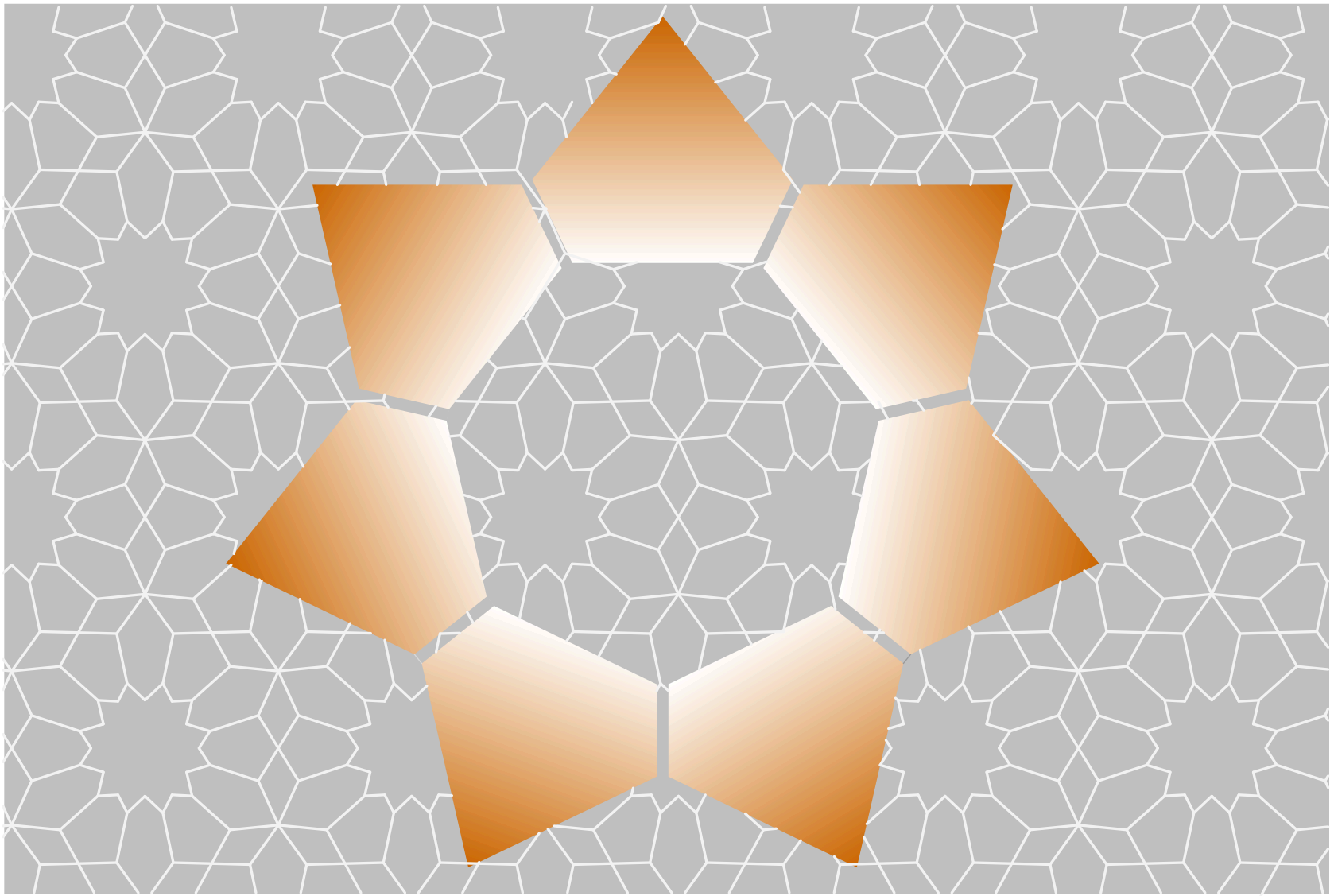
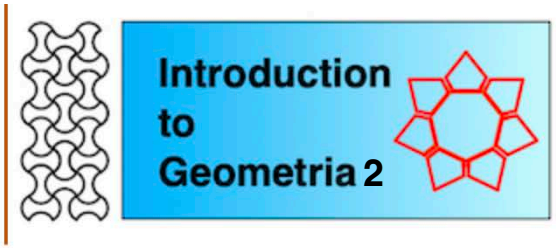
• Geometria2© : User Guide •



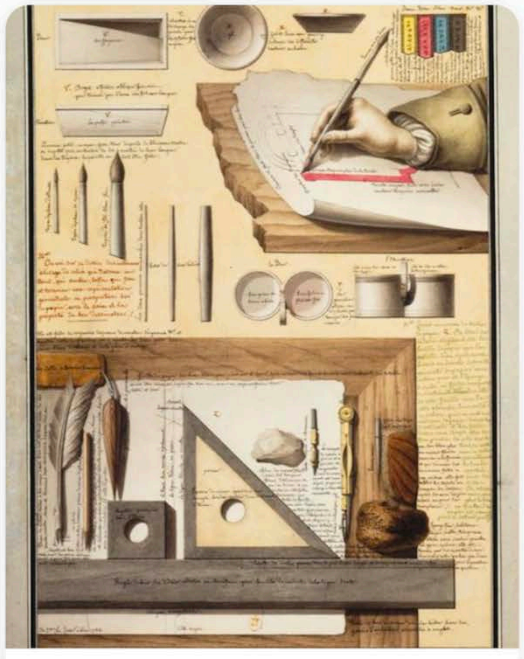
• Design, Education, Drafting and Presentation Software •

• J. Baracs, L. Langlois 2025 •

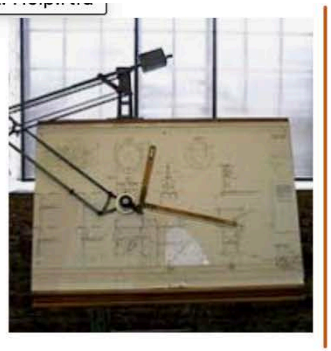


A very short history of drafting.

The basic drafting instruments, the ruler, the compass and the protractor, have been with us for over two thousand years with little change. The tableau below by the 18. century architect J. Le Queu illustrates the inventory of traditional drafting tools:

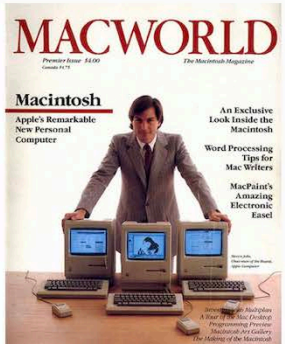


• A notable change occurred in 1901 with the patent (Charles H. Little) of the drafting machine installed on the drafting tables:



• The death sentence of the drafting table with the machine came in 1982 when AutoDesk presented AutoCAD:

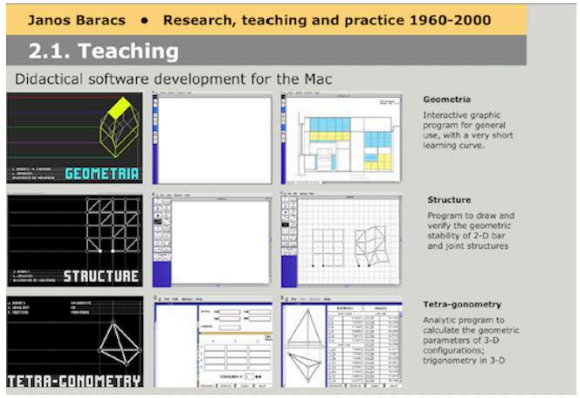
• In 1984, Steve Jobs introduced the first Macintosh computer with built-in memory of 128 KB (!), MacWrite, MacPaint and a nine-inch screen:



• Apple conquered the graphics world, but to our surprise, they have no proprietary graphics software today. Apple enthusiasts use other sources (Adobe, etc.)

We are back!

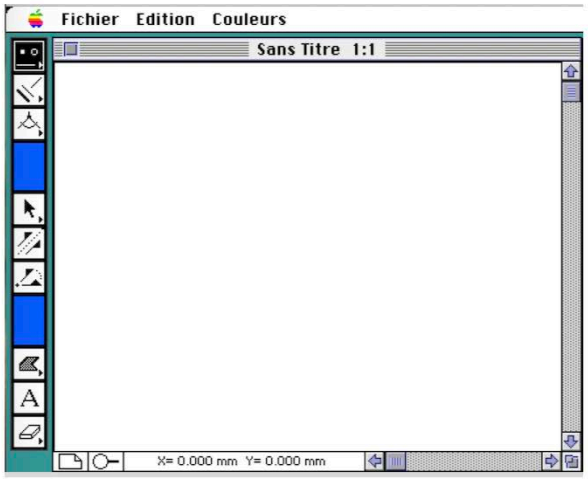
• We developed the original Geometria, the drafting software, i the late eighties at the Université de Montréal with Louis Langlois, Nicolas Chourot and me. We gained experience from developing previously two specialized programs for professionals:



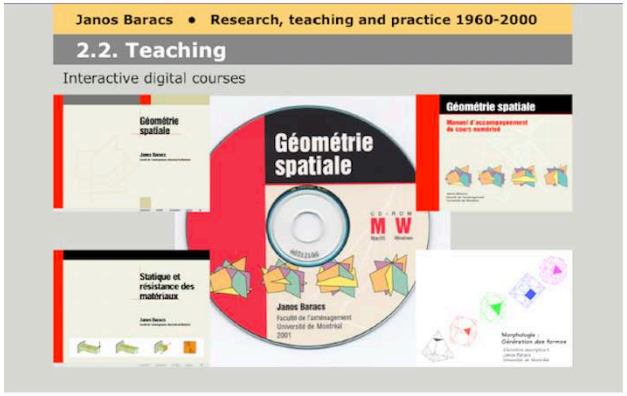
• By that time, a good number of drafting software was availabl on the market, some quite advanced. We did not attempt to compete with them, but instead created a niche for Geometria, highlighting its simplicity. We provided nine tools in three groups construction, transformation, and annotation.

• We resisted the tendency of the graphic software market, where users face several dozen tools and buttons in an overcrowded window.

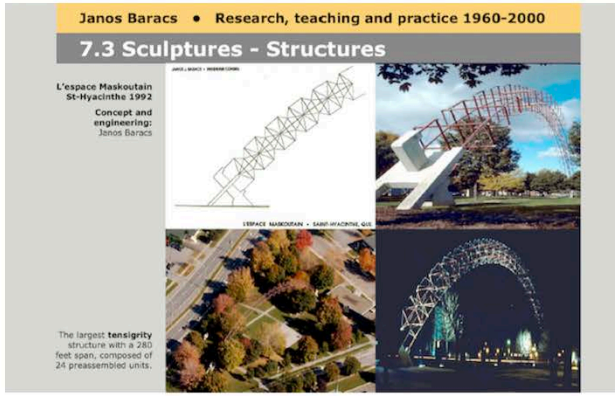
• Here is the old Geometria window on the 9" screen of a Macintosh Plus with nine tools in three groups:



• The old Geometria was widely used as a teaching and presentation program:



• The old Geometria was also used for engineering drawings, an example below indicates it functioned with a high degree of precision:



• In 2001, Apple introduced the system OS X. We did not have the time and means to do a significant update, so from that moment on, Geometria was limited to older machines running the Classic operating system.

The new Geometria

• Almost thirty years later, in 2018, Louis Langlois called me, announced that he had just retired and offered me to work together again on Geometria. I happily accepted his offer.

• Geometria is not

- a design software, or
- a word processor, or
- a desktop publishing software

However, you can perform all three endeavours confidently and competently once familiar with our intuitive interface.

Objectives

• Simplicity and a fast learning curve is our #1 objective.

• The fewest tools and menus with the least options, limited use of keyboard commands, especially requiring two keys.

• We firmly believe that in this beautiful world of the digital information age, we still should teach our young ones to

- spelling and grammar, despite the automatic corrections
- arithmetic, despite our calculators,
- **geometry**, basic constructions, despite the digital tools
- **drafting,** using the instruments, despite the CAD apps.

Thus, Geometria encourages users to have some knowledge o elementary geometry. Also, the user should have (or should acquire) a physical experience with the ruler and the compass. The equal ease of handling letters, numbers and figures is an essential cultural necessity.

• Introduction to more complex and specialized software.

• The user should control the software rather than being controlled by it (as it often happens in today's practice).

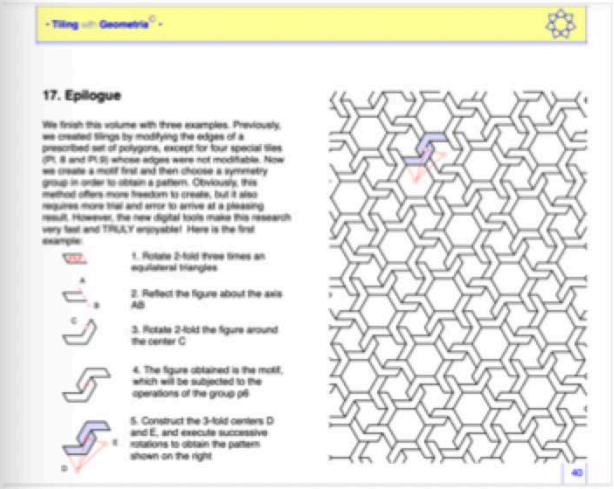
• Geometria is oriented toward the following uses:
- sketching
- illustrations, publications
- creating tilings and patterns
- technical drawings
- teaching (geometry or any other discipline)
- conferences, presentations
- manuals
- instructions and
- any other graphic activity

• Geometria is oriented toward the following users:
- technicians
- architects
- engineers
- designers
- graphic artists and
- people who have never drawn before

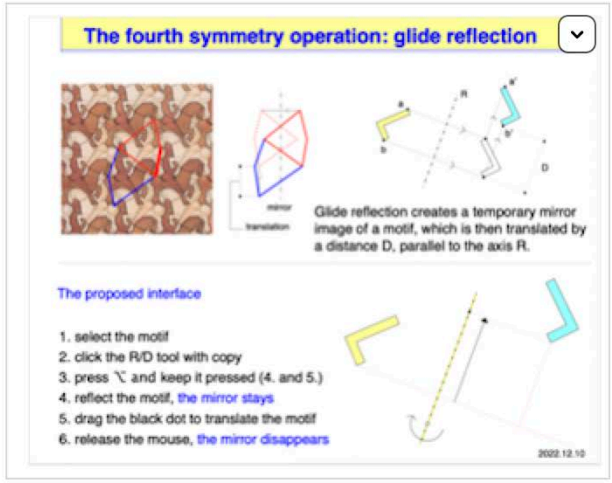
Examples of Geometria documents

In the following, we present a series of documents in different categories, prepared with Geometria while the software was sti in development:

• Illustrations

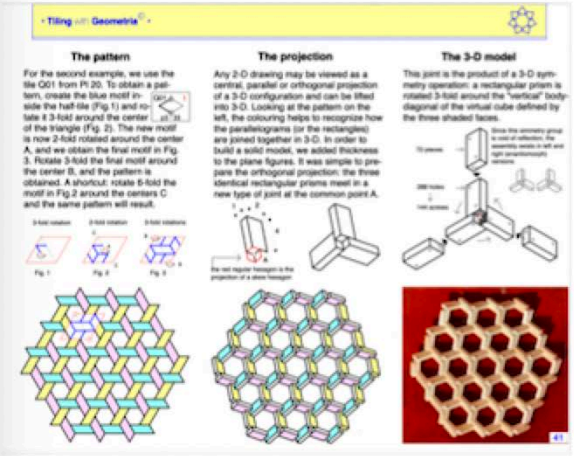


• Instructions



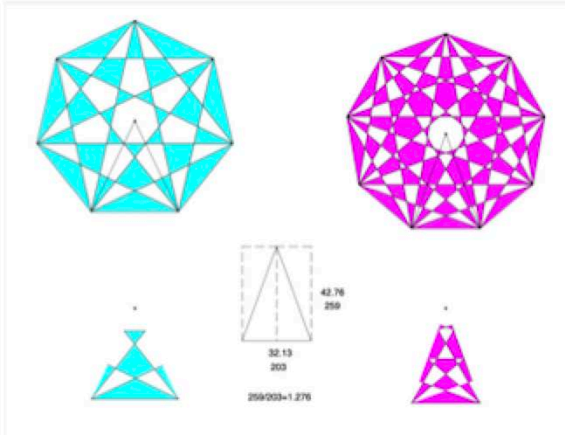
• Course notes, prepared with Geometria 1

• Presentation

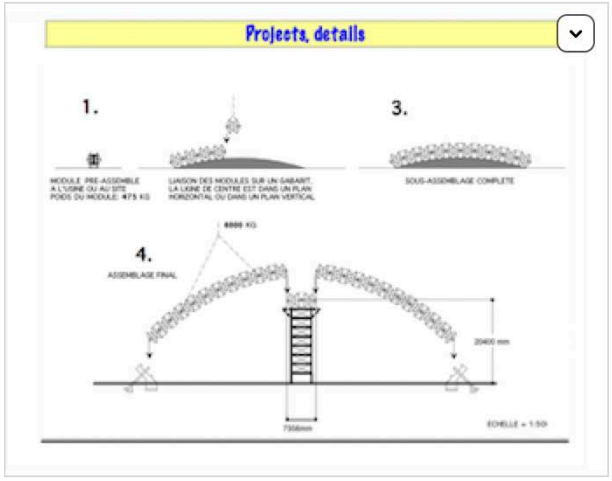


• Design of user interface

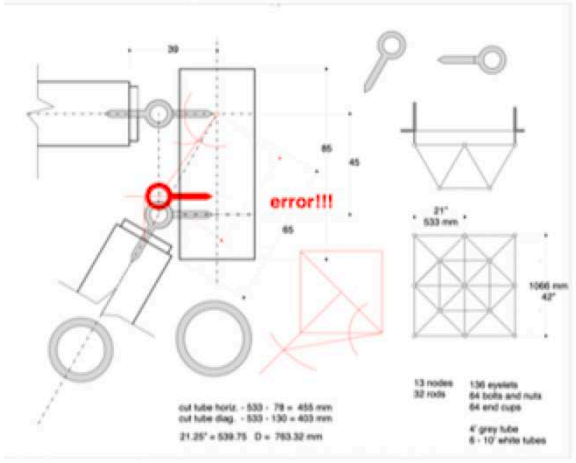
• Graphic art



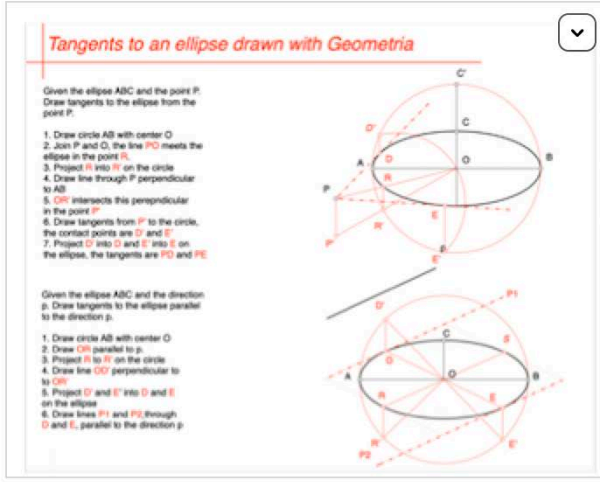
• Technical drawing, prepared with Geometria 1



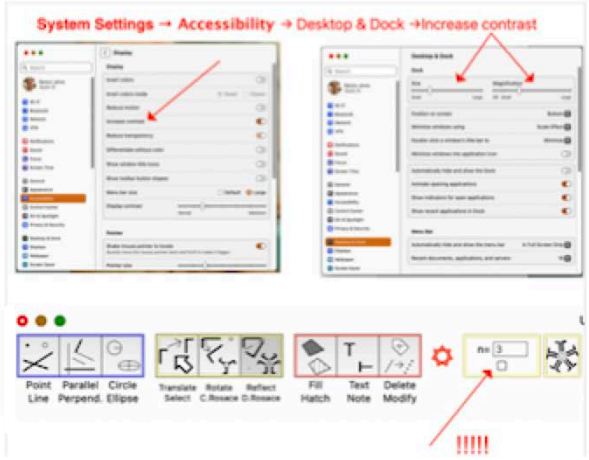
• Assembly details



• Geometric construction



• User Guide



The design of Geometria

• We carefully analyzed the anatomy of drafting and drawing, thus the process and the product. The design of Geometria reflects 40 years of experience in teaching geometry and design, research in applied geometry, and practice in structural engineering, along with a special care for visual aspects.

• We learned that by keeping the number of tools, options, menus, and keyboard commands minimum, the user's mind and memory are liberated for the creative process.

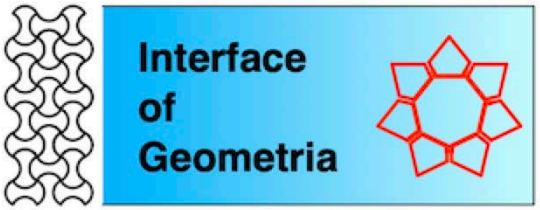
• Symmetry operations play a vital role in the creative process. With this in mind, special care was given in Geometria to the four tools: translation, rotation, reflection, and glide reflection. Friezes, rosettes and mosaics are the fascinating links between geometry and art. We already plan to extend these tools in future versions of Geometria.

• In designing a function, the simplicity of the execution took priority over the algorithm's simplicity.

• When the old Geometria was conceived, most users switched from the drafting table to the computer screen. We claimed then that the transition would be easy because we built Geometria 1 with a strong reminder of the old practice; for instance, we drew lines and curves by first placing the tool.

• We maintained this analogy in the new Geometria with good reason. Now, the majority of the users have no experience with the drafting table. However, by transferring the well-practiced, thousand-year-old routine with instruments to the digital "drafting table," we suggest that using Geometria will more likely enable and encourage the user to learn the logic of elementary geometry and appreciate its beauty.

