM/rc/asirrc’, we can use most functions in Asir/Contrib. The OpenXM/Risa/Asir reads this file, which is specified by the `ASIR_CONFIG` environmental variable, when it starts. The file ‘`names.rr`’ is the top level file of the Asir/Contrib. Most other files are loaded from ‘`names.rr`’. Some packages are not loaded from ‘`names.rr`’ and they must be loaded individually.

A sample of ‘`asirrc`’ to use Asir/Contrib.

```
load("gr")$
load("primdec")$
load("katsura")$
load("bfct")$
load("names.rr")$
load("oxrffc103.rr")$
User_asirrc=which(getenv("HOME")+"/.asirrc")$
if (type(User_asirrc)!=0)
  if (!ctrl("quiet_mode")) print("Loading ~/.asirrc")$
  load(User_asirrc)$
else $
end$
```

3 Function Names in Asir Contrib

Not yet written.

Not yet written.

4 Asir-contrib for Windows

A part of Asir-contrib works on Windows. The following functions and components work on windows; the outer component sm1 and functions in asir-contrib which do not call outer components. In the cygwin environment, the outer components sm1, phc work. The other outer components do not work.

The following functions do not work on Windows. Some of them work in the cygwin environment of Windows.

- gnuplot.*
- om.*
- mathematica.*
- phc.*
- print_dvi_form
- print_gif_form
- print_open_math_xml_form
- print_png_form
- print_xdvi_form
- print_xv_form
- tigers_xv_form

5 Basic (Standard Functions)

5.0.1 base_cancel

`base_cancel(S)`

: It simplifies S by canceling the common factors of denominators and numerators.

Example:

```
base_cancel([(x-1)/(x^2-1), (x-1)/(x^3-1)]);
```

5.0.2 base_choose

`base_choose(L,M)`

: It returns the list of the order M subsets of L .

Example:

```
base_choose([1,2,3],2);
```

It outputs all the order 2 subsets of the set $\{1,2,3\}$

5.0.3 base_flatten

`base_flatten(S)`

: It flattens a nested list S .

Example:

```
base_flatten([[1,2,3],4]);
```

5.0.4 base_intersection

`base_intersection(A,B)`

: It returns the intersection of A and B as a set.

Example:

```
base_intersection([1,2,3],[2,3,5,[6,5]]);
```

5.0.5 base_memberq

`base_memberq(A,S)`

: It returns 1 if A is a member of the set S else returns 0.

Example:

```
base_memberq(2,[1,2,3]);
```

5.0.6 base_permutation

`base_permutation(L)`

: It outputs all permutations of L . BUG; it uses a slow algorithm.

Example:

```
base_permutation([1,2,3,4]);
```

5.0.7 base_position

`base_position(A,S)`
 : It returns the position of A in S .

Example:

```
base_position("cat",["dog","cat","monkey"]);
```

5.0.8 base_prune

`base_prune(A,S)`
 : It returns a list in which A is removed from S .

Example:

```
base_prune("cat",["dog","cat","monkey"]);
```

5.0.9 base_replace

`base_replace(S,Rule)`
 : It rewrites S by using the rule $Rule$

Example:

```
base_replace(x^2+y^2,[[x,a+1],[y,b]]);
```

x is replaced by $a+1$ and y is replaced by b in x^2+y^2 .

5.0.10 base_replace_n

`base_replace_n(S,Rule)`
 : It rewrites S by using the rule $Rule$. It is used only for specializing variables to numbers and faster than `base_replace`.

Example:

```
base_replace_n(x^2+y^2,[[x,1/2],[y,2.0+3*@i]]);
```

x is replaced by $1/2$ and y is replaced by $2.0+3*\text{in } x^2+y^2$.

5.0.11 base_set_minus

`base_set_minus(A,B)`
 : $A \setminus B$

Example:

```
base_set_minus([1,2,3],[3,4,5]);
```

5.0.12 base_set_union

`base_set_union(A,B)`
 : $A \cup B$

Example:

```
base_set_union([1,2,3],[3,4,5]);
```


5.0.13 base_subsetq

`base_subsetq(A, B)`
: if $A \subseteq B$, then it returns 1 else 0.

Example:

```
base_subsetq([1,2],[1,2,3,4,5]);
```

5.0.14 base_subsets_of_size

`base_subsets_of_size(K, S)`
: It outputs all subsets of S of the size K . BUG; it uses a slow algorithm. Do not input a large S .

