

Guide to K_ET Cindy

K_ET Cindy Project Team

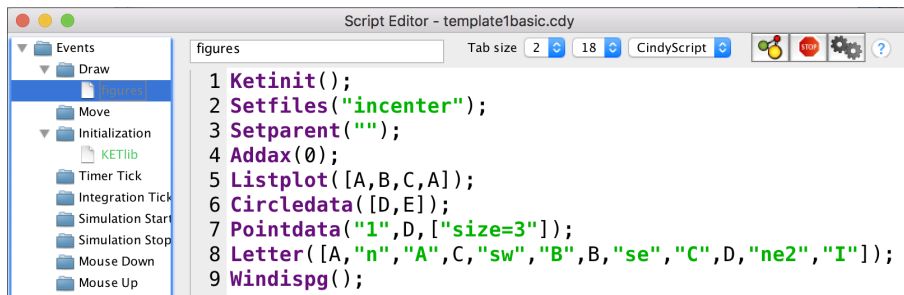
September 6, 2018

- ver.3.2 -

Contents

1	About K_ET Cindy	2
1.1	Overview	2
1.2	Geometric Figures	4
1.3	Graphs of Functions	4
1.4	Drawing Tables	5
1.5	Plotting data	6
2	Cindyscript	7
2.1	Cindyscript editor	7
2.2	Input	8
2.3	Variables and constants	9
2.4	Frequently used commands	10
3	Collaboration with other softwares	11
3.1	Overview	11
3.2	Commands related to Maxima	11
3.3	Commands related to R	12
4	Three Dimentional figures of K_ET Cindy	13
4.1	Summary and Geometric Elements	13
4.2	Lines and Curves	13
4.3	Two Dimensional Figures	14
4.4	Surfaces	14
4.5	Generating Files in Obj Format	15
5	Making Slides	16
5.1	Overall Flow	16
5.2	Editing Text File	16
5.3	Display of Page step by step	17
5.4	Making Flip Animation	17
5.5	Making Animation	17
5.6	Changing Style	18

- (2) Input the KETCindy codes into Cindyscript editor to specify the graphical elements to be displayed in $\text{T}_{\text{E}}\text{X}$ final output. Also KETCindy codes are used to generate supplementary graphical elements and handle them.

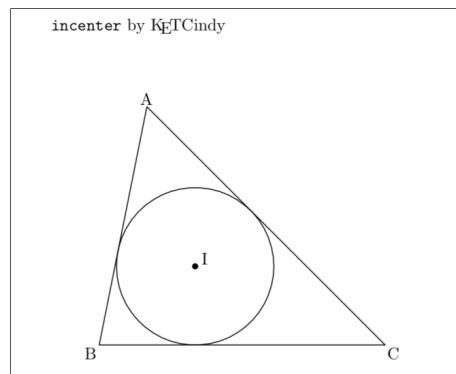


In this stage, the programming capabilities inherently implemented to Cindyscript can be used simultaneously. Execute the whole program by clicking the "Run" button. For more details, see section 3.

- (3) Click the button named **Figures** in Euclidean view to automatically generate the following files in the folder named "fig". Here, "incenter" is the name specified via the command `Setfiles("incenter")` in step (2).

<code>kc.sh</code> or <code>kc.bat</code>	shell script file(Mac) or batch file(Windows)
<code>incenter.r</code>	
<code>incenter.tex</code>	$\text{T}_{\text{E}}\text{X}$ file composed of graphical codes
<code>incentermain.aux</code>	
<code>incentermain.log</code>	
<code>incentermain.pdf</code>	PDF file to display the resulting graphical image
<code>incentermain.tex</code>	$\text{T}_{\text{E}}\text{X}$ file temporarily used to generate the file <code>incentermain.pdf</code>

Subsequently, the file `incentermain.pdf` is automatically displayed as shown below.



We can manipulate this final output by modifying the inputs in steps (1) and (2) before processing the step (3) again.

- (4) Using KETpic package of $\text{T}_{\text{E}}\text{X}$, `incenter.tex` can be read into the targeting $\text{T}_{\text{E}}\text{X}$ document via the command

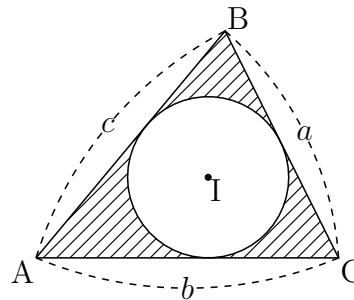
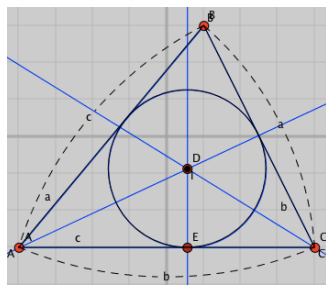
$$\backslash\text{input}\{\text{incenter}\}$$

Then the same figure is embedded in the targeting PDF output.