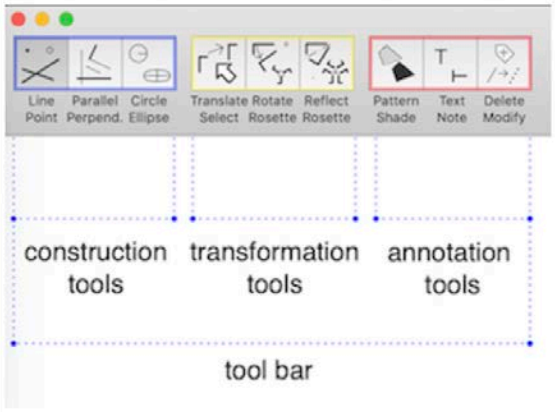
• A few words about our thoughts on the visual aspect of software design. From the beginning, Steve Jobs was personally involved in the aesthetics of every aspect related to information technology. It included the packaging, graphics, window layout, fonts, icons, cursors, and more. This attitude became a popular and well-received identity of Apple products. We gladly follow this "tradition," knowing that a clear, pleasant-looking screen positively impacts the user.



Apple's success is attributed to the particular attention it paid o the human interface:

We followed the Guidelines as much as possible, but ometimes we had to improvise because Apple today does not ave graphic (drawing) software to offer examples to the levelopers. In these cases, where the practice of drafting prefers different approach, we do not follow the Guidelines.

Geometria has nine tools in its toolbar. • We divided the nine ools into three groups, representing the three distinct drafting hases: **construction, transformation** and **annotation**. A colour ode, **consisting of blue**, **yellow,** and **red**, is assigned to the roups.



• The extended toolbar contains the **Attribute Bar**, the **Option Bar** and the **Information Bar**.

The Attribute Bar

• The standard Attribute Bar controls the attributes of lines: style, colour and thickness and is linked to five tools: Line/Point, Parallel/Perpendicular, Circle/Ellipse, Translate/Select and Delete/Modify. The Attribute Bar linked to the Pattern/Shade tool offers three choices, and the Text/Note tool presents two options. The Rotate/C and the Reflect/D tools do not have an Attribute Bar.

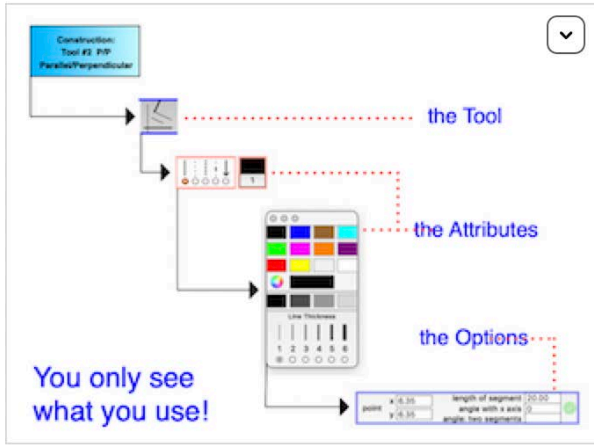
The Option Bar

• There are eight distinct option bars; each is linked to one particular tool and will only become visible when that tool is selected. The exception is the Fill/Hatch tool, which has three option bars.

The Info Bar

• The Info Bar displays the units and the scale selected in the Geometria→Preferences menu item and the percentage of the zoom of the current window.

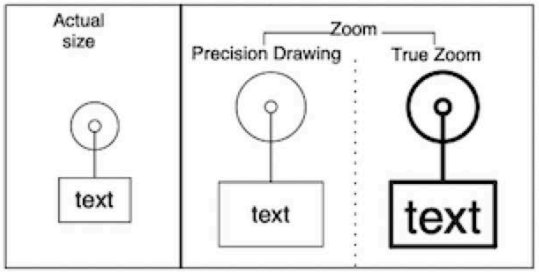
• The colour coding is maintained for the tools, the Attribute Ba the Option Bar, the cursors and the selections while drawing. **To make the screen clean and uncluttered, when you click and use a tool, you only see the attributes and options relevant to this tool.** For example:



• While the Mac OS system has a zoom function, we added a more versatile method better suited for graphic applications.

1. press Option-Command (⌥⌘), and the cursor turns into a hand
2. hover the cursor on the region to be enlarged
3. rotate the scroll wheel or swipe the multi-touch surface up and down to enlarge or reduce the scene, and hover the mouse to select another location
4. press the mouse button and drag to move the zoomed drawing.

• You may choose between two kinds of zoom in the View→Zoom Mode menu item: in Precision Drawing mode (⌥⌘←), the line thickness, nodes, points and text remain the same as in the original size; in True Zoom mode (⌥⌘→), they are all enlarged. The two methods are compared below:

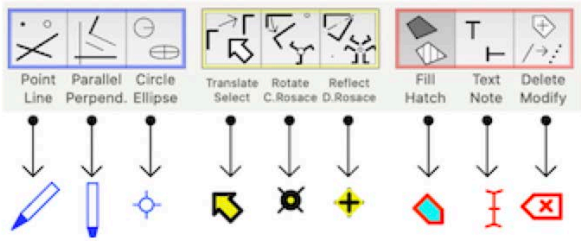


• A click at the Escape key toggles between the actual size and the "fit in the window" size.

• The percentage of the zoom is displayed in the Info Bar

Cursors

• We use nine different cursors in three colours associated with the corresponding nine icons. The different cursors and the different feedback remind the user which tool is in use:



The Help

• Help for Geometria is written for computer users with little or no drafting or graphic experience. Digitally savvy users with good intuition may be able to skip most of it.

• Help in Geometria is divided into ten sections, describing one of the nine tools and the menus. To display Help, select a tool, and go to the menu Help → Geometria Help.

• In most programs, the help window covers most of the working window. In Geometria, Help is displayed in a narrow column on the right side of the screen, where you read this introduction.

• Since the display leaves most of the window free, the user may read the text and execute instructions simultaneously.

The mouse

• The following terminology is used in Help:

- Click: press and instantly release the button.
- Hover: mouse button is up; the mouse (cursor) is moving.
- Press: hold down the mouse button.
- Drag: mouse button is down; the mouse (cursor) is moving
- Release: let the mouse button up
- Scroll: rotate the scroll wheel or swipe the multi-touch surface of the mouse

• We use two three-step mouse actions in Help:

- click - hover - click
- press - drag - release

Keyboard shortcuts

• Standard Mac OS keyboard shortcuts available in Geometria:

- Operations, no selections

⌘ Z undo
⇧⌘ Z redo

- Operations with selection

⌘ A select all
⇧ add, remove selected items

- Operation on selected items

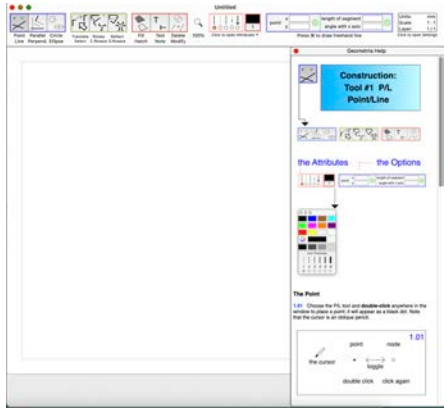
⌘ X cut
⌘ C copy
⌘ P paste
⌘ D repeat operation
⌦ delete
⇧ translate hor. or vert.
⌥ transform with copy

• ESC: toggle between the actual size and "fit in the screen" size: useful when viewing a small screen. On larger screens, clicking on the ESC key will reduce the zoomed image to the actual size.

• Keyboard shortcuts specific to Geometria (for the nine tools) will be described in the **related** Help section.

Construction: Tool #1 P/L Point/Line

The following pages are screenshots of the nine Help files for the nine tools of Geometria2. The help window appears on the right side of the active window when clicking Current Tool in the Help menu:

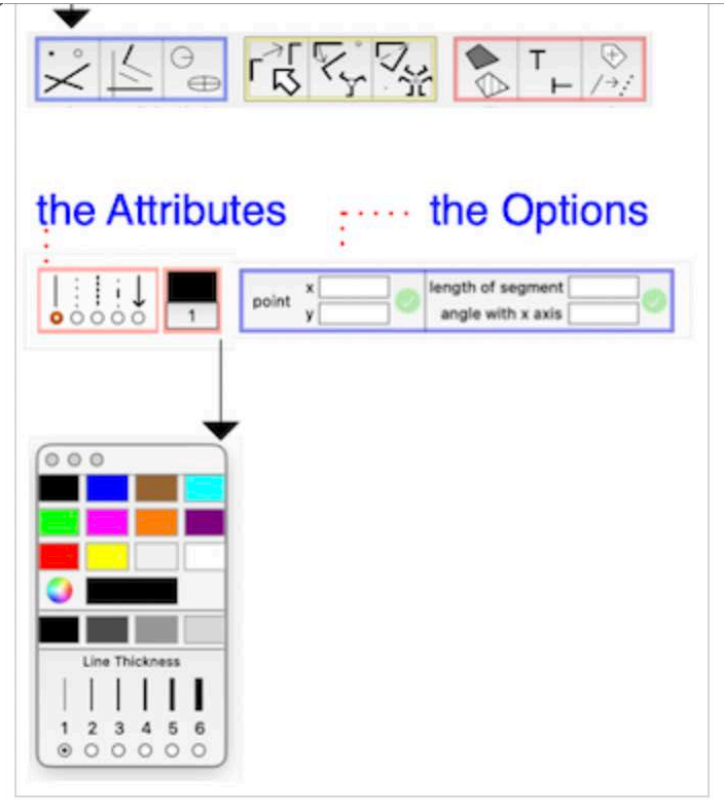


Every action in the Help files is supported by drawings and in most cases by YouTube video clips. However, these blue links are not functioning as we mentioned earlier:

https://youtu.be/vWlSvnaNeIw

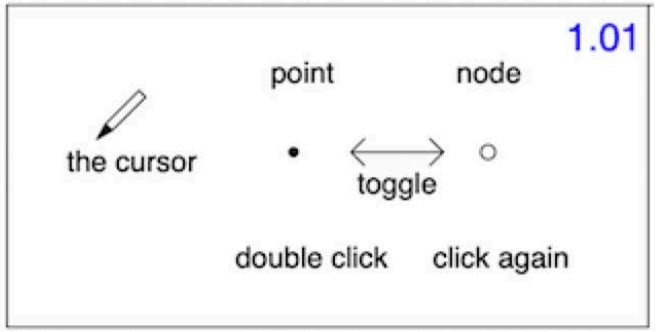
If you wish to view them, please copy the link “manually”.

We included at the end of this doc the website pages of Geometria2.



The Point

1.01 Choose the P/L tool and **double-click** anywhere in the window to place a point; it will appear as a black dot. Note that the cursor is an oblique pencil.

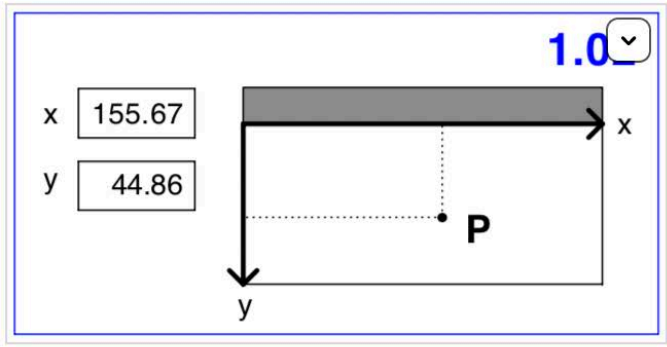


• You may represent a point with a small circle; we will call it a node. To create a node, click on an existing point. This is a toggle action: clicking the node again will return it to its original state.

1.02 The parametric fields have two functions:

a. to indicate the parameters of a point in place,
b. to input the parameters of a point to be placed.

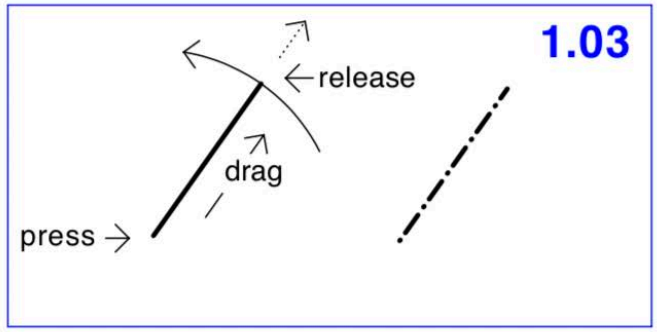
• The Option Bar’s text fields indicate a point’s x and y coordinates.



• You may place a point by typing the coordinates in the x and y fields, followed by a click on the Enter button. Use the Delete and Tab keys for faster entries.

The line

1.03 To draw a line, press to place the initial point, drag the cursor in any direction and release it at the endpoint.



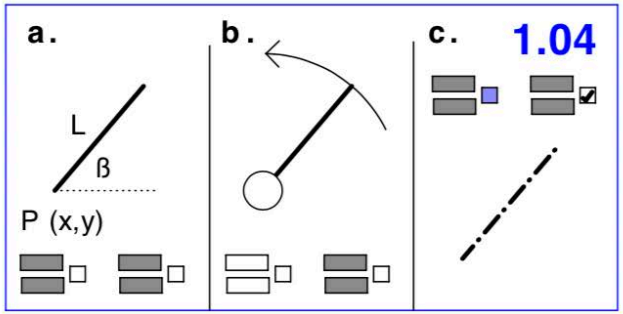
Construction:
Tool #1 P/L
Point/Line

• While dragging the cursor, the line will rotate around the initial point and shorten or lengthen depending on the cursor's position. We detail the snapping action in 1.05, but we show it in practice here:
https://youtu.be/qBVlVDASKtk

The parameters

1.04 Here, the parametric fields have three functions:

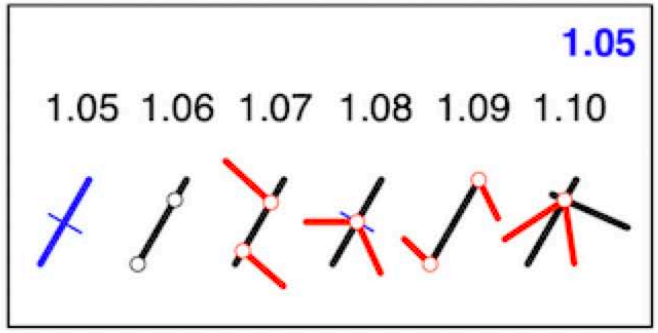
1. to indicate the parameters of a line already drawn,
2. to monitor the parameters of a line while drawing,
3. to input the parameters of a line to be drawn.



• The x and y coordinates of the initial point and the length and angle of the line are indicated in the Option Bar. When you draw a line, the coordinates of the initial fixed point are shown, while the angle and the length of the line are monitored in real-time during the hovering of the cursor.
You can draw a line by typing the coordinates of the initial points (x and y), the length, and angle of the line in the corresponding fields, and then clicking the Enter button. Use the Delete and Tab keys for faster entries.
https://youtu.be/vWlSvnaNeIw

The snap action

1.05 Draw a line and hover the cursor (don't drag) near the line. The line will turn blue with a blue node indicating the midpoint.



1.06 To place a point (dot) on an existing line, double-click on or near (8 points=2.8 mm) the line, which is now blue, and the point will snap on the line. Click on the point again to make it into a node (small circle).

1.07 Draw a line and drag a second line's endpoint near the first line. The first line turns green, and the endpoint of the second line will snap on the first line. This is useful if you want to terminate the second line precisely at some point on the first line

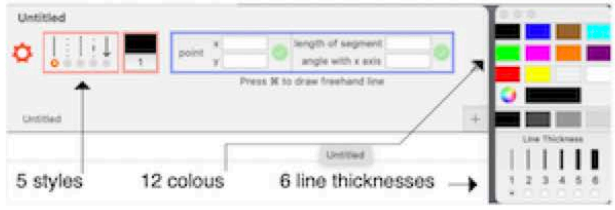
1.08 You can also use the snap action of the midpoint of a line to start or end of another line.

1.09 The snap action allows you to use the endpoint of a line to snap on another line's endpoint by dragging it near.

1.10 Finally, draw two intersecting lines. Drag the endpoint of a third line near the intersection; it will snap on the point of intersection, shown momentarily as a green dot.
https://youtu.be/CNshLvP07bk

The attributes of lines

1.11 You may select (see Tool #4) three attributes for a line in the Attribute Window: style, colour and thickness.



Construction: Tool #1 P/L Point/Line

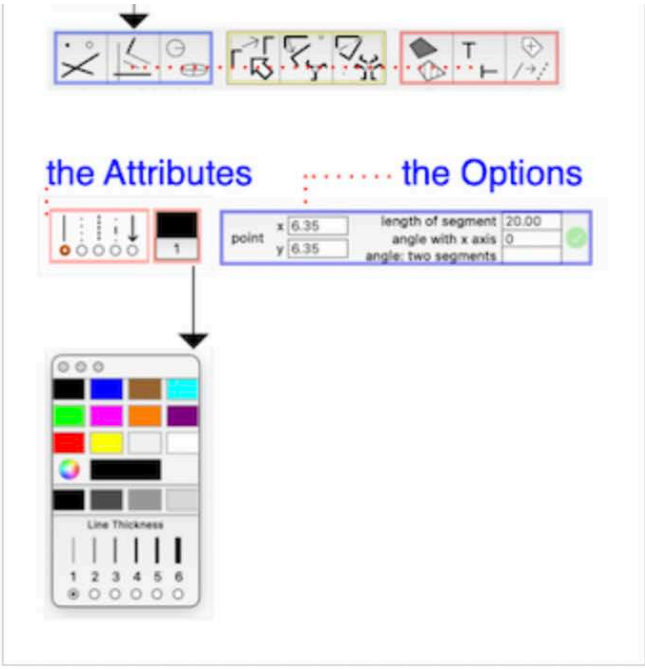
• The default line is solid, black and thin. To draw a different line, first choose the style, the colour, and the thickness. To change the attributes of an existing line, the line had to be selected (see Tool #4). The style is chosen in the Attribute Window. Click the coloured rectangle to display the floating Attribute Window, where you can select the colour and the line thickness. You can choose from 360 combinations of attributes of a line (5x12x6).
• The thickest line, #6, in the floating Attribute Window is 1.5mm. You may create lines up to 10 mm in thickness (see 4.07):

1. select the line
2. press the Shift key and the + key

https://youtu.be/xM3f1O-Ylx8

1.12 To draw a freehand curve, press Command ⌘, then press-drag-release the mouse button. When you release the mouse, you will notice that the curve will be smooth but closely follow the drawn curve.
https://youtu.be/B7H7YheduMc

Construction: Tool #2 P/P Parallel/Perpendicular

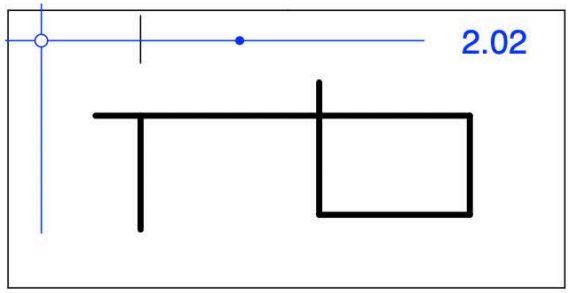


2.01 This unique tool is a versatile innovation, the most frequently used tool in Geometria 2. This single tool can perform a multitude of functions:

- draw horizontal lines (x direction) and vertical lines (y direction) (2.02)
- draw segments with given lengths (2.03)
- create a new direction for parallel and perpendicular lines (2.04)
- draw a line parallel or perpendicular to a given line (2.05)
- install a given length on a line (2.06)
- find the midpoint of a given segment and construct the bisector of the segment (2.07)
- display the angle with the horizontal and the length of a given segment (2.08)
- draw a segment with a given initial point, angle and length (2.9)
- construct the bisector of the angle of two lines (2.10)
- display the angle of two intersecting lines (2.11)
- draw the line at an angle, multiple of 15° to a given line (2.12)
- draw a square with a given edge length and angle with the X direction:
- draw an equilateral triangle, given one of its edges (2.14)

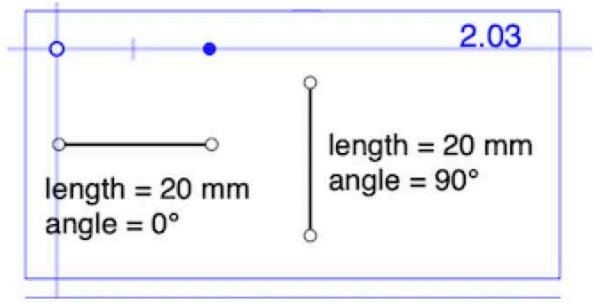
The constructions

2.02 Click on the Parallel / Perpendicular icon (P/P); the new cursor is now a “vertical pencil.”



• The tool (P/P) is presented in the upper left corner of the window by the “Square” tool in its default position: a horizontal and vertical blue line (if the screen is in a vertical plane). The distance between the node and the dot is the module, by default, 20 mm. To draw a horizontal or vertical line, press anywhere in the window, drag the cursor (restricted horizontally or vertically), then release.
https://youtu.be/cFtVcUq8KR0

2.03 To draw horizontal or vertical segments with the default module (20 mm): press - drag (left or right, or up and down) - release the mouse carefully until you see the green dot.



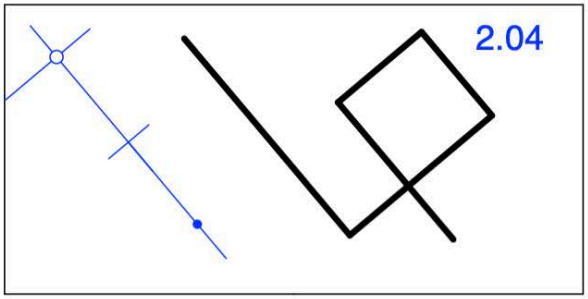
• The length of the segment is the default module, 20 mm. You may notice that while dragging, you could release when a green node appears first: the length of this segment is now half of the module.
https://youtu.be/cFtVcUq8KR0

Construction: Tool #2 P/P Parallel/Perpendicular

2.04 Create new directions:

1. Displace the Square: click to locate the initial point (blue node) of the new direction
2. Hover the cursor and click to locate the endpoint (blue dot) of the new direction*.
3. To draw a line anywhere, press-drag-release
4. The lines are now restricted to the new directions; they will be parallel or perpendicular to the new directions.