Example:

```
base_subsets_of_size(2,[3,5,3,2]);
```

6 Numbers (Standard Mathematical Functions)

6.0.1 number_abs

`number_abs(X)`
:

Example:

```
number_abs(-3);
```

6.0.2 number_ceiling

`number_ceiling(X)`
:

Example:

```
number_abs(1.5);
```

6.0.3 number_factor

`number_factor(X)`
: It factors the given integer X .

Example:

```
number_factor(20);
```

6.0.4 number_floor

`number_floor(X)`
:

Example:

```
number_floor(1.5);
```

6.0.5 number_imaginary_part

`number_imaginary_part(X)`
:

Example:

```
number_imaginary_part(1+2*i);
```

6.0.6 number_is_integer

`number_is_integer(X)`
:

Example:

```
number_is_integer(2/3);
```

6.0.7 `number_real_part`

`number_real_part(X)`
:

Example:

```
number_real_part(1+2*@i);
```

7 Calculus (Standard Mathematical Functions)

8 Series (Standard Mathematical Functions)

9 Special Functions (Standard Mathematical Functions)

Not yet written

10 Matrix (Standard Mathematical Functions)

10.0.1 matrix_clone

`matrix_clone(M)`

: It generates the clone of the matrix M .

Example:

```
matrix_clone(matrix_list_to_matrix([[1,1],[0,1]]));
```

10.0.2 matrix_det

`matrix_det(M)`

: It returns the determinant of the matrix M .

Example:

```
poly_factor(matrix_det([[1,x,x^2],[1,y,y^2],[1,z,z^2]]));
```

10.0.3 matrix_diagonal_matrix

`matrix_diagonal_matrix(L)`

: It returns the diagonal matrix with diagonal entries L .

Example:

```
matrix_diagonal_matrix([1,2,3]);
```

References:

```
matrix_list_to_matrix
```

10.0.4 matrix_eigenvalues

`matrix_eigenvalues(M)`

: It returns the eigenvalues of the matrix M .

Example:

```
matrix_eigenvalues([[x,1],[0,y]]);
```

10.0.5 matrix_identity_matrix

`matrix_identity_matrix(N)`

: It returns the identity matrix of the size N .

Example:

```
matrix_identity_matrix(5);
```

References:

```
matrix_diagonal_matrix
```

10.0.6 matrix_image

`matrix_image(M)`

: It computes the image of M . Redundant vectors are removed.

Example:

```
matrix_image([[1,2,3],[2,4,6],[1,0,0]]);
```

References:

`matrix_kernel`

10.0.7 matrix_inner_product

`matrix_inner_product(A,B)`

: It returns the inner product of two vectors A and B .

Example:

```
matrix_inner_product([1,2],[x,y]);
```

10.0.8 matrix_inverse

`matrix_inverse(M)`

: It returns the inverse of the matrix M .

Example:

```
matrix_inverse([[1,2],[0,1]]);
```

10.0.9 matrix_kernel

`matrix_kernel(M)`

: It returns the basis of the kernel of the matrix M .

Example:

```
matrix_kernel([[1,1,1,1],[0,1,3,4]]);
```

10.0.10 matrix_list_to_matrix

`matrix_list_to_matrix(M)`

: It translates the list M to a matrix.

Example:

```
print_xdvi_form(matrix_list_to_matrix([[1,1],[0,2]]));
```

References:

`matrix_matrix_to_list`

10.0.11 matrix_matrix_to_list

`matrix_matrix_to_list(M)`

: It translates the matrix M to a list.

References:

`matrix_list_to_matrix`

10.0.12 matrix_rank

`matrix_rank(M)`

: It returns the rank of the matrix *M*.

Example:

```
matrix_rank([[1,1,1,1],[0,1,3,4]]);
```

10.0.13 matrix_solve_linear

`matrix_solve_linear(M,X,B)`

: It solves the system of linear equations $M X = B$

Example:

```
matrix_solve_linear([[1,2],[0,1]],[x,y],[1,2]);
```

10.0.14 matrix_submatrix

`matrix_submatrix(M,Ind)`

: It returns the submatrix of *M* defined by the index set *Ind*.

Example:

```
matrix_submatrix([[0,1],[2,3],[4,5]],[1,2]);
```

10.0.15 matrix_transpose

`matrix_transpose(M)`

: It returns the transpose of the matrix *M*.

