

# A T<sub>E</sub>X<sub>MACS</sub> graphics Tutorial

by

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## 1 Introduction

This document describes the T<sub>E</sub>X<sub>MACS</sub>'s graphical tool, that one can use for making drawings, illustrations, organigrams, etc. In section 1, we introduce this graphical tool using a simple example, for which we show in detail the operations that an user must perform to build it step by step. In the sections 2 to 8, we describe all the currently available features of this graphical tool. The section 9 gives an overview of our current ideas for future improvements (feedbacks about that (and also about this very tutorial) are expected, and welcomed :-). Finally, the appendixes A and B summarize the T<sub>E</sub>X<sub>MACS</sub>'s graphical markup and the use of the *Scheme* built-in scripting language to generate calculated drawings, respectively.

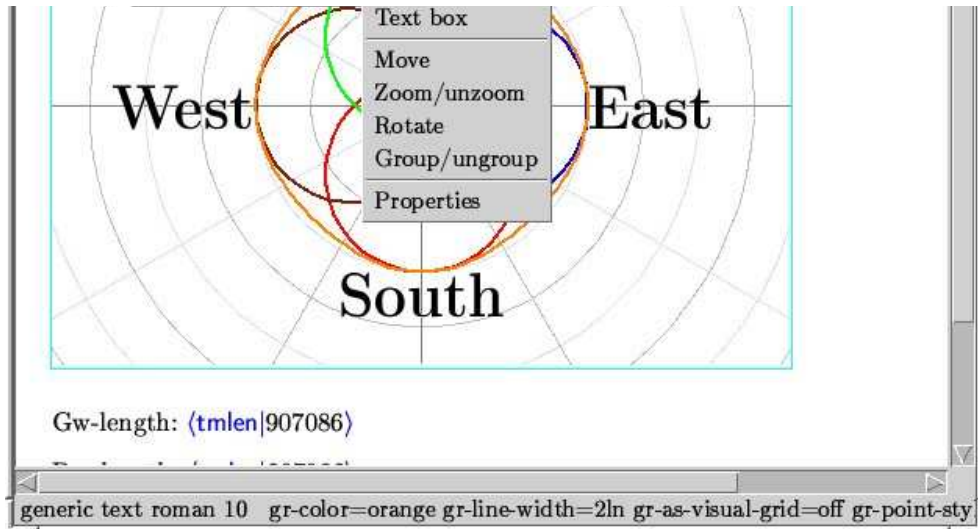
### 1.1 Overview

The T<sub>E</sub>X<sub>MACS</sub>'s graphical tool is built on different complementary tools, namely :

- i. A *Grid*, that you can use to precisely set the position of the cursor. One can change the parameters of a grid in order to make it more or less fine-grained, and also change the colors of the different kinds of lines (axis, units, subunits) of a grid. Two grids simultaneously exist, on the one hand the *Edit grid*, that constraints the position of the cursor, but is invisible, and on the other hand the *Visual grid*, that has no effect on cursor's position, but helps you to see better what you are doing. The two grids can be the same, or either one can use different grids, for example an Edit grid that is a little bit more fine grained than the Visual grid. Finally, three kinds of grids are currently available : *Cartesian* grids, *Polar* grids, and *Logarithmic* grids (see Section 2) ;
- ii. A *Curve* drawing tool. The currently available curves are : *(Poly)lines*, *Closed (poly)lines*, *Splines*, *Closed splines*, *Arcs*, and *Circles*. Different kinds of dots are also available (*disks*, *round dots*, and *square dots*) (see Section 3) ;
- iii. One can also insert a *Text box* at a particular position in the graphics. Such a Text box can contain any kind of T<sub>E</sub>X<sub>MACS</sub> markup, and one can tune its horizontal and vertical alignment (referring to the anchor dot that defines the position of the Text box in the graphics) (see Section 4) ;
- iv. Different kinds of *Properties* of the graphical objects above are available, namely the *Color*, the *Line width*, the *Dash style*, different kinds of *Arrows*, and the *Fill Color*. New Dash styles and new kinds of arrows can be defined by the user (see Section 5 & Appendix A.2) ;
- v. One can *Select* one or more objects, and *Copy*, *Cut* and *Paste* such a set of selected objects (see Section 6) ;
- vi. One can apply operations on a set of selected objects, namely, *Groupings/Ungroupings*, *Moves*, *Zoomings/Unzoomings* and *Rotations* (see Section 7) ;
- vii. Miscellaneous : change the dimensions of the graphics, move the center of the frame, zooming/unzooming of the whole graphics (see Section 8).

## 1.2 Presentation of the user interface

Once you are in graphics mode, the *Graphics menu* :



and the *Graphics iconbar* appear in the interface :

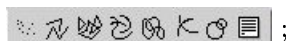


The *graphics iconbar* is made of four parts :

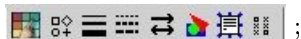
- The *Global graphics properties* sub-iconbar. This iconbar contains two icons, which are shortcuts to the *Graphics/Geometry* and to the *Graphics/Grids* menus, respectively :



- The *Graphics modes* sub-iconbar. This iconbar contains eight icons, which can be used to switch to one of the eight *insert modes* of the graphical editor. These icons are shortcuts to the *Point*, *Line*, *Polygon*, *Spline*, *Closed spline*, *Arc*, *Circle* and *Text box* items of the *Graphics/Mode* menu, respectively :



- The *Graphical objects properties* sub-iconbar. This iconbar contains seven icons, which can be used to change the current current value of one of the seven available *properties* of the graphical objects in the editor. These icons are shortcuts to the *Color*, *Point style*, *Fill color*, *Line properties/Width*, *Line properties/Dashes*, *Line properties/Arrows* and *Text box alignment* items of the *Graphics* menu, respectively. The last icon of the *Graphical objects properties* sub-iconbar is a shortcut to the *Graphics/Enable change* submenu (which is used to enable / disable the change of individual properties in the *Change objects properties* mode) :

