1. Introduction

Mathsay 4.5 is a new powerful math software for students and teachers in middle school, in high school and in university. It shows the concepts of math and makes analysis and calculation in the graph. It offers a tool to explore, visualize, and solve even the most complex mathematical problems. Not only can it help students grasp the concepts and do math exercise, but also can it makes teachers to dynamically plot and demonstrate in the class with the interactive function. Meantime it is easy to be used.

2. Setup

Unzip file first. Read "readme" and see picture before setup.

Firest set up, please select “Yes” button if some dialog boxes are displayed during set up,.

In setup version registered (with serial number), suggest you uninstall trial version first. If not, some dialog boxes will be showed in setup, Please select “No”.

In uninstall, please select “Keep” when some dialog boxes are displayed (some “.ocx”, “.dll” files are in common).


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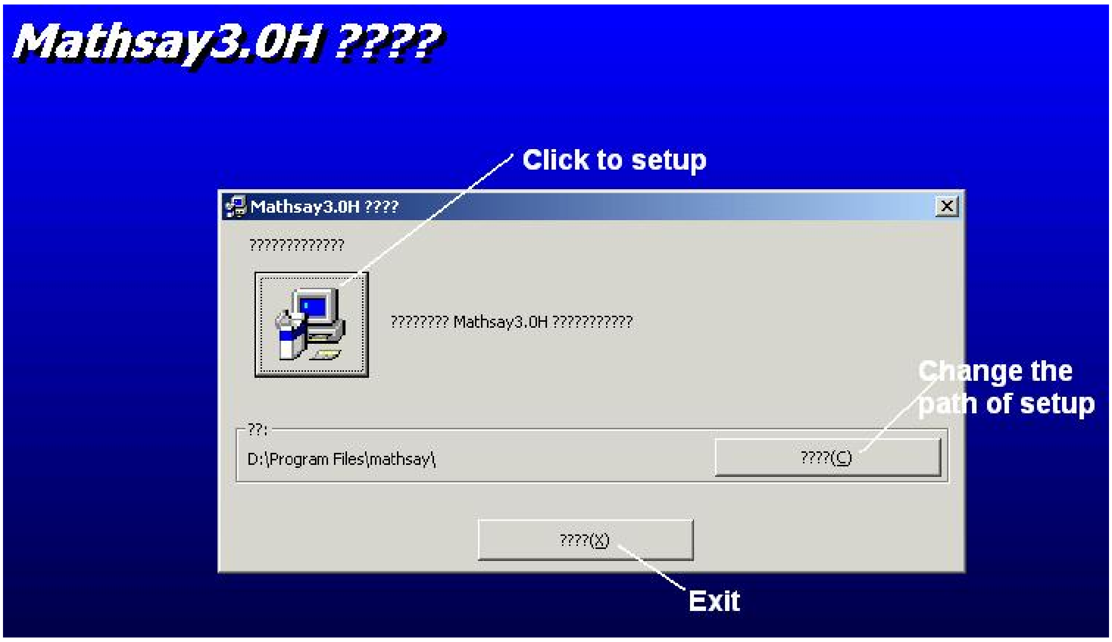
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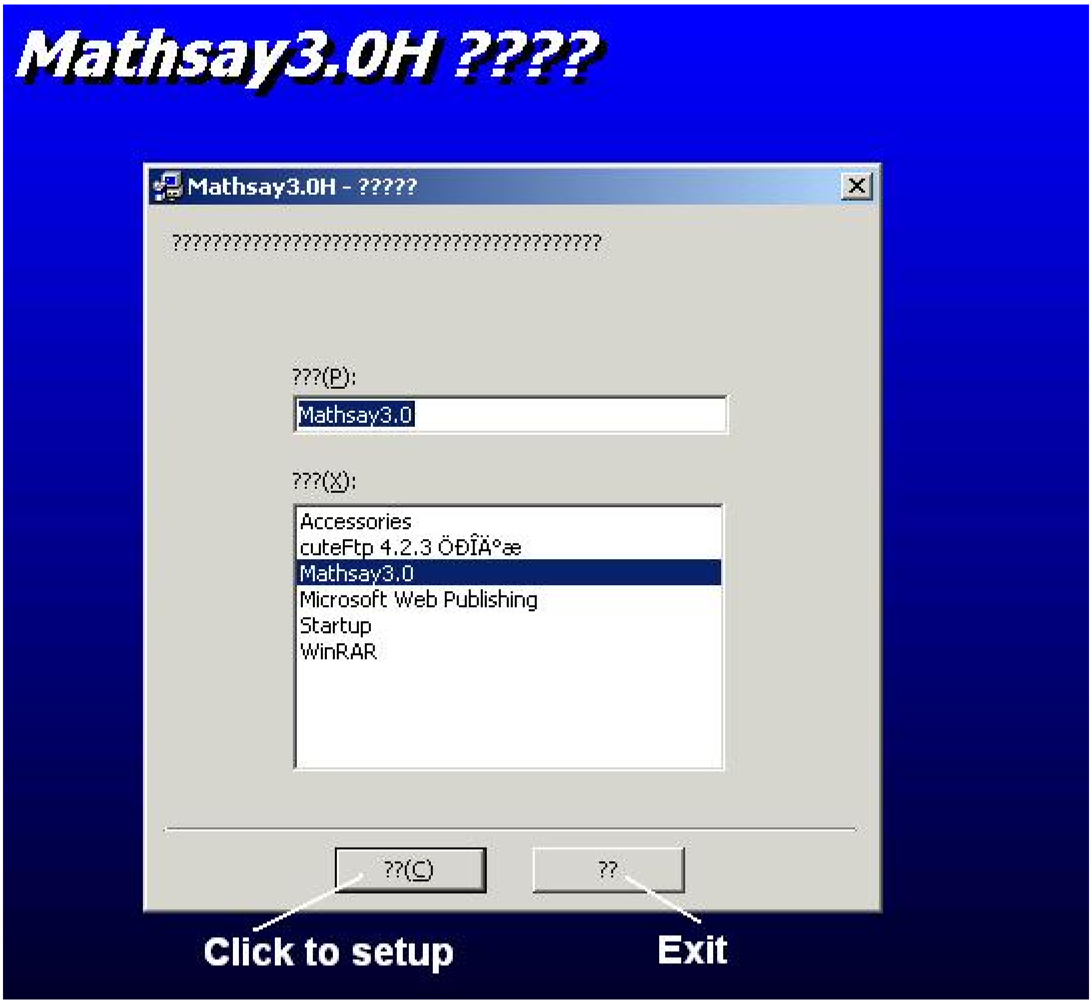


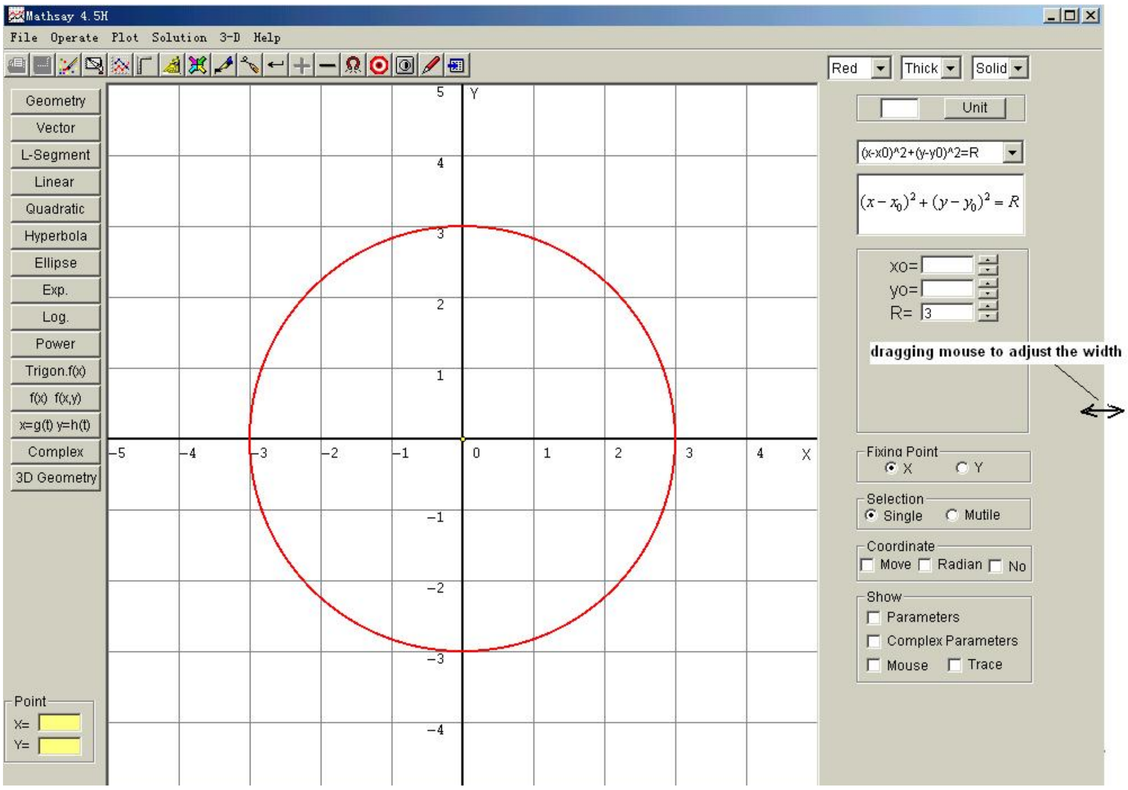
2. Associate the file type (fds and gds) with **Mathsay**

The graph files saved have tow types (in suffix): “.fds” is the type of function and “.gds” is the type of solid geometry. When double click these files first time, a menu box is displayed ---> select “Open way …“. A selection box is displayed to let you select the relative software to open these files. Please click “other” button, the common dialog box displays ---> find where **Mathsay** folder is step by step ---> open the folder ---> click the Mathsay.exe--->click “OK” button to confirm opening these files with the Mathsay.exe program. You can double click these files (in suffix fsd or gds) to open them automatically from now on.

3. Pay a attention in operation

1. The curves and points in curves can be selected by clicking them with left button of mouse. Three small circles are displayed on the curve, line and segment line when they are selected. Then it can be modified, be moved (animation) by dragging mouse, and points can be set in it by entering the value of x or of y.
2. If you want to move the point or mark point, you must select the curve which the point in first. Then you can move it in curve by dragging mouse. Drag point by pressing down left button in 2D and by pressing down right button in 3D-geometry.

