

# Chapter 1

## Basic functionality

This chapter describes the tools used to construction a geometric sketch.

### 1.1 Tools for construction

These tools are ordered in six groups accessible from the second toolbar.

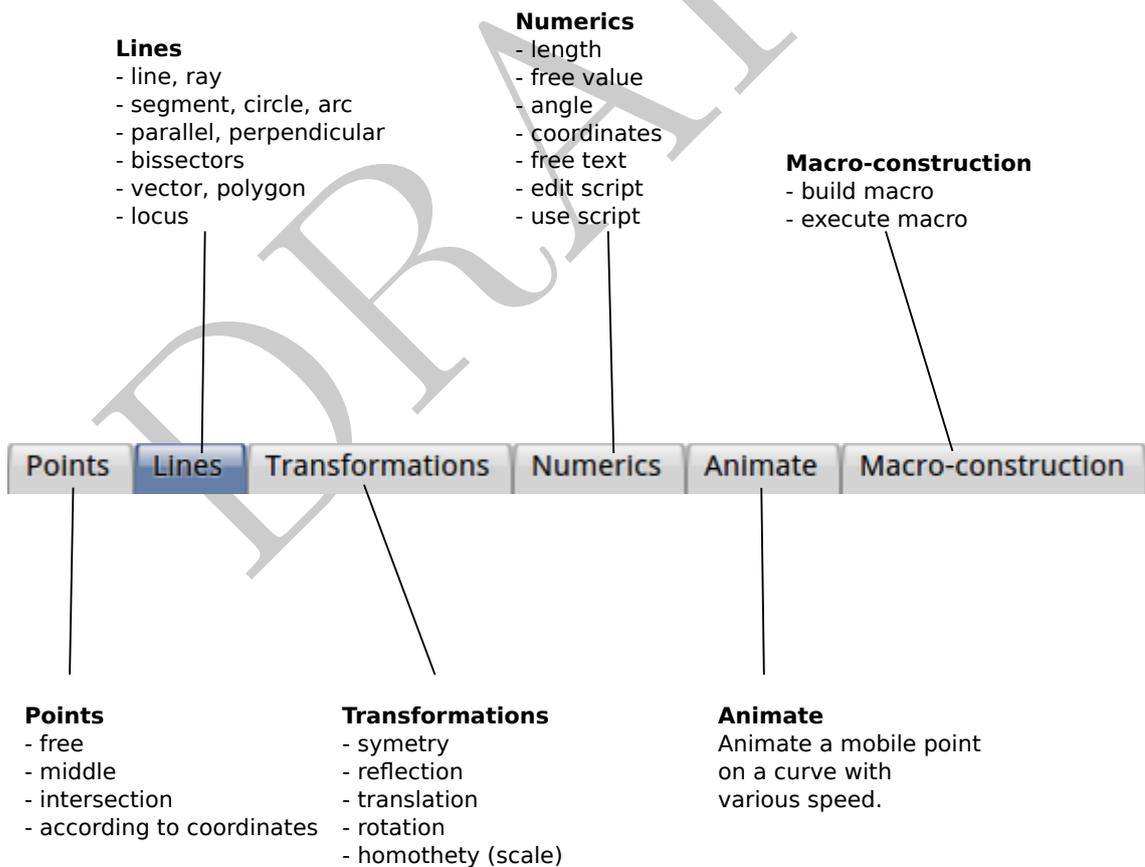


Figure 1.1: Tool categories and the descriptions

When the user clicks one of the buttons of this toolbar, an additional list of buttons displays immediatly. This one groups functions of the same family.

Of the left towards the right, we have access to tools to build points and lines, use transformations, calculate values, animate mobile points, manage the macro-constructions. These functions find themselves in the menu at the top of every DR. GEO window.