References:

`matrix_list_to_matrix`

11 Graphic (Standard Mathematical Functions)

Not yet written.

12 Print (Standard Mathematical Functions)

12.0.1 print_dvi_form

`print_dvi_form(S)`

: It outputs S to a dvi file.

Example:

```
print_dvi_form(x^2-1);
```

References:

```
print_xdvi_form , print_tex_form
```

12.0.2 print_em

`print_em(S)`

: It outputs S by a font to emphasize it.

Example:

```
print_em(x^2-1);
```

12.0.3 print_gif_form

`print_gif_form(S)`

: It outputs S to a file of the gif format.

`print_gif_form(S | table=key0)`

: This function allows optional variables *table*

Example:

```
print_gif_form(newmat(2,2,[[x^2,x],[y^2-1,x/(x-1)]]));
```

References:

```
print_tex_form
```

12.0.4 print_input_form

`print_input_form(S)`

: It transforms S to a string which can be parsed by asir.

Example:

```
print_input_form(quote(x^3-1));
```

12.0.5 print_open_math_tfb_form

`print_open_math_tfb_form(S)`

: It transforms S to a tfb format of OpenMath XML.

Description:

It is experimental. You need to load `taka_print_tfb.rr` to call it.

Example:

```
print_open_math_tfb_form(quote(f(x,1/(y+1))+2));
```

12.0.6 print_open_math_xml_form

`print_open_math_xml_form(S)`

: It transforms S to a string which is compliant to OpenMath(1999).

Example:

```
print_open_math_xml_form(x^3-1);
```

References:

www.openmath.org

12.0.7 print_output

`print_output(Obj)`

: It outputs the object Obj to a file. If the optional variable *file* is set, then it outputs the Obj to the specified file, else it outputs it to "asir_output_tmp.txt". If the optional variable *mode* is set to "w", then the file is newly created. If the optional variable is not set, the Obj is appended to the file.

`print_output(Obj | file=key0, mode=key1)`

: This function allows optional variables *file*, *mode*

Example:

```
print_output("Hello"|file="test.txt");
```

References:

`glib_tops`, (,)

12.0.8 print_ox_rfc100_xml_form

`print_ox_rfc100_xml_form(S)`

: It transforms S to a string which is compliant to OpenXM RFC 100.

Example:

```
print_ox_rfc100_xml_form(x^3-1);
```

References:

www.openxm.org

12.0.9 print_png_form

`print_png_form(S)`

: It transforms S to a file of the format png. dvi2png should be installed.

Example:

```
print_png_form(x^3-1);
```

References:

`print_tex_form`

12.0.10 print_terminal_form

`print_terminal_form(S)`

: It transforms S to the terminal form???

12.0.11 print_tex_form**print_tex_form(*S*)**: It transforms *S* to a string of the LaTeX format.**print_tex_form(*S* | *table*=key0,*raw*=key1)**: This function allows optional variables *table*, *raw*

Description:

The global variable `Print_tex_form_fraction_format` takes the values "auto", "frac", or "/". The global variable `Print_tex_form_no_automatic_subscript` takes the values 0 or 1. BUG; A large input *S* cannot be translated.

Example:

```
print_tex_form(x*dx+1 | table=["dx","\partial_x"]);
```

The optional variable *table* is used to give a translation table of asir symbols and tex symbols.

References:

```
print_xdvi_form
```

12.0.12 print_tfb_form**print_tfb_form(*S*)**: It transforms *S* to the tfb format.

Example:

```
print_tfb_form(x+1);
```

12.0.13 print_xdvi_form**print_xdvi_form(*S*)**: It transforms *S* to a xdvi file and previews the file by xdvi.

Example 0:

```
print_xdvi_form(newmat(2,2,[[x^2,x],[y^2-1,x/(x-1)]]));
```

Example 1:

```
print_xdvi_form(print_tex_form(1/2));
```

References:

```
print_tex_form , print_dvi_form
```

12.0.14 print_xv_form**print_xv_form(*S*)**: It transforms *S* to a gif file and previews the file by xv.**print_xv_form(*S* | *input*=key0,*format*=key1)**: This function allows optional variables *input*, *format*

Example 0:

```
print_xv_form(newmat(2,2,[[x^2,x],[y^2-1,x/(x-1)]]));
```

Example 1:

```
print_xv_form(x+y | format="png");
```

If the optional variable `format="png"` is set, `png` format will be used to generate an input for `xv`.