3. The point and point can be linked by line to form a new line or by line segment to form a new line segment. Ways: Click the button of "Ellipse"→ Select "3 points" in List Box→ Select "Mutile" in "Selection"→ Click points (there is a small circle around it when selected. If 2 points or 3 points can not be selected sporadically, please do it again)→Click "New Line" or "New Segment" in "Plot" menu; Or Press "Shift" button→press left button at the point→move mouse to anther point in 2D and to anther point or the line (side) in 3D-geometry→loosen button--->loosen "Shift".
4. Fraction can be entered in "Enter box". Example: 12/5.
5. In "f(x), F(x,y)" and "x(t), y(t)", Plot with entering expression by keybord, such as y=e^x-tan(x)^2, f(x)=sin(2*x/(x-1))-log(1/3,x-1), y=3*x^cosx-sin(Pi*x), f(x)=sqr(x) and x^4-y^4-2*x^2-x*y^2+2=0, etc. Expression can be transformed to math expression automatically by selecting "Expression". Do not lose "(" or ")" in intering complex expression. π → sym(pi) or pi.
6. Math symbols and expression can be entered and showed in "Expression" by click "Expression" bottom on toolbar and a new windows is showed. When inter text, symbols and expression, please press " Inter" button in starting newline.
6. It will take several seconds in plotting the type of f(x, y)=0 because making accurately calculation.
7. Two curves can be selected by clicking them with mouse at same time. Ways: select "Mutile"→click them.
8. Two points and three points can be selected by clicking them with mouse at same time. (Plot line segment and line, etc.) Ways: select "Mutile" in "Selection"→click "Ellipse" button→select "3 points" in "List Box"→click them in sequence. A small circle is displayed when selected (Please click it again if no).
9. Equation (in "x=g(t),y=h(x)"): Variable is t. Example: $x = 1 - \sin t, y = t - \cos t$
10. Please pay a attention in application for "(" and ")". Example: f(x)= ((x-a)/(x-b))/c→ $f(x) = \frac{\frac{x-a}{x-b}}{c}$; f(x)=(x-a)/((x-b)/c)→ $f(x) = \frac{x-a}{\frac{x-b}{c}}$.
11. If your computer is wide screen, the area for plotting show rectangle but not square , namely circle you plot will change to "ellipse". Please move mouse to the side of form→ arrow change to horizontal double arrow→ dragging mouse flatly to adjust it. See bellow image



4. Math symbol and expression

They must be separated by ":" when used. Example: in :tri(ABC):, know: ang(EAB):=:ang(BOF):….

Please press keybutton "Inter" when start newline.

$\angle ABC$	ang(ABC)	$CD \perp EF$	vert(CD,EF)	arc	arc(AB)
ΔABC	tri(ABC)	parallelogram	para(ABCD)	∵	#as
∴	#so	$ABC \cong JHK$	co(ABC,JHK)	$\Delta ABC \approx \Delta GH$	sim(tri(ABC),tri(GHJ))
$\vec{a}$	vec(a)	$\overline{F}$	conj(F)	$\bigcup_{i=1}^{100}(x-i)$	or(x_i,i,1,100)
$\sum_{i=1}^{100} x_i$	sum(x_i,i,1,100)	$\prod_{i=100}^{100} x_i$	Prod(x_i,i,1,100))	$\bigcap_{i=1}^{100}(x-i)$	and(x_i,i,1,100)
$\geq$	>=	$\leq$	<=	$\approx$	#~
$\times$	&	$\div$	#/	$\neq$	<>
$\pm$	#+-	$\mp$	#-+	$\Rightarrow$	#->
$C \cup D$	#u	$E \cap F$	#n	$R \supseteq x$	R#d_x
$K \subset L$	#c	$R \subseteq x$	R#c_x	$G \supset H$	#d

$R \in x$	R#ex	$R \notin x$	R#fx	$E \wedge F$	E#<F
$E \vee F$	E#>F	sym(inf)	∞	$\sqrt[n]{x}$	Sqrn(x)

Greece Letter

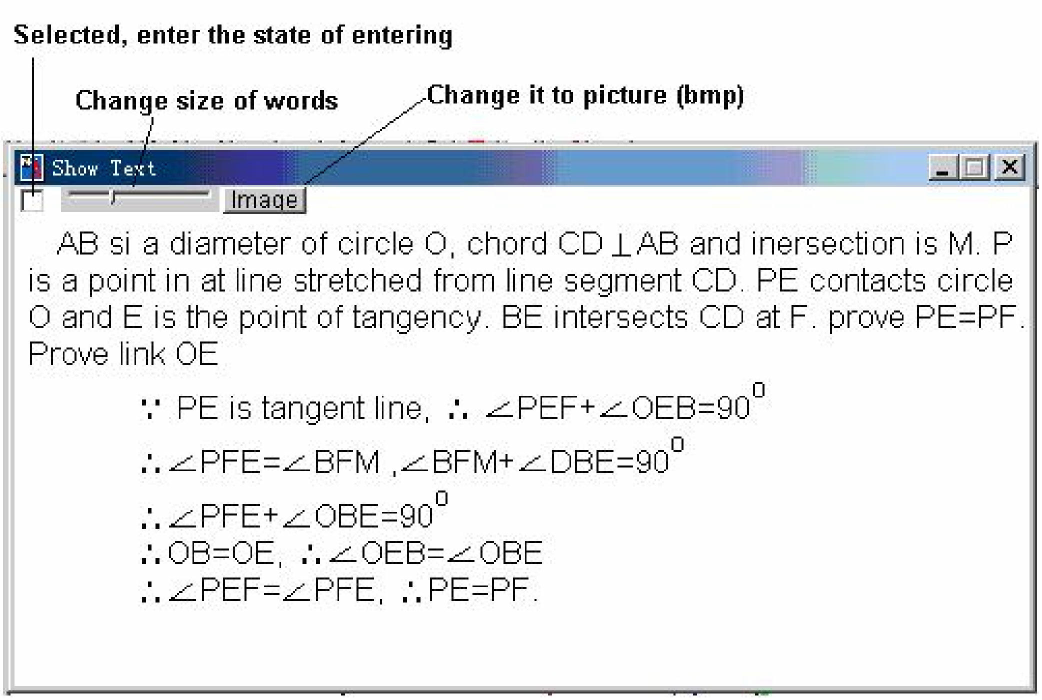
α	sym(a) or sym(alpha)	ι	sym(i) or sym(iot)	ϑ	sym(a) or sym(alpha)
β	sym(b) or sym(beta)	κ	sym(k) or sym(kappa)	ρ	sym(r) or sym(rho)
χ	sym(c) or sym(chi)	λ	sym(l) or sym(lambda)	σ	sym(s) or sym(sigma)
δ	sym(a) or sym(alpha)	μ	sym(m) or sym(mu)	ς	sym(a) or sym(alpha)
ε	sym(a) or sym(alpha)	ν	sym(a) or sym(alpha)	τ	sym(t) or sym(tau)
ϕ	sym(q) or sym(thet)	o	sym(o) or sym(omicron)	υ	sym(u) or sym(upsilon)
φ	sym(p) or sym(phi)	π	sym(p) or sym(pi)	ω	sym(a) or sym(alpha)
γ	sym(g) or sym(gamma)	ϖ	sym(v) or sym(omega)	ξ	sym(x) or sym(xi)
η	sym(h) or sym(eta)	θ	sym(a) or sym(alpha)	ψ	sym(p) or sym(psi)
Δ	sym(d) or sym(delta)			ζ	sym(z) or sym(zeta)

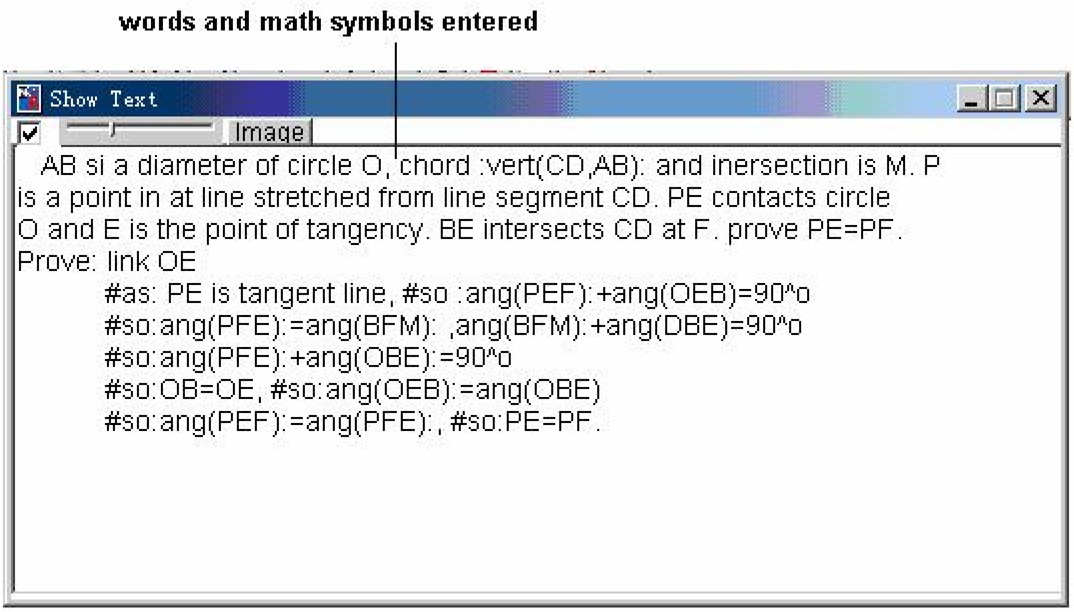
Grope of equation: list(expression1, condition1; expression2, condition2; expression3, condition3; expression4, condition4; expression5, condition5).

Log: log(a,E)→ $\log_a E$.