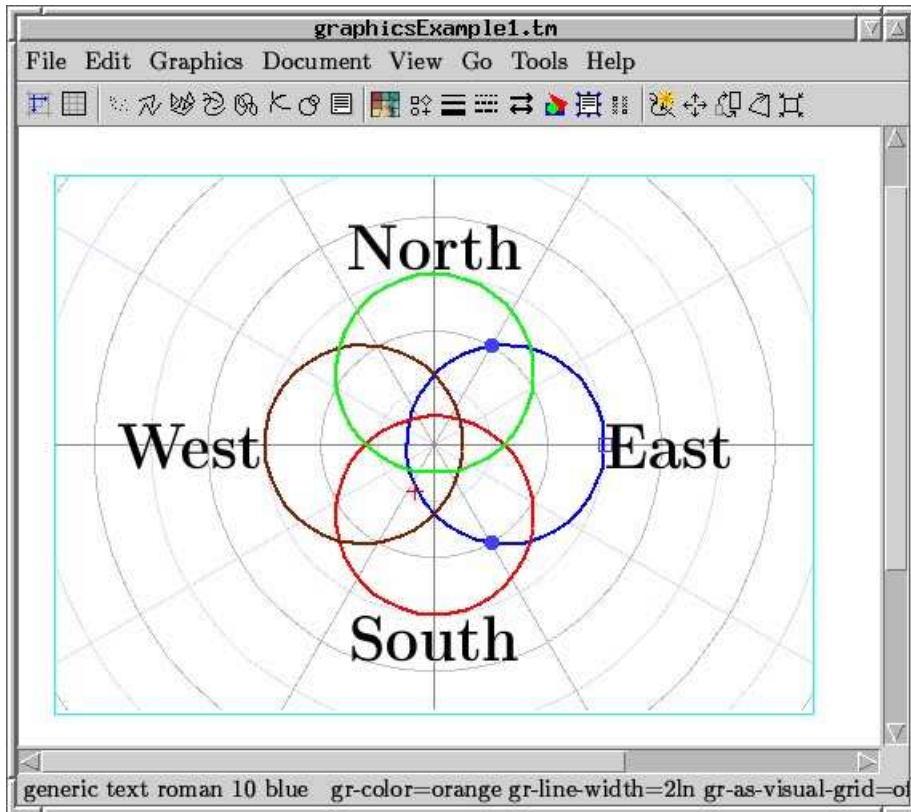


- The *Group operations* sub-iconbar. This iconbar contains five icons, which can be used to switch to one of the five *group modes* of the graphical editor. These icons are shortcuts to the *Properties*, *Move*, *Zoom/unzoom*, *Rotate* and *Group/ungroup* items of the *Graphics/Mode* menu, respectively :



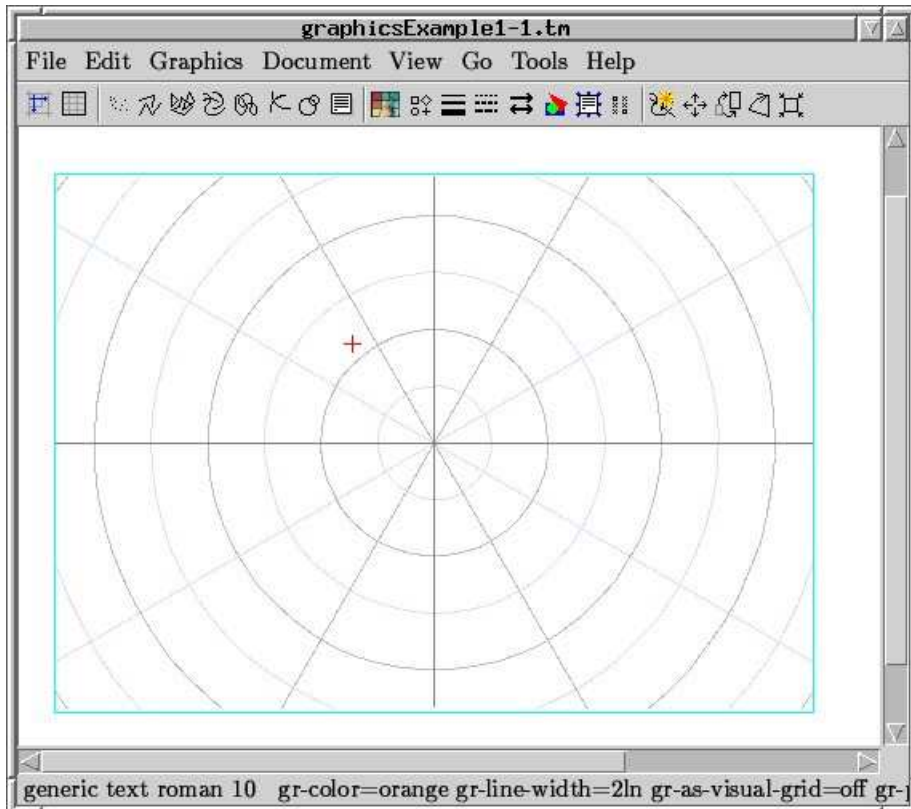
### 1.3 Introductory example

In order to allow you to immediately try the  $\text{T}_{\text{E}}\text{X}_{\text{MACS}}$ 's graphical tool, even if you know nothing about that yet, we will now show you step by step how to build the following drawing :



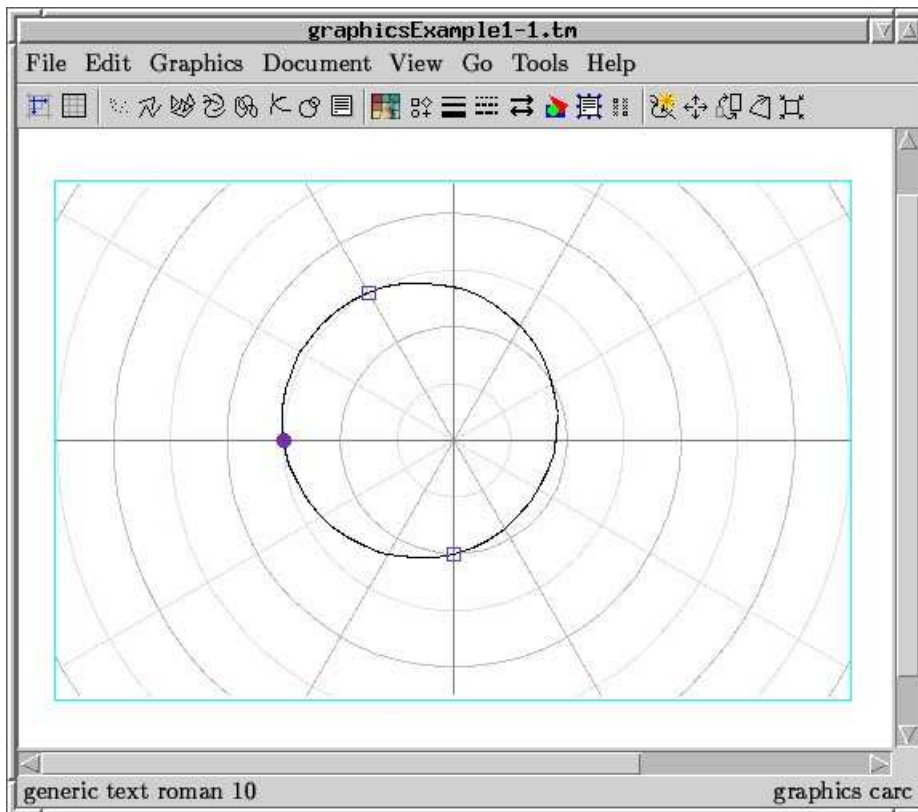
### 1.3.1 Insert a new graphics and set the parameters of the grids

First, let's insert a new Graphics in the document. For this, do *Insert/Image/Draw image*. Then, add a Polar grid in the Graphics, using *Graphics/Grids/Visual grid/Type/Polar*. Then, we need to set the parameters of the grid ; to do it, select *Graphics/Grids/Visual grid/Unit length/2*, then select *Graphics/Grids/Visual grid/Number of polar steps/6*, then select *Graphics/Grids/Visual grid/Number of subunit steps/2*. We finally obtain a Graphics with the following Grid :