1.2 Geometric Figures

Producing geometric figures in the plane is easy. Moreover, we can add hatchings in some areas, which is better than shading for monochrome printing. The following are the main parts of the script.

```
Listplot([A,B,C,A]);
Circledata([D,E]);
Bowdata([B,A],[1,0.5,"Expr=c","da"]);
Bowdata([C,B],[1,0.5,"Expr=a","da"]);
Bowdata([A,C],[1,0.5,"Expr=b","da"]);
Hatchdata("2",["oi"],[["crDE"],["sgABCA"]],["dr,0.7",""]);
Pointdata("I",D,["size=4"]);
Letter([A,"sw","A",B,"ne","B",C,"se","C",D,"se","I"]);
```



1.3 Graphs of Functions

KETCindy can produce graphs of functions with

```
Plotdata("1","x^2","x");
```

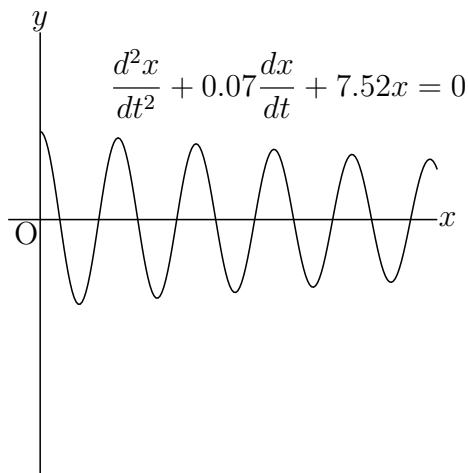
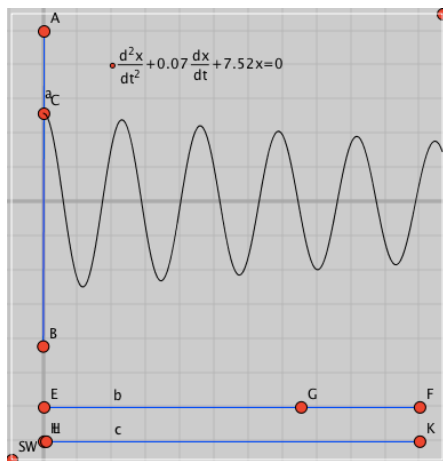
or parametrically with

```
Paramplot("1","[2*cos(t),sin(t)]", "t=[0,2*pi]");
```

Here we give an example of the solution curve of a differential equation. The script is:

```
Deqplot("1","y``=-L.x*y'-G.x*y","t=[0,XMAX]",0,[C.y,0]);
// the equation is y'=-ay'-by (a=L.x, b=G.x).
// C.y,0 are initial values of y and y' at t=0.
Expr(M,"e","\displaystyle\frac{d^2 x}{dt^2}+"
      "+L.x+"\frac{dx}{dt}"+G.x+"x=0");
```


Note that points C, G, L on segments AB, EF, HK are movable, and are used to decide the coefficients and the initial value as you can see in the above scripts.



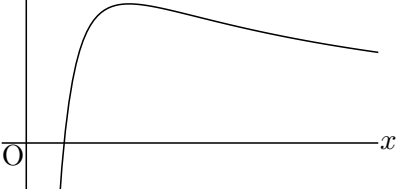
1.4 Drawing Tables

Writing the code for tables to be inserted into the $\text{T}_{\text{E}}\text{X}$ documents is sometimes troublesome. However, it is not a hard job for $\text{K}_{\text{E}}\text{T}_{\text{C}}\text{indy}$ (see the output in Figure).

```
xLst=apply(1..7,15);
yLst=[10,10,10,10,80];
rmvL=apply(1..6,"c"+text("#)+"r4r5");
rmvL=concat(rmvL,["r2c1c2","r3c1c2"]);
Tabledata("",xLst,yLst,rmvL);
Tlistplot(["c1r1","c2r4"]);
Tlistplot(["c2r1","c1r4"]);
Putrowexpr(1,"c",
  ["x","0","\cdots","e","\cdots","e\sqrt{e}","\cdots"]);
Putrowexpr(2,"c",["y`","","+","0","-","-","-"]);
Putrowexpr(3,"c",["y`","","-","-","-","0","+"]);
Putrowexpr(4,"c",["y","","","10/e","","15/e\sqrt{e}",""]);
Putcell("c0r4","c7r5","c","\input{fig/graph}");
```

x	0	\cdots	e	\cdots	$e\sqrt{e}$	\cdots
y'		+	0	-	-	-
y''		-	-	-	0	+
y			$\frac{10}{e}$		$\frac{15}{e\sqrt{e}}$	

y



x

O

1.5 Plotting data

Here we call the data computed to generate the graphs of functions and geometric elements "Plotting data" which is abbreviated as PD. The PD to draw segment is the list of coordinates of its two endpoints. For example, when the coordinates of the points A and B are (1, 1) and (3, 2) respectively, PD of the segment AB named `Listplot ([A,B])` is stored in the form `[[1,1],[3,2]]`. Also the PD to draw a curve is the collection of those for drawing small segments which connect contiguous dividing points of the curve. PD are automatically given names via `KETCindy` following the rules below.