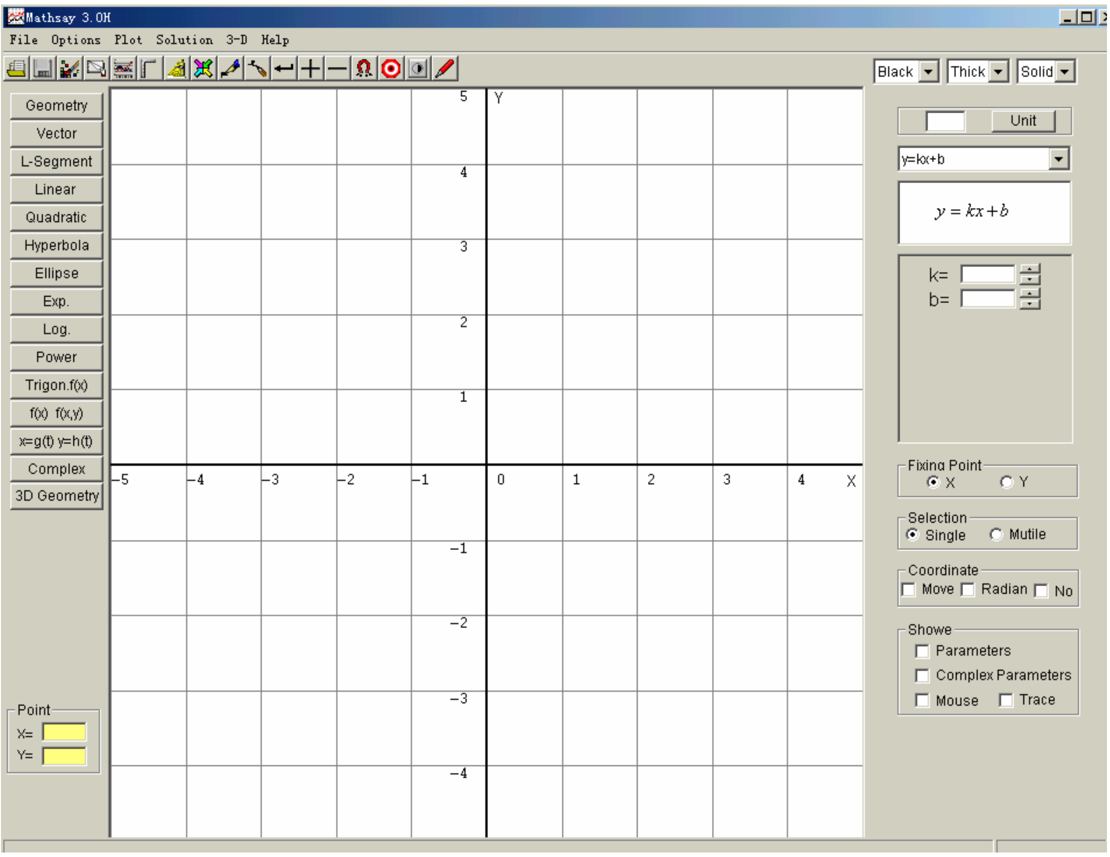
Example: Show Greece Letter $\angle\alpha$ → :ang(sym(a)):

Example:

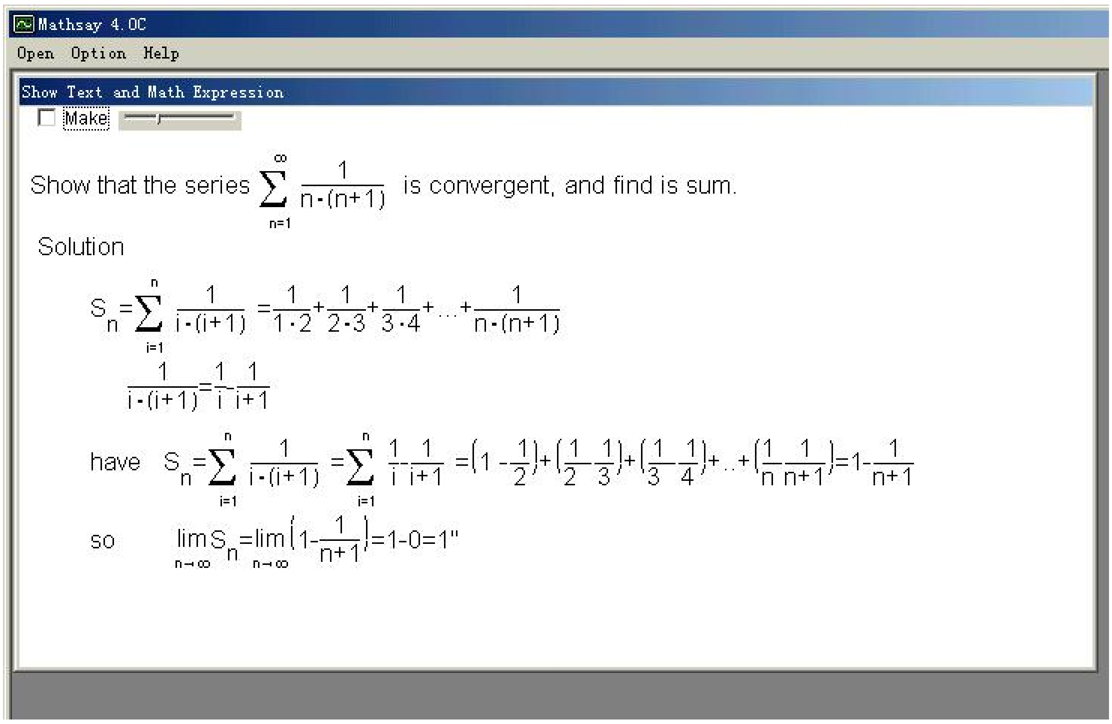




5. Operation



In 4.0C, interface is



Select "Make"→ Inter bellow text in text box.

"Show that the series :sum(1/(n*(n+1)),n=1,sym(inf)): is convergent, and find is sum.

Solution

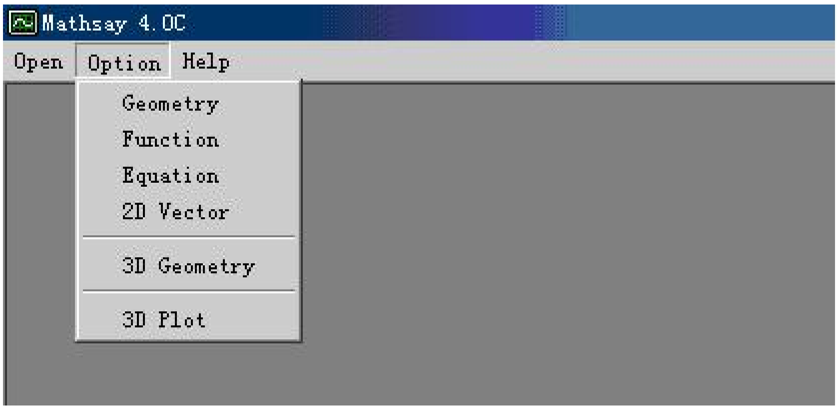
S_n=:sum(1/(i*(i+1)),i=1,n):=1/(1*2)+1/(2*3)+1/(3*4)+...+1/(n*(n+1))

:1/(i*(i+1))=1/i-1/(i+1)

have S_n=:sum(1/(i*(i+1)),i=1,n):=:sum(1/i-1/(i+1),i=1,n):=(1 - 1/2)+(1/2 - 1/3)+(1/3 - 1/4)+..+(1/n-1/(n+1))=1-1/(n+1)

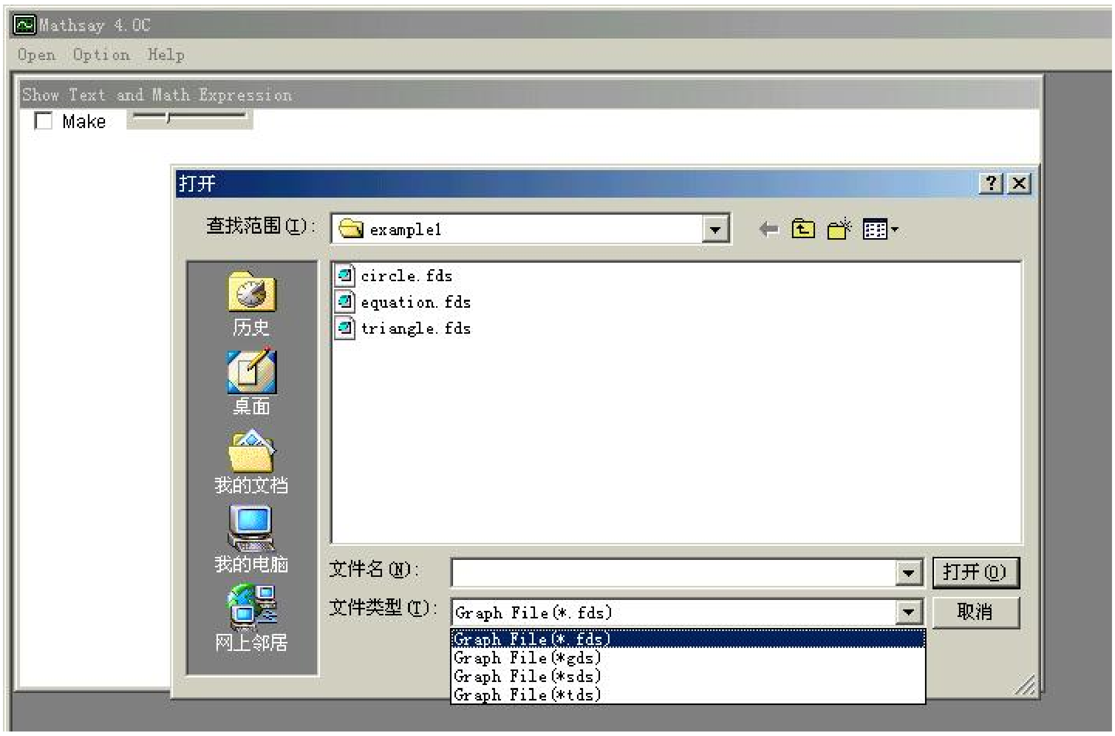
so :lim(S_n,n,sym(inf)):=:lim((1-1/(n+1)),n,sym(inf)):=1-0=1"

→ remove selection in "Make" to show expression.

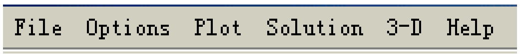


Plot can be selected in list menu.

In "File Open", Four type files can be opened (fds: geometry, function,etc.; gds: D geometry; sds: 3D Plot; tds: Math expression). See Image:



5.1 Menu bar



5.1.1 File

Open: open the file.
Save: save the file.
New: clean the screen.
Image: save as a picture (bmp).
Exit: end the program.

5.1.2 Operations

Plot: plot the curves, straight line, point, line segment, vector and complex.
Undo: cancel previous operations. All operations can be canceled in sequence.
Set points: set points in the curve and line with inputting value of x or value of y. There are four kinds of points. (1) In coordinate: when the curve or line selected, you can set the point with entering the value of x, only when line is vertical with y axis, you determine the point by inputting the value of y. (2) In rotation: only for straight line (linear function) and line segment. When the point is set, the line selected can be rotated around this point by dragging mouse. (3) In scale: only for line segment. The point is set by entering value in scale (in λ). The value is unchanged when the length is changed (move segment line or the ends of segment line).

Move: the curve selected can be moved dynamically (animation) by inputting moving value in x and in y.

Central: set the central of aria for plotting. Example: make (300,-120) central. It is useful for showing functions.

Mark points: mark a point.

Mark curve: mark a curve, line and vector.

5.1.3 Plot

New Line: plot tangent, vertical line, parallel line and the line that intersects a line selected in any angle automatically;

Line Segment: plot line segment in linking tow points selected.

Circle: plot circle determined in tow points. The point you first select is the center of a circle. It can be dynamically modified when you move points.

New Vector: plot the vector in tow points selected by clicking with mouse in coordinate.