### 1.1.1 Point tools

#### Point libre

##### Point

Create a free point in the plane or on a line object (segment, ray, straight line, arc, circle, locus):

1. In the first case, the created point can be moved wherever in the plane of the sketch. To build it the user clicks simply in the background.
2. In the second case, the point is free only in the line where it was created ; it is stuck on the object. To build this type of point, the user clicks on a line (i.e. straight line, ray, segment, circle, arc, etc.).

To create one **intersection point** between two lines (i.e. straight line, ray, segment, arc, circle), it is enough to click in the intersection of these. Moreover, DR. GEO indicates it by the help bubble: *Intersection*.

**How to place a point given its coordinates?** A possibility is to place two free values in the sketch – tool Numerics, section 1.1.4, p. 5 – then build the point with this two values as coordinates – tool point defined by its coordinates, section 1.1.1, p. 2. This possibility has an advantage on the previous one, the point so built cannot be directly moved with the mouse, the point is blocked in a way in its position.

#### Middle

##### Middle

Create the middle of two point or a segment:

1. In the first case, the user selects two points.
2. In the second case, its selects a segment.

#### Intersection

##### Intersection

Create one or several intersection(s) of two lines (i.e. straight line, ray, segment, arc, circle). The user has to select two lines. When one of the chosen lines is an arc or a circle then two intersection points are created.

#### Point defined by coordinates

##### Coordinates

Create a point defined by its coordinates. The user selects a script returning a couple of x-y coordinates – section ??, p. ?? – or two values: first one is the abscissa and second one the ordinate.

**How to construct a point constrained by its coordinates?** This function is mainly used to construct a locus of point. This construction supposes beforehand the existence of two values – section 1.1.4, p. 5 – the point is then constructed by selecting these two values.

### 1.1.2 Line tools

#### Line

##### Line

Create a straight line defined by two points. The user clicks on two points.

#### Parallel line

##### Parallel

Create a line parallel to a given direction and going through a point. The user clicks a point and a direction (i.e. straight line, ray, segment or vector).

#### Perpendicular line

##### Perpendicular

Create a line perpendicular to a given direction and going through a point. The user clicks a point and a direction (i.e. straight line, ray, segment or vector).

#### Perpendicular bisector

##### Perpendicular bisector

Create a perpendicular bisector given a segment or two points. The user clicks on a segment or two points.

#### Angle bisector

##### Angle bisector

Create the angle bisector of an angle formed by three points. The user clicks on a geometric angle (defined by three points) or clicks on three points, the line will go through the second point.

#### Ray

##### Ray

Create a ray defined by two points. The user clicks on two points, the first one is the origin, the second one a point on the ray.

#### Segment

##### Segment

Create a segment given two points.

#### Vector

##### Vector

Create a vector given two points. The user select two points, the first one is the origin, the second one the extremity.

Once the vector is created, it can be moved independently of the two points. This remains true when the vector is built from a transformation – section 1.1.2, p. 4.

## Circle

### Circle

Create a circle. The user can create its from different selections:

1. the centre and a point on the circle,
2. the centre and number (the radius),
3. the centre and a segment whose length is the radius.

## Arc by trois points

### Arc

Create an arc going through three points. Le first one is the origin, the third one is the extremity and the second one is a point on the arc.

## Arc, centre

### Arc (center)

Create an arc defined by its centre, origin and aperture. The first one is the centre, the second one is the origin and the third one gives the angle at the centre.

## Locus

### Locus

Locus defined by two points. The user selects two points, one is free on a line, the other one is a depending point (i.e. when moving the first one, the second point changes).

## Polygon

### Polygon

Create a polygon defined by  $n$  points. The user selects  $n+1$  points defining the polygon submits. The first and last ones are the same point, it indicates to DR. GEO the selection is over. Mobile point can be added on polygon, but it is not possible to compute an intersection with another line. However geometric transformation of polygon are allowed.

## Polygon regular

### Regular polygon

Crée un polygone régulier défini par deux points et une valeur numérique. L'utilisateur sélectionne son centre, un sommet et une valeur indiquant le nombre de sommets.