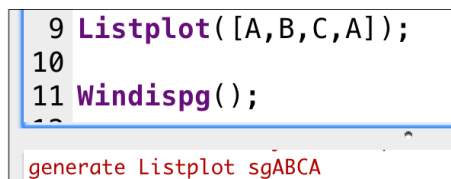
- The beginning part of the PD's name depends on the kind of the corresponding graphical element. For instance, `sg` is associated to segments and `cr` is associated to circles.
- When some extra name is specified as the first argument in the definition of PD, it is added to the beginning part given above. For instance, the PD defined below is given the name `sg1`.

```
Listplot("1",[[0,0],[1,2]]);
```

- When the extra name is not needed, the names of the points are added to the beginning part given above. For instance, the PD defined below is given the name `sgABC`.

```
Listplot([A,B,C]);
```

Once PD are generated, their names are displayed on the console view of Cinderella. For instance, when the PD named `sgABCA` is generated, the corresponding message is displayed as shown below.



```
9 Listplot([A,B,C,A]);
10
11 Windisp();
12
generate Listplot sgABCA
```

Also the content of PD is displayed via the function `println()` of Cindyscript. For instance, inputting the command `println(sgABCA)` makes the following list displayed.

```
[[1,3],[-1,0],[3,0],[1,3]]
```

This list is composed of the coordinates of the points A, B, and C.

These names of PD are used when the corresponding PD need to be transformed. For instance, PD to draw the parallel transport of the segment AB is generated via the `KETCindy` command

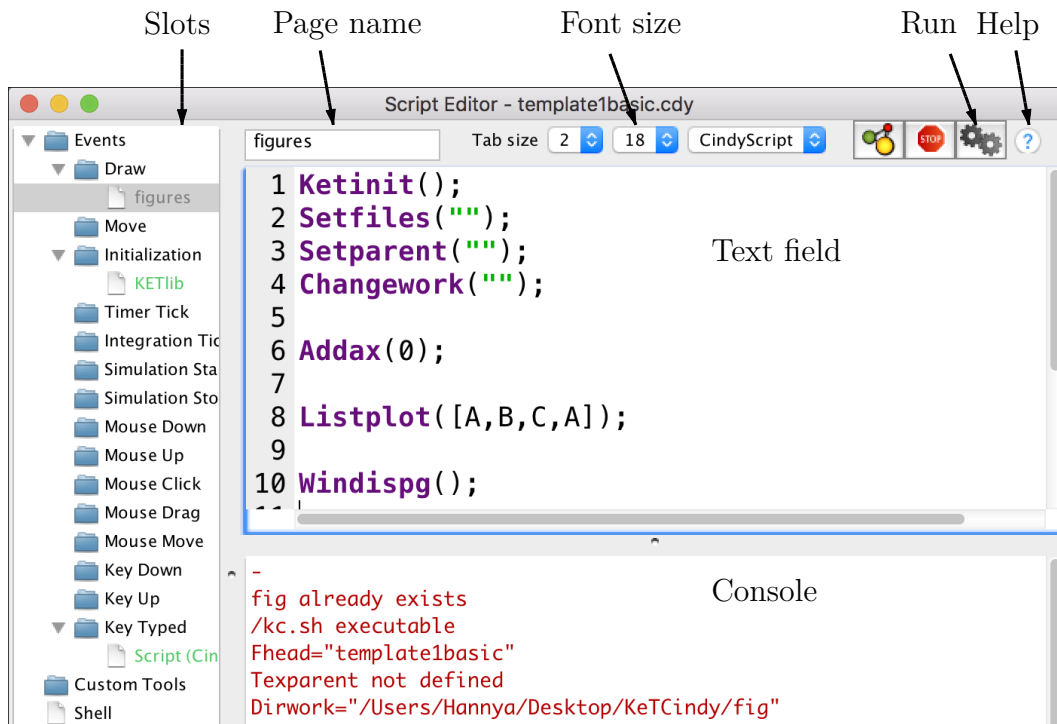
```
Translatedata("1","sgAB",[2,3]);
```

PD can be generated also by using the programming capability of Cindyscript which can be subsequently used in `KETCindy`. For more details, see the example of `Listplot()` in the command reference. Inclusion of too much elements into a single PD may cause some error. To prevent such error, PD should be divided into several PD each of which is composed of 200 elements or so.

2 Cindyscript

2.1 Cindyscript editor

Choose "Cindyscript" in the "Scripting" menu or push keybuttons Ctrl+9 (Windows) / Command+9 (Mac), then Cindyscript editor opens as shown below.



Commands can be input into preferred "slot". Specific timing for execution of commands is assigned to each slot. The slot for current work can be chosen only by clicking the corresponding tab in the menu. Users can add extra pages to each slot. For instance, when some initialization other than those included in KETlib is needed, clicking the folder icon of "Initialization" makes a new page open in which extra commands can be input. The name of each page can be given by directly inputting it into the "Page name" column. The font size of the scripts can be tuned by changing the number in the "Font size" column. Frequently used slots are listed below.

- Draw

The commands in this slot are executed when some change, like movement of point, occurs in the Euclidean view. In `templatebasic1.cdy`, the prototype page named `figure` including the KETCindy commands like `Ketinit()`; and `Windispg()`; which are unconditionally necessary has been prepared. The KETCindy commands for drawing should be input into this slot.