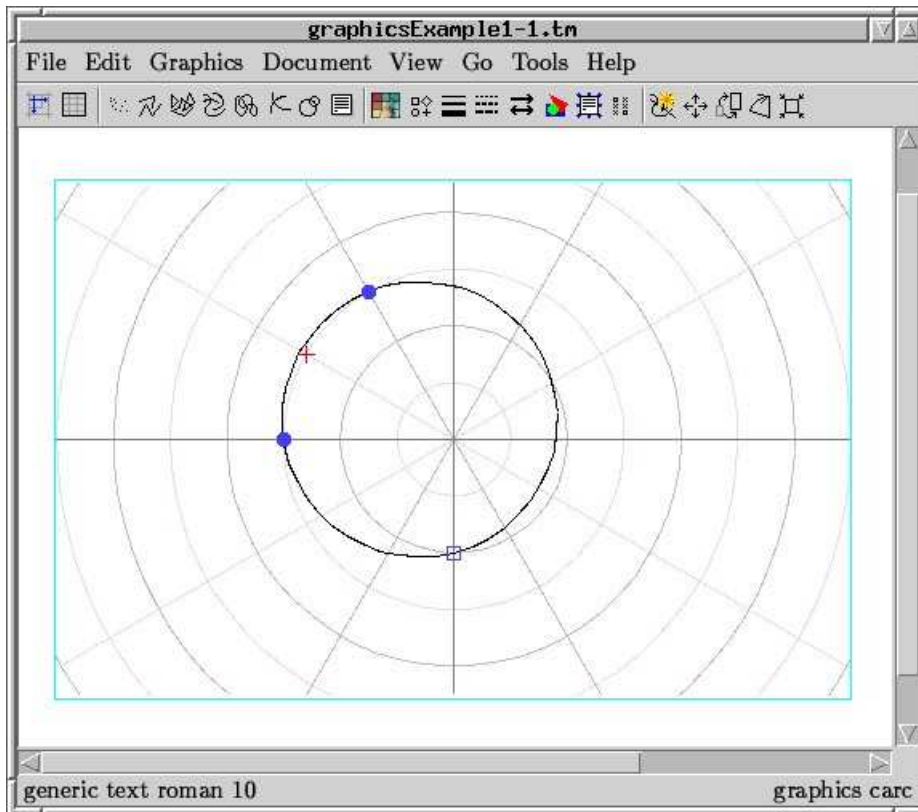


### 1.3.2 Insert a first circle

Now, we will insert a circle into the Graphics. To do this, choose *Graphics/Mode/Circle*, then move the cursor over the Graphics, and click the *Right mouse button* ; as soon as you move the mouse, you will see that you are moving the end of a line : when you click again on the *Right mouse button*, the third point of our Circle will be added, and our line will thus turn into a moving Circle. Finally, when you click on the *Left mouse button*, the whole Circle is inserted into the Graphics, and you are ready to insert another graphical object. We get something like :



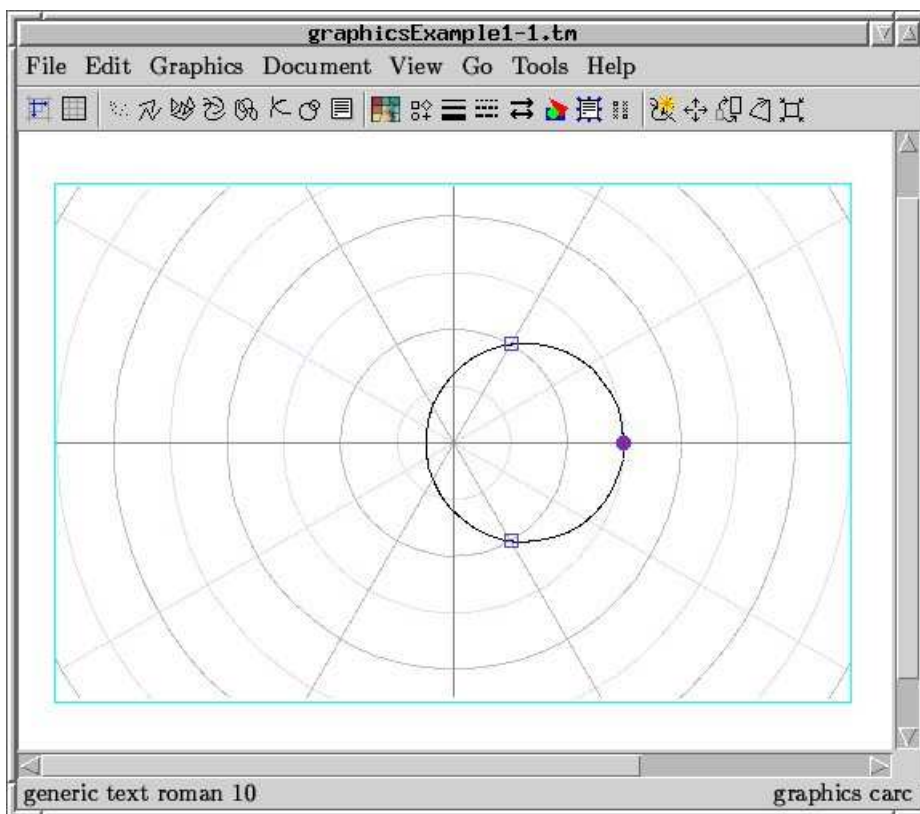
We will now see how to move the points of the circle to their intended positions. Observe that when you move the mouse above the circle, either the current *edge* is selected, or if the mouse is around one of the three *control points* that define the Circle, the current control point on the Circle becomes selected :



The edition of curves (lines, splines, ...) always behaves this way in  $\text{T}_{\text{E}}\text{X}_{\text{MACS}}$ . It should be noted that :

- when a *control point* of a curve is selected, in order to *move* it, one can **drag & drop** it, or either just click on it using the **Left mouse button**, *move* the point to the right position, then perform another **Left click** to set the new position of the control point ;
- when an *edge* is selected, in order to *insert* a new point, one can **drag & drop** or either perform a sequence **Left click/Move/Left click** ;
- when an *ambiguity* exists, or if you are around a control point but want to select one of the adjacent edges, just hit the **Tab** key until the element you want becomes selected [doesn't work ; fix it].

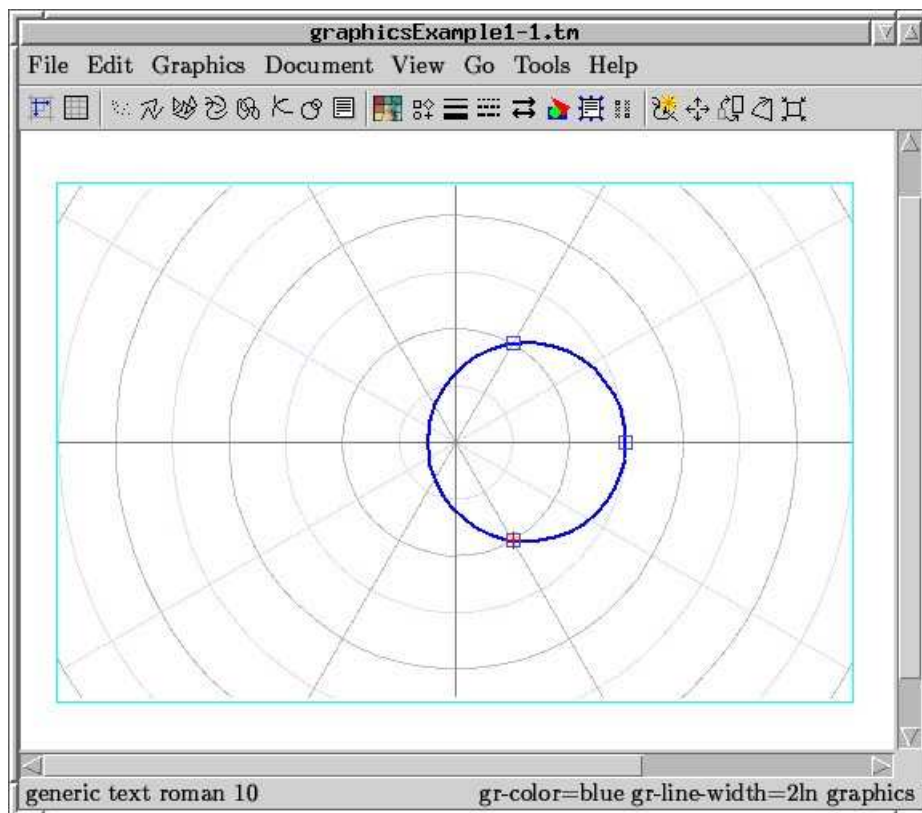
Now, let's move the Circle at the right position. We obtain :