### 1.1.3 Transformation tools

#### Reflection

##### Reflection

Transform an object by a reflection. The user clicks on the object to transform and the axe – straight line – of the reflection. When the object to transform is a straight line, the first clicked is the axe of the reflection.

## Symmetry

### Symmetry

Transform an object by a central symmetry. The user clicks on the object to transform and the centre of symmetry (a point). When the object to transform is a point, the first clicked is the centre of the symmetry.

## Translation

### Translation

Transform an object by a translation. The user clicks on the object to transform and a vector. When the object to transform is a vector, the first clicked is the vector of translation.

## Rotation

### Rotation

Transform an object by a rotation. The user clicks on the object to rotate, a centre (point) and an angle. When the object to transform is a point, the first clicked is the centre. The rotation angle can be defined by three different means:

- **numeric value:** the angle is therefore the value interpreted in radians (Examples of numeric value: free value, distance between two points, segment length, a coordinate, a value returned by a DR. GEO script, etc.),
- **a geometric angle defined by three points:** its measure is interpreted in degrees. Beware, in this case the measure ranges only in the interval  $[0 ; 180]$ ,
- **an oriented angle between two vectors:** its measure is interpreted in degrees in the interval  $]-180 ; 180]$ .

## Homothety (scale)

### Homothety (scale)

Transform an object by a homothety. The user clicks on the object to transform, the centre and the factor (i.e. a number). When the object to transform is a point, the first clicked is the centre.

## 1.1.4 Numerics and text tools

### Distance, length & number

#### Distance, length, value

Create a numeric value. The value, depending on the user selection, may be computed or user edited:

1. for two points it is the distance between these two,
2. for a segment it is its length,
3. for a vector it is its norm,
4. for a circle it is its perimeter,
5. for an arc it is its length,
6. for a line it is its slope,
7. pour a point and a slope it is the distance between these two,

8. a **mouse click on the background** it is a value the user edit (i.e. a free value).

This last possibility is very interesting for some situations. It lets the user chooses an arbitrary value for a given length, a radius circle, an angle measure (in radians) or the coordinates of a point. The value is then used from other specific tools to construct a circle, a rotation or a point defined by its coordinates.

### Angle

#### Angle

Compute the angle defined by three points or two vectors. In the first case, the angle is considered as non oriented (i.e. angle whose measure belongs to the interval  $[0 ; 180]$ ). In the second case, the angle is oriented and its measure belongs to the interval  $]-180 ; 180]$ .

### Coordinates

#### Coordinates, equation

Create the coordinates (abscissa and ordinate) of a point or vector.

### Free text

#### Text

Add a bloc of text in the sketch. The user clicks at the wished position, then edit the text. To edit again the text, the users selects the tool to modify the property of an object, section 1.1.6, p. 8.

### Inserting a Smalltalk script

#### Use a script

Insert a DR. GEO Smalltalk script in the sketch. The script expects 0 to  $n$  objects as arguments. It returns an object whose text representation is printed in the sketch, at the position clicked by the user. A script is used for its border effect or for the object its returns, ready to be used for subsequent constructions.

### Editer a Smalltalk script

#### Edit a script

Edit or create a Smalltalk script. Un script editor is opened for the user to edit its script.

The DR. GEO Smalltalk script are reviewed in detail in the book part related to advanced functionalities ?? and exactly at the section ??, p. ??.

## 1.1.5 Macro-construction tools

### Create a macro-construction

#### Build macro

Extract a construction sequence from the sketch and compile it as a macro-construction.

### Play a une macro-construction

#### Execute Macro

Play (i.e. execute) a macro-construction. The macro-construction can be just newly created or loaded from a file

The macro-constructions are covered in detail in the section ??, p. ??.

### 1.1.6 Misc tools

#### Delete an object



An object can be deleted from tool. The action is undo-able with the undo button in the toolbar or from the undo menu item in the Edit menu.