- Initialization

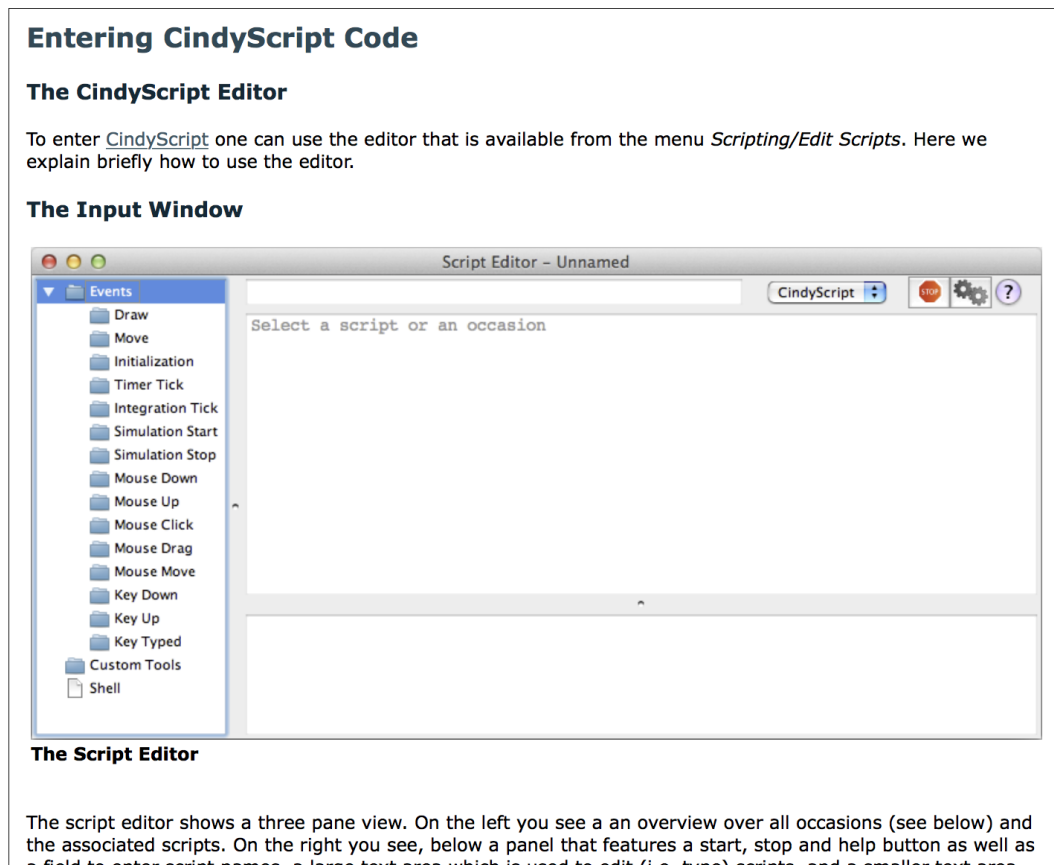
The definitions of functions and the initial values of variables are input here. The commands in this slot are executed only once just after the "Run" button is clicked. Thus, the initial data in this slot is changed when some modifications are made in other slots. In `templatebasic1.cdy`, the prototype page named `KETlib` including the default setting of KETCindy has been prepared.

- Key Typed

The commands in this slot are executed when some key is pushed.

Clicking "Run" button or pushing the keybuttons Shift+Enter makes the whole program be executed. The results derived from executing the function `print()` and error messages are displayed on the console view which is put at the bottom part of Cindyscript editor. Each error and its location is displayed together with the message "WARNING" or "syntax error". The outputs displayed on the console can be copied to other usual text editors.

Click the "Help" button, then reference manual of Cinderella opens as shown below.



2.2 Input

The attribute of each input into Cindyscript is specified via the color of the corresponding letters as listed below.

- The functions which are inherently implemented to Cinderella are displayed via blue color.
- The functions which are defined by user, including those of `KE TCindy`, are displayed via purple color.
- The functions which are not yet defined are displayed via red color.
- Strings are displayed via green color.

As in the console view, copying and pasting to the other usual editing software via pushing the keybuttons Ctrl+C and Ctrl+V is accessible. Cutting and pasting via Ctrl+X and Ctrl+V is also possible. Also as in the other editing software, preferred strings can be specified via dragging mouse or pushing the keybutton Shift and moving the sursor. Serching for words via pushing Ctrl+F has not been enabled.

The fundamental rule of describing scripts on Cindyscript editor are listed below.

- Upper- and lowercase letters are distinguished. Using lowercase letters is preferable.

- As in $\text{T}_{\text{E}}\text{X}$, several blanks are regarded as a single blank.
- A semicolon should be located at the end of each row. Starting a new paragraph does not result in the ending of commands.

Particularly, in case of $\text{K}_{\text{E}}\text{T}_{\text{C}}\text{Cindy}$, the input of commands are controlled by the following rules.

- The names of global variables begin with uppercase letters.
- The names of local variables begin with lowercase letters. Local variables are declared at the beginning part of the definitions of functions along with the Cinderella command `regional()`.
- The names of functions begin with uppercase letters.

2.3 Variables and constants

The declaration of the attribute of each variable is not needed in Cindyscript since it is automatically decided according to the input. Moreover, the different kind of value can be input without any declaration.

Example

```
a=10;
b=2;
c=a+sqrt(b);
a="the square root of"
println("The sum of"+a+b+"'and 10 is'+c);
```

In this example, the attribute of variable `a` was firstly integer, and then changed to string at the fourth row.

The strings should be input with double quotation marks. The mathematical operations which involve several kind of variables must be taken much care. Exceptionally, connecting string and number with `+` results in the generation of one single string.

The variable `pi` is reserved in Cindyscript as the ratio of the circumference of a circle to its diameter. Also the variable `i` is reserved as the imaginary unit. When `i` is used as variable once, it is changed to the imaginary unit via the command

```
i=complex(0,1);
```

There are also some reserved variables in $\text{K}_{\text{E}}\text{T}_{\text{C}}\text{Cindy}$. Among them, the following ones can be changed by users.