### 1.3.3 Set the properties of this first circle

We will now turn our Circle into a blue, thicker one. To do this, we first set the current graphical properties by choosing *Graphics/Color/Blue*, then *Graphics/Line properties/Width/2ln*. To apply these properties to the circle, you must first select the appropriate edit mode : to do this, go to *Graphics/Mode/Properties*. Next, go inside the graphics and click on the Circle : then it immediately becomes thicker and blue. We obtain :



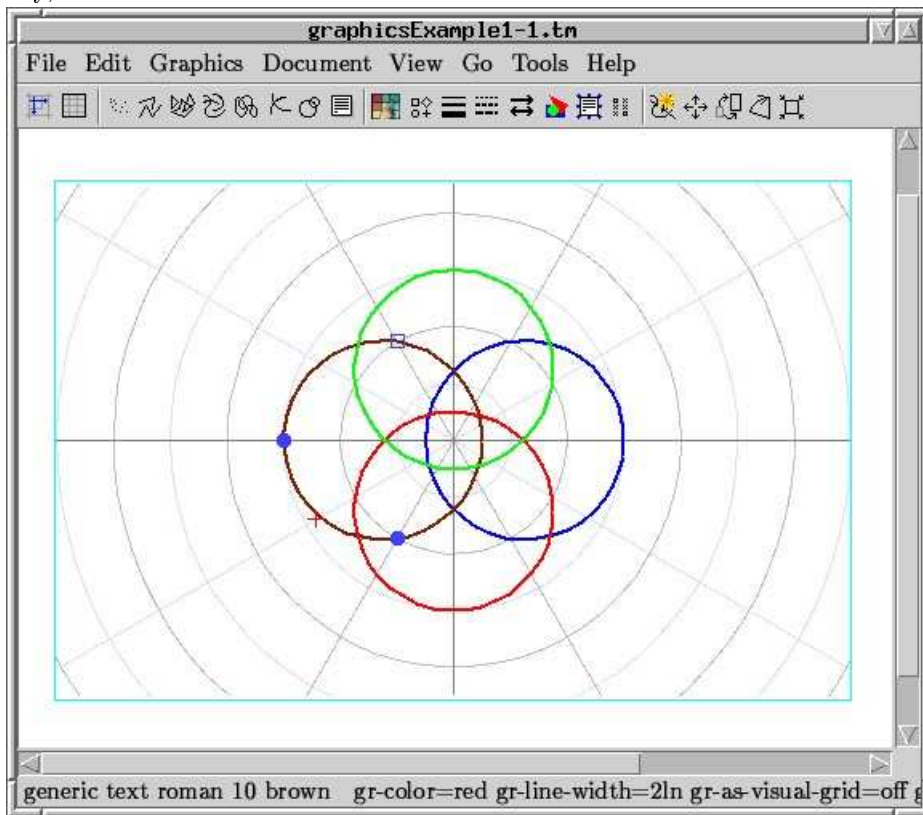
### 1.3.4 Make four copies of this circle

We will now see how to *Copy & paste* graphical objects. Go to *Graphics/Mode/Move*, then move the cursor above the Circle, then click on the **Right mouse button** : the Circle becomes part of the current Copy & paste selection. To perform the *Copy* operation itself, you can use the usual  $\text{T}_{\text{E}}\text{X}_{\text{MACS}}$  keyboard shortcut for Copy, namely **Ctrl-Insert**. The selection mark disappears. To perform the *Paste* operation, hit **Ctrl-Y** (three times, because we want three copies of the Circle).

### 1.3.5 Set the position and the color of each one of the circles

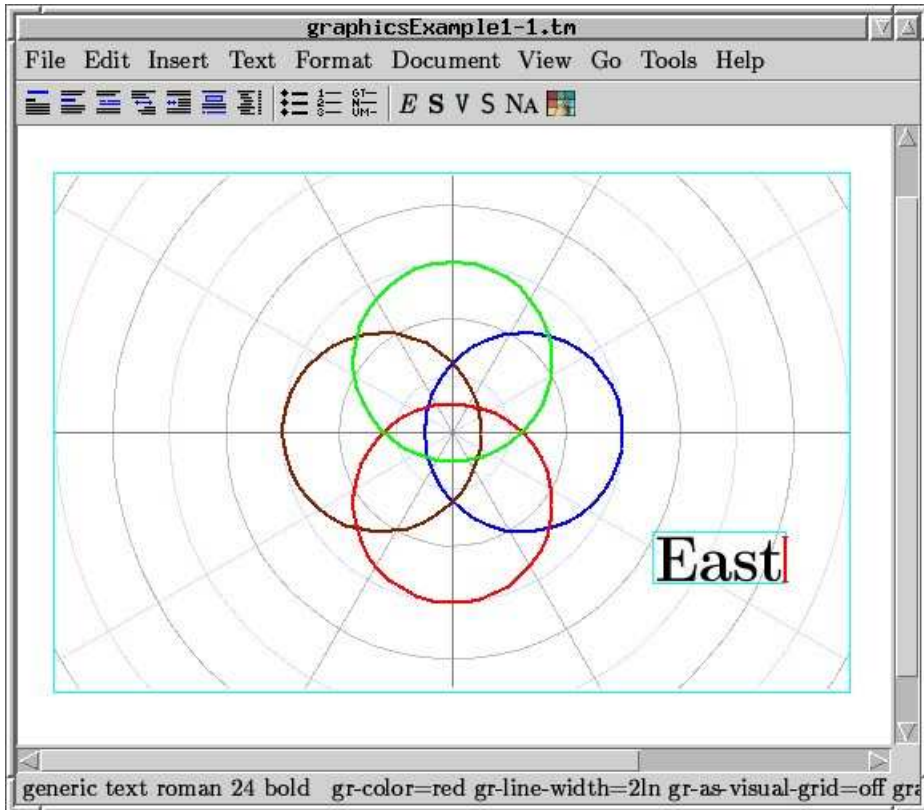
Now, let's move each one of the four (currently) superposed Circles to a different position (in order to move an object in *Move* mode, just **drag & drop** it ; warning, once it has been drag & dropped, the object becomes the only element of the current selection : so after each drag & drop, click on the **Middle mouse button** to forget the selection). Then, select *Graphics/Mode/Properties*, and assign the appropriate color to each one of them. Next, in order to be able to easily access the control points, change the Edit grid : select *Graphics/Grids/Edit grid/Number of subunit steps/Other*, and type "20". Then go back to *Graphics/Mode/Circle*, and move each one of the circles to its intended position.