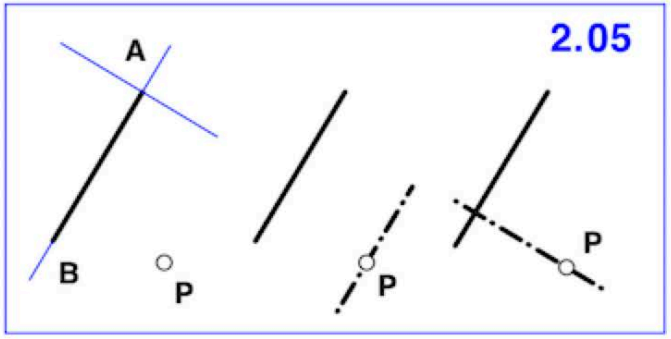
• If the second click is outside the window, the Square will return to its last position.



https://youtube.com/shorts/-72mB5pCugk?feature=share

2.05 Given a line AB and a point P not on the line. Draw a line parallel and perpendicular to AB through point P.

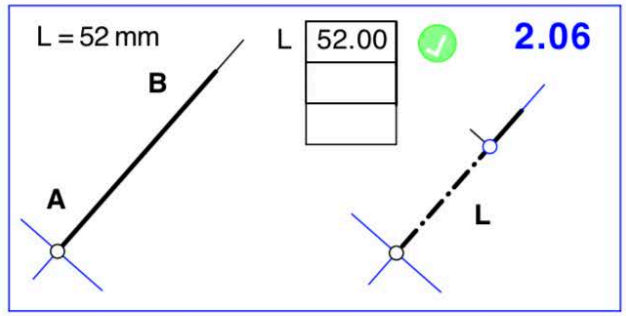
1. While the P/P tool is active, click on point A, hover and click on point B.
2. Double-click on point P; the Square is now anchored on point P. Lines drawn through P are restricted to lines parallel or perpendicular to AB.
3. To draw parallel or perpendicular lines through P, press on P, then drag and release.



https://youtube.com/shorts/-72mB5pCugk?feature=share

2.06 Install a given distance (52 mm) on a given line AB:

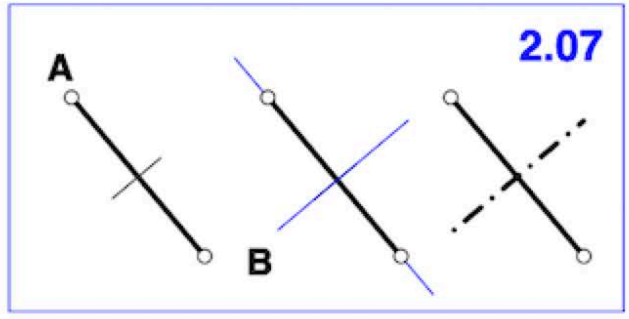
1. Click on point A, hover the cursor and click on any other point on the line.
2. Type in the parametric field the given length.
3. Click the green Enter button or press the Enter key.
4. A blue dot is shown on the line at the given distance from point A
5. You may mark the new point with a dot or a node. To do this, press and hold the Shift key, and while you hold it, the P/P tool changes to the P/L tool. Release the Shift key; you are back with the P/P tool.



https://youtu.be/4XnklOKdUW0

2.07 Given the segment AB. Construct its bisector (a line perpendicular to AB at the midpoint of AB):

1. Click point A, hover the cursor and click point B,
2. Double-click on the small dash indicating the midpoint.
3. To draw the bisector, click-drag-release on the perpendicular blue line

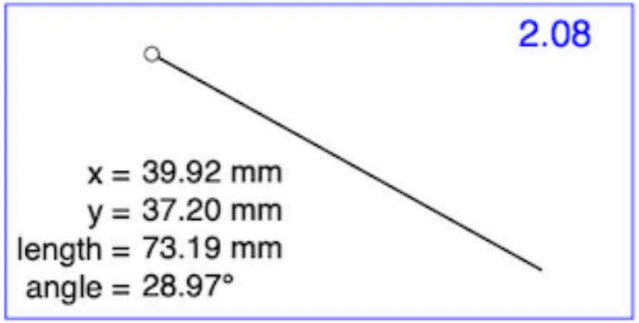


https://youtu.be/4XnklOKdUW0

Construction: Tool #2 P/P Parallel/Perpendicular

2.08 Verify the x and y coordinates of the initial point, the length and the angle with the horizontal of a drawn segment:

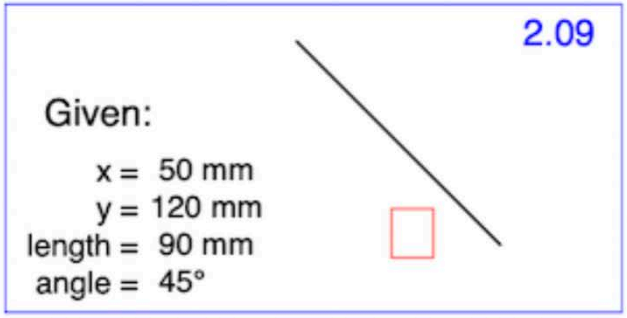
1. Click point A, hover the cursor and click point B.
2. The data is now displayed in the parametric fields.
3. If you first click on point B, the angle shown is the supplementary angle (180°-ß) of the angle shown first.



https://youtu.be/7ql6iDBd19U

2.09 Draw a segment of a given initial point (x, y), angle and length:

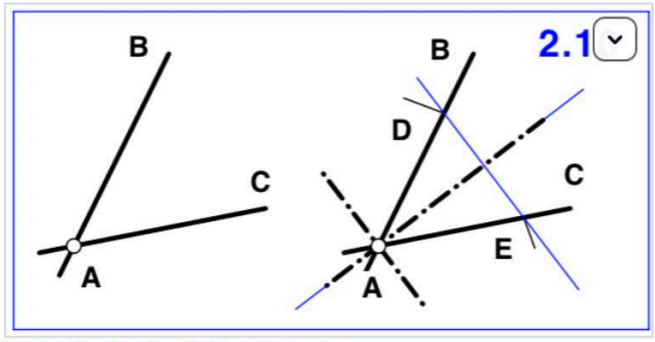
1. Type the data into the parametric fields.
2. Click the green Enter button or press the Enter key.
3. Use the Delete and Tab keys for faster entries.



https://youtu.be/7ql6iDBd19U

2.10 Construct the bisector of the angle of two lines, AB and AC

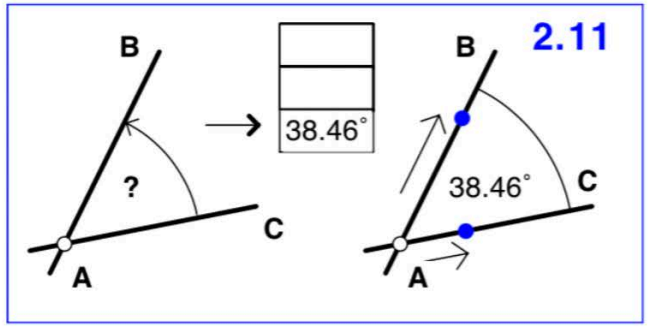
1. Install two points, D and E, respectively, on AB and AC at equal distances from the common point A, see 2.06.
2. The bisector of the angle between the lines is the bisector of the segment DE (see 2.07). A more straightforward solution is shown in 3.12 with the C/E tool (Compass).



https://youtu.be/Sd7-Z7oNesk

2.11 Measure the angle of two lines intersecting at point A:

1. Press and hold Command, click at A, hover and release anywhere on the line AB.
2. Do the same on the line AC.
3. The "angle: two lines" is displayed in the parametric field
4. The sign of the angle is negative if it is checked counterclockwise (if you click first on AC, then on AB).

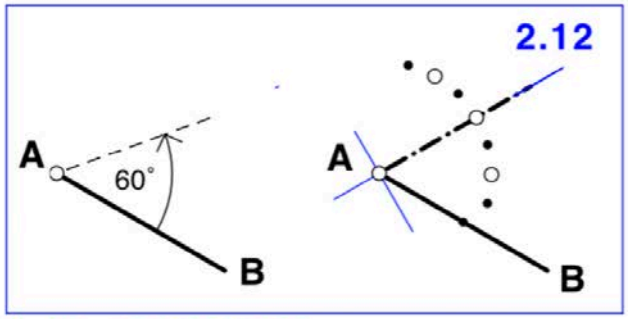


https://youtu.be/Sd7-Z7oNesk

Construction: Tool #2 P/P Parallel/Perpendicular

2.12 Draw a line through A at an angle, a multiple of 15° to a given segment AB:

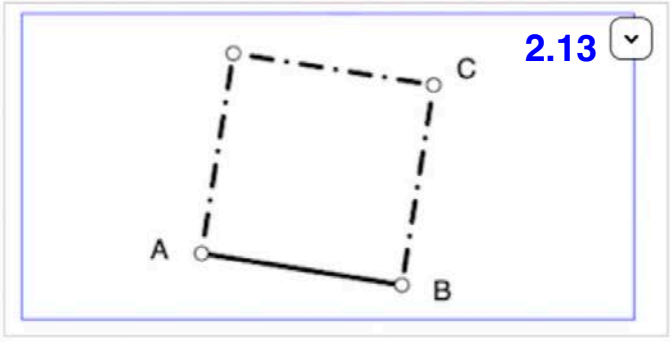
1. Click on A, hover, then click on B.
2. Press Command and click on A. You will see a protractor-like scale: dots and nodes showing angles, multiples of 15°
3. Click on the dot (or node), indicating the desired angle and draw the line along the blue line.



https://youtu.be/F4qpCjdq8Us

2.13 Draw a square given one of its edges, AB.

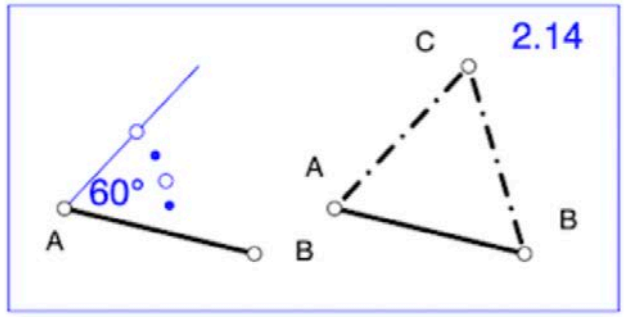
1. Click on point A, hover the cursor and click on B.
2. Press on B and drag the cursor perpendicular to AB; stop when the green dot appears at point C.
3 Repeat the same action for the third and fourth edges



https://youtube.com/shorts/OBS6vD6mpIA?feature=share

2.14 Draw an equilateral triangle, given one of its edges, AB.

1. Click on point A, hover the cursor and click on B.
2. Press Command and click on A.
3. Hover the cursor and click the blue node 60°
4. Join point A with the blue dot C; join C to B.



https://youtube.com/shorts/OBS6vD6mpIA?feature=share

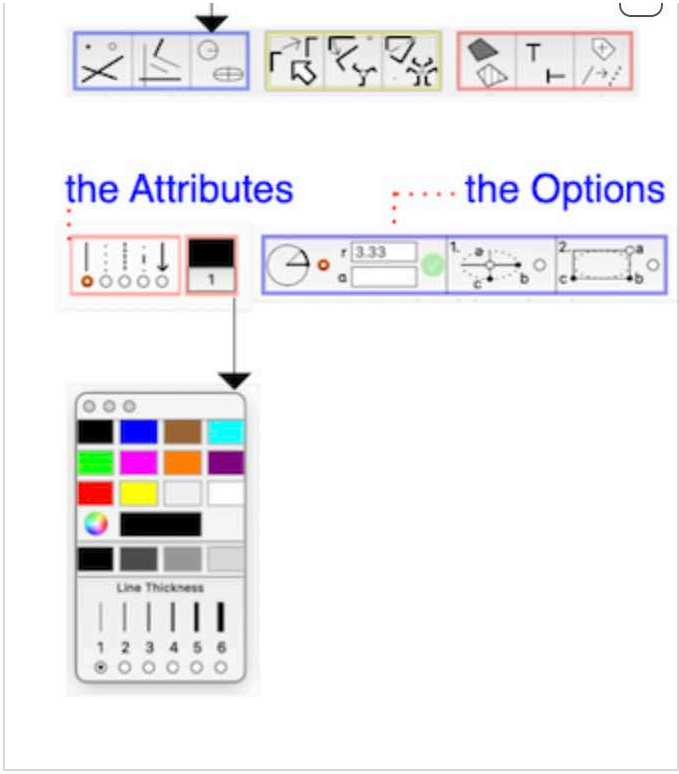
2.15 The Snap function described in 1.05-1.10 for points and lines (segments) applies to the lines (segments) created with the P/P tool.

2.16 The Attribute function described in 1.11 for points and lines (segments) applies to the lines (segments) created with the P/P tool.

2.17 To return the Square to its default position, click the P/P icon

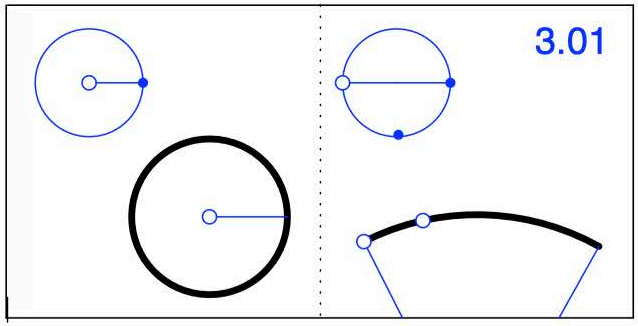
2.18 Use Command-Z to undo operation(s), use Shift-Command-Z to redo operations(s)

Construction: Tool #3 C/E Circle/Ellipse



The circle, description

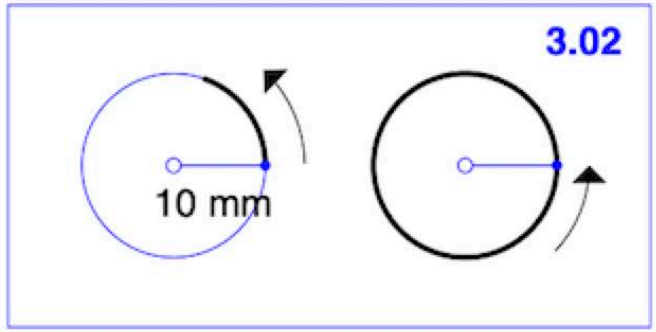
3.01 This tool allows the user to draw circles, circular arcs and ellipses. The tool for the circles and arcs is the Compass, and the ellipses are the Ellipsograph. Click on the C/E icon, and the Compass will appear by default. If an ellipse appears, click the radio button in the Option Bar showing the circle option.



• The Compass is a blue circle; the centre is indicated by a blue node and a horizontal radius (by default 10 mm), with a blue dot on the circumference. You may also draw a circle, going through 3 points (see 3.12)

The constructions

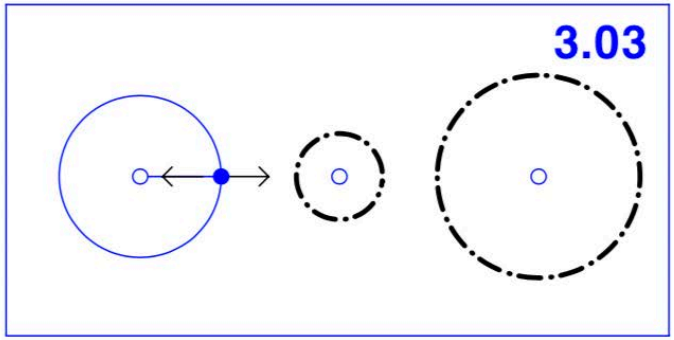
3.02 To draw an arc or a circle with a radius of 10 mm (the default module), click anywhere in the window to locate the centre, place the cursor on the blue dot of the circumference, then press, drag in a circular (tangential) motion and release at the endpoint of the arc or the initial point for a circle. You may also place the circle's centre in the window by the press-drag-release motion.



• To start an arc from another location, click elsewhere on the circumference; the blue dot is now relocated, and the arc will begin from this new location.
https://youtu.be/H_9rMeEdpqo

3.03 To modify the circle's radius or an arc, click anywhere in the window to locate the centre. Place the cursor on the blue dot and press - drag in the direction of the blue radius - release. As you drag, the radius changes; you may release at an existing point. In that case, the arc or the circle will snap at that point. To draw the circle or the arc, see above.

Construction: Tool #3 C/E Circle/Ellipse

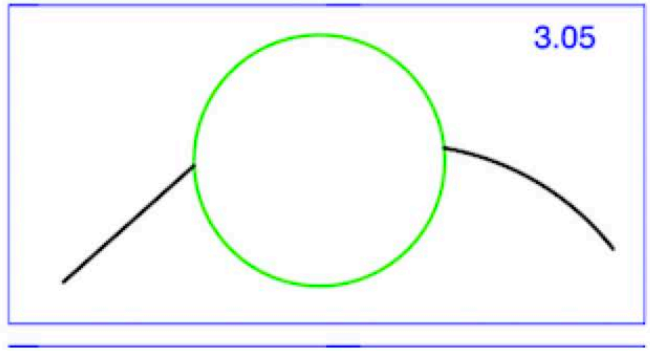


https://youtu.be/H_9rMeEdpqo

3.04 Draw an arc or a circle with a numerically given radius: click to locate the centre. Enter the given value in the parametric field "r" and click the Enter button. To draw the circle or the arc, see above.

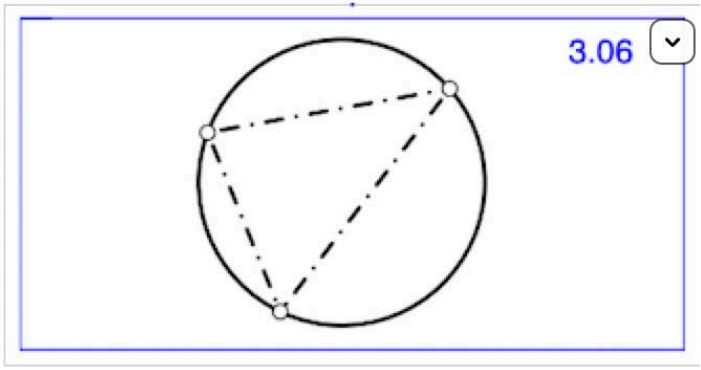
https://youtu.be/H_9rMeEdpqo

3.05 When you approach a circle with the endpoint of a segment, the circle turns green, and the endpoint snaps on the circumference. Once the cursor is inside, the circle becomes blue, and you see the centre as a blue node and a blue dot on the circumference.



• Lines, circles and arcs will snap on these points. The feedback: the dot and the node turn green.
https://youtu.be/711CxSG6UcM

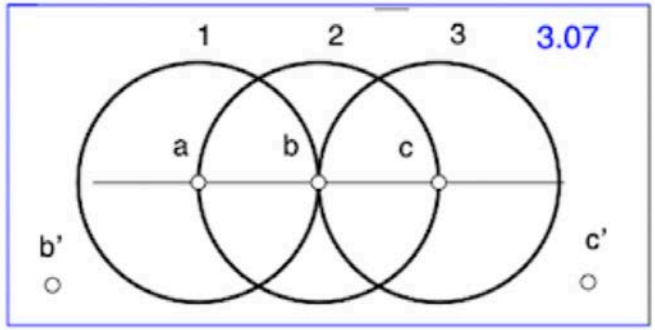
3.06 To place a point on the circumference, click the cursor near it; it will snap on the circumference. We inscribed a triangle in the circle.



https://youtu.be/711CxSG6UcM

3.07 To place the centre of a new circle on the circumference of an existing circle, displace the compass temporarily. Now, if you click anywhere on the circumference of an existing circle, the centre will snap to the circumference.

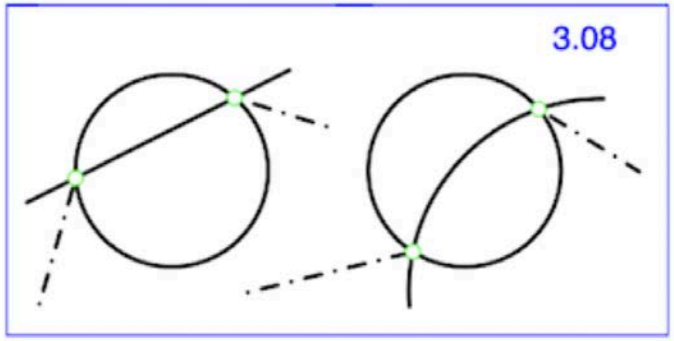
Construction: Tool #3 C/E Circle/Ellipse



https://youtu.be/Aahay1SdD_g

For example, we illustrate the construction of three circles such that the center of circle #2 lies on circle #1, and the center of circle #3 lies on circle #2.