Angle Bisector: plot the angle bisector between lines automatically.

Directrix: plot directrix automatically.

Asymptote: plot asymptote automatically.

Quadratic: plot quadratic determined in tow points. Points can be selected by clicking them in “Mutile”. It can be dynamically modified when you move points.

5.1.4 Solution

Intersection: find solutions and determine intersections (line and line, line and quadratic, line and ellipse, line and circle, line and hyperbola, circle and circle). Select line first.

Angle: measure the degree of angle dynamically (tow lines or line segments intersect each other). Select three points at same time (second point is vertex). Degrees of three angles can be showed dynamically synchronously. (select an angle→ select an angle again→ select an angle again).

Triangle Area: measure triangle area dynamically. Select three points at same time. Three triangle areas can be showed.

Relations: is “Line Segment” before 3.0. Dynamically show the relations among line segments. Example, AB^2 =BC*CD. Dynamically show the relations beteeen line segments and angles. Example, $\frac{a}{\sin\angle BAC}=\frac{b}{\sin\angle ABC}$. Operation to see Example 4 in Geometry.

Value of X-Y: Show the value of X and Y for a f(x) or f(x, y), such as the value of $x+y$ for $\log_2(x+y+3)-\log_2 x-\log_2 y=0$ and its trace can be showed.

Vector Sum: plot the resultant vector that is the sum of two vectors automatically.

Vector Difference: plot the resultant vector that is the difference of two vectors automatically.

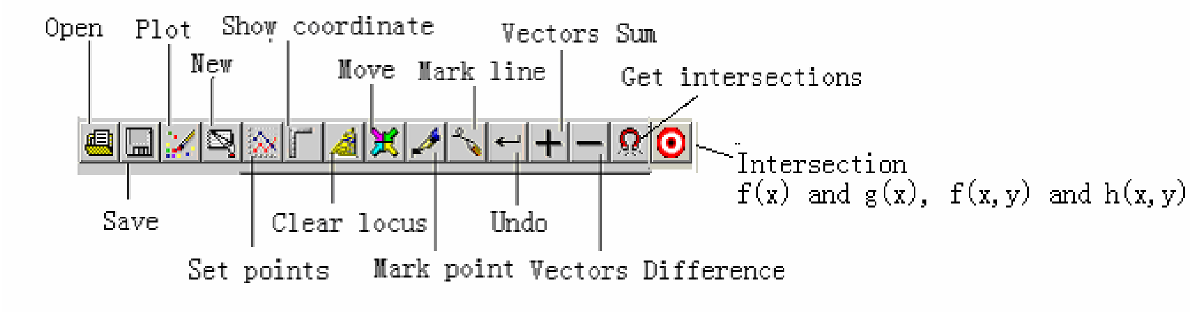
5.1.5 3-D

Solid Geometry: plot many kinds of solids and plane, line, points in three-dimensional space, such as cub, pyramid and prism.

Solid Show: show various kinds of solids in space, such as cylinder, cone, sphere, corona, prism, pyramid and frustum.

Sphere: show many kinds of inscribed sphere and of circumscribed sphere.

5.2 Tools bar



Pay attention:

" Points of intersection": get intersections of curves except curves plottd by " f(x),f(x,y)".

"Intersection f(x) and g(x,y),…": get intersection of curves plotted by " f(x),f(x,y)". Operation: click the curve→ click other→ click at intersection (round) in image→ click it. Accurate intersection (value) can be got.

5.3 Button of function (math curves)

Many kinds of math curves (functions) can be selected with clicked.

Vector: $a(X,Y)$ and $\vec{a} = m\vec{b}$.

L-segment: $P(X,Y)$, $y = kx + b$ and (x_1, x_2);

Line: $y = kx + b$, $(y - y_0) = k(x - x_0)$, $\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$, $Ax + by + C$;

Quadratic: $(x - x_0)^2 = 2p(y - y_0)$, $(y - y_0)^2 = 2p(x - x_0)$, $y = Ax^2 + Bx + C$, $x = Ay^2 + By + C$;

Hyperbola: $\frac{(x - x_0)^2}{a^2} - \frac{(y - y_0)}{b^2} = 1$ and $\frac{(y - y_0)^2}{a^2} - \frac{(x - x_0)^2}{b^2} = 1$. The hyperbola determined by foci $|F_1F_2|$ and e.

Ellipse: $\frac{(x - x_0)^2}{a^2} + \frac{(y - y_0)^2}{b^2} = 1$, $\frac{(x - x_0)^2}{b^2} + \frac{(y - y_0)^2}{a^2} = 1$. The ellipse determined by foci $|F_1F_2|$ and e, $(x - x_0)^2 + (y - y_0)^2 = 1$ and the circle determined by three points selected.

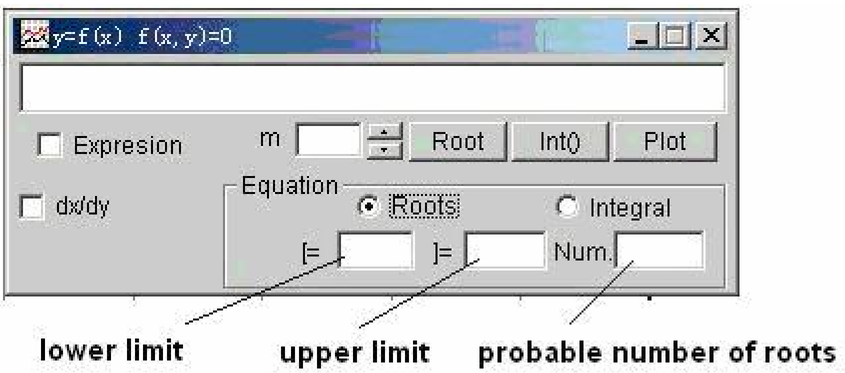
Exp.: $y = a^{x-b}$;

Log.: $y = \log_a x$;

Power: $y = k(x - a)^{\frac{n_1}{n_2}}$

Trigonometry: trigonometric function: $y = A\sin(Bx + C)$, $y = A\cos(Bx + C)$, $y = tg(kx)$, $y = Ctg(kx)$.

f(x),f(x, y):

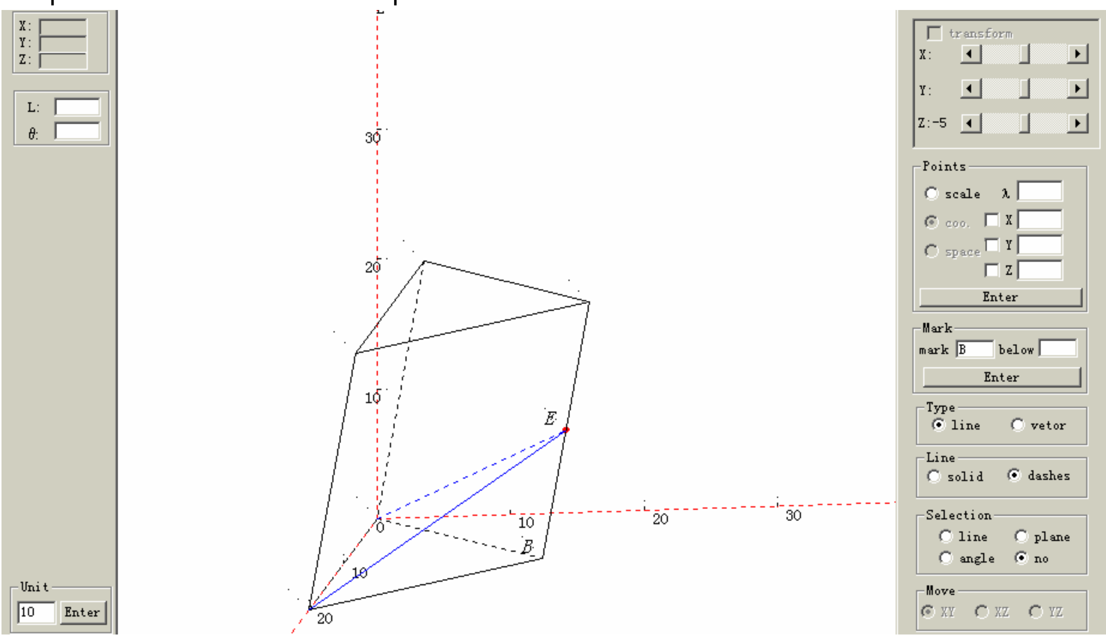


Clicked, it is showed. You can enter any expression to plot, such as $y = \sin x + \frac{\cos x}{x-2} - \frac{(x-1)^2}{x}$, $y = x^5 - 2x^3 - 3x^2 + x + 2$ and f(x)= $e^{\log x}$. In expression: $2x$ →2*x, $\sin x$ →sinx, tan^{2}x→tan(x)^2, $\sqrt[3]{x^2}$ →x^(2/3), $\frac{x-1}{x-3}$ →(x-1)/(x-3). pi→ π , $\sqrt[3]{(x-1)^2}$ →(x-1)^(3/2), $\sin 2(x-3)$ →sin(2*(x-3)), $\frac{(x-2)^2}{2x-1}$ →(x-2)^2/(2*x-1), $\log_{\frac{1}{e}}(x-1)$ →log(1/e,x-1). When curve plotted in "f(x),F(x,y)" is clicked (selected), its color changes to pink and this windows is showed and the math expression is showed on it. Roots (in y=0 or f(x)=0) can be found. Select the curve (equation) first, then enter numbers ([and] is bound, Num. is numbers of root estimated), then click button "Roots". Pay attention: the bigger is the field ([…]), the longer will it take.