Finally, You should obtain :



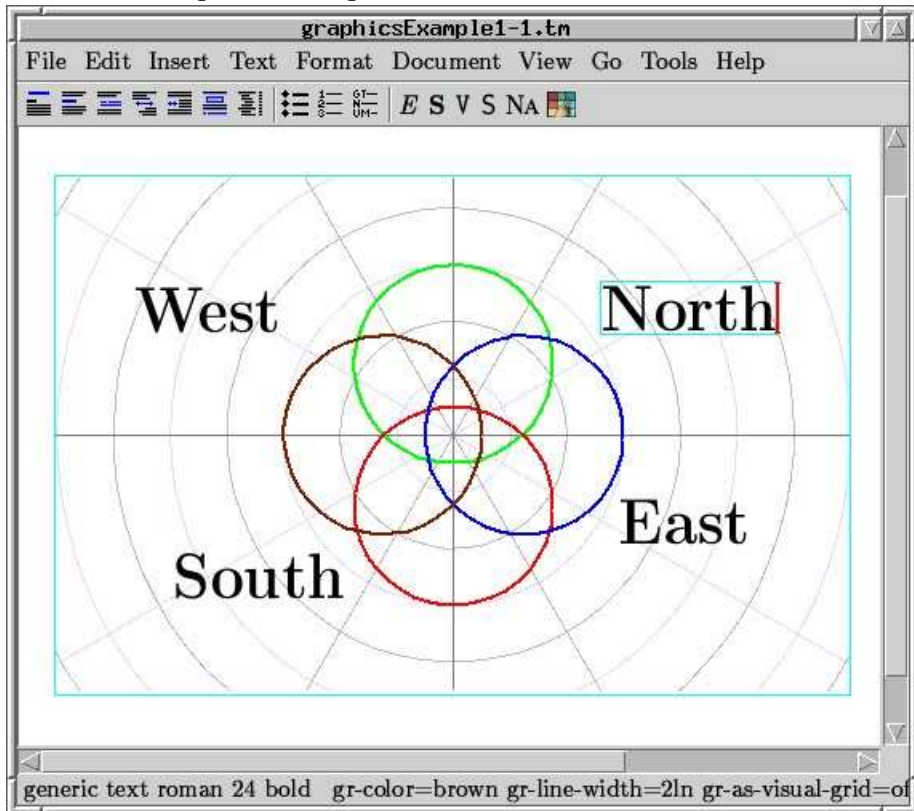
### 1.3.6 Add a text box

We will now add a text box with the text “East” in bold, size 24. To do this, go to *Graphics/Mode/Text box*, then move the cursor into the graphics, then click on the *Right mouse button* : a new Text box is inserted, and the text cursor appears ; type “East” ; turn this text to bold, size 24. You should obtain something like :



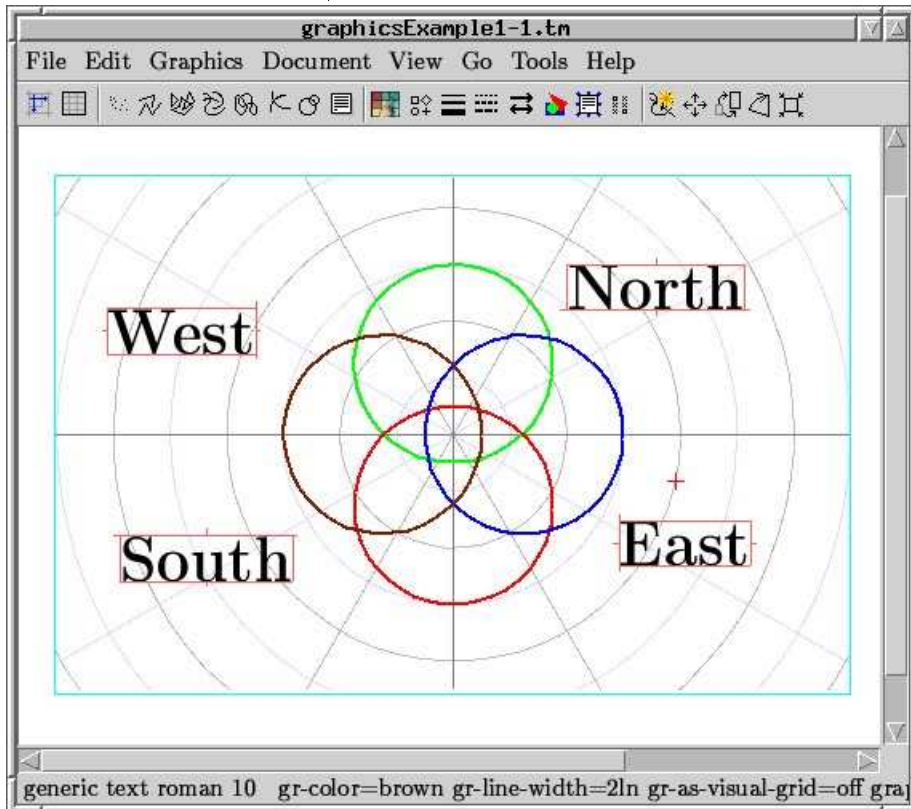
### 1.3.7 Make four copies of this text box

Now, let's make four copies of the text box you just inserted (you can proceed as we did previously for the Circles). Move each one of the boxes to a different position, then set the appropriate text in each one of the text boxes. We get something like :



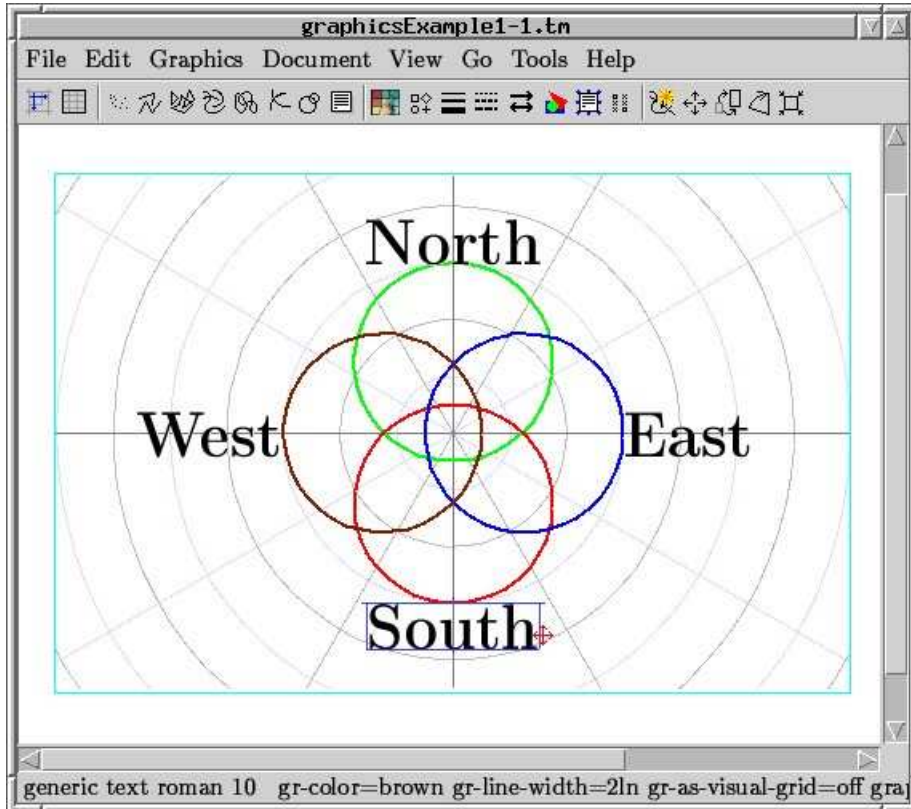
### 1.3.8 Change the alignment of each one of the text boxes