References:

```
print_tex_form , print_gif_form
```

13 Polynomials (Standard Mathematical Functions)

13.0.1 poly_degree

`poly_degree(F)`

: It returns the degree of F with respect to the given weight vector.

`poly_degree(F | weight=key0, v=key1)`

: This function allows optional variables *weight*, *v*

Description:

The weight is given by the optional variable *weight* *w*. It returns $\text{ord}_w(F)$

Example:

```
poly_degree(x^2+y^2-4 |weight=[100,1],v=[x,y]);
```

13.0.2 poly_elimination_ideal

`poly_elimination_ideal(I,VV)`

: It computes the ideal intersection of I and the monomial ideal generated by VV .

`poly_elimination_ideal(I,VV | grobner_basis=key0, v=key1)`

: This function allows optional variables *grobner_basis*, *v*

Description:

If *grobner_basis* is "yes", I is assumed to be a Grobner basis. The optional variable *v* is a list of variables which defines the ring of polynomials.

Example 0:

```
poly_elimination_ideal([x^2+y^2-4,x*y-1],[x]);
```

Example 1:

```
A = poly_grobner_basis([x^2+y^2-4,x*y-1]|order=2,v=[y,x]);
poly_elimination_ideal(A,[x]|grobner_basis="yes");
```

References:

`gr` , `hgr` , `gr_mod` , `dp_*`

13.0.3 poly_expand

`poly_expand(F)`

: This is an alias of `poly_sort`.

References:

`poly_sort`

13.0.4 poly_factor

`poly_factor(F)`

: It factorizes the polynomial F .

Example:

```
poly_factor(x^10-y^10);
```

13.0.5 poly_gcd`poly_gcd(F,G)`: It computes the polynomial GCD of F and G .

Example:

`poly_gcd(x^10-y^10,x^25-y^25);`**13.0.6 poly_grobner_basis**`poly_grobner_basis(I)`: It returns the Grobner basis of I .`poly_grobner_basis(I | order=key0,v=key1)`: This function allows optional variables $order$, v

Description:

The optional variable v is a list of variables which defines the ring of polynomials.

Example:

`A = poly_grobner_basis([x^2+y^2-4,x*y-1] | order=2,v=[y,x]);`**13.0.7 poly_hilbert_polynomial**`poly_hilbert_polynomial(I)`: It returns the Hilbert polynomial of the ideal I .`poly_hilbert_polynomial(I | s=key0,v=key1)`: This function allows optional variables s , v

Description:

The optional variable v is a list of variables.

Example:

`poly_hilbert_polynomial([x1*y1,x1*y2,x2*y1,x2*y2] | s=k,v=[x1,x2,y1,y2]);`**13.0.8 poly_initial**`poly_initial(I)`: It returns the initial ideal of I with respect to the given order.`poly_initial(I | order=key0,v=key1)`: This function allows optional variables $order$, v

Description:

The optional variable v is a list of variables. This function computes $\text{in}_{\prec}(I)$

Example:

`poly_initial([x^2+y^2-4,x*y-1] | order=0,v=[x,y]);`

13.0.9 poly_initial_coefficients**poly_initial_coefficients(*I*)**: It computes the coefficients of the initial ideal of *I* with respect to the given order.**poly_initial_coefficients(*I* | order=key0, v=key1)**: This function allows optional variables *order*, *v*

Description:

The optional variable *v* is a list of variables. The order is specified by the optional variable *order*

Example:

```
poly_initial_coefficients([x^2+y^2-4,x*y-1]|order=0,v=[x,y]);
```

13.0.10 poly_initial_term**poly_initial_term(*F*)**: It returns the initial term of a polynomial *F* with respect to the given weight vector.**poly_initial_term(*F* | weight=key0, order=key1, v=key2)**: This function allows optional variables *weight*, *order*, *v*

Description:

The weight is given by the optional variable *weight* *w*. It returns $\text{in}_w(F)$

Example:

```
poly_initial_term(x^2+y^2-4 |weight=[100,1],v=[x,y]);
```

13.0.11 poly_solve_linear**poly_solve_linear(*Eqs*, *V*)**: It solves the system of linear equations *Eqs* with respect to the set of variables *V*.