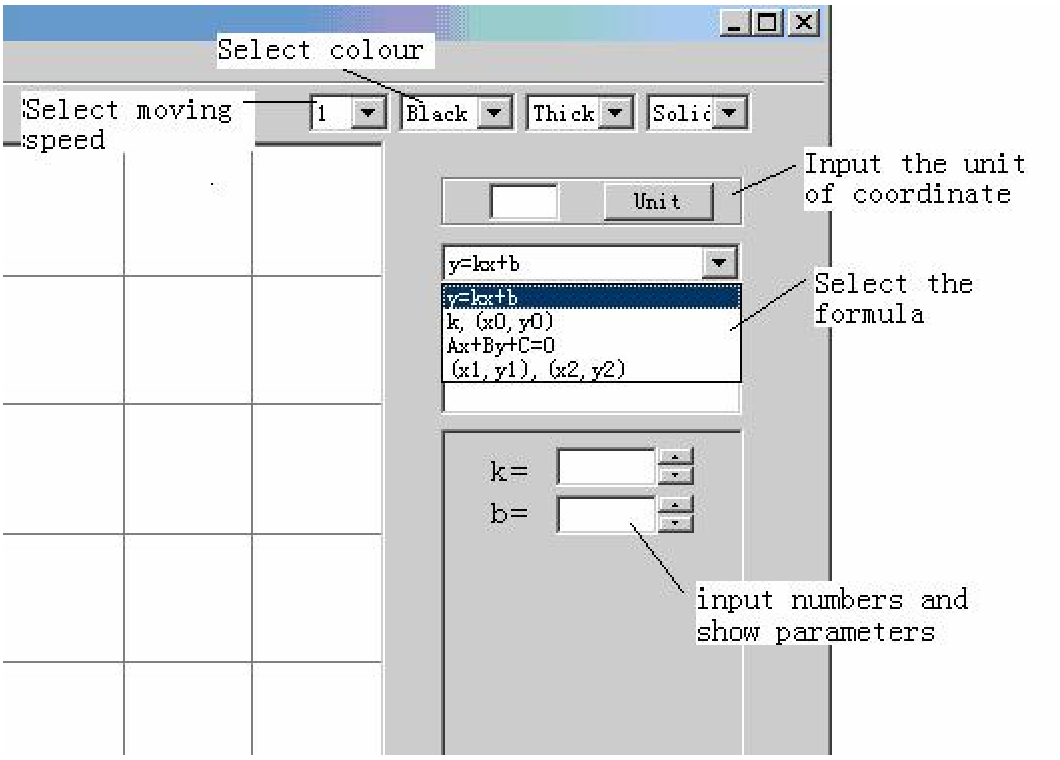
X(t),y(t): variable is t. Example: x=2cost+tsint, y=2sint-tcost. Start newline to inter y=…after x=….

Complex: Plot $z = a + bi$ and $z = r(\cos\alpha + \sin\alpha)$

3D Geometry: Plot many kinds of solids, such as cub, pyramid, prism and plane, line, point in three-dimensional space.



5.4 Selection In Color, Width And Style



5.5 List Box

Offer the list of choices. Corresponding math expressions (the math curve) can be selected.

Example: clicking the button of line, the four types of expression appear in "list of choices": $y = kx + b$, $(y - y_1) = k(x - x_1)$, $Ax + By + C = 0$, $\frac{y - y_1}{x - x_1} = \frac{y_2 - y_1}{x_2 - x_1}$ for selecting.

5.6 Show the formula

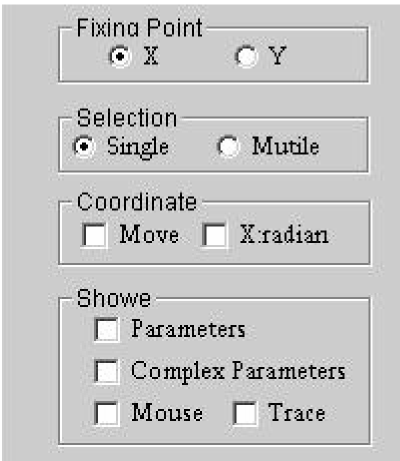
Show corresponding formula when the list is selected and curve (except plotted in "f(x), f(x,y)) is selected.

5.7 Entering Box

Entering coefficients (numbers) in these boxes to plot and show the coefficients when a curve, line and vector are selected.

5.8 Fixing Point

When the curve is modified, it is unchanged that the value of the points in the curve in x or in y.



5.9 Selection

Single: selected. Plot. Select, modify and move curves. Set the points in curves. Calculate.

Mutile: selected. Select tow curves for finding intersections (line and line, line and quadratic, line and ellipse, line and circle, line and hyperbola). Select three points or tow points for plotting a line and a line segment determined by tow points, for plotting a circle determined by three points or tow points and for plotting the angle bisector (select tow lines at same time). Measure angles and triangle areas (select three points).

5.10 Coordinate

Move: selected, axis can be moved by dragging mouse. The arrow change to cross arrow when pointer move to the zero. Then press down left button and drag mouse.

Radian: selected, the unit of axis in x is radian.

No: selected. Do not show coordinate.

5.11 Show

Parameters: selected, a small window is displayed to show the parameters of ellipse, of hyperbola and of quadratic, such as e and focus etc. Selected, a window is displayed. Click the curve.

Complex parameter: selected. Show complex and vector. Operation is same as "Parameters".

Mouse: selected. Show the value of mouse pointer in coordinate.

Trace: selected. Show the locus of point, of dx/dy and of value. Example, click the point. There is a black dot in the point. Remove trace with clicking the button "Clean locus" in Tool Bar.

5.12 Example

Geometry.

Example1: Plot points, line segments (sides) and circle.

Plot: points: Click the button of "Geometry"→ Select "points in List Box→ move mouse to the position you want to plot point→ Click with left key→ Click “Plot” button in tool bar or press “F6”. Point can be selected and moved→clicking it with left key→ Arrow change to cross arrow→ Press left key and move it by dragging mouse.

Plot line segment and line:

Linking tow points: First select tow points at same time. Click the button of "Ellipse"→ Select "3 points" in List Box→ Select "Mutile" in "Selection"→ Click points. There is a small circle around the point when selected→ Select color and the type of line. Click "Line Segment" or "New Line" in Menu "Plot"→ Select "Single" in "Selection" to move points. Select the point by clicking it. Arrow change to cross arrow→ Press left button and move it. The line segment or line can be changed.

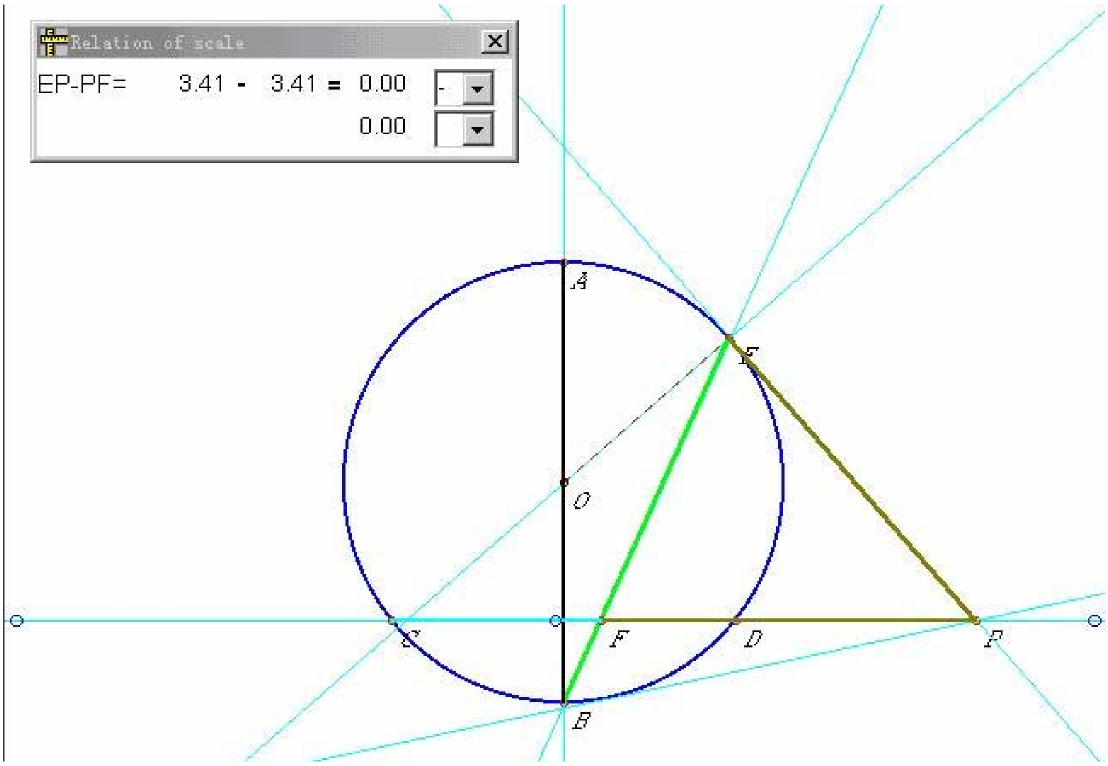
Direct: Click "Linear" button→ Select color and the type of line. Click "Plot" button in tool bar or press “F6”. A horizontal line is plotted. It can be move and rounded (in "single" in "Selection"). Click it. There are three small circles on it→ move mouse to middle of point and arrow change to cross arrow → Press left key and move it up and down by dragging mouse. Click the line. Click “Set Point” in tool bar. “Select point” box is displayed. Enter numbers or click the position on line you want to set → Click "Inter" in "Point (around)" to set the point→ Move mouse to the end of line and arrow change to diagonal arrow→Press left key and move it by dragging mouse.

Plot Circle: Select "Circle" in List Box. Move mouse to the position where the centre of a circle is in and click→ Inter the number in "R="→ Click "Plot" button in tool bar or press “F6”. Points can be set on circumference. Select circle by clicking it→ Click “Set Point” in tool bar. “Select point” box is displayed. Enter numbers or click the position on circumference you want to set in. Click "Enter". The tow points are displayed on the circumference. They can be moved along the circumference. Click the circle to select--> Move mouse to the point. Arrow changes to cross→Press left key and move it by dragging mouse.

Modify circle: Click circle. Tow small circle is in circumference when selected. Move mouse to the circle→ Arrow changes to horizontal arrow→ Press left key and drag mouse. Circle can be changed to bagger or smaller.

Plot tangent:: Click circle to select it. Click "New Line" in menu "Plot". A box is displayed. Click the point that is on circumference or outside circle with right key. Then click " Tangent" button.

Example 2: AB is diameter, chord CD⊥AB, P is a point in extended line CD, PE is tangent and E is point contact. BE intersects CD in F. Prove PE=PF.



Step1: Plot circle. Click “Geometry” button--> Select “Circle” in List Box--> Move mouse to the position where the center of circle is in and click--> Click “Plot” button in Tool Bar or press “F6” key.

Step2: Plot chord CD. Plot line first (can be moved and get intersections). Click "Linear"→ Click "Plot"→ Click the line to select it→ Move mouse to the middle small circle in line (arrow changes to cross arrow). Press left key and move line up or down by dragging mouse. Get line segment CD. Select “Mutile” in “Selection”→ Click the line first, then click circle→ Click “Intersection” button in Tool Bar to get intersections. Mark them C and D. Select “Single” in “Selection”.

Step3: Plot diameter AB. Click Line CD (not line segment CD)--> Click “New Line” in menu . A box is displayed→ Click point O with right key (numbers is displayed in text boxes, which are the value in coordinate). Inter 90 in “Angle” text box (vertical). Click “Inter”→ Get intersections A and B. Select “Mutile” in “Selection”→ Click the line first, then click circle--> Click “Intersection” button in Tool Bar to get intersections. Mark them A and B. Link A and B with line segment to get line segment AB.