We will now change the alignment of each one of the text boxes. To do this, select *Graphics/Mode/Properties*, then move the mouse cursor above one of our text boxes. By clicking on the *Left mouse button*, one can *change the horizontal alignment* of a text box ; on the other hand, by clicking on the *Right mouse button*, one performs a *change of the vertical alignment* of a text box (warning : there are *four* possible positions : bottom, base, center and top). The appropriate alignments are shown below (we edited the image to show these alignments, thus this image doesn't show what you will really see in the editor) :

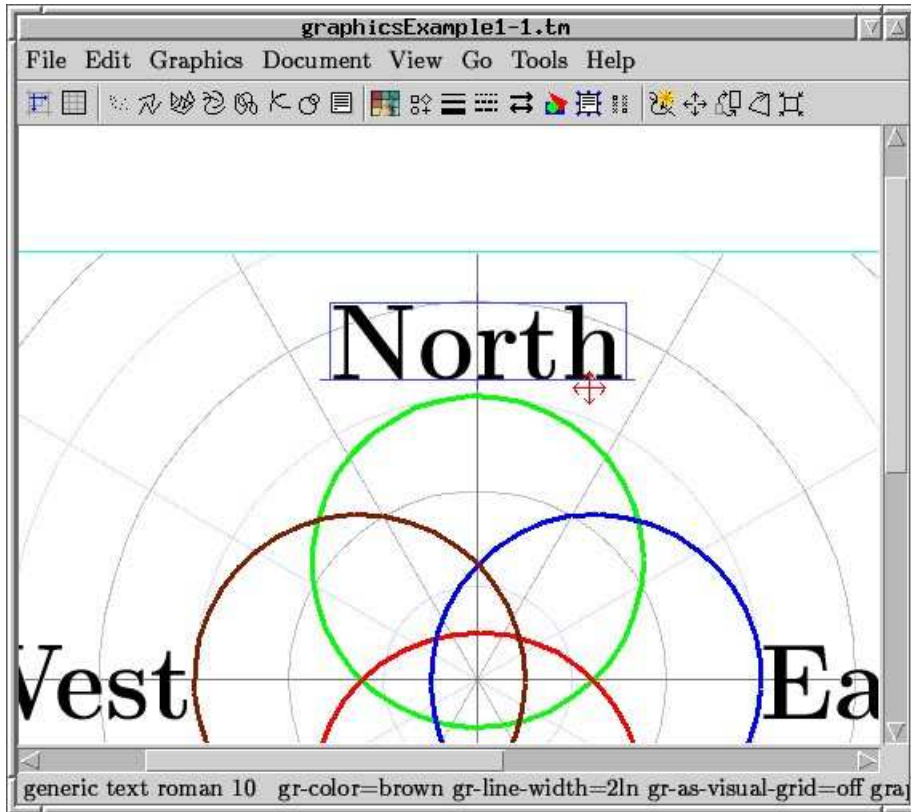


### 1.3.9 Move each one of the text boxes at its intended position

Now, go back to *Graphics/Mode/Text box* (warning : because of the grid, it is not the same if you perform the move using the *Move* mode), and move each one of the text boxes at its intended position. We get :



The text box for “North” appears to be a little bit too close to the green Circle. You can move it a little bit upwards (to see better, you can change the Shrinking factor by selecting i.e. *View/Shrinking factor/3*). You should obtain :

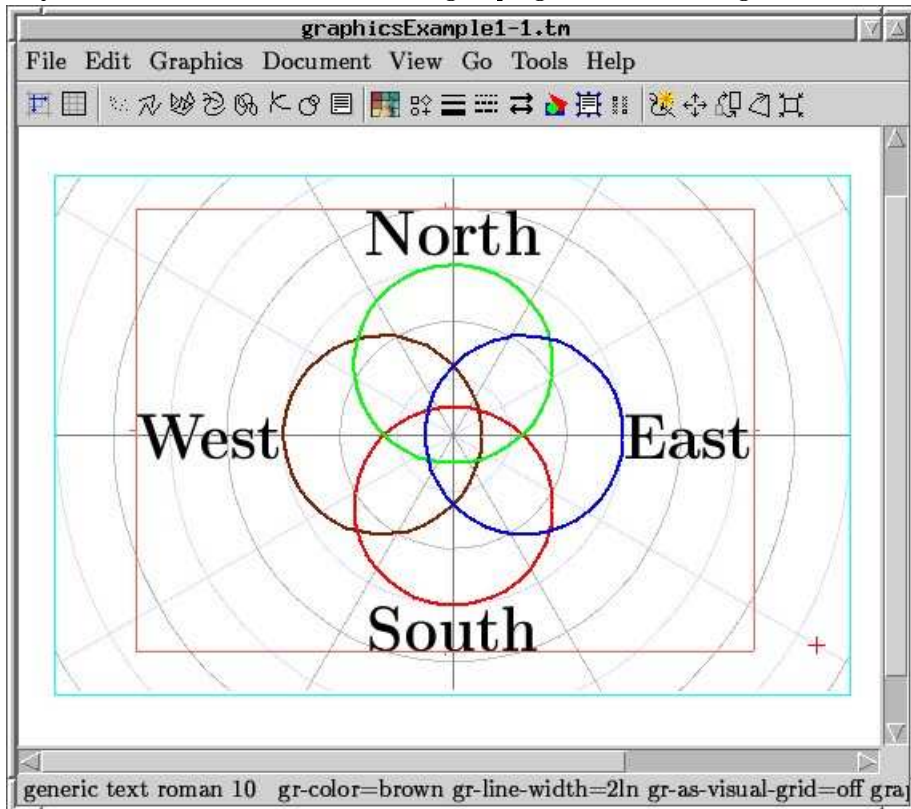


You can now go back to the usual Shrinking factor (if you changed it).



### 1.3.10 Select all, group it

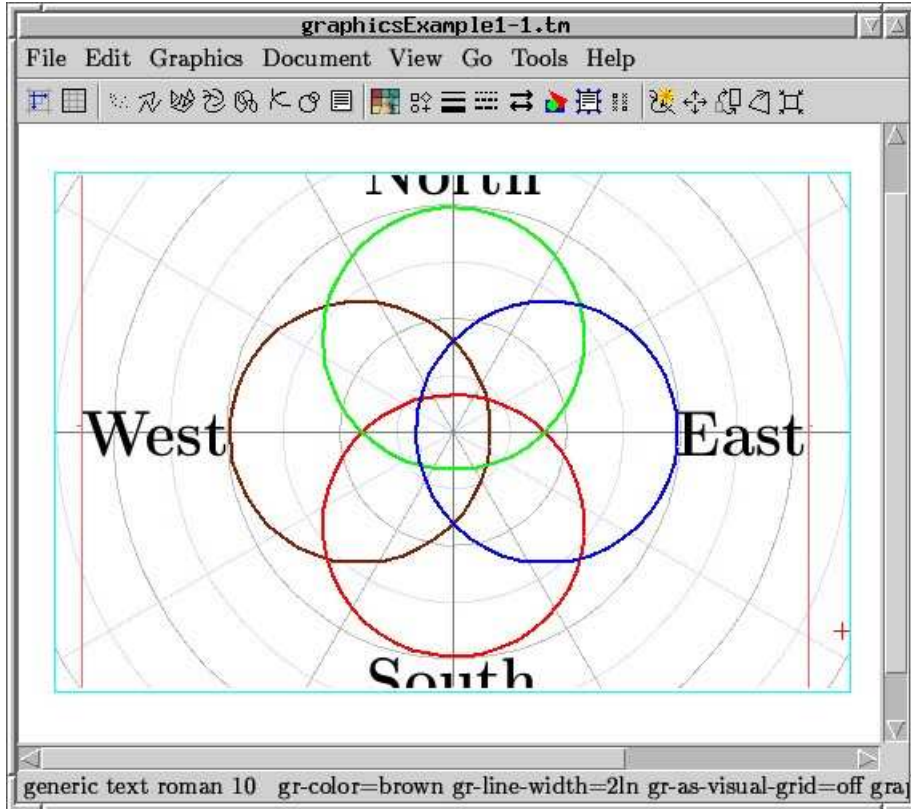
To do this, select **Graphics/Mode/Group/ungroup**. You can then create and stretch a rectangle for performing the selection (the **Right mouse button** is for *starting the selection*, **moving the mouse** is for *stretching it*, and then another **Right mouse click** to *perform the selection itself*), or either select successively each one of the objects (anyway, before starting this task, it can be more convenient to disable the Edit grid using **Graphics/Grids/Edit grid/Type/No grid**). Once the selection is done, click the **Left mouse button** to perform the grouping itself. Thus we get :