#### Change the style of an object



Each geometric object has its own style attributes as colour, thickness, label, size and shape. Moreover, an object can be hidden without deleting it. For example, hiding intermediary construction is useful. All these attributes are edited from the lateral panel showing up when the user selects a given items in the sketch. To do so, the users first enters in the style mode clicking the  button from the toolbar.

**Style of point.** The lateral panel for style of point is for all sort of point. Colour, shape, size, name and visibility are adjusted from there. For free point on the plane or on a curve, its position is lockable.

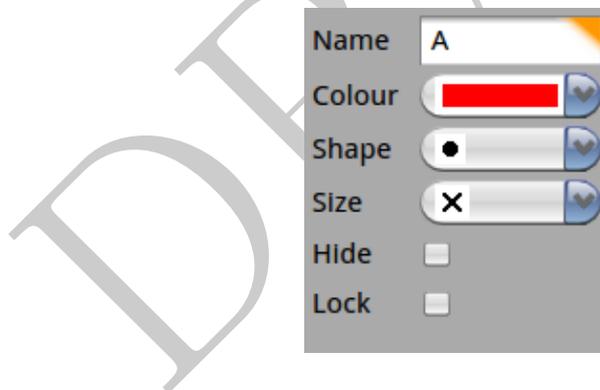


Figure 1.2: Lateral panel to edit style of point

**Style of line.** The lateral panel for style of line is for straight line, ray, segment, vector, circle, arc, locus and polygon. Colour, thickness, shape, arrow and mark for segment, label, visibility are adjusted from there.

Moreover, for segments there are supplementary styles as **arrow** and **mark**.

**Style of value.** The lateral panel for style of value is for all sort of value: free value edited by the user, measure, computed by a DR. GEO Smalltalk script. Colour, label and visibility are adjusted from here. The value can also be locked.



Figure 1.3: Lateral panel to edit style of line



Figure 1.4: Lateral panel to edit style of line

### Object property



Some object's property are numerically editable. Are concerned free point on the plane or on a curve, free value and script. To edit the property, select this tool then choose one of these objects on the sketch; a dialog box will show up:

**Free point.** Selecting a free point, a dialog box let you edit its abscissa and ordinate

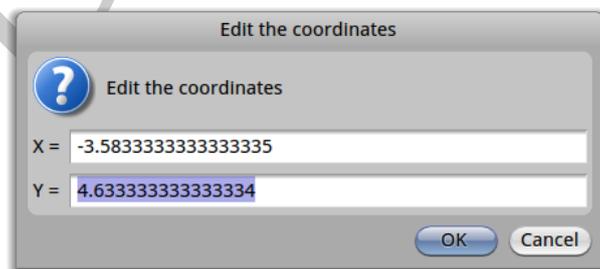


Figure 1.5: Edit the coordinates of a free point

**Free point on curve.** Selecting a free point on curve, a dialog box let you edit its curvilinear abscissa. It is normalised in the interval  $[0 ; 1]$ .

**Free value.** Selecting a free value, a dialog box let you edit its value.

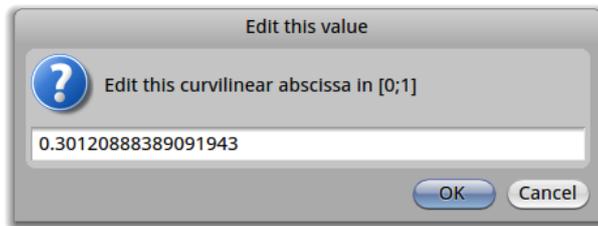


Figure 1.6: Edit the curvilinear abscissa of free point on a curve

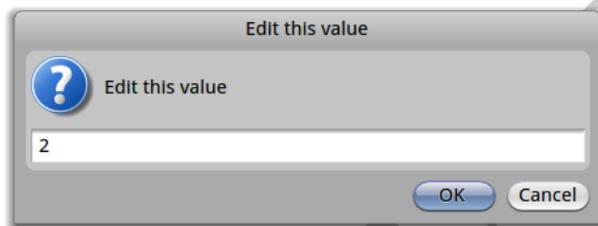


Figure 1.7: Edit a free value

**Script.** Selecting a script, an editor is open to let you study and edit it. To save any modification to a script, use the key shortcut `CTRL-S` or the entry *Do-it* in the contextual menu over the script (right mouse click to display it).