3.08 The points of intersection of a circle or an arc with a line or with another circle or an arc are kept in memory.

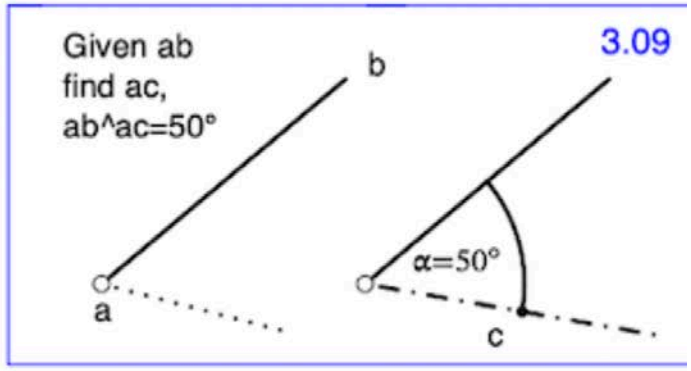


• The endpoints of a line or an arc will snap on them. The feedback is a temporary green node near the intersection with the endpoint of a line.
https://youtu.be/Aahay1SdD_g

3.09 We can use the C/E tool to solve the following problem: given a segment **ab** and an angle **α**. Draw the segment **ac** at an angle **α** to **ab.**

1. draw a circle with the centre **a**
2. type the angle of 50° into the **α** field
3. click Enter, and the blue dot jumps to point **c**
4. draw the arc **bc**
5. join **a** and **c**

The segment **ac** is at 50° to segment **ab**

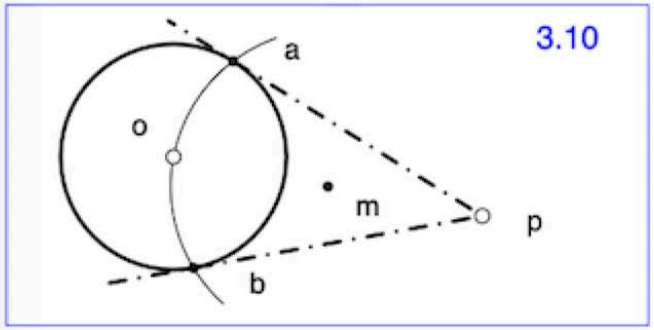


https://youtu.be/yPEMpu_Aa7A

3.10 Given a circle with centre **o** and the point **p**. Construct the tangent through **p** to the circle.

1. find the midpoint **m** of segment **op**
2. draw an arc centred at **m** with the radius **op/2**
3. this arc intersects the given circle in two points, **a** and **b**
4. The tangents are **ap** and **bp**

Construction: Tool #3 C/E Circle/Ellipse

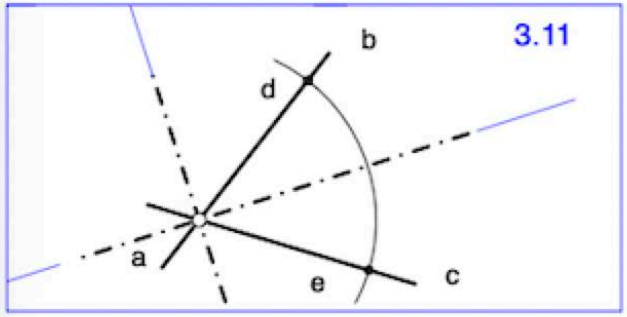


https://youtu.be/yPEMpu_Aa7A

3.11 Construct the bisector of the angle of two lines, **ab** and **ac**

1. draw an arc with centre **a**
2. this arc meets **ab** in point **d**, **ac** in point e
3. with the P/P tool, click at **d**, then hover and click at **e**
4. with the P/P tool, click at the midpoint of de, hover and click at **a**
5. double click at **a**; you will see the two bisectors as blue lines

• This construction is simpler than the one described in 2.10.
https://youtu.be/4QdrrWopp_A

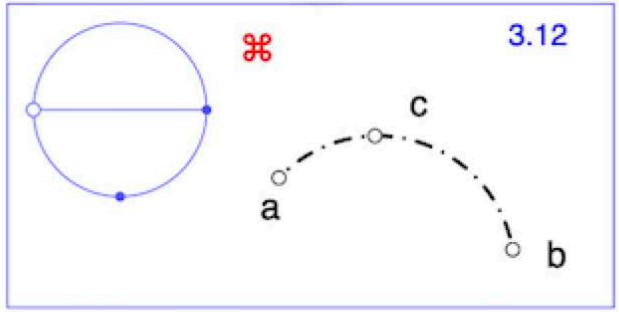


https://youtube.com/shorts/uJS9bAwmCII?feature=share

3.12 Draw the arc through three given points, **a**, **b**, c.

1. Select the C/E tool and press ⌘
2. the compass now has a node and two blue dots
3. click at **a**; the node is anchored
4. press, drag and release one of the blue dots on **b**
5. press, drag and release the second blue dot on **C**
6. release the key ⌘ and draw the arc

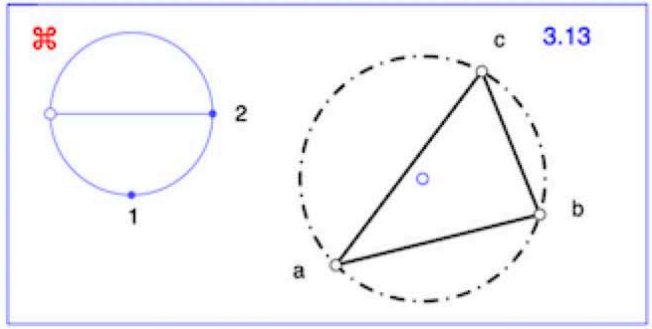
This function is useful when the circle's centre is outside the window. The simple method will not work: the bisectors meet outside the window.



https://youtube.com/shorts/uJS9bAwmCII?feature=share

3.13 The same function allows you to construct the circumscribed circle of a triangle:

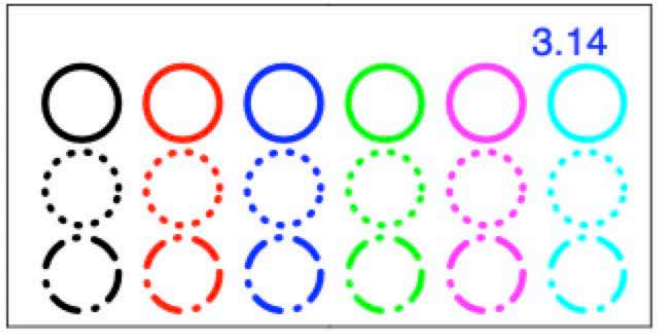
1. press the key ⌘: the new compass has a node and two dots on the circumference
2. click on **a** to locate the node
3. press-drag-release dot **#1** on **b**
4. press-drag-release dot **#2** on **c**



Construction: Tool #3 C/E Circle/Ellipse

• You may also find the centre of the circumscribed circle at the intersection of two bisectors of two edges of the given triangle.
https://youtube.com/shorts/uJS9bAwmCII?feature=share

3.14 The style, thickness and colour of lines (segments) created with the C/E tool are selected in the Attribute Bars.



3.15 To return the Compass to the default position, click the C/E icon.

The ellipse - description

3.16 We introduce two ways to draw ellipses. Both constructions are based on the so-called conjugate diameters of an ellipse. Two diameters are conjugate if, at the endpoint of one diameter, the tangent to the ellipse is parallel to the other diameter.

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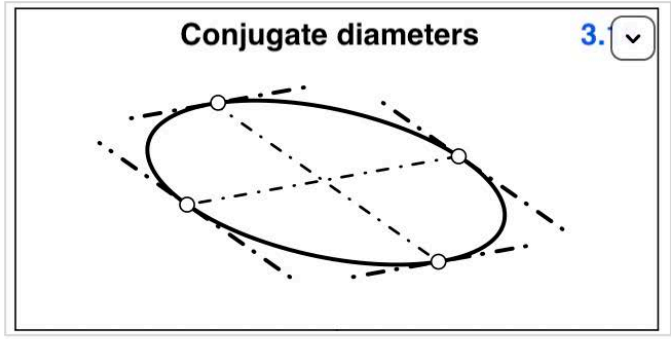
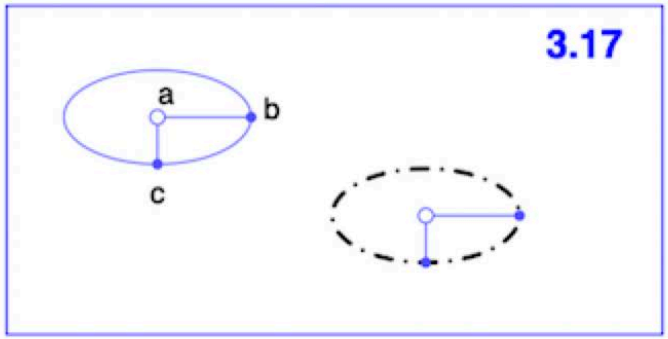


• Thus, to every diameter of an ellipse belongs another unique diameter, its conjugate diameter. Method #1 allows the user to display the major axes of the ellipse. Method #2 simplifies inscribing an ellipse in a parallelogram (rectangle).

The construction; method #1

3.17 Click on the Circle/Ellipse (C/E) icon and click the radio button in the Method #1 field. The tool (C/E) is presented in the upper left corner of the window by the "Ellipsograph" tool in its default position: a blue ellipse.



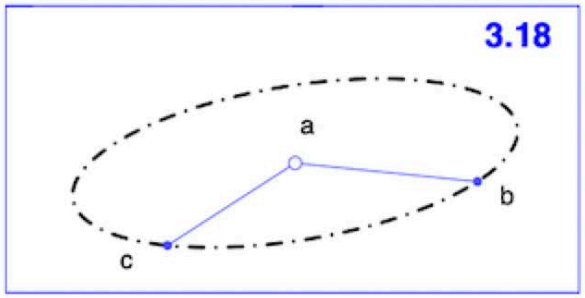
Construction: Tool #3 C/E Circle/Ellipse

• The ellipsograph in the upper left corner displays the major axes **ab** and **ac** (the longest and shortest conjugate radii). The ellipsograph may be relocated by clicking anywhere in the window or press-drag-release node **a**. Draw the ellipse by clicking on the circumference.

3.18 Draw an ellipse with arbitrary geometry:

1. click anywhere in the window to place the node **a**
2. press-drag-release the dot **b** anywhere
3. press-drag-release the dot **c** anywhere
4. draw the ellipse by clicking on the circumference.

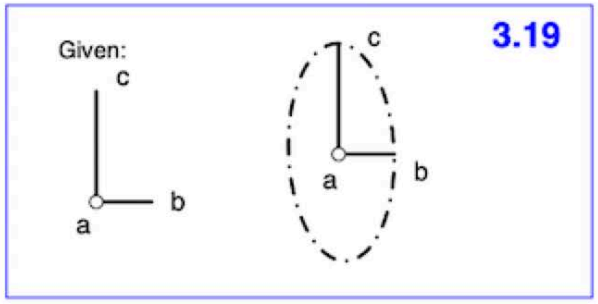
• The two endpoints, **b** and **c,** will determine the shape of the ellipse.



https://youtube.com/shorts/pC6xoKRhlkk?feature=share

3.19 Given the half-major axes, draw the ellipse.

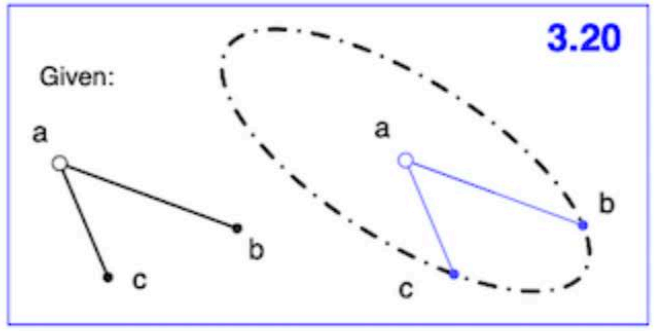
1. click on **a** to locate the centre
2. press-drag-release the dot on **b**
3. press-drag-release the other dot on **c**
4. draw the ellipse by clicking on the circumference.



https://youtube.com/shorts/pC6xoKRhlkk?feature=share

3.20 Given the conjugate radii **ab** and **ac**, draw the ellipse.

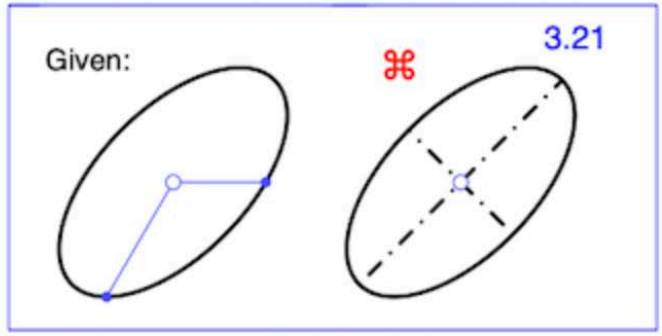
1. click on **a** to locate the centre
2. press-drag-release the dot on **b**
3. press-drag-release the other dot on **c**
4. draw the ellipse by clicking on the circumference.



https://youtube.com/shorts/a5wUfEtSz6k?feature=share

3.21 Given an ellipse, find its major axes:

1. press the key ⌘
2. click on the circumference of the ellipse

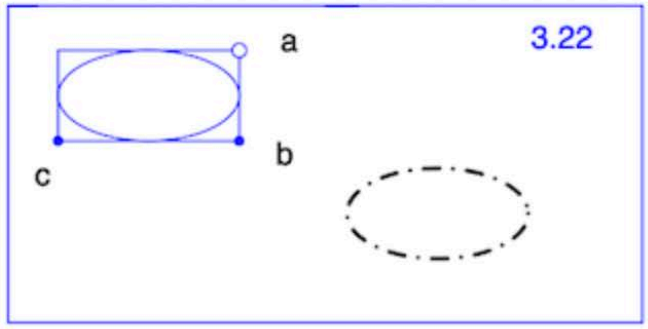


https://youtube.com/shorts/a5wUfEtSz6k?feature=share

Construction:
Tool #3 C/E
Circle/Ellipse

The construction, method #2

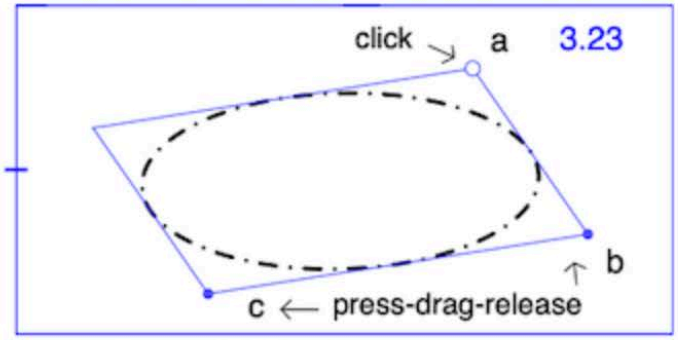
3.22 Click on the Circle/Ellipse (C/E) icon and click the radio button in the Method #2 field. The tool (C/E) is presented in the upper left corner of the window by the "Ellipsograph" tool in its default position: a blue ellipse inscribed in a rectangle whose edges are tangent to the ellipse.



• The ellipsograph may be relocated by clicking anywhere in the window or press-drag-release node **a**. Draw the ellipse by clicking on the circumference.

3.23 Draw an ellipse with arbitrary geometry:

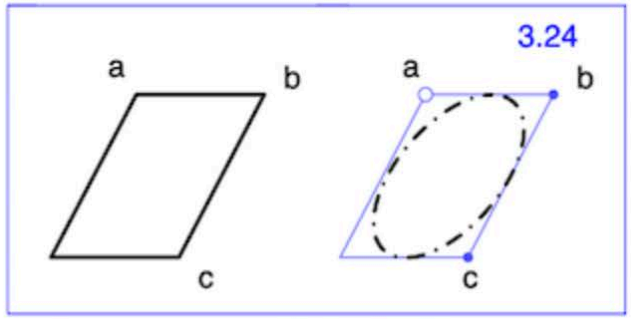
1. click anywhere in the window to place the node **a**
2. press-drag-release dot **b** anywhere
3. press-drag-release dot **c** anywhere
4. draw the ellipse by clicking on the circumference.



https://youtu.be/ycAT0h0Ahh4

3.24 Given a parallelogram, draw the inscribed ellipse:

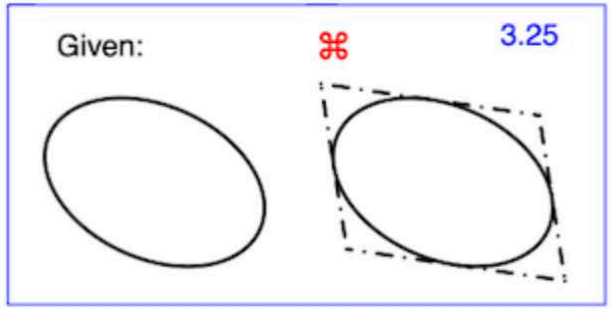
1. click at **a** to place the node
2. press-drag-release the dot **b**
3. press-drag-release the dot **c**
4. click on the circumference of the ellipse



https://youtube.com/shorts/jS2U9-IKYjU?feature=share

3.25 Given an ellipse**,** redraw the circumscribed parallelogram:

1. press the key ⌘
2. click on the circumference of the ellipse

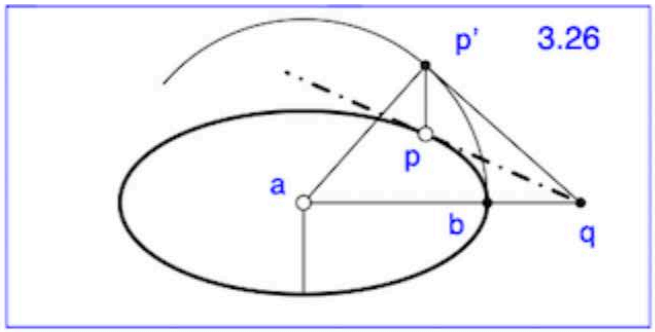


https://youtube.com/shorts/jS2U9-IKYjU?feature=share

3.26 Draw the tangent **pq** by point **p** to the ellipse:

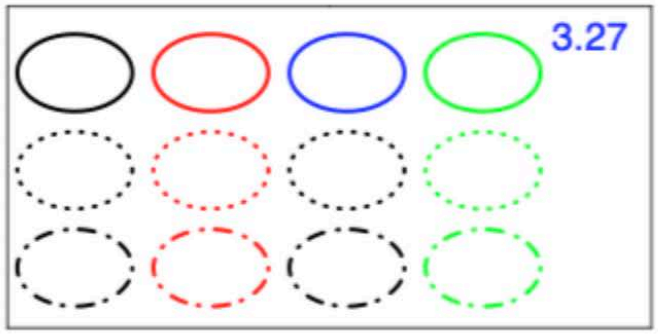
1. draw an arc centred in **a** with radius **ab**
2. project **p** perpendicular to **ab** on the arc into **p.'**
3. draw tangent **p'q** to the arc (perpendicular to **ap'**)
4. join **p** and **q**

Construction: Tool #3 C/E Circle/Ellipse



https://youtu.be/pBcns6DHKs4

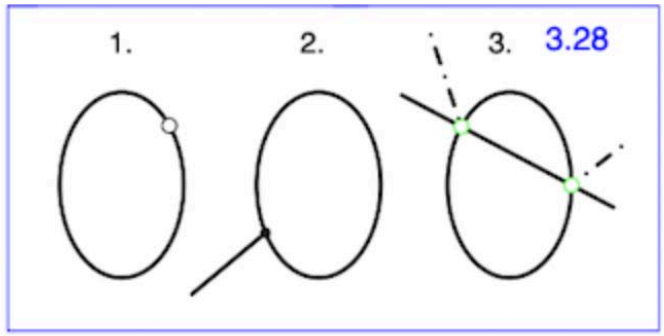
3.27 The style, thickness and colour of curves created with the C/E tool are controlled by the Attributes Bar.



• To return the Ellipsograph to its default position, click the C/E icon.

3.28 Snap functions on the ellipse:

1. to place a point on the circumference, bring the cursor near; the ellipse turns blue, double-click to draw the point (feedback: the ellipse is momentarily green)
2. drag the endpoint of a segment near; it will snap on the circumference (feedback: the ellipse is momentarily green)
3. the intersection of the ellipse with a segment is in the memory; drag the endpoint of the segment, and it will snap on the intersection (feedback: green node)

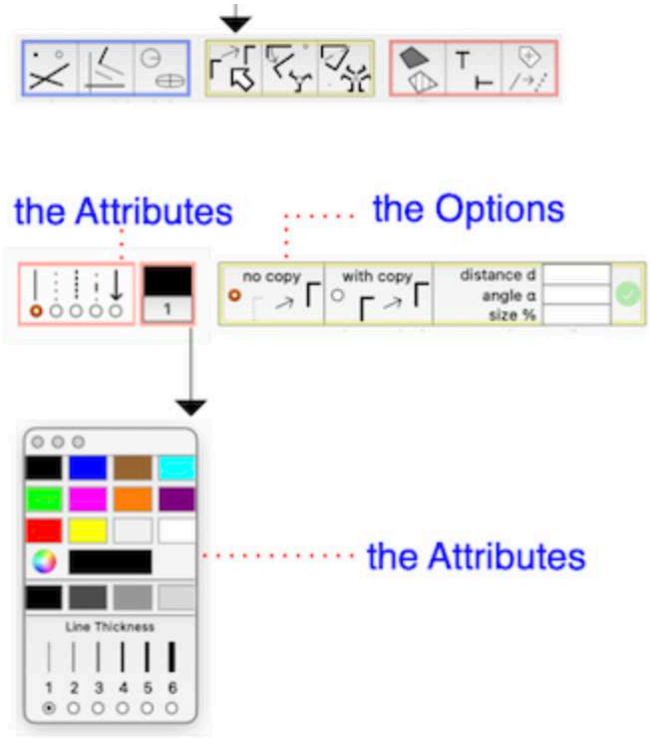


• We did not code the intersections of an ellipse with an arc or another ellipse; they rarely meet in real life.

3.29 To return the C/E tool to its default position, click the C/E icon.

3.30 Use Command-Z to undo operation(s), use Shift-Command-Z to redo operations(s)

Transformation:
Tool #4 T/S
Translate/Select

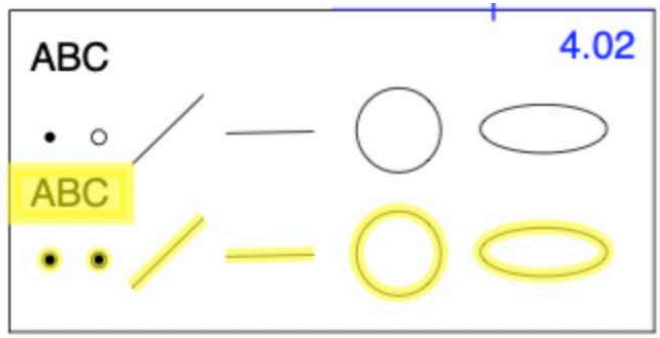


The selection - description

4.01 The second group in the yellow frame, called the Transformation tools in Geometria's Tool Bar, enables the users to apply the basic symmetry operations: translation, rotation, reflection and glide reflection. We must select the objects we wish to transform to do these operations on the screen. At the end of this chapter, we will resume the list of the relevant Apple-sanctioned keyboard shortcuts, which greatly help to accelerate the use of these tools.