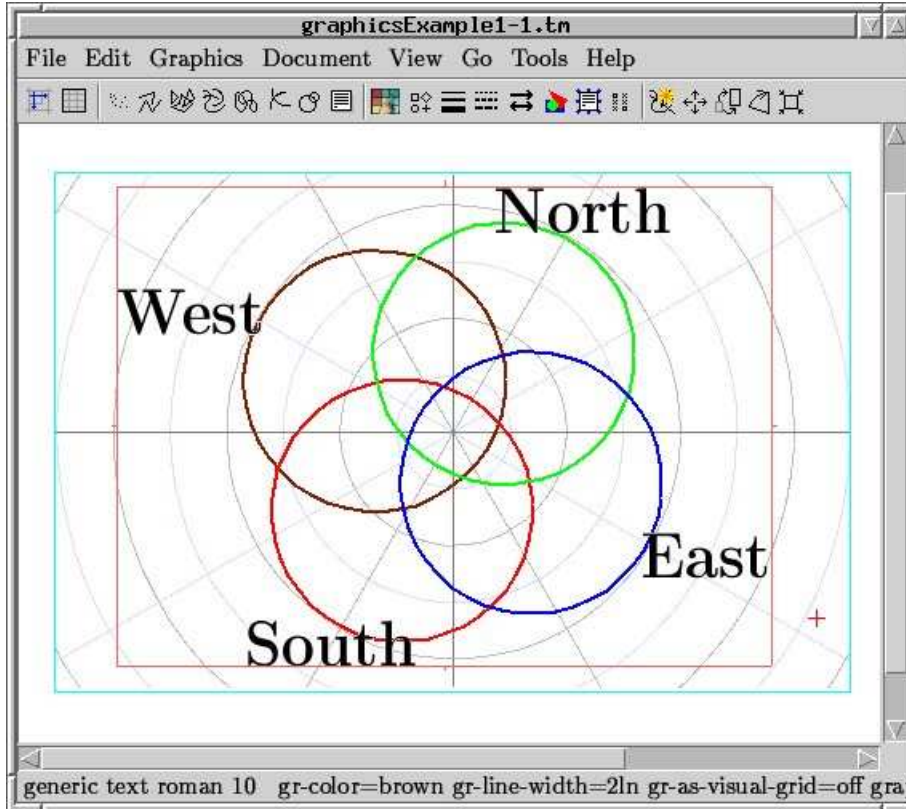


### 1.3.11 Unzoom and rotate the whole

Finally, to *Unzoom* the object, go to *Graphics/Mode/Zoom/unzoom*, and then just click somewhere above the object, then *drag & drop* with the *Left mouse button*. We get for example :



To *Rotate* the object, select **Graphics/Mode/Rotate**, and proceed as previously. Finally, we get something like :



### 1.3.12 Change the geometry of your graphics

You can adjust the dimensions of your graphics using **Ctrl-Left**, **Ctrl-Right**, **Ctrl-Down** and **Ctrl-Up**, in order to *Decrease / Increase the width*, resp. *Decrease / Increase the height* of your drawing. It is also possible to *Zoom*, resp. *Unzoom the whole graphics* by pressing '+', resp. '-' on the keyboard. Finally, you can *Move the center of the frame* of the graphics using **Left**, **Right**, **Down** and **Up**.

## 2 Grids

<i>Action</i>	<i>Behaviour</i>
(Visual/Edit) grid/Type	Set a new Visual/Edit Grid (possible types are Empty, Cartesian, Polar, Logarithmic)
(Visual/Edit) Grid/Unit length	Set the Unit length
(Visual/Edit) Grid/Center	Set the Center
(Visual/Edit) Grid/Number of polar steps	Set the # polar steps (polar grids only)
(Visual/Edit) Grid/Logarithmic base	Set the Logarithmic base (logarithmic grids only)
(Visual/Edit) Grid/Number of subunit steps	Set the # subunit steps
Edit Grid/As visual grid	The Edit grid is/is not as the Visual Grid
Visual Grid/Color of the axes	Set the color of the axes
Visual Grid/Color of the units	Set the color of the units
Visual Grid/Show subunits	Show/don't show the subunits
Visual Grid/Color of the subunits	Set the color of the subunits

## 3 Curves

### 3.1 Submodes

<i>Action</i>	<i>Behaviour</i>
Graphics/Mode/Point	Enter the Add points mode
Graphics/Mode/Line	Enter the Add lines mode
Graphics/Mode/Polygon	Enter the Add polygons mode
Graphics/Mode/Spline	Enter the Add splines mode
Graphics/Mode/Closed spline	Enter the Add closed splines mode
Graphics/Mode/Arc	Enter the Add arcs mode
Graphics/Mode/Circle	Enter the Add circles mode

### 3.2 Operations

<i>Action</i>	<i>Behaviour</i>
Ctrl- <u>  </u>	Undo (available all the time)
Tab	Turn active the next element (control point, edge, or object)
Left drag & drop	Move the point under cursor or add a new point to the edge under cursor
Left mouse button	Start moving a point (when no curve edition is currently occurring, and when the control point above the cursor is active)
Left mouse button	Start adding a point (when when no curve edition is currently occurring, and when the edge above the cursor is active)
Left mouse button	Finish editing a curve (when editing a curve). In the particular case of Arcs and Circles, one cannot finish editing if the curve has less than 3 points)
Middle mouse button	Remove the active control point (if any)
Right mouse button	Start a new curve (when no curve edition is currently occurring)
Right mouse button	Add a new point (when editing a curve)

## 4 Text boxes

<i>Action</i>	<i>Behaviour</i>
Graphics/Mode/Text box	Enter the Add text boxes mode
Left drag & drop	Move the Text box under the cursor
Left mouse button	Start moving a Text box (when no move is currently occurring)
Left mouse button	Insert the text cursor into a Text box
Left mouse button	Finish moving a Text box
Middle mouse button	Remove the Text box under the cursor (if any)
Right mouse button	Add a new Text box