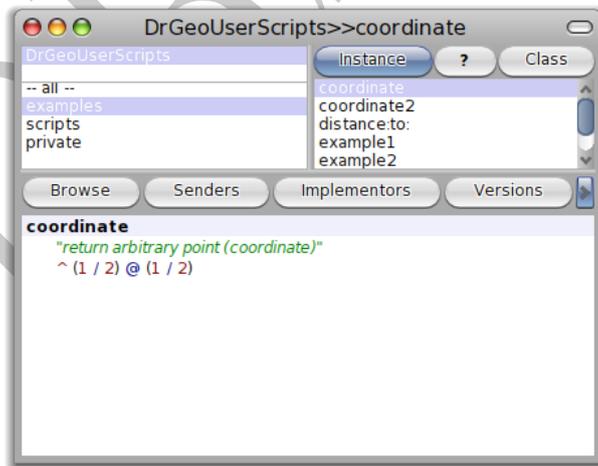


Figure 1.8: Edit a script

**Text.** Selecting a script, a dialog box let you edit it. The text can be formatted in several lines with carriage return – keyboard key `RETURN`.



Figure 1.9: Edit a text

## 1.2 Misc functions

### 1.2.1 Moving the Sketch

The sketch can be moved with the wheels in the right bottom corner or directly with the right mouse button.

### 1.2.2 Scaling the sketch

The sketch scale can be adjusted with the wheel on the top right of the window. The mouse wheel offers this same service; press simultaneously the keyboard key `SHIFT` to speed up the scaling

### 1.2.3 Moving an object



An object is moved by mouse grabbing and dragging. The whole sketch is then recomputed and redrawn to respect the properties. Almost all geometric objects can be moved. If necessary, DR. GEO moves the associated free points. For example, when the user drags a line defined by two points, the points are moved simultaneously, this is reverse dragging.

In this mode, it is possible to change the nature of a point from:

- a free point on the plane
- a free point on a curve
- an intersection point

to a point as:

- a free point on the plane
- a free point on a curve
- an intersection point

For example, transforming a free point on the plane as an intersection point. However, there is one constraint: it is not possible to mutate a point toward a “younger” line (a free on or intersection). Younger line means means created chronologically after the point.

Pressing the keyboard key `SHIFT` while grabbing a point will display an information text about the point you can mutate and the possible destination.

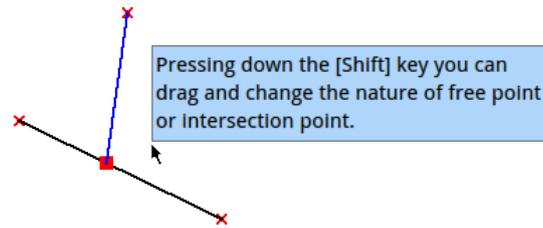


Figure 1.10: Pressing [Shift] to mutate a point

### 1.2.4 Merging points

Two free points can be merged: to do so drag one point over the second destination point and hold for a few seconds, the points are merged

### 1.2.5 Cloning curve

Various type of curve can be cloned to quickly duplicated identical object: to do so press and hold the mouse button over the curve to clone, a cloned curve is display and ready to be positioned at the user wished position

### 1.2.6 Grid

It is possible to show or hide a grid in every sketch with the button  in the toolbar. The grid adjusts itself according to the sketch scale. When saving a sketch, the state grid is saved as well.

When creating or moving points, it is possible to stick these ones to the grid – or at a closest gridded position with constrained point. To do activate the magnet tool from the button  in the toolbar.