Example:

```
poly_solve_linear([2*x+3*y-z-2, x+y+z-1], [x,y,z]);
```

13.0.12 poly_sort**poly_sort(*F*)**: It expands *F* with a given variables *v*=*V* and a given weight *w*=*W*. It returns a quote object. If *truncate* option is set, the expansion is truncated at the given degree.**poly_sort(*F* | v=key0, w=key1, truncate=key2)**: This function allows optional variables *v*, *w*, *truncate*

Example:

```
poly_sort((x-y-a)^3 | v=[x,y], w=[-1,-1])
returns a series expansion in terms of x and y.
```

14 Complex (Standard Mathematical Functions)

15 Graphic Library (2 dimensional)

The library `glib` provides a simple interface like old BASIC to the graphic primitive (`draw_obj`) of Risa/Asir.

15.0.1 `glib_clear`

`glib_clear()`
: Clear the screen.

15.0.2 `glib_flush`

`glib_flush()`
: ; Flush the output. (Cfep only. It also set `initGL` to 1.).

15.0.3 `glib_line`

`glib_line(X0,Y0,X1,Y1)`
: It draws the line $[X0,Y0]$ – $[X1,Y1]$ with *color* and *shape*

`glib_line(X0,Y0,X1,Y1 | color=key0,shape=key1)`
: This function allows optional variables *color*, *shape*

Example:

```
glib_line(0,0,5,3/2 | color=0xff00ff);
glib_line(0,0,10,0 | shape=arrow);
```

15.0.4 `glib_open`

`glib_open()`
: It starts the `ox-plot` server and opens a canvas. The canvas size is set to `Glib_canvas_x` X `Glib_canvas_y` (the default value is 400). This function is automatically called when the user calls `glib` functions.

15.0.5 `glib_plot`

`glib_plot(F)`
: It plots an object *F* on the `glib` canvas.

Example 0:

```
glib_plot([[0,1],[0.1,0.9],[0.2,0.7],[0.3,0.5],[0.4,0.8]]);
```

Example 1:

```
glib_plot(tan(x));
```

15.0.6 `glib_print`

`glib_print(X,Y,Text)`
: It put a string *Text* at $[X,Y]$ on the `glib` canvas.

`glib_print(X,Y,Text | color=key0)`
: This function allows optional variables *color*

Example:

```
glib_print(100,100,"Hello Worlds" | color=0xff0000);
```

15.0.7 glib_ps_form

`glib_ps_form(S)`

: It returns the PS code generated by executing *S* (experimental).

Example 0:

```
glib_ps_form(quote( glib_line(0,0,100,100) ));
```

Example 1:

```
glib_ps_form(quote([glib_line(0,0,100,100),glib_line(100,0,0,100)]));
```

References:

`glib_tops`

15.0.8 glib_putpixel

`glib_putpixel(X,Y)`

: It puts a pixel at $[X,Y]$ with *color*

`glib_putpixel(X,Y | color=key0)`

: This function allows optional variables *color*

Example:

```
glib_putpixel(1,2 | color=0xffff00);
```

15.0.9 glib_remove_last

`glib_remove_last()`

: Remove the last object. `glib_flush()` should also be called to remove the last object. (cfep only).

15.0.10 glib_set_pixel_size

`glib_set_pixel_size(P)`

: Set the size of putpixel to *P*. 1.0 is the default. (cfep only).

15.0.11 glib_tops

`glib_tops()`

: If `Glib_ps` is set to 1, it returns a postscript program to draw the picture on the canvas.

References:

`print_output`

15.0.12 glib_window

`glib_window(Xmin,Ymin,Xmax,Ymax)`

: It generates a window with the left top corner $[Xmin,Ymin]$ and the right bottom corner $[Xmax,Ymax]$. If the global variable *Glib_math_coordinate* is set to 1, mathematical coordinate system will be employed, i.e., the left top corner will have the coordinate $[Xmin,Ymax]$.

Example:

```
glib_window(-1,-1,10,10);
```

16 OpenXM-Contrib General Functions

16.1 Functions

16.1.1 ox_check_errors2

`ox_check_errors2(p)`

:: get a list of error objects on the stack of the server *p*.

return List

p Number

- It gets a list of error objects on the server stack.
- It does not pop the error objects.

```
[219] P=sm1.start();
```

```
0
```

```
[220] sm1.sm1(P," 0 get ");
```

```
0
```

```
[221] ox_check_errors2(P);
```

```
[error([7,4294967295,executeString: Usage:get])]
```

```
Error on the server of the process number = 1
```

```
To clean the stack of the ox server,
```

```
type in ox_pops(P,N) (P: process number, N: the number of data you need to pop)
out of the debug mode.
```

```
If you like to automatically clean data on the server stack,
set XM_debug=0;
```

17 OXshell Functions

OXshell is a system to execute system commands from ox servers. As to details, see the files OpenXM/src/kan96xx/Doc/oxshell.oxw and OpenXM/doc/Papers/rims-2003-12-16-ja.tex.