<code>Fhead</code>	the beginning part of the file name which can be set by <code>Setfiles()</code>
<code>Texparent</code>	the name of parent file which can be set by <code>Setparent()</code>
<code>Dirhead</code>	the beginning part of the path
<code>Dirlib</code>	the path to the library ketlib
<code>Dirbin</code>	the path to ketbin
<code>Dirwork</code>	the path to the working directory which can be set by <code>Changework()</code>
<code>Shellfile</code>	the name of shell file

Contrarily, the reserved variables listed below are the global variables used in the library of $\text{K}_{\text{E}}\text{T}_{\text{C}}\text{Cindy}$, whence cannot be changed by users.

ADDAXES, ArrowlineNumber, ArrowheadNumber, BezierNumber, COM0thlist, COM1stlist, COM2ndlist, Dq, FUNLIST, Fnamesc Fnamescibody Fnameout Fnametex, GDATAList, GLIST, GCLIST, GOUTLIST, KCOLOR, KETPICCOUNT, KETPICLAYER, LETTERlist, LFmark, MilliIn, PenThick, PenThickInit, POUTLIST, SCALEX, SCALEY, SCIRELIST, SCIWRLIST, TenSize, TenSizeInit, ULEN, XMAX, XMIN, YaSize, YaThick, YMAX, YMIN, VLIST

2.4 Frequently used commands

3 Collaboration with other softwares

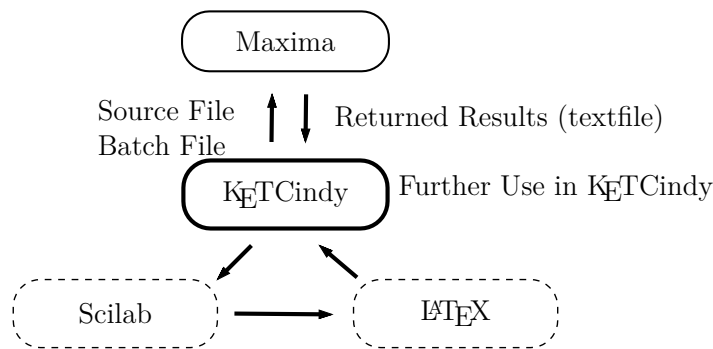
3.1 Overview

K_ET_Cindy has functionalities to call other softwares such as Maxima, Risa/Asir, R and C. Here, we introduce how to call Maxima.

The steps are as follows.

1. Generate the shell file to call a CAS.
2. Execute the file.
3. Return the result as text.
4. Use the result in K_ET_Cindy.
5. Produce the PDF file.

And the flowchart is as follows:



When interfacing with Maxima, commands `Mxfun`, `CalcbyM` and `Mxtex` are all we need to complete the task. `Mxfun` and `CalcbyM` are for calling single command and multi commands of Maxima respectively. `Mxtex` is used for code conversion to `LaTeX`. The output of Maxima is returned to K_ET_Cindy as a string or a list of strings for further processing.

The options of these commands are:

- "m/r" To decide whether the result file will be made again or not.
If these options are not given, K_ET_Cindy decides automatically.
- "Disp=y/n" To decide whether the result will be displayed in the console or not.
It is only available for `Mxfun` and `Mxtex`. The default is "y".

3.2 Commands related to Maxima

Mxfun

The arguments are name of variable in K_ET_Cindy, name of a function of Maxima, and a list of arguments of the function.

```
Mxfun("1","diff",["sin(x)","x"]); // The return is "cos(x)", assigned to mx1.
```

The above is equivalent to

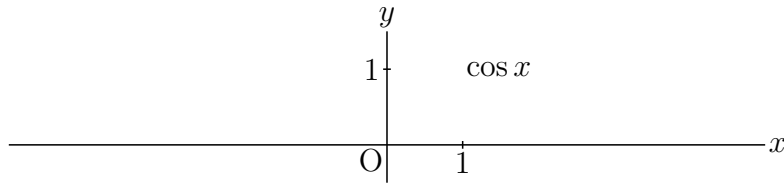
```
Mxfun("1","diff(sin(x),x)",[]);
```

Mxtex

The arguments are name of variable in K_ET_Cindy, an expression in Maxima format.

```
Mxtex("1",mx1); // The return is "\cos x", assigned to tx1.
```

```
Expr([0,1],"e",tx1);
```



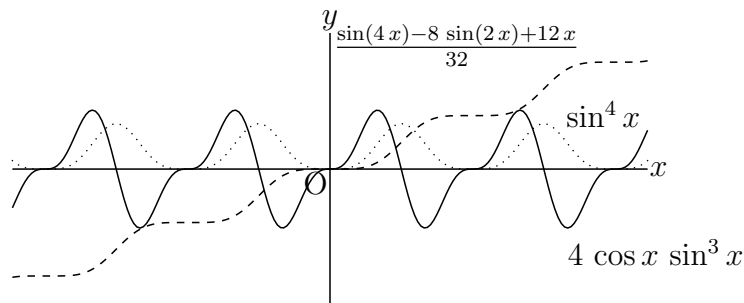
CalcbyM

The arguments are name of variable in KeTCindy, a list of commands and the arguments of Maxima.

```
fn="sin(x)^4";
cmdL=[
  "df:diff",[fn,"x"],
  "df:ratsimp",["df"],
  "F:integrate",[fn,"x"],
  "F","ratsimp",["F"],
  "df::F",[]
];
CalcbyM("ans",cmdL);
```

The returned value is a list of df and F as strings, though these are not displayed in the console. They can be used, for example,

```
Plotdata("1",fn,"x",["Num=200","do"]);
Plotdata("2",ans_1,"x",["Num=200","dr"]);
Plotdata("3",ans_2,"x",["Num=200","da"]);
Mxtex("1",fn);
Mxtex("1",ans_1);
Mxtex("2",ans_2);
Expr([A,"e",tx1,B,"e",tx2,C,"w",tx3]);
```



Remark See KeTCindyreferenceE.pdf for more information.