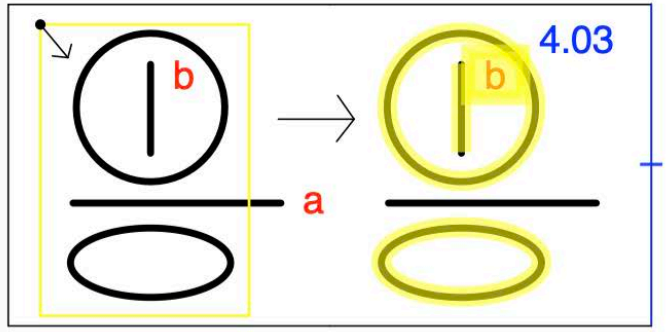
4.02 The selection tool (cursor) is a yellow arrow. Click on an object (dot, node, line, circle, arc, ellipse and text): the selected object is indicated with a transparent yellow strip. To select an arc, a circle or an ellipse, click the circumference or the centre.

• To delete a selected object, type "delete".



• This tool does not allow you to select a segment of a line, limited to one or more points (dots and nodes). Tool #9, Delete/Modify, you can select a segment. To deselect all selected objects, click anywhere in the window.

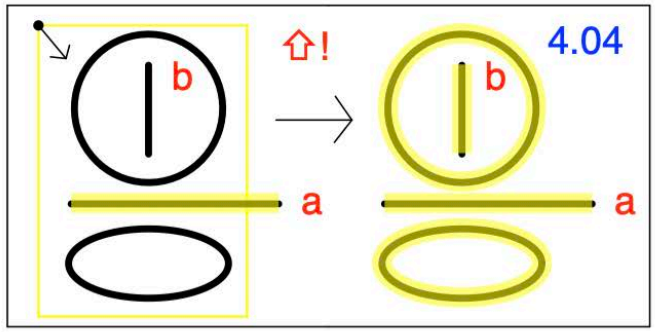
4.03 To select all objects in the window, press Command-A. You may choose a group of objects lying entirely within a "ghost" rectangle. Press and drag the cursor diagonally from the upper left vertex of the now visible yellow, transparent rectangle and release the cursor at the lower right vertex.



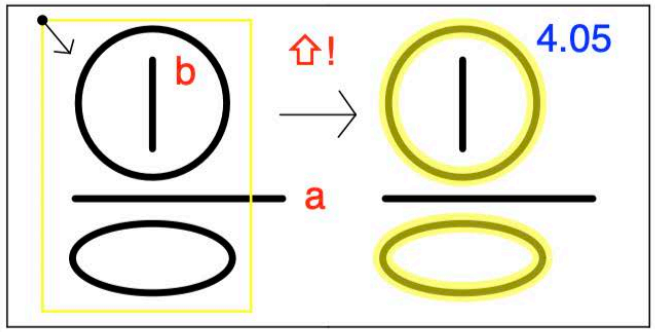
• All objects lying entirely inside the rectangle are selected, and the rectangle disappears, but the selected objects are indicated now with the yellow transparent strip. Note that line **a** is not selected because part of it lies outside the yellow rectangle.

4.04 If you want to add an object (line **a**, part of it lies outside the yellow rectangle) to a selected group, press the Shift key and click the object.

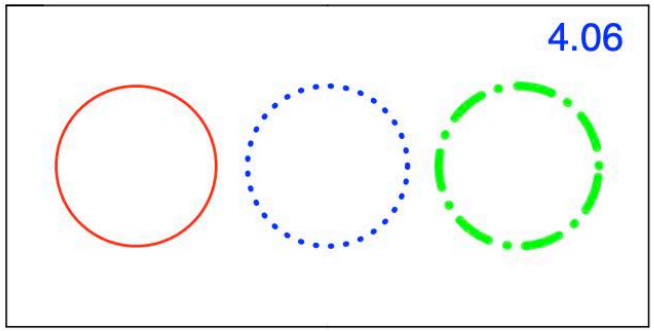
Transformation:
Tool #4 T/S
Translate/Select



4.05 If You want to deselect an object (line **b**) from a group, press the Shift key and click the object. Now the selected group does not contain **a** or **b**.



4.06 Select an object or objects and assign three attributes (see 1.11, 3.14, 3.27) in the Attribute Bar: style, width and colour.



4.07 The selection tool is also used to

extend a line or a segment

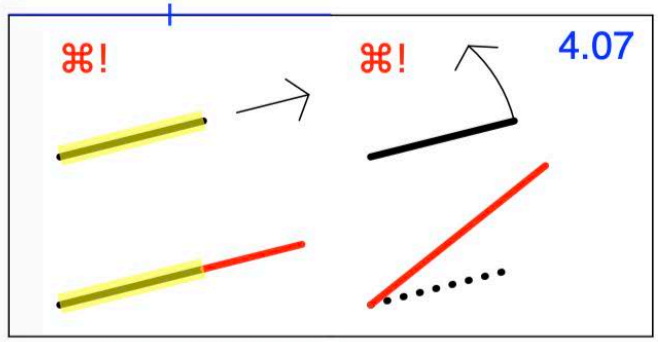
- rotate a line or a segment about one of its endpoints

Select the line, press Command and press at one of its endpoints (should not be a dot or a node)

1. If you drag the cursor in the direction of the line, it will extend or shorten following the motion of the cursor
2. release when the desired length is obtained
3. if you drag the cursor perpendicular (tangentially) to the line, it will rotate about the other endpoint
4. release when the desired angle is obtained
5. The extended or rotated endpoint will snap on points of other objects (see 1.05)

• The extended or rotated endpoint will snap on points of other objects (see 1.05).

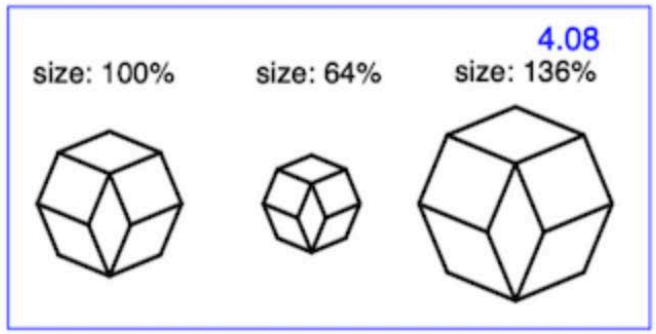
• If you want to control the thickness of a line, circle or arc visually, select the item, press shift (⇧) and +: the item will grow thicker beyond the #6 thickness up to 10 mm.



https://youtu.be/sLXA8GYYbZ0

4.08 Objects may be resized: select them, enter a percentage in the parametric window (Option Bar), and click the green checkbox. I you wish to keep the original, create a copy (select and translate the object) and apply the desired size to the copy.
Selected objects may be eliminated by typing the Delete key. A fast way to clean up the entire widow is to type Command-A (select all) and type Delete.

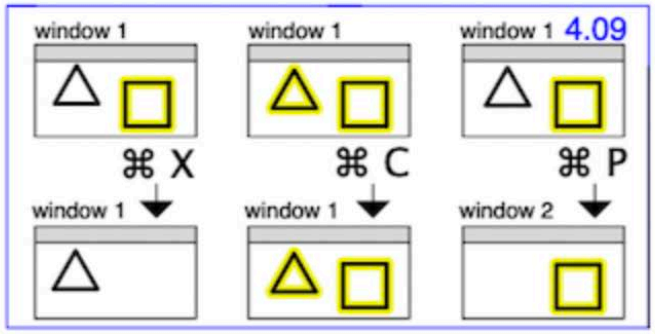
Transformation: Tool #4 T/S Translate/Select



https://youtu.be/mMZ82NTIfLc

4.09 We have another important application of the T/S tool: Cut, Copy and Paste.

- Cut (Command X): the selected objects are removed and stored in the Clipboard; you may paste them in a different location in the same window or into another window
- Copy (Command C): the selected objects rest visible: you may paste them in a different location in the same window or into another window
- Paste (Command P): the content of the Clipboard is either pasted in a different location in the same window or into another window

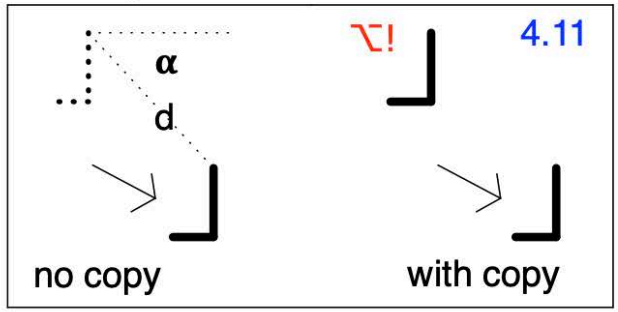


https://youtu.be/9jRP5gtSuOA

The translation - description

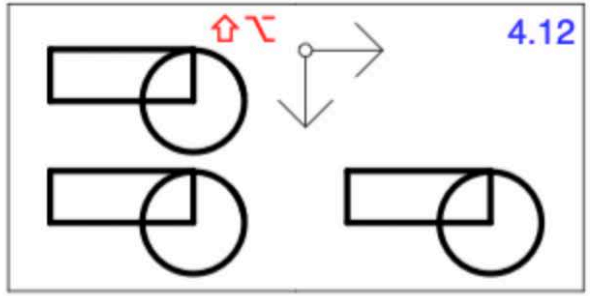
4.10 Translation is a symmetry operation when every point of a figure is moved by the same distance and at the same angle. The original figure is the pre-image, and the translated figure (copy) is the image. The operation is determined by a distance and an angle (vector); if you repeat the same operation on the same figure several times, you obtain several copies (images). This explains the parameters in the parametric windows related to the T/S tool: no copy, with copy, distance, and angle.

4.11 Figure "L" is composed of two segments, so select one, press Shift and select the other one. Press anywhere on the figure, drag to distance **d** at an angle **α** and release. The pre-image is shown with a dotted line to suggest that no copy was left behind.
The other "L" on the right side is translated with copy: select the figure, press Option, press - drag - release. Now a copy is left at the original location.



https://youtu.be/KaRIwhH7YW8

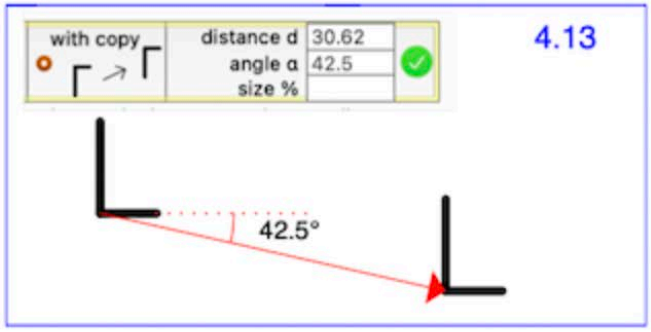
4.12 You can restrain the motion during translation to either horizontal (x direction) or vertical (y direction) displacements. Select the figure, hold down the Shift key, drag and release.



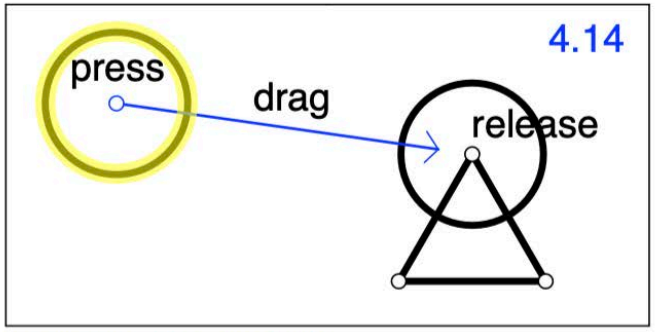
https://youtu.be/KaRIwhH7YW8

Transformation:
Tool #4 T/S
Translate/Select

4.13 You may translate a figure by choosing the two parameters: the distance and the angle. Enter the values in the parametric fields and click the Enter button. To repeat a translation, type Command-D. Executing small translations using parameters (like 1 mm., 0.5 mm etc.) is much better.



4.14 You want one point (endpoint, dot or node) of a group or figure to land on any other point in the widow: select the figure, press on the chosen point on the pre-image, and drag and release on the target point. A green node will confirm the snap.



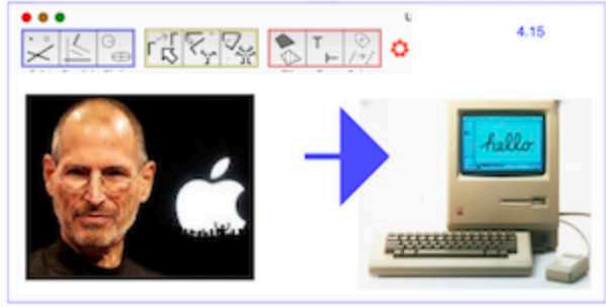
https://youtu.be/4NwHVml8aIQ

Screenshots in Geometria

4.15 It is a valuable function to paste any document (any format or extension) into Geometria and then size it and position it in the window.

1. open the document to be installed in Geometria
2. open the app Screenshot (Finder→ Menu→ Go→ Utilities)
3. move and resize the highlighted rectangle to select the desired portion
4. at the bottom of the screen, click from the left at the third icon (Capture Selected Portion)
5. click Options, select Save to: Clipboard, Timer: Non
6. click Capture
7. open Geometria and paste the image (⌘V)
8. the image may be resized and positioned in the window
9. the image remains on the clipboard until you paste (⌘V) again something else

• You may also take screenshots by taping ⇧⌘4; see below. Once you have pasted your images, you can superpose graphics, text, etc., and compose the page layout with Geometria's tools.

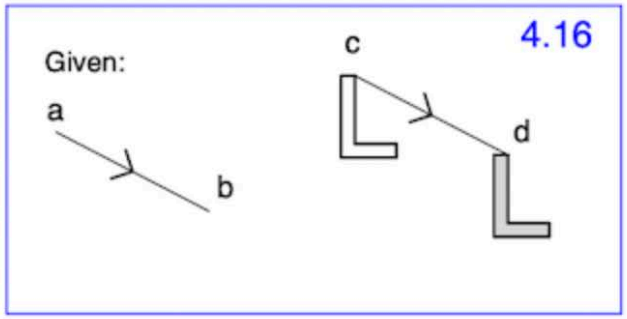


https://youtu.be/CiNidQquoEo

4.16 Translate a motif, given the vector ab of the displacement:

1. select the vector **ab**
2. grab point **a** of the vector and translate it to a point of the motif, for instance, to the point **c**
3. select the motif
4. grab point **c** and translate the motif to point **d**

Transformation:
Tool #4 T/S
Translate/Select



4.17 We limited our **keyboard shortcuts** specific to Geometria: we only use the Command key for six of the nine tools. All the other keyboard shortcuts applied above are standard global Apple keyboard shortcuts, and we resume the complete list below. We use the standard symbols for the so-called modifier keys.

Command ⌘
Shift ⇧
Option ⌥

• To use a keyboard shortcut, press and hold one or more modifier keys and then press the last key of the shortcut. For example, to use Command-C (copy), press and hold the Command key, then the C key, release both keys

Operations, no selections

⌘ Z undoes the last operation
⇧⌘ Z redo the previous operation
⇧⌘ 4 take a screenshot (alternate method)

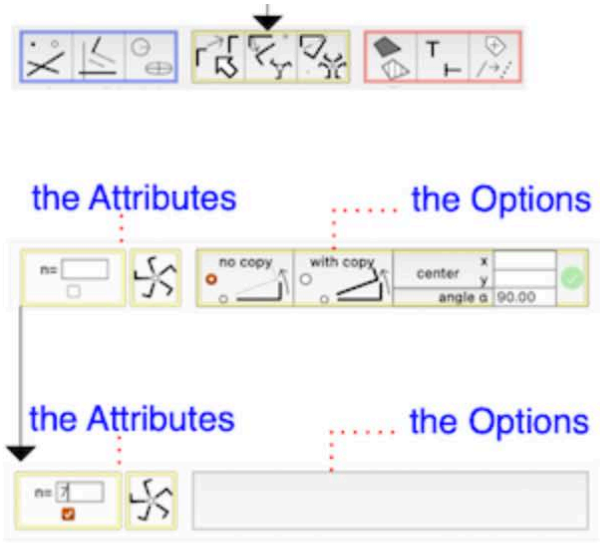
Operations on selection

⌘ A select all items
⇧ add or remove selected items

Operation on selected items

⌘ X cut
⌘ C copy
⌘ V paste
⌘ D duplicate operation
⌦ delete
⇧ translate horizontally or vertically
⌥ translate with copy

Transformation:
Tool #5 R/C
Rotate/C. Rosace



Rotation - description

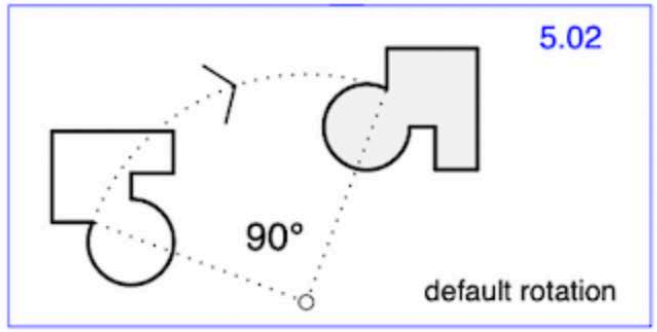
5.01 The second group in the yellow frame in Geometria's Tool Bar is called the Transformation tools; they enable the users to apply the basic symmetry operations: translation, rotation, reflection and glide reflection. To do these operations on the screen, we must select (T/S) the objects we wish to transform. The R/C tool is used for the following type of rotations:

- 90° rotation
- parametric rotation
- manual rotation
- cyclic rotation (c. rosace)

• Similar to the T/S tool, we may rotate using the "no copy" or the "with copy" option. The clockwise rotation has the positive (+) sign.

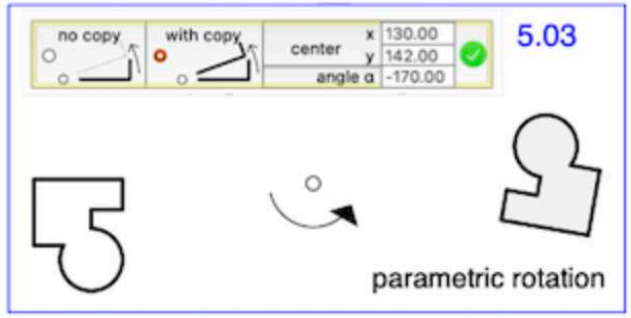
5.02 **90° rotation**, this is the default angle

1. select the object(s) and click the R/C tool
2. hover and click the cursor to locate the centre of rotation
3. you may snap the cursor on an existing point
4. or animate the rotation by the press-drag-release action



https://youtu.be/6JsrG3sw8vo

5.03 You may control the rotation of the selected objects by entering the **parameters**: the x and y coordinates of the centre and the angle α of the rotation. Click the green checkbox, and the rotation is performed.



https://youtu.be/7ZmX2m5UKDY

5.04 You visually control the centre and the angle with **manual rotation:**

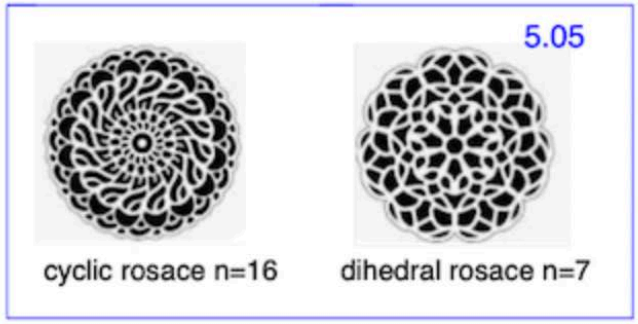
1. select the object(s) and click the R/C tool
2. hold down the Command key (⌘). The cursor changes
3. drag (!) the cursor (the centre of rotation) anywhere in the window; you may snap on an existing point
4. grab any point of the object and move it in a circular motion around the centre, clockwise or anti-clockwise

Transformation:
Tool #5 R/C
Rotate/C. Rosace

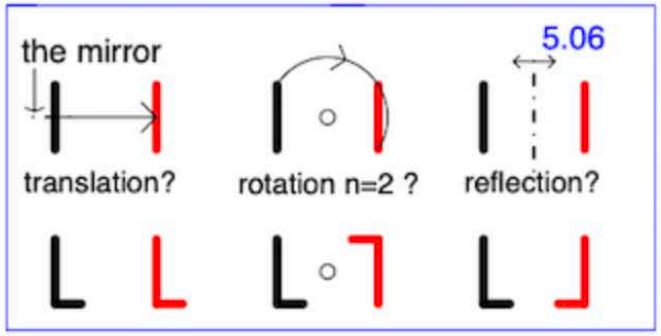
https://youtu.be/r73gwpxLQA4

Rosaces - description

5.05 We use the French architectural term rosace for figures generated by rotating a motif n-times (n-fold rotation) around a point at an angle of 360°/n, where n is a positive integer. A rosace is a symmetrical figure without translation. If it contains rotation only, we call it cyclic; if it also has reflection, it is a dihedral rosace. Dihedral rosacea are described in section 6 (R/D tool).