Step4: Plot tangent EP. Get point P. Click line CD to select it--> Click “Set Point” in Tool Bar. A box is displayed. Click the line with left key and Click “Inter” in “Point”. A point is set in the position you just click. Mark it P. The point can be moved on line by dragging mouse. Click circle to select it→ Click “New Line” in menu “Plot”. A box is displayed→ Click point P with right key (numbers is displayed in text boxes) and click “Tangent” button.

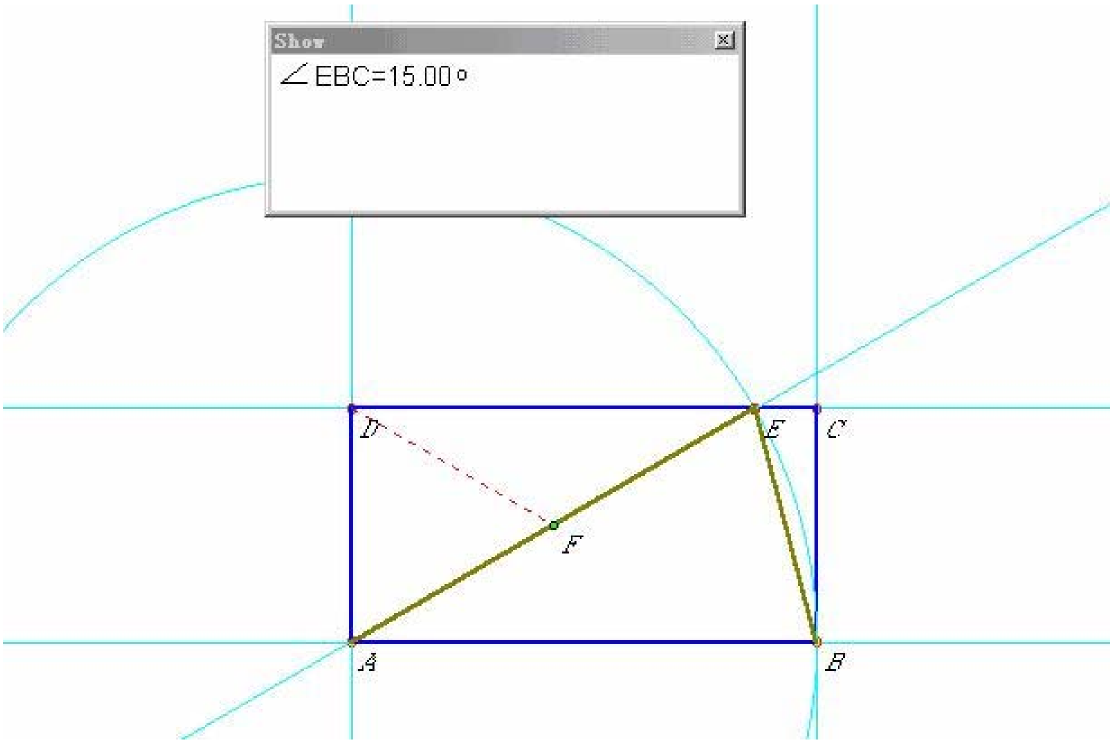
Step5: Get point E. Plot vertical line passing point O. Click line EP to select it→ Click “New Line” in menu “Plot”. A box is displayed→ Click point O with right key→ Inter 90 in “Angle” box. Click “Inter”→ Get line OE. Select “Mutile” in “Selection”→ Click the line EP, then click line OE→ Click “Intersection” button in Tool Bar to get a point of intersection. Mark it E.

Step6: Plot line BE. Click "Ellipse", select "3 Points" in List Box and select "Mutile" in "Selection"→ Click point B and point E→ Click "New Line" in menu "Plot"→ Get point F. Select "Mutile" in "Selection"→ Select line FP and line BF→ Click "Intersection" button in Tool Bar to get the point of intersection. Mark it F.

Step7: Link EP and BE with line segment.

Step8: Show. Click "Relation" in Menu "Solution". A box is displayed→ Inter "EP-PF={d1"→ Click line segment EP (variable d1 is the length of EP) → inter "–d2"→ Click line segment PF (variable d1 is the length of PF) → Inter "}=v1" (variable v1 is the value in evaluating {d1-d2} → Select "Show" to form expression→ Click point P and move it, or click circle and modify if. Length EP and FP can be showed dynamically.

Example 3: Rectangle ABCD. E is a point in CD. If AE=AB=2BC. $\angle EBC$=?



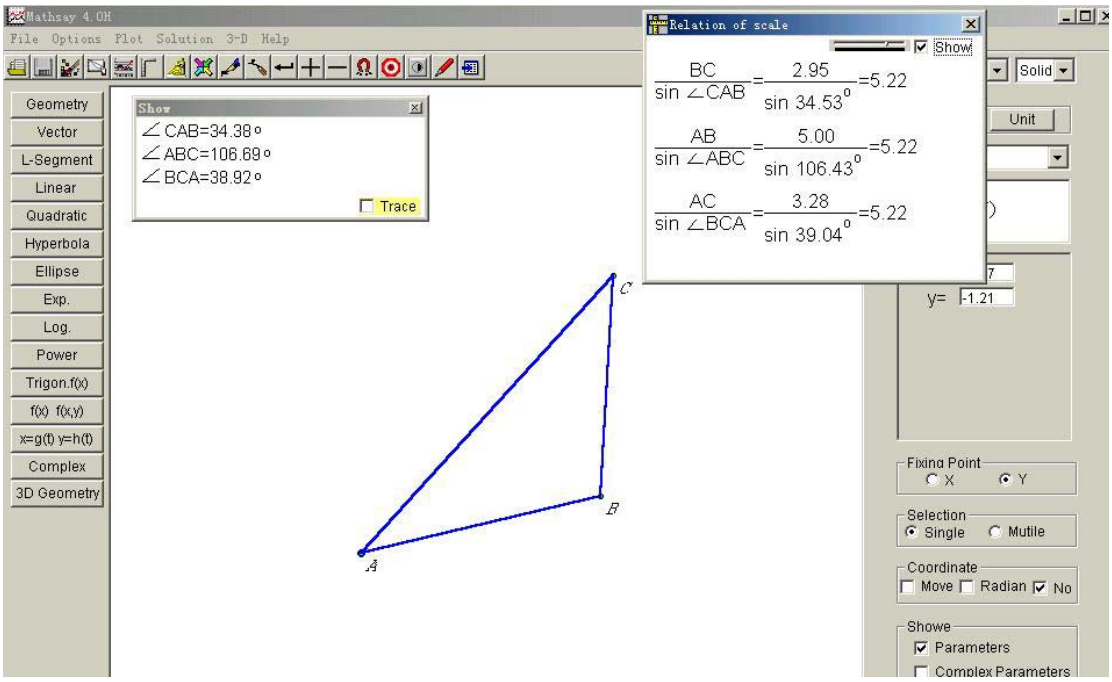
Step1: Plot points A, B, C and D. Plot line AB and line CD. Click "Linear" button→Inter "-1" in "b=", click "Plot" or press F6→ Inter "1" in "b=", press F6 again. The distance between line AB and line CD is 2. (The line can be moved up or down)→ Click line AB to select it. Click "Set Point" in Tool Bar. "Set Point" box is displayed→ Inter "-2" in "X=" in "Set Point". Then click "Inter" button. Mark it A→ Inter "2" in "X=" in "Set Point", click "Inter" button again. Mark it B. The distance between point A and point B is 4 (AB=2CD)→ Plot line AD and line BC. Click line AB→ Click "New Line" in menu "Plot". A box is displayed → Click point A with right key and inter 90 in "angle". Click "Plot" button→ Plot line BC→ Get Point C and D. Select "Mutile" in "Selection"→ Click the line AD or line CD→ Click the line CD or line AD→ Click "Intersection" button in Tool Bar to get the point of intersection. Mark it D→ Get intersections C→ Link AB, BC, CD and DA with line segment.

Step2: Get point E. Click "Ellipse" button→ Select "3 Points"→ Select "Mutile" in

"Selection"--> Click point A first (the center of circle), then click point B--> Click "Circle" in menu "Plot"→ Select "Mutile" in "Selection"→ Click line CD first, then click the circle. Click "Intersection" button in Tool Bar to get the point of intersection. Mark it E (AE=AB).

Step3: Measure $\angle EBC$. Select "Parameters" in "Show". A windows is displayed (to show parameters)→ Click "Ellipse" button--> Select "3 Points"→ Select "Mutile" in "Selection"--> Click point E→ Click point B--> Click point C→ Click "Angle" in menu "Solution". The number is displayed--> Select "Single" in "Selection".

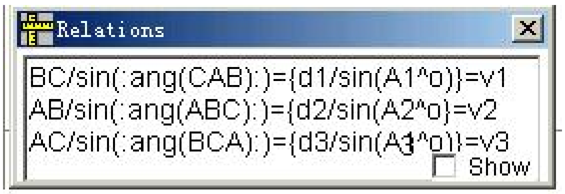
Example 4: Show law of sines in triangle.



Step1: Plot triangle ABC.

Step2: measure angles in turn. Select "parament" in "Show". A windows is displayed to showe the value of angles. → Check "Ellipse" → Select "3 Points" in "List Box". → Select "Multue" in "Selection" (for selecting three points at the same time). → Click point C, point A and point B in turn (small circle around it). → Click "Angle" in "Solution" in Menu Bar. The value of $\angle CAB$ is showed. Measure $\angle ABC$ and $\angle BCA$ in the same way. These angles are changed dynamically when points are movied by dragging mouse.

Step3: Enter expression. Click "Relation" in "Selution" in Menu Bar. A windows to show relation is displayed. → Inter expression. Pay attention: A1, A2, A3, d1, d2, d3, d4, v1, v2 and v3 are variables.



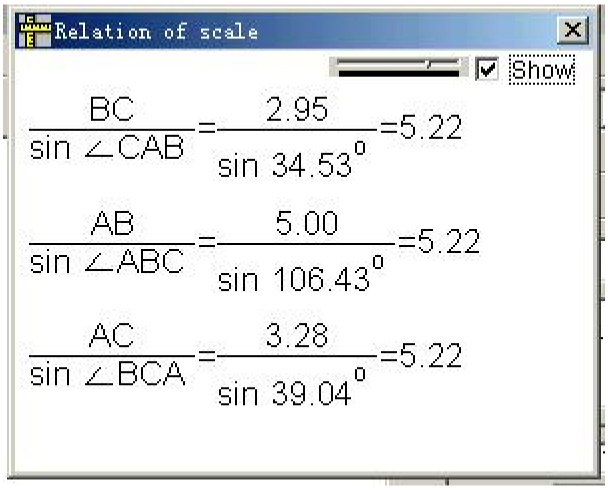
A1: first angle measured. A2: second angle measured. A3: third angle measured. Three angles can be assigned. Unit of measure is degree.

d1: length of line segment selected by clicking. Option: inter “d1”, then click the line segment to select it. d1 is the length of it. If assign d2 is its length, please press “Back Space” to delete d1→ Inter d2, then click it. Four can be assigned most.

v1, v2 and v3: the velues of expressions calculated automatically.