3.3 Commands related to R

Rfun and CalcbyR are similar to Mxfun and CalcbyM.

See KeTCindyreferenceE.pdf or samples/s08R for more information.

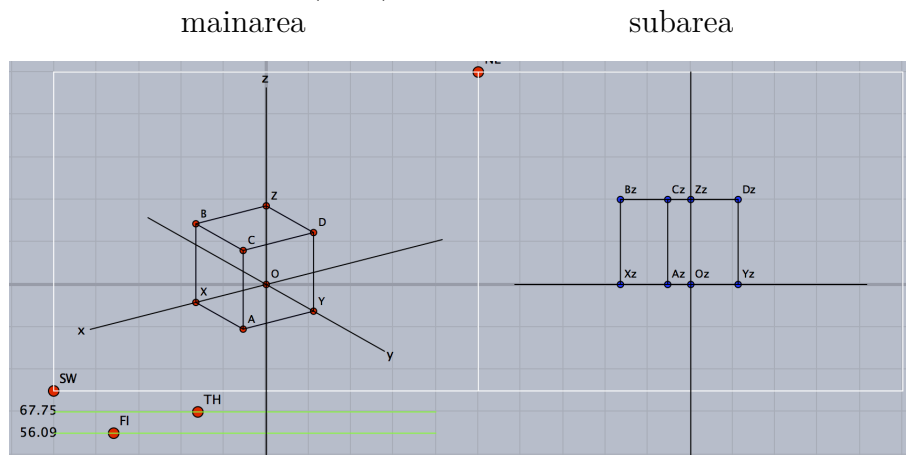
4 Three Dimentional figures of K_ET_Cindy

4.1 Summary and Geometric Elements

In KeTCindy's 3D-mode, there are two rectangular areas surrounded by a white frame on the Euclidean view.

The main area on the left side of the screen is similar to that of two dimentional figures. Figures in this area will be drawn to the T_EX document. The view direction can be moved with sliders under the main area. TH and FI mean angles θ and φ respectively, which are polar cocordinates of the view direction.

Figures from the view direction $(0, \varphi)$ are displayed in the sub area on the right side.



With internal command `Ptseg3data` which is called in `Start3d`, a point put to the main area with the drawing tool of Cinderella is regarded as a 3D point by K_ET_Cindy, and a corresponding point is put in the sub area. Though the initial coordinate of z is 0, we can change it moving the point in the sub area.

For example, if we put point **A** on the main area, point **Az** will be put in the sub area and the 3D coordinates calculated from **A** and **Az** are assigned to variable **A3d**.

Remark Note that point **Az** will not be deleted automatically even if point **A** is deleted. We should delete it manually.

Geometric segment in the main area generates the corresponding geometric segment in the sub area as well.

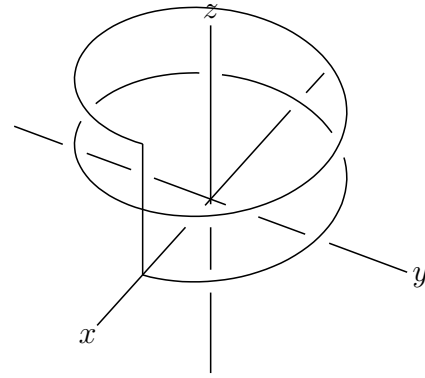
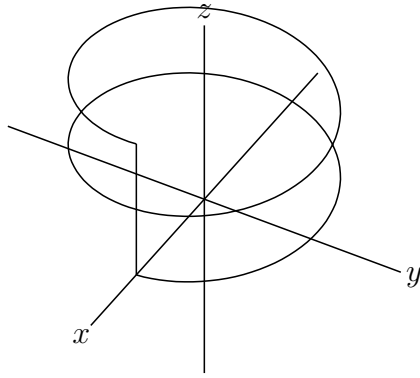
4.2 Lines and Curves

K_ET_Cindy commands `Spaceline` and `Spacecurve` are used to draw lines and curves in the space. Additionally, `Xyzax3data` is used to draw axis.

Examples

```
Xyzax3data("", "x=[-5,5]", "y=[-5,5]", "z=[-5,5]");
Spacecurve("1", "3*[cos(t),sin(t),0.1*t]", "t=[0,4*pi]", ["Num=200"]);
pt1=[3,0,0]; pt2=[3,0,3*0.1*4*pi];
Spaceline("1", [pt1,pt2]);
Skeletonparadata("1");
```

Remark The last command `skeleton elimination` is for skeleton elimination. Compare two figures below. The right one is with skeleton elimination.