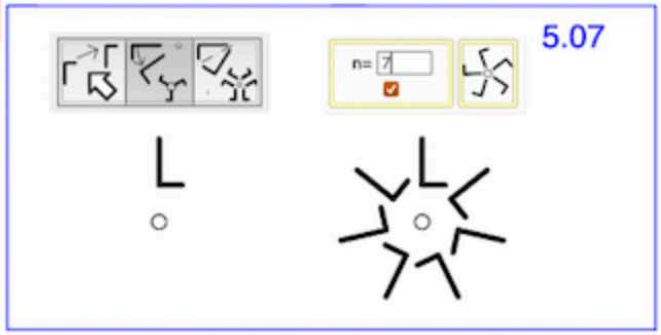


5.06 We go back to the same motif to illustrate symmetry operations. The letter "L" will be used in the following because it is simple and not symmetric. The letter "I" is simpler, but it is symmetrical about a mirror (its bisector), and this would lead to confusion:



5.07 Drawing of a **cyclic rosace**:

1. select a motif, click the R/C rotation tool, and a new Attribute Bar appears
2. enter a value for n, for instance, 7
3. click the checkbox
4. hover and click the cursor to locate the centre of rotation
5. or animate the rotation by the press-drag-release action
6. you may snap the cursor on an existing point

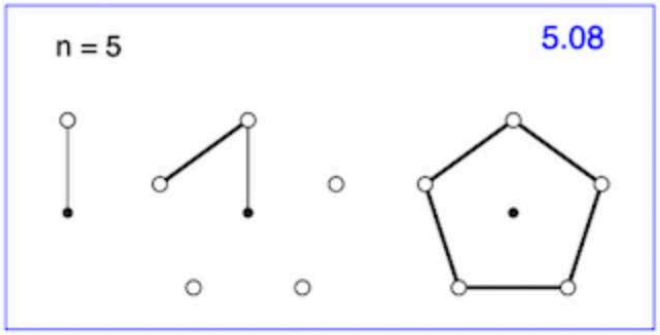


https://youtu.be/cKHcAtmWUOQ

5.08 We can construct any regular polygon with a cyclic rotation:

1. place the centre of the polygon (dot) and one of its vertex (node)
2. select the node and construct a rosace, here **n** = 5
3. join two adjacent vertices
4. select this segment and rotate it 5-fold
5. the nodes can be deleted with one click (see the D/M tool)

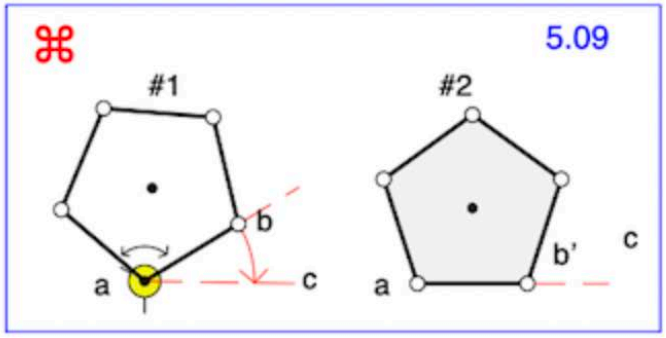
Transformation:
Tool #5 R/C
Rotate/C. Rosace



https://youtu.be/pBZ6C06RLEs

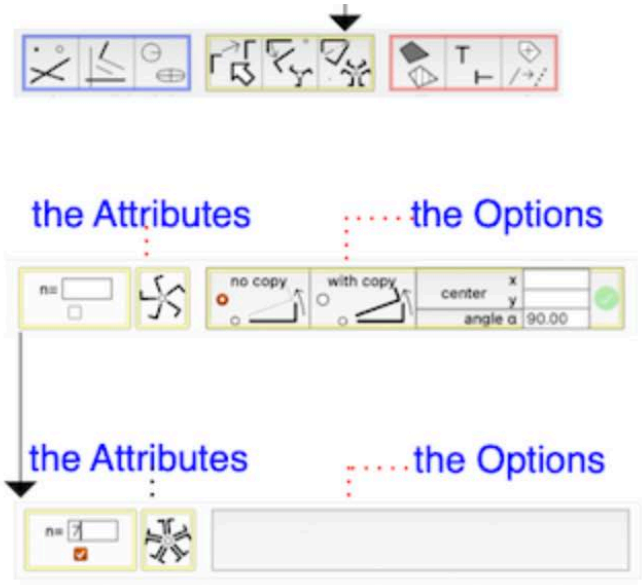
5.09 Another application of the manual rotation: we want to rotate pentagon #1 into pentagon #2 where the edge **ab** becomes the horizontal edge **ab'**.

1. select the pentagon
2. click the R/C tool
3. click "no copy"
4. press ⌘
5. drag the cursor to vertex **a**
6. drag the vertex **b** onto line **ac** (**b** will snap on **ac**)



https://youtu.be/pBZ6C06RLEs

Transformation: Tool #6 R/D Reflect/D. Rosace



Reflection - description

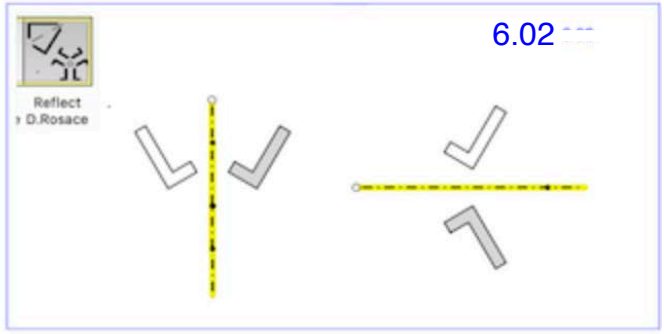
6.01 The second group in the yellow frame in Geometria's Tool Bar is called the Transformation tools; they enable the users to apply the basic symmetry operations: translation, rotation, reflection and glide reflection. To do these operations on the screen, we must select (T/S) the objects we wish to transform. The R/D tool is used for the following type of reflections:

- reflection about x and y directions
- reflection about any direction
- reflection with parameters
- glide reflection
- drawing dihedral rosacea
- drawing rounded rectangles
- drawing mosaics

• Similar to the T/S and the R/C tools, we may reflect using the "no copy" or the "with copy" option.

6.02 The most frequently used reflection is parallel or perpendicular to the x direction:

1. select the motif
2. click the R/D tool; the axis of reflection will appear with a dot and a node parallel to the y direction
3. select "no copy" or "copy."
4. locate the axis by clicking the node anywhere in the window or snap on an existing point
5. the figure is reflected
6. click on the R/D tool again; now the axis is parallel to the x direction
7. locate the new axis by clicking anywhere in the window or snap on an existing point

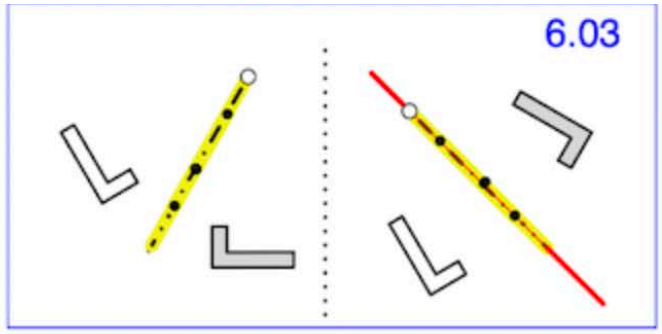


https://youtu.be/TqtbBMeM_b4

6.03 Reflection about any axis or about an existing line (segment):

1. select a motif
2. click the R/D tool; the axis of reflection will appear with a dot and a node parallel to the y direction
3. select "no copy" or "copy."
4. locate the node by pressing anywhere in the window or snapping on an existing point
5. drag the black dot around the node in a circular motion
6. locate the axis by releasing the black dot anywhere in the window or snap on another existing point

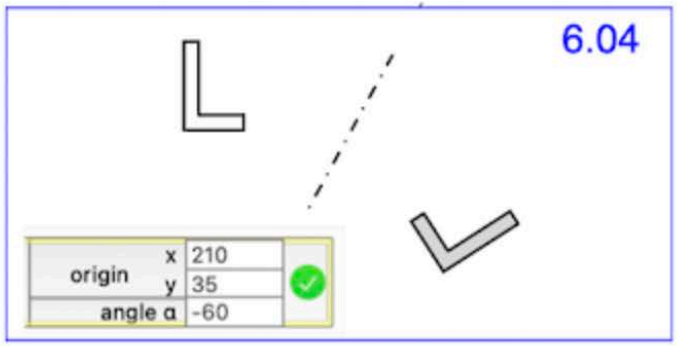
Transformation:
Tool #6 R/D
Reflect/D. Rosace



https://youtu.be/WQPBq3LiOWA

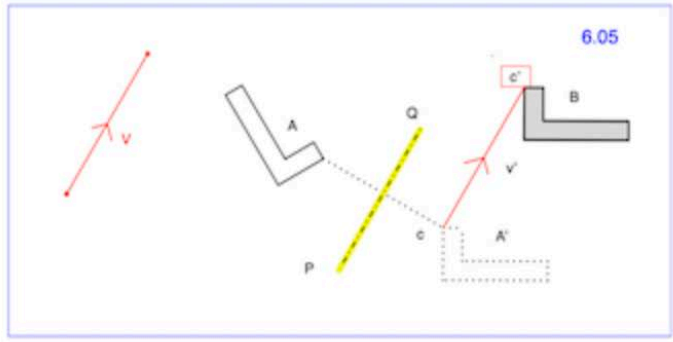
6.04 Reflect a motif, given a point and the angle of the axis:

1. enter the coordinates x and y of the origin of the mirror and the angle α with the X axis
2. select "no copy" or "copy."
3. click the green checkbox



6.05 The symmetry operation is called a **glide reflection** if a motif is reflected about an axis and translated parallel to this axis. We can execute this symmetry operation in the following way:

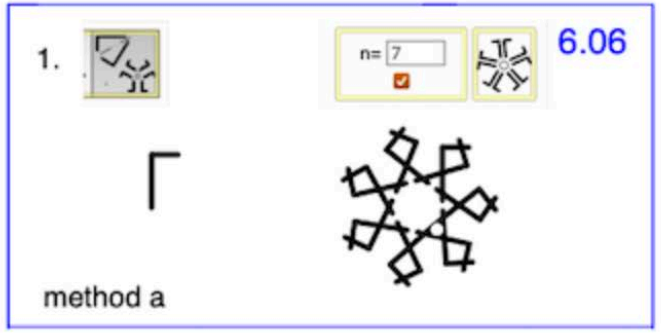
1. given the vector **v**, the axis PQ parallel with **v** and the motif A
2. using the axis PQ, reflect A into A'
3. translate the vector **v** to any vertex, for instance, **c** of A'
4. translate A' into B (**c** to **c'**)



https://youtu.be/_Nqz9gSzAvo

6.06 An n-fold dihedral rosace combines n rotations and n reflections. We show the **Method a** to draw a dihedral rosace:

1. select a motif, click the R/C rotation tool, and a new Attribute Bar appears
2. enter a value for **n**, for instance, 7
3. click the checkbox, and the Option bar disappears
4. press and drag the cursor; the motion of the rosace is animated
5. release the cursor to complete the rosace

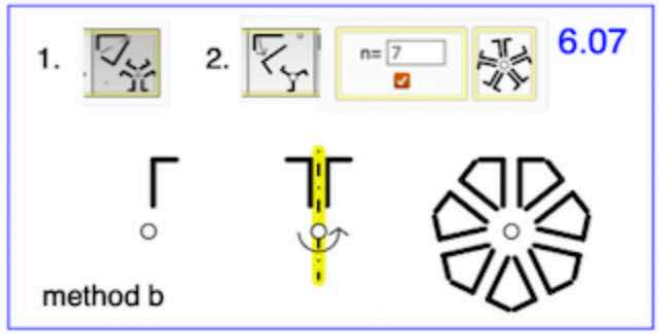


https://youtu.be/wke2LfW_0ys

6.07 **Method b** is a hybrid solution to draw a dihedral rosace: we use the R/D and the R/C tools:

Transformation: Tool #6 R/D Reflect/D. Rosace

1. select a motif, click the R/D reflection tool
2. reflect the motif with copy, here the axis is in the y direction going through the given centre
3. select the reflected motifs
4. click the R/C tool
5. enter a value for **n**, for instance, 7
6. press and drag the cursor to see the animated rosace
7. release the mouse on the centre



https://youtu.be/6e8KD8rcmSU

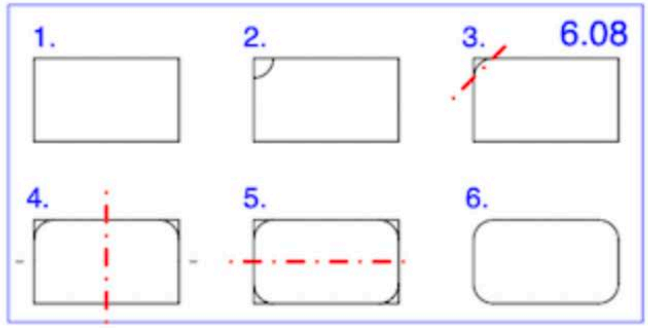
• Comparing the two methods:

method a:
- • simpler to use
- • less control of the outcome
- • presents a large variety

method b:
- • involves two tools
- • the result is more predictable
- • limited variety

6.08 We include an example to demonstrate the following: Despite Geometria not having a dedicated tool to draw rounded rectangles, we show below how to draw them with our basic tools in a few steps.

1. given a rectangle (or a square)
2. draw a quarter of a circle centred at a vertex
3. reflect the arc without a copy about a mirror passing par the endpoints of the arc
4. reflect the arc about the mirror (y direction) going through the midpoint of the edges (note the convenience of the visible midpoints of segments)
5. reflect the two arcs the mirror x direction) going through the midpoint of the edges
6. erase the four corners (D/M tool, see later)



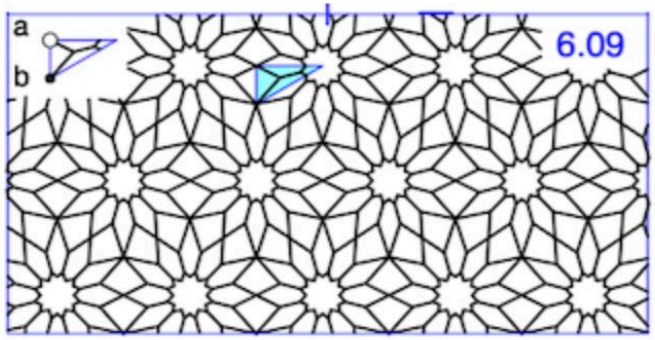
• No doubt, drawing took longer, but as we said earlier, we favour fewer tools and encourage the user to acquire some geometric skills.
The user should save this example and file it in a library of constructions for future use with possible modifications.
https://youtu.be/Vhf0728zJus

6.09 The advanced symmetry operations of Geometria are beneficial in creating an infinite variety of patterns. We use the term mosaic when a motif is subjected to a combination of the four (or fewer) symmetry operations repetitively and periodically. The terms tiling and tessellation are also used in the literature for the same concept.
The example below presents how a simple motif of five segments results in a rich mosaic through repetitive reflections. While we reflect the motif about an edge of the triangle, the other two edges are reflected, and they act as mirrors again, leading to an infinite reflected motif.

draw a small 30°-60° triangle (P/P tool,⌘, see 2.12)

2. draw a motif inside the triangle
3. the three edges of the triangle will act as mirrors
4. select the motif
5. click the R/D tool and press ⌘; a yellow triangle appeared in the upper left corner of the window
6. click at the vertex **a** to place the node of the yellow triangle
7. press and drag the dot to vertex **b;** the mosaic appears

Transformation:
Tool #6 R/D
Reflect/D. Rosace

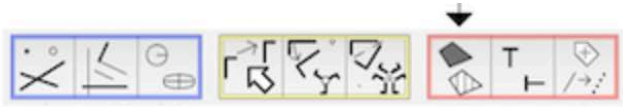


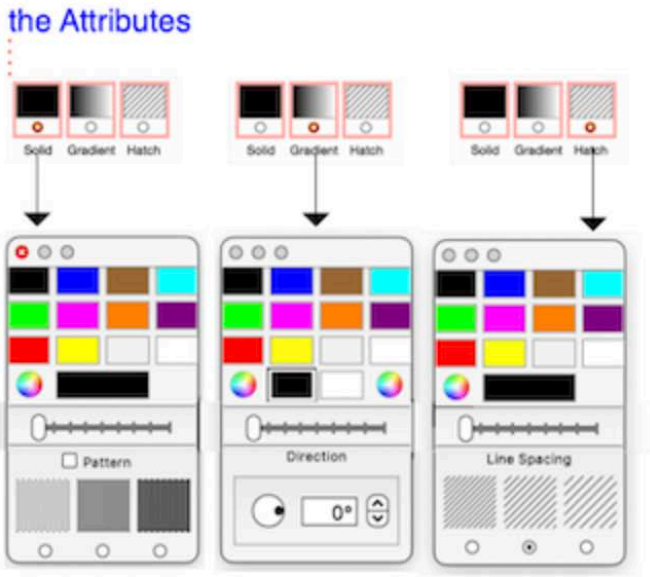
• You may ignore the first step, the 30°-60° triangle; just draw a motif. The result will very likely be a mosaic with lines intersecting. You may like it. It is gratifying to explore the following four design variables by the designer:

- the orientation of the special triangle
- the size of the triangle
- the design of the motif
- the motif orientation in the triangle

https://youtu.be/lbutqi4snrg

Annotation
Tool #7 F/H
Fill/Hatch





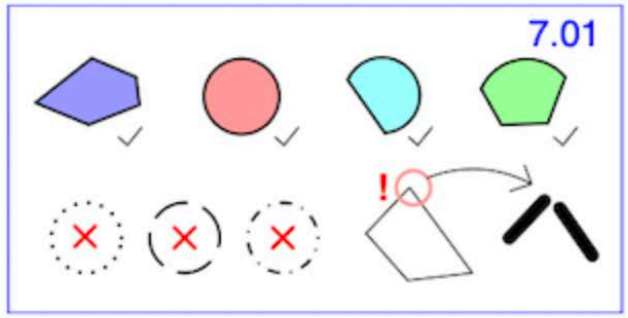
Description

The Fill/Hatch tool offers the user three distinct ways to fill a region:

I. Solid: uniform colour and pattern
II. Gradient: progression of one or two colours
III. Hatch: closely placed parallel lines

7.01 The F/H functions will cover polygons, circles, arcs and combinations of arcs and polygonal chains. The tool F/H will not function if the area is bounded by line styles other than solid lines.

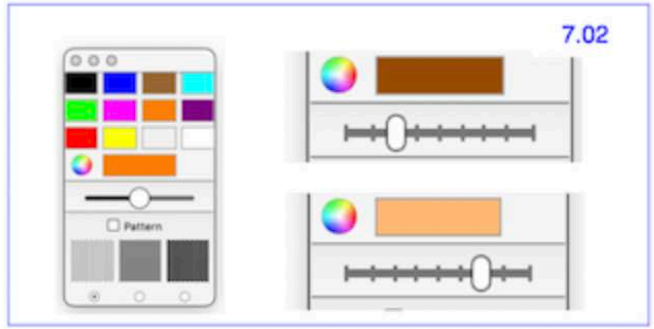
• If the contour is not closed completely, even a tiny gap between two segments, F/H is prevented; you will hear a warning sound and see a message. Close the gap to fill the region.



https://youtu.be/7WhyUmjk084

7.02 The slider, devised for Geometria, allows you to control the saturation of 10 of the 12 basic colours in the floating Attribute window.

• If the slider appears on your screen very faint, go to Settings → Accessibility → Display,→ click on Increase contrast.



https://youtu.be/xo8puGImKiE

7.03 If a figure has more than one contour (one or more “holes” inside), F/H will fill the outer contour, ignoring the contours inside. We offer two methods to avoid this anomaly.

Method I.

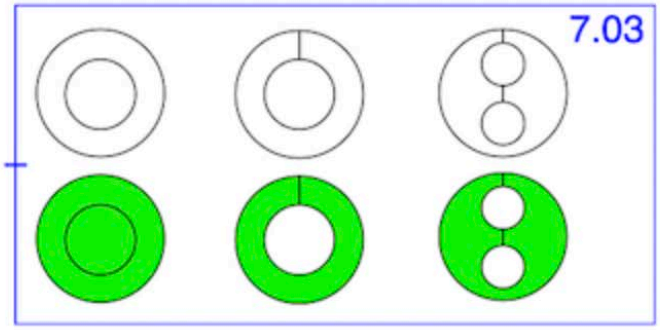
1. select a colour and click inside the figure; the holes are also filled
2. select another colour (like white) and click inside every hole

Annotation Tool #7 F/H Fill/Hatch

Method II.

1. select a colour
2. connect every pair of contours with one (and only one) segment; you need **n** segments for **n** holes, not forming a circuit
3. click inside the outer contour, not in a hole
4. if the segments are the same colour as the fill colour, the segments are not visible

• This ritual will be simplified in the first update of this software.

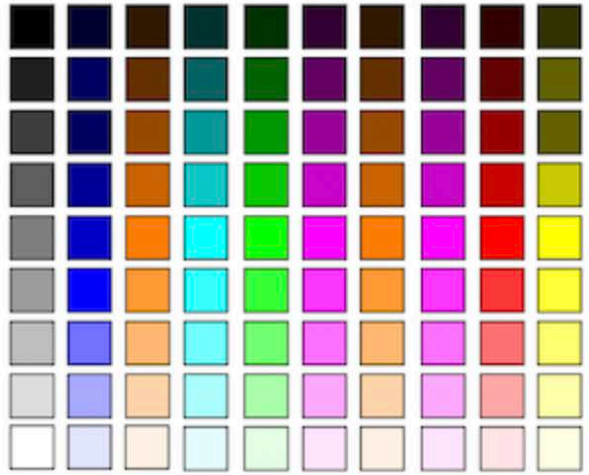


https://youtube.com/shorts/arlQO_EfmnY?feature=share

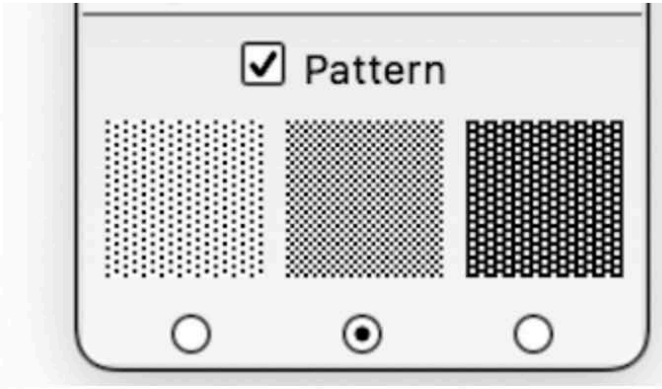
7.04 Click on **Solid**, the first attribute in the bar. The Option Bar offers four different percentages of saturation for the selected colour. The floating Attribute Window presents the following choices:

I. Twelve basic colours
II. The Apple's colour wheel
III. Slider
IV. Pattern

• The slider effect on ten of the twelve colours:



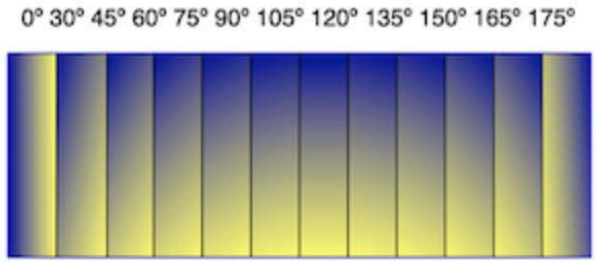
• Click the Pattern checkbox and select one of the three options:



• Click on **Gradient,** the second attribute in the bar. The Option Bar offers four orientations of the colour transition. The floating Attribute Window presents the following choices:

I. Twelve basic colours; select two colours (start and end colours)
II. Use Apple's colour wheel to locate the two more refined colours (start and end colours)
III. Or, use the slider to control both colours
IV. Direction of the transition: manually rotate the black dot in the circle or enter the desired transition angle in the text field.