17.0.1 oxshell.get_value

`oxshell.get_value(NAME, V)`

: It get the value of the variable *NAME* on the server *ox_shell*.

Example:

```
oxshell.set_value("abc", "Hello world!");
oxshell.oxshell(["cp", "stringIn://abc", "stringOut://result"]);
oxshell.get_value("result");
```

References:

`oxshell.oxshell` , `oxshell.set_value`

17.0.2 oxshell.oxshell

`oxshell.oxshell(L)`

: It executes command *L* on a *ox_shell* server. *L* must be an array. The result is the outputs to stdout and stderr.

Example:

```
oxshell.oxshell(["ls"]);
```

References:

`ox_shell` , `oxshell.set_value` , `oxshell.get_value`

17.0.3 oxshell.set_value

`oxshell.set_value(NAME, V)`

: It set the value *V* to the variable *Name* on the server *ox_shell*.

Example:

```
oxshell.set_value("abc", "Hello world!");
oxshell.oxshell(["cat", "stringIn://abc"]);
```

References:

`oxshell.oxshell` , `oxshell.get_value`

18 Utility Functions

Utility functions provide some useful functions to access to the system and to process strings.

18.0.1 util_filter

`util_filter(Command, Input)`
 : It executes the filter program *Command* with the *Input* and returns the output of the filter as a string.

`util_filter(Command, Input | env=key0)`
 : This function allows optional variables *env*

Example:

```
util_filter("sort", "cat\ndog\ncentipede\n");
```

18.0.2 util_find_and_replace

`util_find_and_replace(W, S, Wnew)`
 : It replaces *W* in *S* by *Wnew*. Arguments must be a list of ascii codes.

18.0.3 util_find_substr

`util_find_substr(W, S)`
 : It returns the position of *W* in *S*. If *W* cannot be found, it returns -1. Arguments must be a list of ascii codes.

18.0.4 util_index

`util_index(V)`
 : It returns the name part and the index part of *V*.

Example:

```
util_index(x_2_3)
```

References:

```
util_v
```

18.0.5 util_load_file_as_a_string

`util_load_file_as_a_string(F)`
 : It reads a file *F* as a string.

18.0.6 util_part

`util_part(S, P, Q)`
 : It returns from *P*th element to *Q*th element of *S*.

18.0.7 util_read_file_as_a_string

`util_read_file_as_a_string(F)`
 : It reads a file *F* as a string.

18.0.8 util_remove_cr

`util_remove_cr(S)`

: It removes `cr/lf/tabs` from *S*. Arguments must be a list of ascii codes.

18.0.9 util_timing

`util_timing(Q)`

: Show the timing data to execute *Q*.

Example:

```
util_timing( quote( fctr(x^50-y^50) ) );
```

18.0.10 util_v

`util_v(V,L)`

: It returns a variable indexed by *L*.

Example:

```
util_v("x", [1,3]);
```

References:

`util_index`

18.0.11 util_write_string_to_a_file

`util_write_string_to_a_file(Fname,S)`

: It writes a string *S* to a file *Fname*.

19 Other Manuals

This section introduces other manuals in the asir-contrib project.

This section also describes functions that have not yet been classified. These will be moved to independent sections in a future.

19.0.1 dsolv (Solving the initial ideal for holonomic systems)

`../dsolv-html/dsolv-en.html`

19.0.2 ok_diff (Okutani's library for differential operators)

`../ok_diff-html/ok_diff-en.html`

19.0.3 ok_dmodule (Okutani's library for D-modules)

`../ok_dmodule-html/ok_dmodule-en.html`

19.0.4 (Plucker relations)

`../plucker-html/plucker-en.html`

19.0.5 pfpcoh (Ohara's library for homology/cohomology groups for $p \leq q$)

`../pfpcoh-html/pfpcoh-en.html`

19.0.6 (gnuplot ox server for graphics)