4.3 Two Dimensional Figures

Data of two dimensional figures such as polyhedra or planes are given in obj format.

Examples

```
Start3d();
vertex=[[2,2,-2],[2,-2,-2],[-2,-2,-2],[-2,2,-2]];
Reflect3d1(`1'',vertex,[[0,0,0],[1,0,0],[0,1,0]]);
vertex=concat(vertex,ref3d1);
edge=[[1,2,6,5],[1,5,8,4],[1,4,3,2],[2,3,7,6],[3,4,8,7],[5,6,7,8]];
cube=[vertex,edge];
plane=[[[-3,1,-3],[3,-1,-3],[-4,5,3],[2,3,3]],[[1,2,4,3]]];
tmp=Concatobj([cubic,plane]);
VertexEdgeFace("1",tmp,["Vtx=nogeo","Edg=nogeo"]);
Nohiddenbyfaces("1","phf3d1"); // for the figure on the left
```

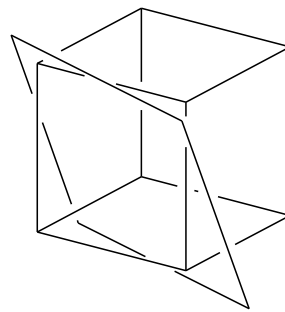
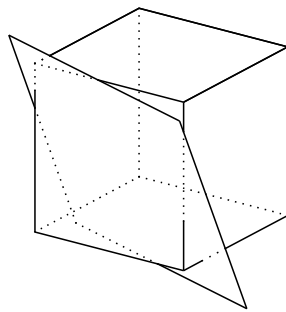
Remark

Command `Concatobj` combines data in obj format.

Command `VertexEdgeFace` assigns vertices to `phv`, edges to `phe` and faces to `phf`.

Command `Nohiddenbyfaces` is for hiddenline elimination.

Use `Skeletonparadata("1")` if the figure on the right is desirable.



Remark See `KetCindyreferenceE.pdf` or `samples/s05spacefigure` for more information.

4.4 Surfaces

Two variable function is defined as a list of one of the followings.

1. ["z=f(x,y)","x=[a,b]","y=[c,d]"]

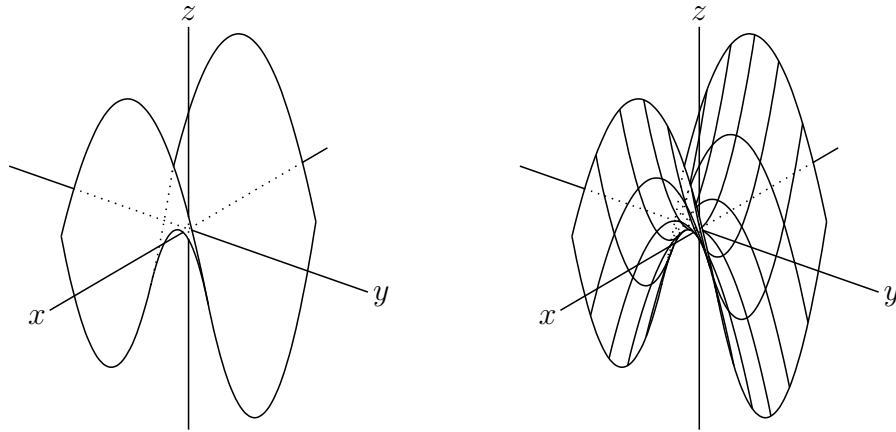
2. ["z=f(x,y)", "x=x(u,v)", "y(u,v)", "u=[a,b]", "v=[c,d]"]
3. ["p", "x=x(u,v)", "y=y(u,v)", "z=z(u,v)", "u=[a,b]", "v=[c,d]"]

Optionally, you can add what boundaries should be drawn. The default is "wesn". Here, for example, "w" means the boundary defined by $[a, t]$ ($c \leq t \leq d$).

KE_TCindy calls C to speed up the calculation of hidden lines elimination.

Example

```
Start3d();
Xyzax3data("", "x=[-5,5]", "y=[-5,5]", "z=[-5,5]");
fd=["z=x^2-y^2", "x=[-2,2]", "y=[-2,2]", "senw"];
Startsurf();
Sfbdparadata("1", fd);
Crvsfparadata("1", "ax3d", "sfbd3d1", fd);
ExeccmdC("1"); Windisp();
```



Remark Wires can be added if necessary with command `Wireparadata` as seen in the upper right side figure. The line-style also can be changed.

See `KeTCindyreferenceE.pdf` or `samples/s09surfaceC` for more information.

4.5 Generating Files in Obj Format

KE_TCindy can generate files of 3D figures in obj format. Moreover, KE_TCindy also can call Meshlab which is a 3D viewer.