## 5 Properties of the objects

<i>Action</i>	<i>Behaviour</i>
Graphics/Mode/Properties	Enter the mode for changing properties
Color	Set the current color
Point style	Change the point style
Line properties/Width	Set the current line width
Line properties/Dashes	Set the current dash pattern
Line properties/Arrows	Set the current arrows
Fill color	Set the current fill color
Alignment/Horizontal	Set the current horizontal alignment
Alignment/Vertical	Set the current vertical alignment
Enable change	Enable / disable the change of one property
Left mouse button	Assign the current properties to the object under the cursor (if it is a point, a curve, or a composite object)
Left mouse button	Change the horizontal alignment (if the object under the cursor is a Text box)
Middle mouse button	Copy the properties of the object under cursor in the current properties
Right mouse button	Change the vertical alignment (if the object under the cursor is a Text box)

## 6 Selecting & grouping the objects

<i>Action</i>	<i>Behaviour</i>
Graphics/Mode/Group/ungroup	Enter the Group/Ungroup mode (all the actions below, except the grouping/ungrouping using the Left mouse button, are also available in any of the three other modes)
Left mouse button	Group the currently selected objects, or either, ungroup the object under the cursor, or ungroup the selection if it is only made of one composite object
Middle mouse button	Forget the current selection
Right mouse button	Add/Remove the object under the cursor to/from the selection
Right drag & drop [yet implemented]	Perform a multiselection
Right mouse button	Start a multiselection using a stretching rectangle (if no multiselection is currently being done, and if there is no object under the cursor)
Right mouse button	Perform the multiselection (if a multiselection is currently being done)

## 7 Transforming the objects

<i>Action</i>	<i>Behaviour</i>
Graphics/Mode/Move	Enter the Move mode
Graphics/Mode/Zoom/Unzoom	Enter the Zoom/unzoom mode
Graphics/Mode/Rotate	Enter the Rotate mode
Left drag & drop	Perform the operation on the current selection or either, if the selection is void, on the object under cursor (if any)
Left mouse button	Start the operation (if no operation has yet been started)
Left mouse button	Finish the operation (if an operation has already been started)

## 8 Miscellaneous

<i>Action</i>	<i>Behaviour</i>
+	Zoom
-	Unzoom
Left	Move the center to the left
Right	Move the center to the right
Down	Move the center down
Up	Move the center up
Ctrl-Left	Decrease the width of the graphics
Ctrl-Right	Increase the width of the graphics
Ctrl-Down	Decrease the height of the graphics
Ctrl-Up	Increase the height of the graphics
Shift-Ctrl-Up ↔ Down	Toggle the alignment of the graphics

## 9 Plans for the future

- Other kinds of curves (i.e. conics) ;
- Zooming & rotating the Text boxes.

*Long live Free Software !*

## Appendix A Overview of the graphical markup

### A.1 Graphical objects

- `<point|x|y>` ;
- `<line|<point|x1|y1>|...|<point|xn|yn>>` ;
- `<cline|<point|x1|y1>|...|<point|xn|yn>>` ;
- `<spline|<point|x1|y1>|...|<point|xn|yn>>` ;
- `<cspline|<point|x1|y1>|...|<point|xn|yn>>` ;
- `<arc|<point|x1|y1>|<point|x2|y2>|<point|x3|y3>>` ;
- `<carc|<point|x1|y1>|<point|x2|y2>|<point|x3|y3>>` ;
- `<gr-group|graphical object1|...|graphical objectn>` ;
- `<text-at| $\text{\TeX}_{\text{MACS}}$  markup|<point|x|y>|halign|valign>`.

### A.2 Graphical properties

- color : red, blue, green, ... ;
- point-style : disk, round, square ;
- line-width : 2ln, 0.01cm, ... ;
- dash-style : `<tuple|b1|...|bn>`,  $b_i \in \{0, 1\}$
- dash-style-unit : 2ln, 0.01cm, ... ;
- line-arrows : `<tuple|arrow1|arrow2>`, *arrow<sub>1</sub>* and *arrow<sub>2</sub>*  $\equiv \text{\TeX}_{\text{MACS}}$  graphical markup ;
- fill-color : red, blue, green, ... ;
- halign : left, center, right ;
- valign : top, center, base, bottom.

## Appendix B Graphical output using Scheme

In this appendix, we show an example Scheme function that draws lines that link together a set of points located on a circle. Each one of the points is linked with all the others. The parameters are the radius of the circle, the number of steps step on the circle, the color and the line width of the lines.

*Code of the function :*

```
(tm-define (rose radius nsteps color lwidth)
  (define pi (acos -1))
  (define points '())
  (define lines '())
  (define r 0)
  (set! radius (tree->stree radius))
  (set! r (/ (length-decode radius)
            (length-decode "1cm")))
  (set! nsteps (string->number (tree->stree nsteps)))
  (set! color (tree->stree color))
  (set! lwidth (tree->stree lwidth))
  (foreach-number (i 0 < nsteps)
    (with t (/ (* 2 i pi) nsteps)
      (set! points
        (cons '(point ,(number->string (* r (cos t)))
                  ,(number->string (* r (sin t)))
                )
              points))
    ))
  (foreach (p1 points) (foreach (p2 points)
    (set! lines (cons '(line ,p1 ,p2) lines))
  ))
  (with size (string-append (number->string (* 2.0 (+ r 1))) "cm")
    '(with gr-geometry (tuple "geometry" ,size ,size)
      color ,color
      ,(cons 'graphics (append lines points)))))
```

*Code of the two Scheme macros (foreach) and (foreach-number) :*

```
(define-macro (foreach i . b)
  '(for-each (lambda
    (,(car i))
    ,(cons 'begin b))
    ,(cadr i)))

(define-macro (foreach-number i . b)
  '(do ((,(car i) ,(cadr i)
    (,(if (memq (caddr i) '(> >=)) '- '+) ,(car i) 1)))
    ((,(if (eq? (caddr i) '>)
      '<=
      (if (eq? (caddr i) '<)
        '>=
        (if (eq? (caddr i) '>=) '< '>)))
    ,(car i) ,(caddr i))
    ,(car i)
    ,(cons 'begin b)))
```

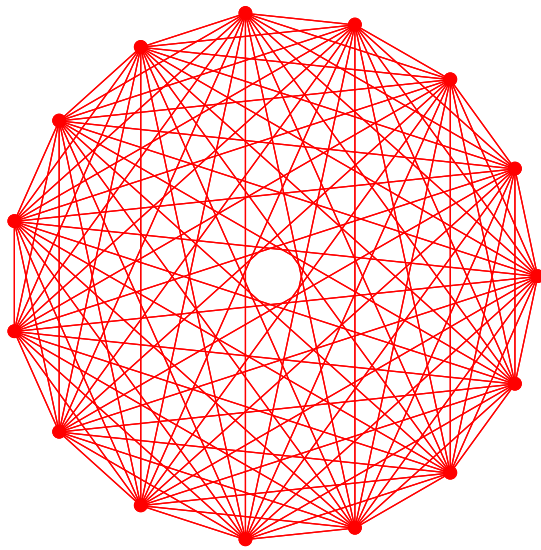
Code of the embedding  $T_{E^X_{MACS}}$  macro :

```
<assign|rose|<macro|r|st|col|lw|<extern|rose|r|st|col|lw>>>
```

Using an instance of this macro, for example :

```
<rose|3.5cm|15|red|2ln>
```

We get the following drawing :



*That's all folks !*