`../gnuplot-html/gnuplot-en.html`

19.0.7 mathematica (Mathematica (TM) ox server)

`../mathematica-html/mathematica-en.html`

19.0.8 om (om (java) ox server for translating CMO and OpenMath)

`../om-html/om-en.html`

19.0.9 phc (PHC ox server for solving systems of algebraic equations by the homotopy method)

`../phc-html/phc-en.html`

19.0.10 sm1 (Kan/sm1 ox server for the ring of differential operators)

`../sm1-html/sm1-en.html`

19.0.11 tigers (tigers ox server for toric universal Grobner bases)

`../tigers-html/tigers-en.html`

19.0.12 f_res (Comuting resultant)

`../f_res-html/f_res-en.html`

19.0.13 mt_graph (3D grapher)

`../mk_graph-html/mk_graph-en.html`

19.0.14 noro_mwl (Mordel Weil Lattice)

`../noro_mwl-html/noro_mwl-en.html`

19.0.15 nn_ndbf (local b-function)

`../nn_ndbf-html/nn_ndbf-en.html`

19.0.16 [[todo_parametrize]]

`todo_parametrize/todo_parametrize.toc`

With loading the file `todo_parametrize/todo_parametrize.rr` the function `parametrize` is installed. The function finds a parametric expression of a given rational curve. As to details, see See section “” in *A package for algebraic curves* (in Japanese).

```
[1205] load("todo_parametrize/todo_parametrize.rr");
1
[1425] parametrize(y^2-x^3);
[155*t^2+20*t+1,720*t^4+1044*t^3+580*t^2,155*t^4+20*t^3+t^2,(-x)/(y)]
[1426] parametrize(y^2+x^3);
[-t,1,t^3,(-x)/(y)]
```

19.0.17 taji_alc

With loading the file `taji_alc.rr` functions for algebraic local cohomology groups in one variable are imported.

```
import("taji_alc.rr");
taji_alc.laurent_expansion(x,(x-1)^3);
```

19.0.18 Manual and papers which are not written in texinfo.

Links to manuals and papers related to files and commands in `asir-contrib` are at OpenXM documents (<http://www.math.kobe-u.ac.jp/OpenXM/Current/doc/index-doc-en.html>).

Index

(Index is nonexistent)

(Index is nonexistent)

Short Contents

1	Introduction	1
2	How to load Asir/Contrib	3
3	Function Names in Asir Contrib	4
4	Asir-contrib for Windows	5
5	Basic (Standard Functions)	6
6	Numbers (Standard Mathematical Functions)	9
7	Calculus (Standard Mathematical Functions)	11
8	Series (Standard Mathematical Functions)	12
9	Special Functions (Standard Mathematical Functions)	13
10	Matrix (Standard Mathematical Functions)	14
11	Graphic (Standard Mathematical Functions)	17
12	Print (Standard Mathematical Functions)	18
13	Polynomials (Standard Mathematical Functions)	22
14	Complex (Standard Mathematical Functions)	25
15	Graphic Library (2 dimensional)	26
16	OpenXM-Contrib General Functions	28
17	OXshell Functions	29
18	Utility Functions	30
19	Other Manuals	32
	Index	34

Table of Contents

1	Introduction	1
2	How to load Asir/Contrib	3
3	Function Names in Asir Contrib	4
4	Asir-contrib for Windows	5
5	Basic (Standard Functions)	6
5.0.1	base_cancel	6
5.0.2	base_choose	6
5.0.3	base_flatten	6
5.0.4	base_intersection	6
5.0.5	base_memberq	6
5.0.6	base_permutation	6
5.0.7	base_position	7
5.0.8	base_prune	7
5.0.9	base_replace	7
5.0.10	base_replace_n	7
5.0.11	base_set_minus	7
5.0.12	base_set_union	7
5.0.13	base_subsetq	8
5.0.14	base_subsets_of_size	8
6	Numbers (Standard Mathematical Functions)	
	9
6.0.1	number_abs	9
6.0.2	number_ceiling	9
6.0.3	number_factor	9
6.0.4	number_floor	9
6.0.5	number_imaginary_part	9
6.0.6	number_is_integer	9
6.0.7	number_real_part	10
7	Calculus (Standard Mathematical Functions)	
	11
8	Series (Standard Mathematical Functions) ..	12