Examples

```
Xyzax3data("", "x=[-5,5]", "y=[-5,5]", "z=[-5,5]");
fd=["p", "x=4*sin(V)*cos(U)", "y=4*sin(V)*sin(U)", "z=4*cos(V)",
    "U=[pi/2,4*pi/2]", "V=[0,pi]", "we"];
Mkobjcmd("1", fd, [40,40, "-"]);
Mkobjcrvcmd("2", "ax3d", [0.05, "xy"]);
Mkobjsymbcmd("x", 0.2, 0, [0,1,0], [5.2,0,0]);
Mkobjsymbcmd("y", 0.2, 0, [1,0,0], [0,5.2,0]);
Mkobjsymbcmd("z", 0.2, 0, [0,1,0], [0,0,5.2]);
SetObj();
```

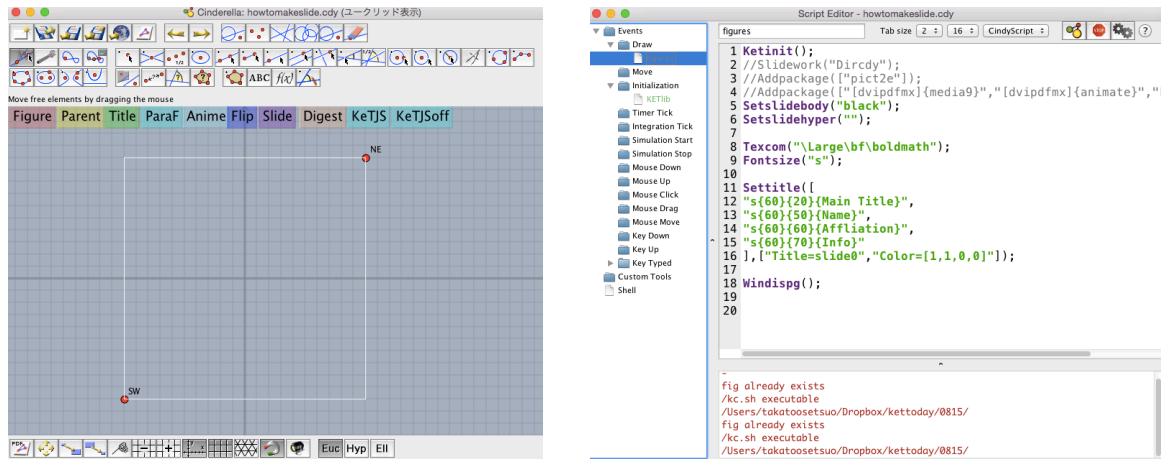
Remark See `KeTCindyreferenceE.pdf` or `samples/s13meshlab` for more information.

5 Making Slides

5.1 Overall Flow

KE_TCindy has functions to make slides for presentation. For this, follow steps below:

- 1) Copy and rename `template2slide.cdy` in `ketcindy` folder to a work folder and double-click the file (here, we call `sample.cdy`). Then the followings will appear.



- 2) Edit "Settitle", for example,


```
Settitle([
    "s{60}{20}{How To Use}",
    "s{60}{50}{a \ketcindy\ member}",
    "s{60}{60}{\ketcindy\ project}",
    "s{60}{70}{Aug. 20th}"
], ["Color=[1,1,0,0]"]);
```
- 3) Press button "Title", then the title page will be displayed. At the same time, text file "sample.txt" will be created if it does not exist. This `sample.txt` is a template file for making slides.
- 4) Press button "Slide", then KE_TCindy will make `sample.tex` from `sample.txt`, typeset it, and display `sample.pdf` which contains slides for presentation.

5.2 Editing Text File

- 1) Put `//` at the last of each line.

Rm) Use `||||` for `//`.

- 2) Commands are

```
title::titleslidenamename(::wallpaper)//
    Rem) Put only once at the first line.
main::(main title)//
new::(page title)//
enumerate//
    =\begin{enumerate}
    Rem) Add the option such as [(1)] using :: .
itemize//
    =\begin{itemize}
```



```

layer::{xsize}{ysize}//
    =\begin{layer}{xsize}{ysize}
    Rem) "layer" is an environment defined in ketlayer.sty.
item::sentence//
    =\item sentence
putnote::dir{xpos}{ypos}::filename(,scale)//
    =putnotedir{xpos}{ypos}{\input{fig/filename}}|
    Rem) "putnote" is a command defined in ketlayer.sty
end//
    =\end{itemize,enumerate,layer}
...//
    To insert a blank line.
Rem) Any other TeX command is available.

```

5.3 Display of Page step by step

- 1) Put just after new,
`%repeat=number of steps//`
- 2) Put at the head of each line as
`%[2,-]::sentence`
`display at all steps from 2`
`%[-,2]::sentence`
`display at all steps until 2`
`%[1..3,5]::sentence`
`display at steps of 1,2,3 and 5`
- 3) Use `%thin` to display with thin letters.
`%thin::[2,-]::sentence`
- 4) The dencity can be changed with `Setslidebody` or `\setthin`.

5.4 Making Flip Animation

- 1) Define function `Mf(s)`, the state at `s`.
- 2) Put command `Setpara` in the script editor as
`Setpara(subfolder,functionstr(mf(s)),range,options);`
`options=["m/r", "Div=25"];`
- 3) Describe in the text file as
`%repeat=, para=subfolder:{0}:s{60}{10}:input(:scale)//`
- 4) Press buttons `ParaF` and `Flip`, then `subfolder` will be generated.
- 5) Press button `Slide`.

5.5 Making Animation

- 1) Add the following in the script editor
`Addpackage(["[dvipdfmx]{animate}"]);`

- 2) Add in the second option of Setpara,
"Frate=num of frame in the second,"Scale=scale,"OpA=option of animation"
- 3) Press buttons ParaF and Anime, then subfolder will be generated.
- 4) Use \input, not layer, to display.

5.6 Changing Style

The default styles such as size and color of letters can be changed. See KeTCindyReferenceE, pdf or samples/s07slides.