Annotation
Tool #7 F/H
Fill/Hatch

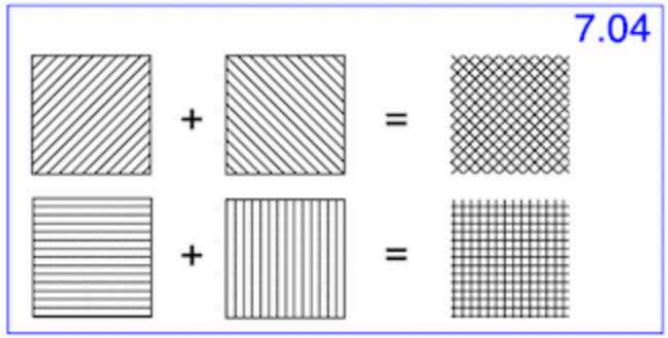


• Click on **Hatch**, the third attribute in the bar. The Option Bar offers four orientations of the hatchings. You can choose the spacing and colours of the parallel lines in the floating Attribute Window. The slider controls the saturation of the selected colour.

• You may combine two or more different orientations of the hatchings into one.

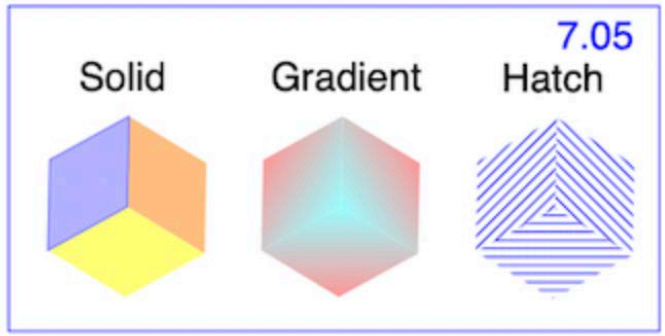
1. make a copy of the region you want to fill with the combination of two hatchings, **a.** and **b**.
2. fill the original region with hatchings **a**.
3. fill the copied region with hatchings **b**.
4. copy the region with hatching **a**. and paste it (superpose) on the region with hatching **b.** (use the snap action of two corresponding vertices or centres)

• Two of the 17 possible combinations of hatchings are shown below:



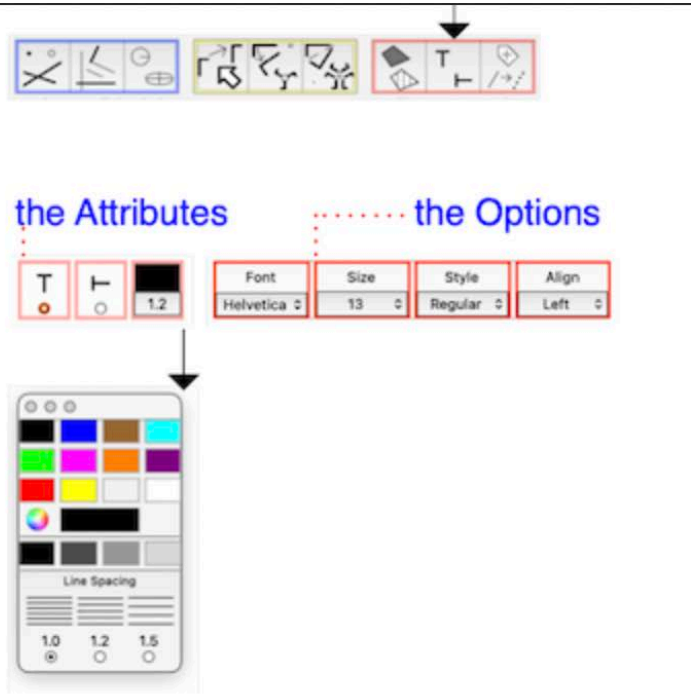
https://youtu.be/X7mQta-Lp-8

7.05 The three fill functions are illustrated with examples below:



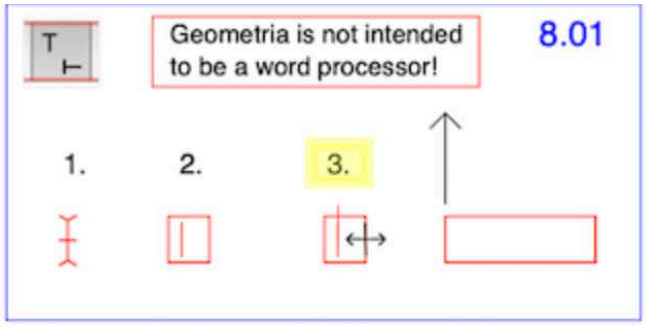
https://youtu.be/NYNlJxRMWvA

Annotation: Tool #8 T/N Text/Note



8.01 While Geometria may not be intended for word processing, it boasts various features and resources for crafting visually stunning documents seamlessly integrating graphics, text, and images per Apple's interface standards. To get started, let's look at the text input field.

1. click the T/N tool: the text cursor appears
2. hover the cursor and click again to locate your text. A little red rectangle containing the cursor will show up.
3. to set the text field's width, place the cursor on the right vertical edge of the rectangle; press and drag the cursor to adjust the length of the eventual text; this adjustment is also available for an existing text
4. the text will wrap into a new line
5. the height of the text field is controlled by the amount of text written in the text field



https://youtu.be/FuQQXI9E-e4

8.02 Text attributes may be chosen from the Option Bar, from the Attribute Bar or the menu Format:

Option Bar: Font
Size
Style
Align

Attribute Bar: Colour
Line Spacing
Note (vertical text)

• You find additional text attributes in the menu Format:

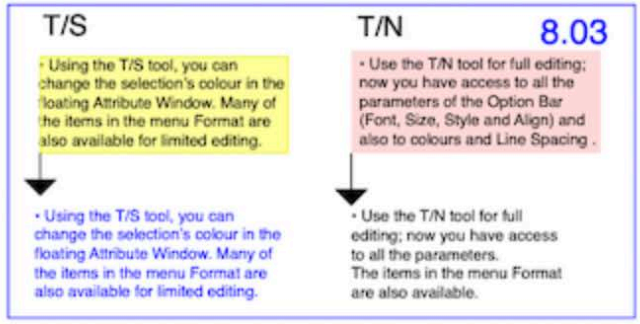
https://youtu.be/hyC-bmeDYLs

8.03 Text can be edited in two ways:

1. click the T/S tool and select the text box
2. click the T/N tool and select with the cursor words, lines, paragraphs or a text box

Annotation: Tool #8 T/N Text/Note

• Using the T/S tool, you can change the selected text box's colour in the floating Attribute Window. Many items in the menu Format are also available for editing.
• To fully edit your document, utilize the T/N tool. This grants you access to all the parameters in the Option Bar, such as Font, Size, Style, and Alignment. Additionally, you can adjust colours and line spacing in the Attribute Window. The menu Format is also at your disposal.

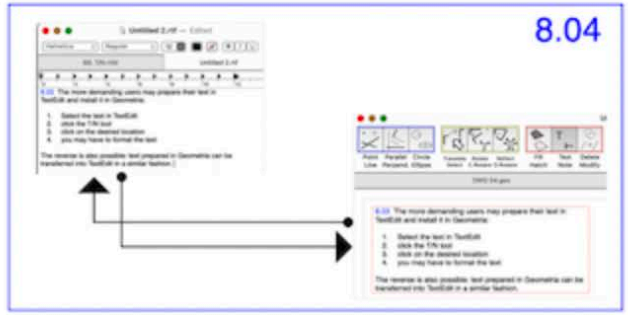


https://youtu.be/P0Hr1w01UoY

8.04 The more demanding users may prepare their text in TextEdit (Mac OS) and install it in Geometria:

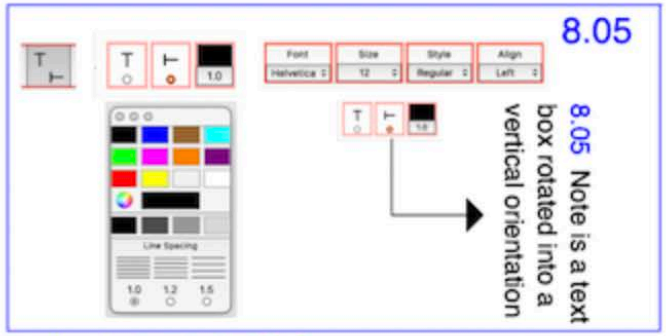
1. Select and copy the text in TextEdit
2. click the T/N tool
3. click on the desired location
4. paste the selection; you may have to re-format the text

• The reverse is also possible: text prepared in Geometria can be similarly transferred into TextEdit.



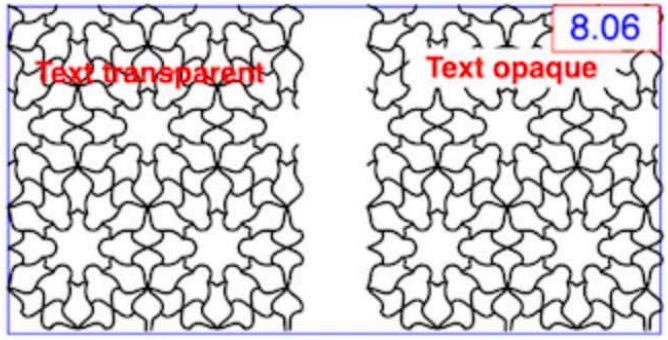
https://youtu.be/q7Vl9wVm4vk

8.05 To create a Note, click the Note button ⊢. This will produce a text box rotated vertically, allowing you to write from top to bottom. Please note that editing options are limited in this format, and you will not have control over the size of the text box.
• This function is helpful to orientate numbers while dimensioning drawings or labels in narrow text fields for tables (see video below))



https://youtu.be/7hg_U2x9m2c

8.06 If a text box is superposed on a drawing, it is useful to attribute Opaque to the text box. Select the text and choose: menu → Format → Text → Opaque. This menu item toggles between the two formats.

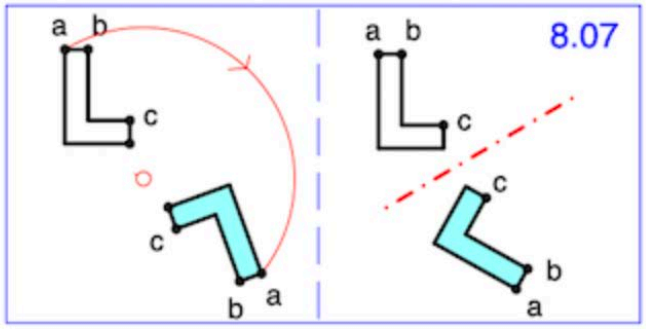


https://youtu.be/N1b-l9xB0ZA

8.07 If you subject a figure with labels to any of the four symmetry operations (translation, rotation, reflection and glide reflection), the labels will move with the figure but keep their original orientation

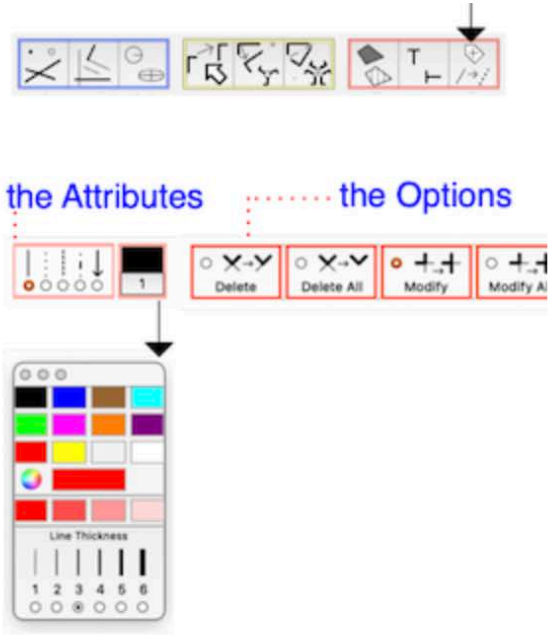
Annotation:
Tool #8 T/N
Text/Note

8.07 If you subject a figure with labels to any of the four symmetry operations (translation, rotation, reflection and glide reflection), the labels will move with the figure but keep their original orientation



https://youtu.be/EDx6_K7b-sQ

Annotation: Tool #9 D/M Delete/Modify



Description

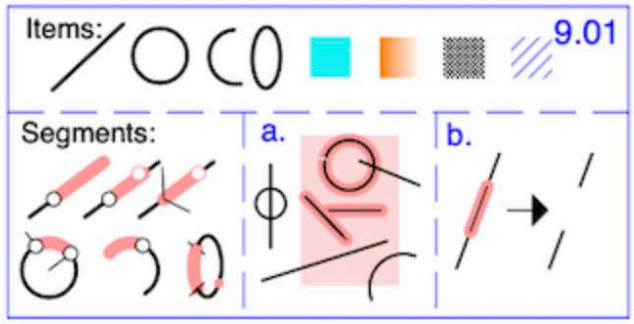
The Delete/Modify tool offers the user six distinct drafting functions on these items:

1. delete an item or a text
2. delete items within a phantom rectangle
3. shorten or interrupt a segment
4. delete all items with identical attributes
5. modify an item's attributes
6. modify all items with identical attributes

9.01 We use the term "item"; it includes lines, segments, circles, arcs, ellipses, fills, gradients, textures, and hatchings. We use the term "segment": it is part of a line, a circle, an arc or an ellipse, limited by two points. A point may be an endpoint or a point incident with an item, for instance, an intersection point with another item.

• If you have several items to be deleted, all lying entirely in a phantom rectangle, drag the cursor diagonally and release (a.).

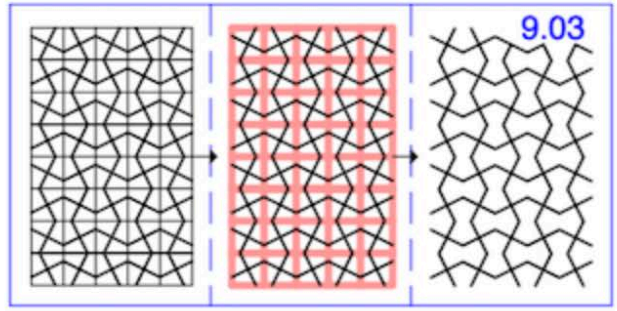
• If you want to shorten or interrupt a certain length of a segment, press-drag-release the cursor on the particular length (b.).



https://youtu.be/tDurR3C6zm8

9.02 Click the D/M tool and check the **Delete** option (default). Click on an item or a text; it will be deleted. Remember, the T/S tool will delete the entire line (see 4.02).
https://youtu.be/tDurR3C6zm8

9.03 Click the D/M tool and check the **Delete All** option. Click on an item (see above); all items with precisely the same attributes will be deleted. This function applies to the entire window.



https://youtu.be/SjqI0WN9Hn4

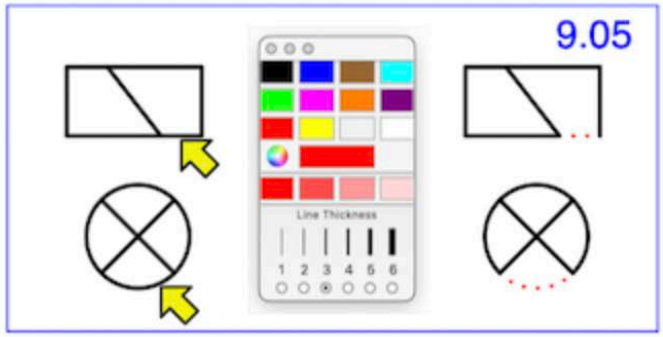
9.04 If you want to delete all items with identical attributes limited to **part 2**. in Window 9.04 a, do the following (see video below):

1. select and cut (⌘ x) (**part 2.** in Window 9.04 a
2. from the menu **File**, click **New**
3. paste **part 2.** in the new Window 9.04 b
4. execute the **Delete All** option
5. copy the revised option
6. paste the revised option into Window 9.04 a

Annotation: Tool #9 D/M Delete/Modify

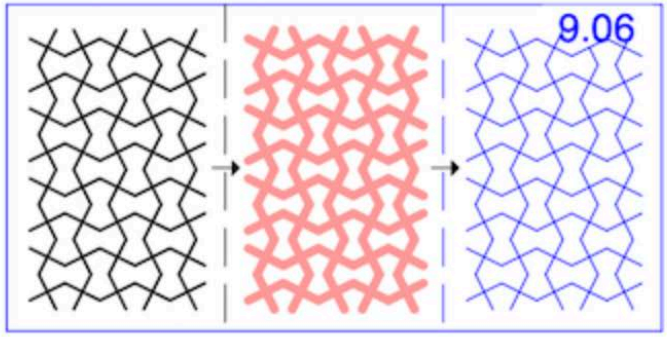
• This process is much more straightforward using layers; see the menu item Preferences.
https://youtube.com/shorts/hAJdlW6U_3Y?feature=share

9.05 Click the D/M tool and check the **Modify** option. Select one or more attributes and click on a segment. The attributes of this segment will be modified with the selected attributes.



https://youtu.be/bE9wcrfgJIc

9.06 Click the D/M tool and check the **Modify All** option. Select one or more attributes and click on an item. All items with the same attributes will be modified to the selected attributes. This function applies to the entire window.



https://youtu.be/Is0SaT6PECI

9.07 If you want to modify all items limited to a part of the window, do the followings:

1. select and cut **part 2**. in Window 9.07a
2. from the menu **File**, click **New**
3. paste **part 2.** in the Window 9.07b
4. execute the **Modify All** option
5. copy the revised option
6. paste the revised option into Window 9.07a

• This process is much simpler using layers; see the menu item Preferences.

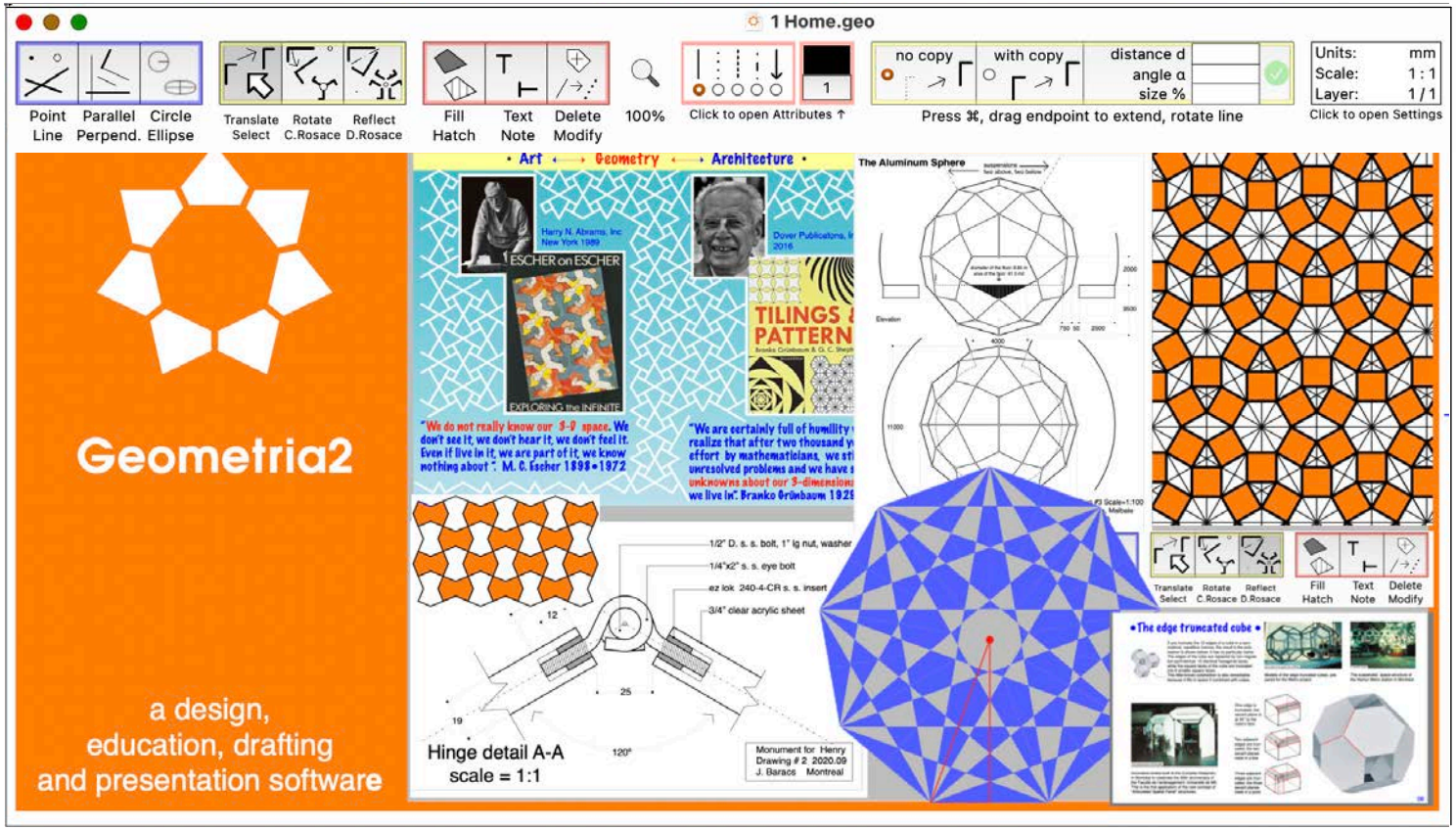
• When you press an item in cases 2.03 and 2.05, it will highlight all the items with precisely the same attributes with a thick red line. If you change your intention, drag the cursor away from the item and release it; the modification is cancelled.