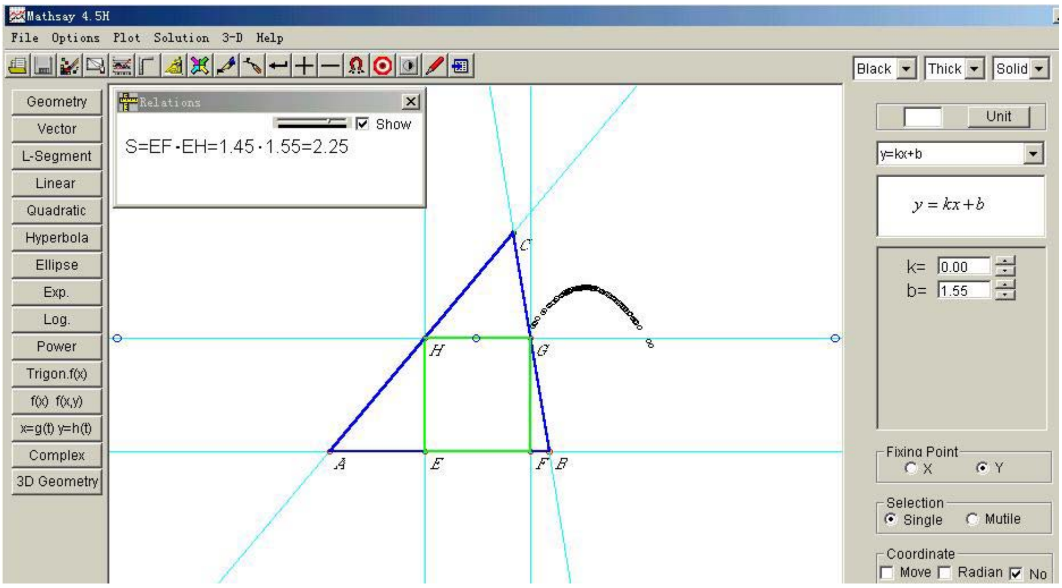
Variables A and d must be enveloped with “{ }”. See image. Symbol “^o” is used to showe “degree”.

Step5: seclext “Show” to show expression.



Step6: select “Single” in “Selection”. → Click a point (A or B, or C) to select it and move it to show relations by dragging mouse automatically.

Example5: A triangle ABC, side AB=a, the height on side AB is h. Rectangle EFGH is inscribed, see image. How height is HE, the area of rectangle is maximum? (Plot triangle ABC in setting AB=3 and its height = 3, you can also set other numbers)



Step1: Plot line AB. “Linear” button→ click “Plot” on Tool Bar (or press F6) in k=0→ set points A and B: ckick line AB, ckick “Set Point” on Tool Bar, a box is displayed. Inter -1.5 in “Set point”, then click “Inter” to set point A. Inter 1.5 to set point B (side AB=1.5-(-1.5)=3, or set A=-2 and B=1, any numbers can be set on the condition that the length AB is 3);

Step2: Plot point C. click “Geometry” button→ move arrow to above line AB to click, then click “Plot” on Tool Bar to plot point C→ select “Mouse” in “Show”→ click point C to select it, then move it→ when the value in coordinate is (…, 3), namely y=3 (for height=3, b=0 in plotting line AB. y=2 if b=-1, etc.).

Step3: Plot line AC and line BC;

Step4: Link AB, BC and AC with line segments to form a triangle;

Step5: Plot line GH (Click “Linear” button then to plot). It can be moved up and dowen by dragging mouse→ get points of intersection, they are H and G;

Step6: Plot vertical lines HE and GF→ get points of intersection (E,F,G and H) to forme a rectangle EFGH.

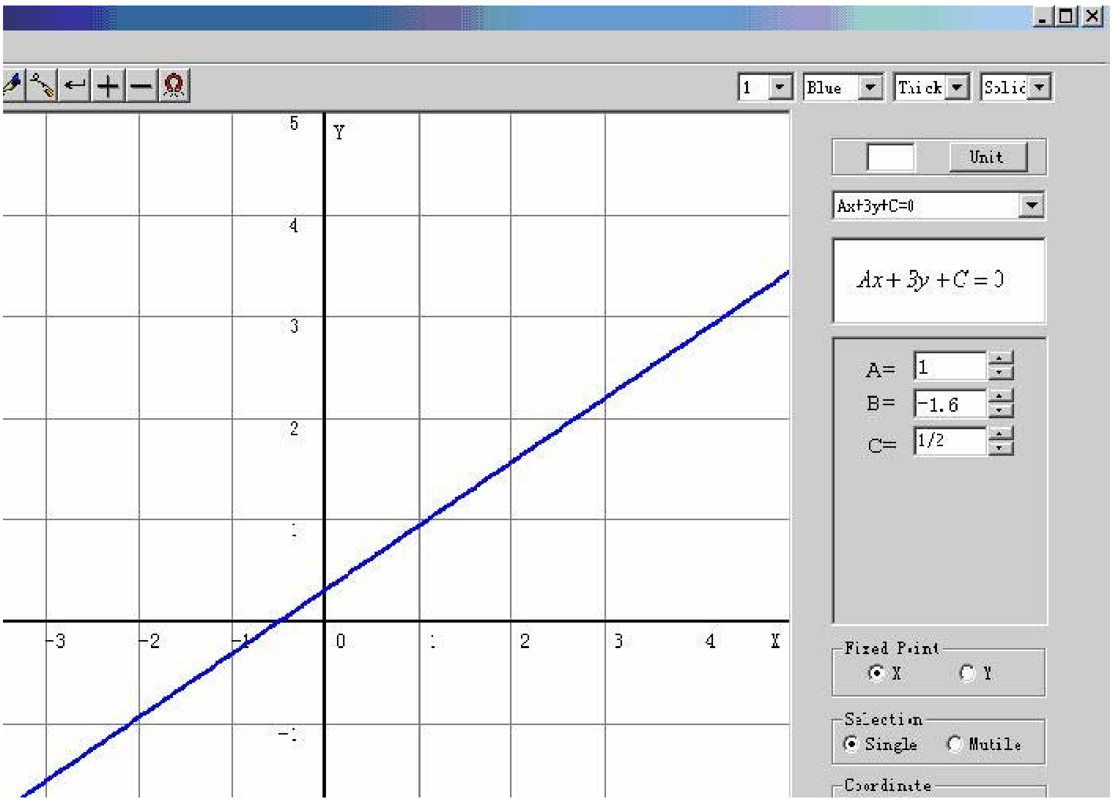
Step7: Enter expression for the area EFGH. Click “Relation” in “Selution” in Menu Bar. A windows to show relation is displayed. → Inter expression. Inter “S={d1”→ click line segment EF to select it→ inter “}*{d2”→ click EH→ inter “}=v1”. v1 is the value of expression→ seclext “Show” to show expression.

Step8: click line GH to select it and select “Locus” in “Show”→ move arrow to middle of GH. Arrow shows cross arrow→ press left button→ move mouse up and dowen to change area EFGH. Area EFGH can be showed dynamicly.

Coordinate Geometry

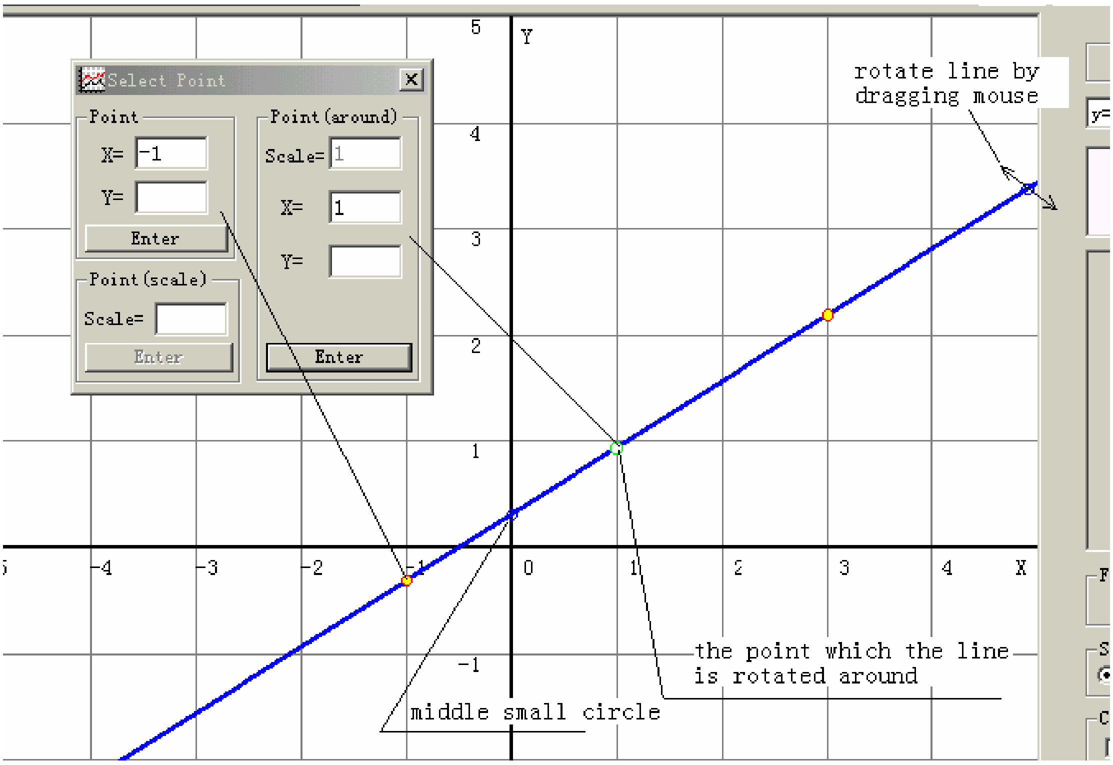
<u>Example1</u>: Plot $x - 1.6y + \frac{1}{2} = 0$.

Step1: Click “line” button in “Button of function”→Select “Ax+By+C=0” in “List Box”→Enter 1 in “A”, -1.6 in “B” and 1/2 in “C”→ Select color, line width and line style →Click “Plot” button in tool bar or press “F6”. See picture.



Step2: Set points. Click the line. A small circle is displayed in middle of line and tow points

in ends of the line when selected→Click “Set Point” in tool bar. “Select point” box is displayed. Enter numbers. See illustration.