9	Special Functions (Standard Mathematical Functions)	13
10	Matrix (Standard Mathematical Functions)	14
10.0.1	matrix_clone	14
10.0.2	matrix_det	14
10.0.3	matrix_diagonal_matrix	14
10.0.4	matrix_eigenvalues	14
10.0.5	matrix_identity_matrix	14
10.0.6	matrix_image	15
10.0.7	matrix_inner_product	15
10.0.8	matrix_inverse	15
10.0.9	matrix_kernel	15
10.0.10	matrix_list_to_matrix	15
10.0.11	matrix_matrix_to_list	15
10.0.12	matrix_rank	16
10.0.13	matrix_solve_linear	16
10.0.14	matrix_submatrix	16
10.0.15	matrix_transpose	16
11	Graphic (Standard Mathematical Functions)	17
12	Print (Standard Mathematical Functions)	18
12.0.1	print_dvi_form	18
12.0.2	print_em	18
12.0.3	print_gif_form	18
12.0.4	print_input_form	18
12.0.5	print_open_math_tfb_form	18
12.0.6	print_open_math_xml_form	19
12.0.7	print_output	19
12.0.8	print_ox_rfc100_xml_form	19
12.0.9	print_png_form	19
12.0.10	print_terminal_form	19
12.0.11	print_tex_form	20
12.0.12	print_tfb_form	20
12.0.13	print_xdvi_form	20
12.0.14	print_xv_form	20

13	Polynomials (Standard Mathematical Functions)	22
13.0.1	poly_degree	22
13.0.2	poly_elimination_ideal	22
13.0.3	poly_expand	22
13.0.4	poly_factor	22
13.0.5	poly_gcd	23
13.0.6	poly_grobner_basis	23
13.0.7	poly_hilbert_polynomial	23
13.0.8	poly_initial	23
13.0.9	poly_initial_coefficients	24
13.0.10	poly_initial_term	24
13.0.11	poly_solve_linear	24
13.0.12	poly_sort	24
14	Complex (Standard Mathematical Functions)	25
15	Graphic Library (2 dimensional)	26
15.0.1	glib_clear	26
15.0.2	glib_flush	26
15.0.3	glib_line	26
15.0.4	glib_open	26
15.0.5	glib_plot	26
15.0.6	glib_print	26
15.0.7	glib_ps_form	27
15.0.8	glib_putpixel	27
15.0.9	glib_remove_last	27
15.0.10	glib_set_pixel_size	27
15.0.11	glib_tops	27
15.0.12	glib_window	27
16	OpenXM-Contrib General Functions	28
16.1	Functions	28
16.1.1	ox_check_errors2	28
17	OXshell Functions	29
17.0.1	oxshell.get_value	29
17.0.2	oxshell.oxshell	29
17.0.3	oxshell.set_value	29

18	Utility Functions	30
18.0.1	util_filter	30
18.0.2	util_find_and_replace	30
18.0.3	util_find_substr	30
18.0.4	util_index	30
18.0.5	util_load_file_as_a_string	30
18.0.6	util_part	30
18.0.7	util_read_file_as_a_string	30
18.0.8	util_remove_cr	31
18.0.9	util_timing	31
18.0.10	util_v	31
18.0.11	util_write_string_to_a_file	31
19	Other Manuals	32
19.0.1	dsolv (Solving the initial ideal for holonomic systems) ...	32
19.0.2	ok_diff (Okutani's library for differential operators)	32
19.0.3	ok_dmodule (Okutani's library for D-modules)	32
19.0.4	(Plucker relations)	32
19.0.5	pfpcoh (Ohara's library for homology/cohomology groups for p F q)	32
19.0.6	(gnuplot ox server for graphics)	32
19.0.7	mathematica (Mathematica (TM) ox server)	32
19.0.8	om (om (java) ox server for translating CMO and OpenMath)	32
19.0.9	phc (PHC ox server for solving systems of algebraic equations by the homotopy method)	32
19.0.10	sm1 (Kan/sm1 ox server for the ring of differential operators)	32
19.0.11	tigers (tigers ox server for toric universal Grobner bases)	32
19.0.12	f_res (Comuting resultant)	33
19.0.13	mt_graph (3D grapher)	33
19.0.14	noro_mwl (Mordel Weil Lattice)	33
19.0.15	nn_ndbf (local b-function)	33
19.0.16	[[todo_parametrize]]	33
19.0.17	taji_alc	33
19.0.18	Manual and papers which are not written in texinfo. ...	33
	Index	34