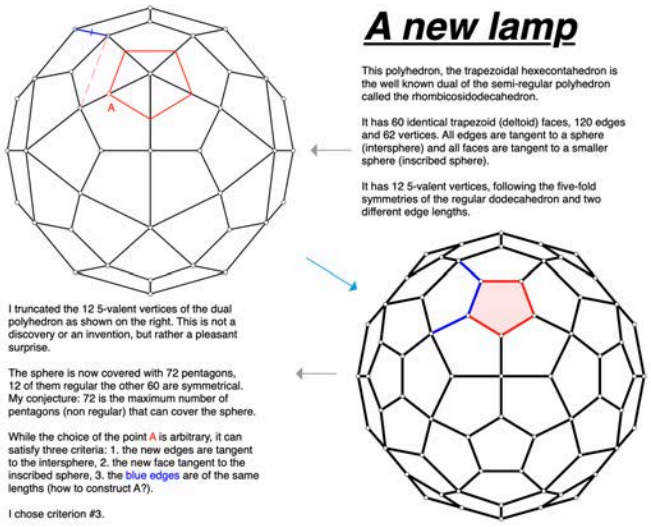
Geometria2 is aimed at the following **uses**:

- illustrations, publications
- tilings, patterns and rosases
- technical drawings
- teaching or learning geometry
- conferences, presentations
- manuals and instructions
- interface design

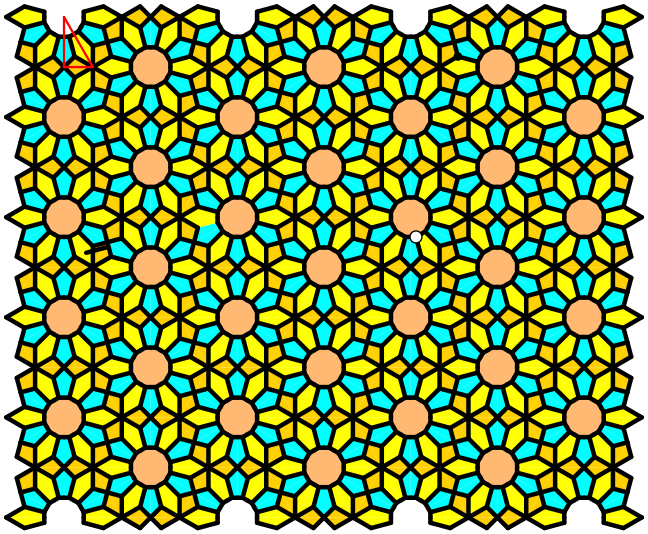
Geometria2 is aimed at the following **users:**

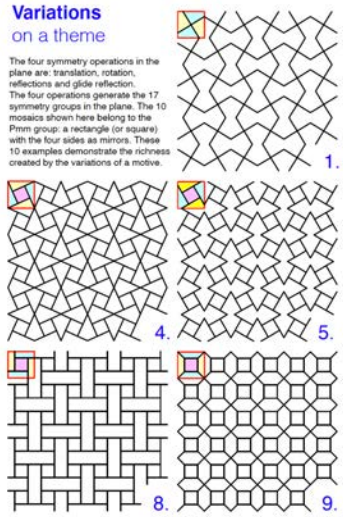
- technician
- architects
- engineers
- designers
- graphic designers, artists
- geometry students and teachers
- people who have never drawn

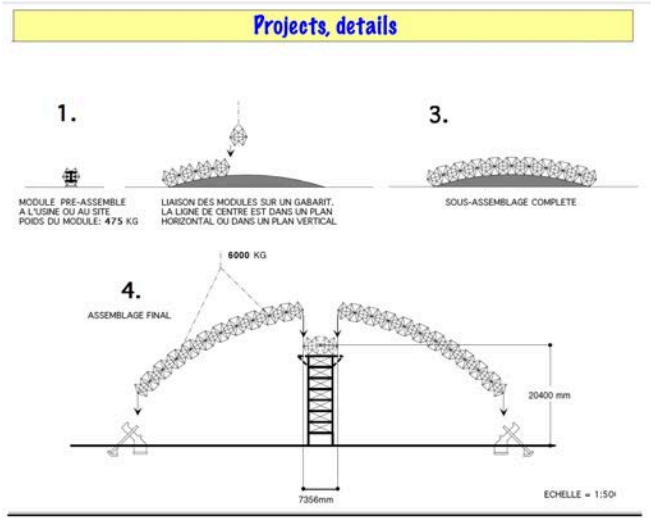




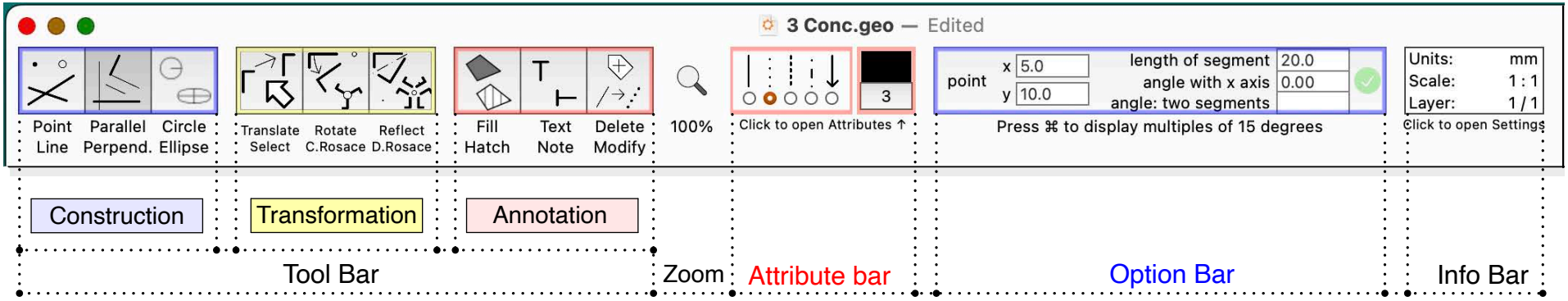
• We show two technical drawings, two tilings and a photo montage. They demonstrate the ease of **integrating** text, drawings and photos. The preparation of these drawings were **simple**, **fast,** and **precise**.
• Special care was given in Geometria to the three tools of the symmetry operations: **translation, rotation, reflection.** Friezes, rosettes, tilings and patterns are fascinating links between geometry and art, little explored in Western cultures.

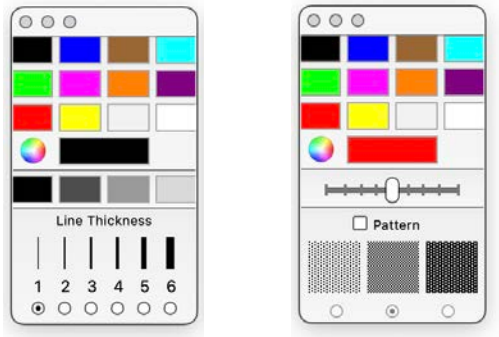




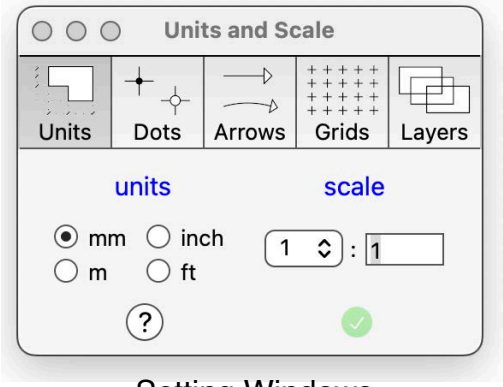


"Digital Drafting Table"





Attribute Windows



Setting Windows

• We thoroughly examined the essence of drafting and drawing, investigating both the process and the product. The design of Geometria2 reflects 40 years of experience in teaching geometry and design, research in applied geometry, and practice in structural engineering, with an emphasis on visual aspects.

• We promote the analogy of the "Digital Drafting Table." Today, most users lack experience with the drafting table. However, by transferring the well-practiced, thousand-year-old routine of working with instruments to Geometria2, we suggest that using this software will likely enable and encourage users to learn the logic of elementary geometry and appreciate its beauty. Among the tools, the second tool (P/P) exemplifies this best: it is an improved digital version of the drafting machine attached to the drafting table. This tool alone can perform thirteen different functions with ease.

• Contrary to the current practice in the digital industry, we kept the number of tools (nine) and menu items to a minimum, while offering the functions necessary for all the graphic needs. Accordingly, Help is provided in nine chapters, and when it is displayed, it leaves the working window mostly uncovered, allowing it to be free to draw.

• We enter a crowded market of graphic software. We aim to compete with simplicity and innovation, striving to make things simpler in future updates.

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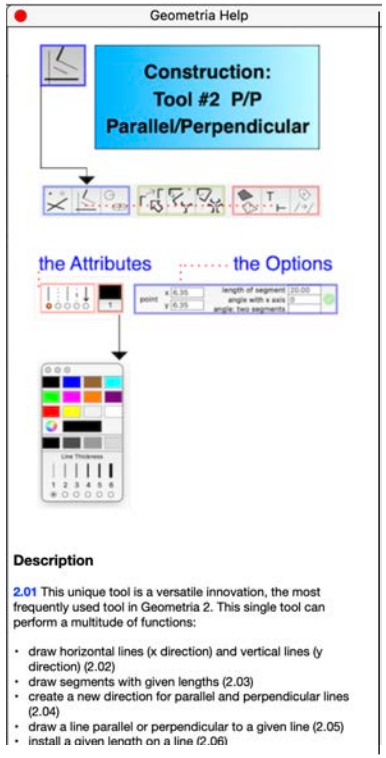


Help Window

A very brief history: the geometry of drafting.

The title given to this software suggests that we are keen students of geometry. Drafting and geometry is inseparable; the images on the right are historical highlights from both fields.

1. Euclid (325 BC-265 BC)is credited with establishing geometry as a rigorous science.

2. G. Desargues (1591-1661) added a new geometry, called projective geometry.

3. The 18. century architect J. Le Queu illustrates the inventory of traditional drafting tools.

4. In 1901, Charles H. Little patented the drafting machine, installed on the drafting tables.

5. Autodesk first published AutoCAD in 1982 and quickly replaced the drafting tables in offices.

6. The first Macintosh was introduced on January 24, 1984, by Steve Jobs.

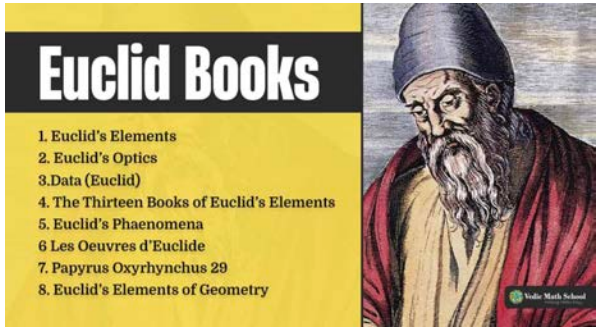
7. We published Structural Topology (1979-1997), an interdisciplinary journal on morphology.

8. Published by B. Grünbaum/G. Shephard in 1987, the first complete treatment of the subject.

9. Geometria1 was published in 1988; this version, Geometria2 will be completed in 2025.

Please forgive us for being pretentious; we included our faces (9.) among the giants of history. We did this to link us with the sources of our inspiration while designing this software.

1.



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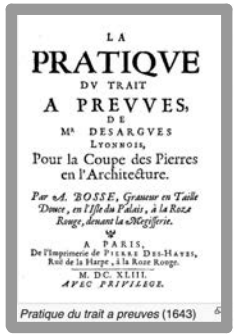


Pratique du trait a preuves (1643)

3.

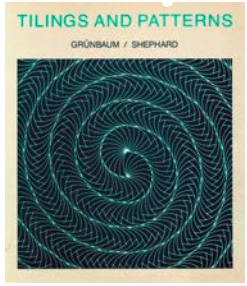
4.

5.

6.

7.

8.



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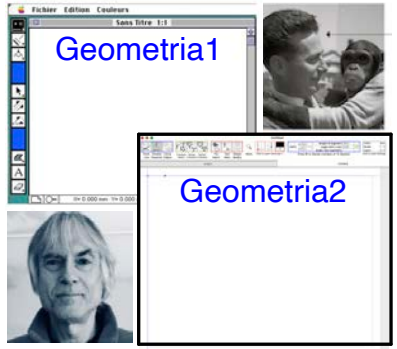


The following documents are available for free download. They were all prepared with the software Geometria2.

1. A detailed and illustrated description of the software, available also in Help

2. The document presents the basics of symmetry operations in the plane

3. Short and simplified instructions to construct 3-D geometrical configurations

4. The title suggests a particular pattern: identical squares in a regular motion

5. Die-cut cardstock regular polygons to be assembled into polyhedra

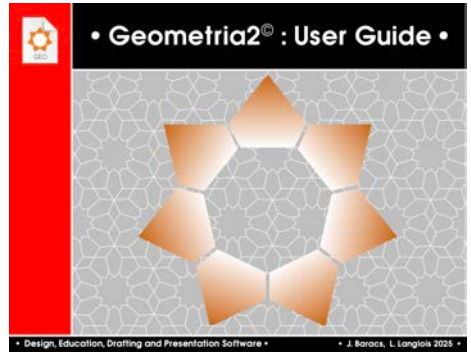
6. A short geometrical analysis of the fascinating patterns of M. C. Escher

7. The path: a geometric idea - a physical model - a built structure

1.

Read PDF

Downl. PDF



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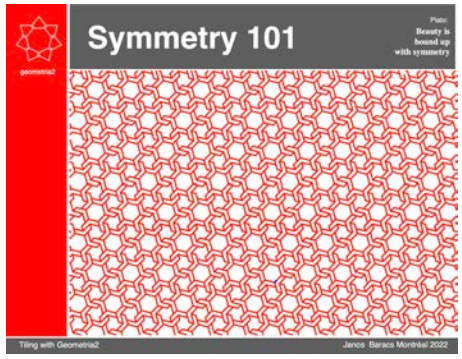

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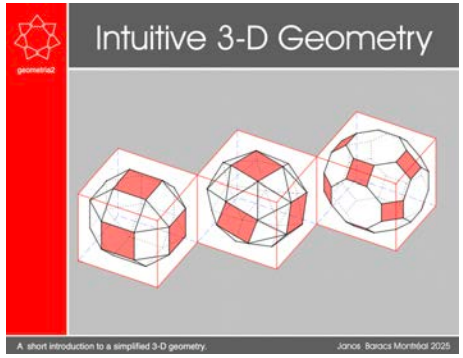

4.

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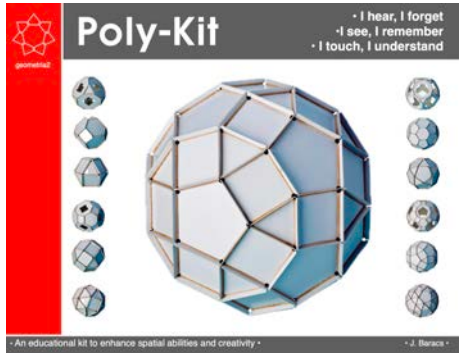

6.

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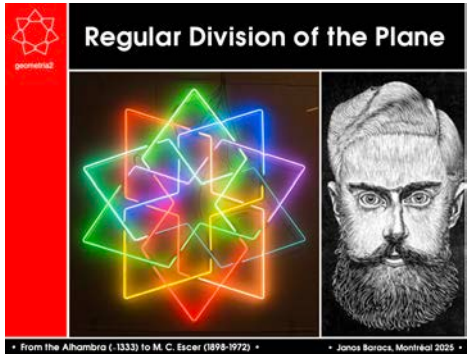

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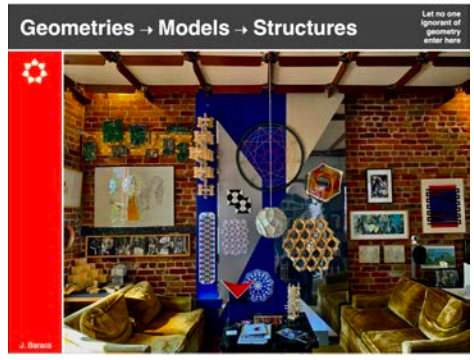


We are here to help you…support@geometria2.com or:

name

email*

country

state, province

apple device*

operating system*

subject*

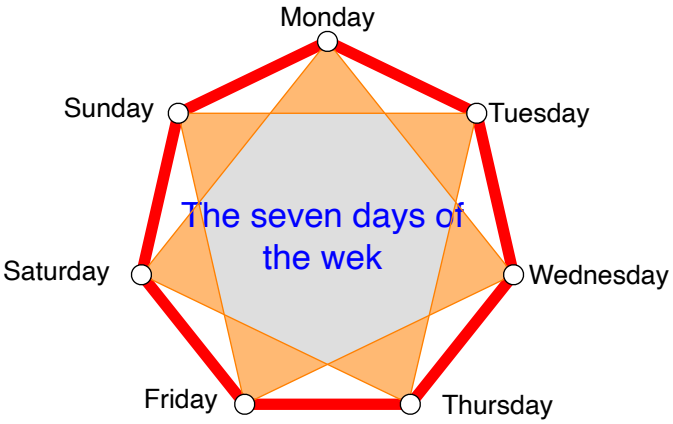
message*

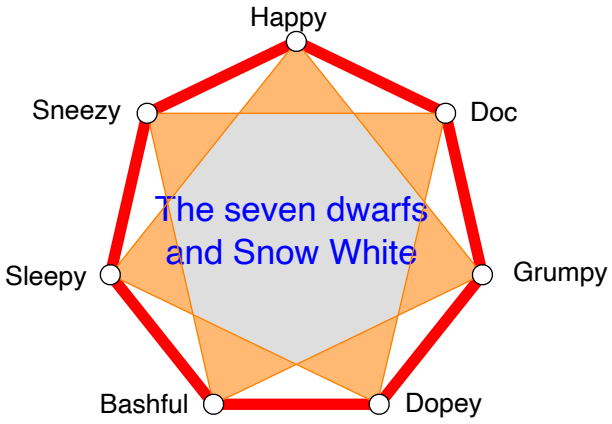
relevant screenshot

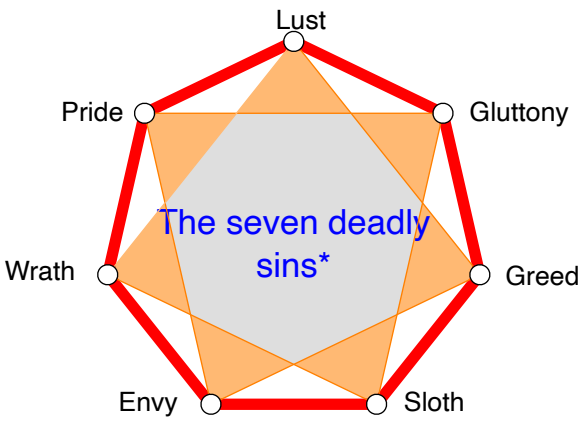
* required

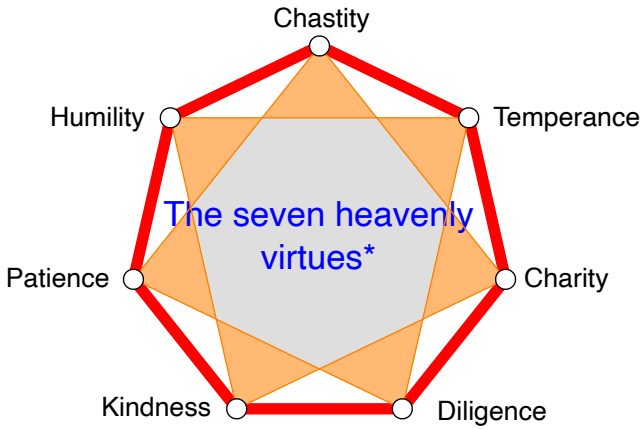
Your email is only used to respond to this query!

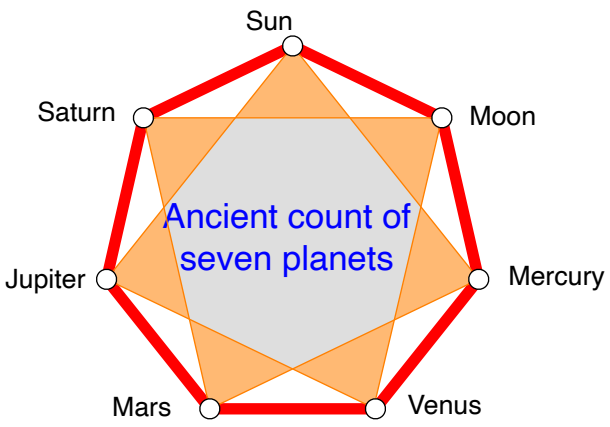
Submit

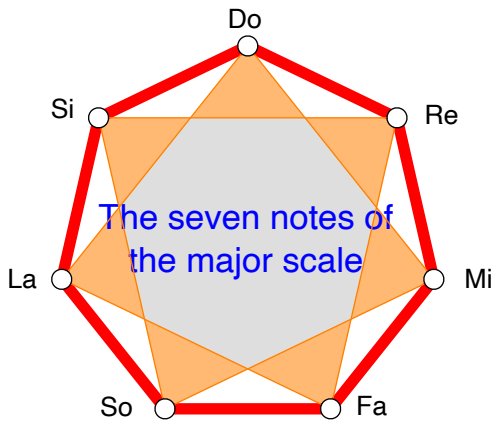

Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
The seven days of the wek


Happy
Doc
Grumpy
Dopey
Bashful
Sleepy
Sneezy
The seven dwarfs and Snow White


Lust
Gluttony
Greed
Sloth
Envy
Wrath
Pride
The seven deadly sins*


Chastity
Temperance
Charity
Diligence
Kindness
Patience
Humility
The seven heavenly virtues*


Sun
Moon
Mercury
Venus
Mars
Jupiter
Saturn
Ancient count of seven planets


Do
Re
Mi
Fa
So
La
Si
The seven notes of the major scale