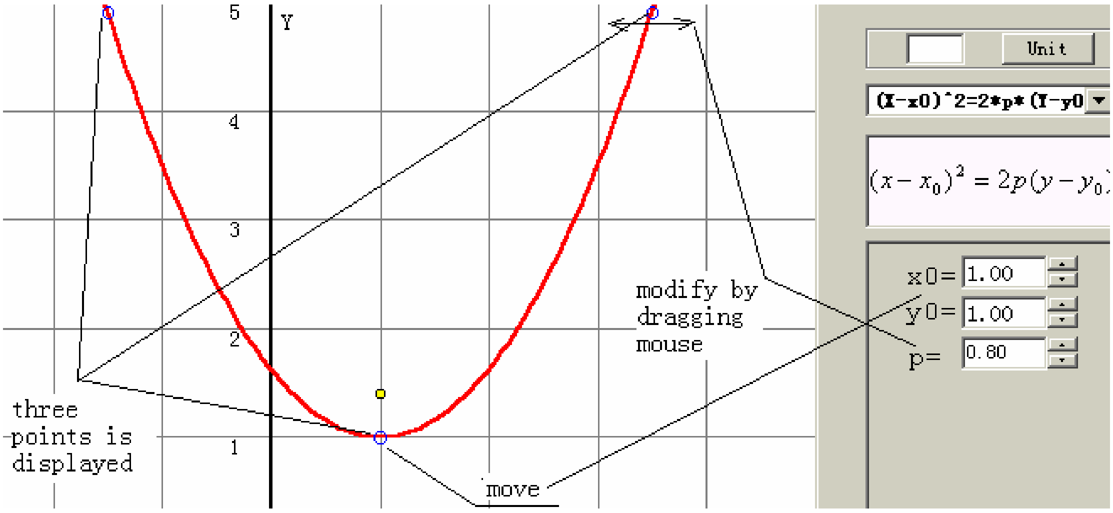


Step3: move the line. Move mouse pointer to the middle small circle, Arrow changes to cross arrow. Press left button and drag mouse to move the line.

Example2: Plot $(x-1)^2 = 1.6(y-1)$

Step1: Click “Quadratic” button in “Button of function”→Select “(x-xo)^2=2p(y-yo)” in “List box”→Enter 1 in x_0, 1 in y_0 and 0.8 in p→Select color, line width and line style→Click “Plot” or press “F6”;

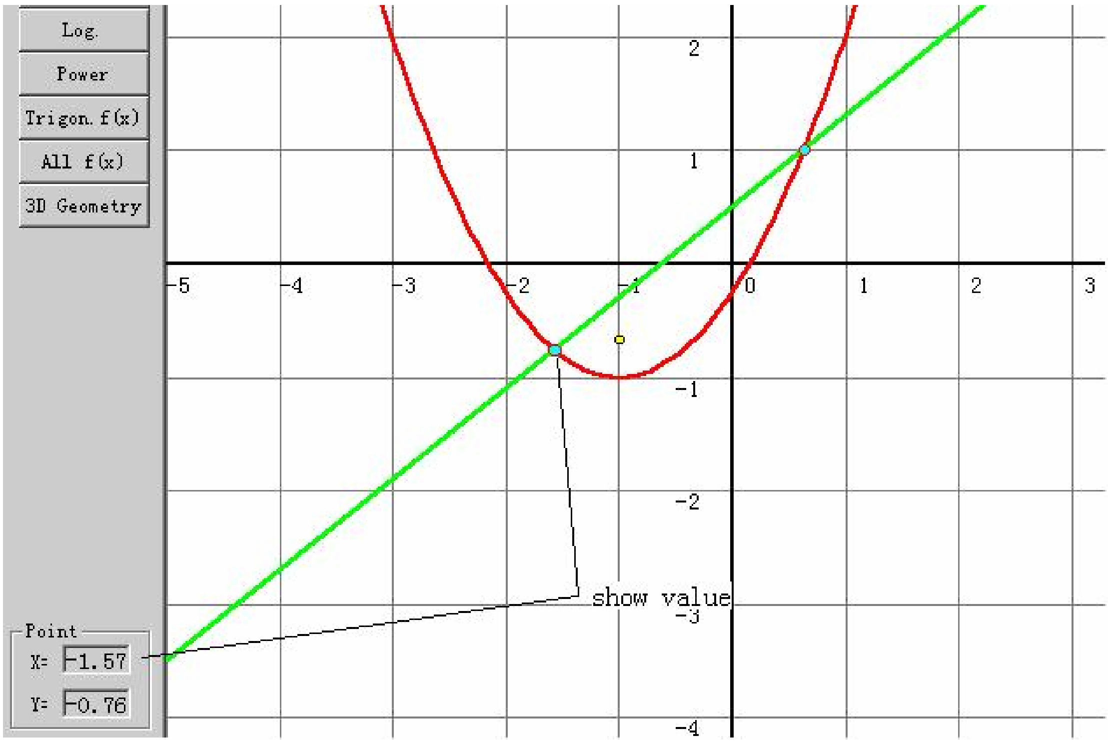
Step2: Modify and move. Click it. Three small circles are displayed in the curve when it selected →See illustration. You can move the pointer to the small circle and pointer changes to horizontal double arrow. Press left button and move mouse to modify the quadratic (p is changed).



Example 3: Plot $(x+1)^2 = \frac{4}{3}(y+1)$ and $y = -0.8x + 0.5$. Find their solutions (intersections).

Step1: Click “Quadratic” button in “Button of function”--->Select “(x-xo)^2=2p(y-yo)” in “List Box”→Enter –1 in x_0, 1 in y_0 and 2/3 in p in “Enter Box”→Select color, line width and line style→Click “Plot” or press “F6”;

Step2: Click “line” button in “Button of function”→Select “y=kx+b” in “List Box”→Enter –0.8 in “k” and 1 in “b”→Click “Plot” button in tool bar or press “F6”. See illustration.



Step3: Find the solutions and show them. Click “Mutil” in “Selection”→ Click the line first (selected, tow small circles is displayed in the tow ends of the line and a small circle is displayed in the middle of it)→Click the curve of quadratic (select)→Click

"Intersection" button in tool bar. The intersections are displayed. See illustration. When move mouse pointer to one of intersections, the arrow change to across and show the value of the point in coordinate in "Point" box.

Step4: You can modify and move the curve or the line. Select "Single" in "Selection"→Move mouse pointer to the point in middle of the line. Arrow changes to across arrow. Press down left button and move the line by dragging mouse to see the change of points. In addition, you can modify the quadratic and see change.

Example 4: Plot ellipse and modify it.

Step1: Click "Ellipse" button in "Button of function"→Select "(x-xo)^2/a^2+(y-yo)^2/b^2=1" in "List Box"→ Enter 3 in a and 2 in b in "Enter Box"→ Select color, line width and line style→ Click "Plot" or press "F6", see illustration.

Step2: Click the ellipse to select it (the tow small circles are displayed in the side of ellipse and a small circle in center. If not, click it again). Moving mouse to the small circle in side, mouse pointer changes to horizontal double arrow or vertical double arrow. Press down left button and drag mouse. The ellipse can be modified (a or b is changed) and parameters (numbers) change in "Enter Box" meantime.

Step3: Move the ellipse (animation). Select a number in the list of "moving speed"→ Click "Move" button in tool bar→ A enter box is displayed for entering moving value in x and in y. Enter the value. Click "Inter". The ellipse moves dynamically.

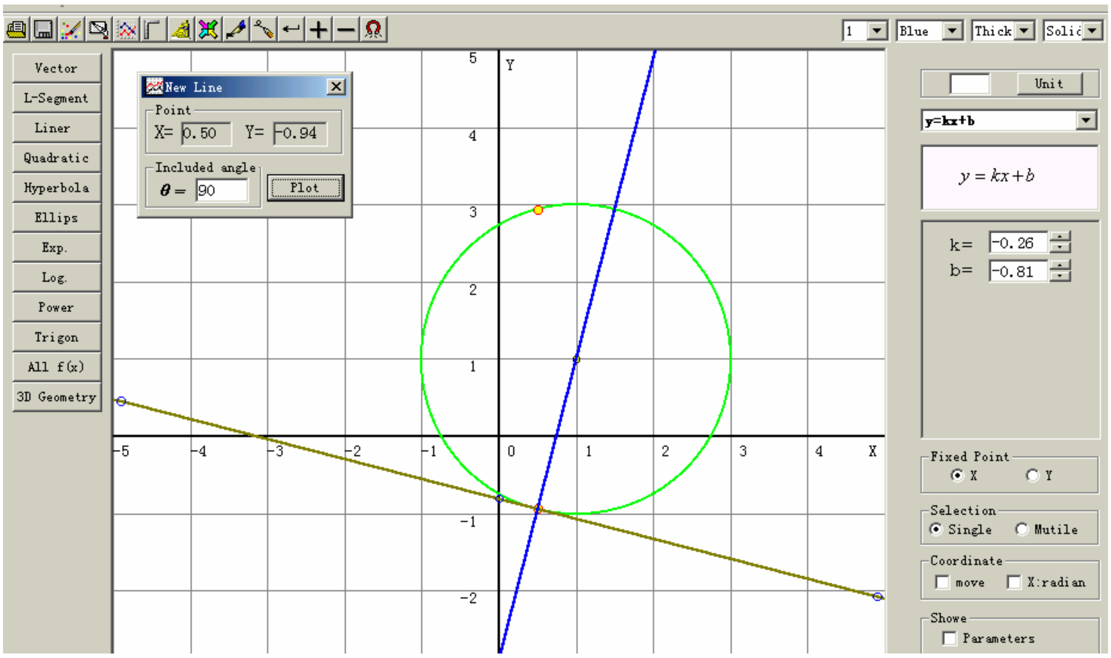
Example 5: Plot circle and the tangent, the vertical line.

Step1: Click "Ellipse" button in "Button of function"→Select "$(x-x_0)^2+(y-y_0)^2=R$ in "List Box"→Enter 2 in "R", 1 in "a" and 1 in "b" in "Enter Box"→ Select color, line width and line style→ Click "Plot" or press "F6";

Step2: Click the circle (select it)-->Click "Set Point" button. "Select point" box is displayed→ Enter 0.5 in "x" in "Point" box. Click "Enter" button. The points are displayed.

Step3: Click "New Line" in "Solution" in menu bar. "New Line" box is displayed → Click the one of points with right button (select it). The value of the point in coordinate is displayed→ Click "Tangent" button. The tangent is plotted automatically. See illustration;

Step4: Click the tangent (select it)→ Click "New Line" in "Solution" in menu bar, "New Line" box is displayed→ Click the point which the tangent touches circle in with right button. The value of the point in coordinate is showed →Enter 90 (vertical) in angle box. Click "Plot" button. The vertical line is plotted automatically. See illustration.



Step5: You can move the point and observe the relations within them. Click the circle (select it)→ Move mouse pointer to the point, the arrow changes to cross→ Press down left button and move the point in circumference.

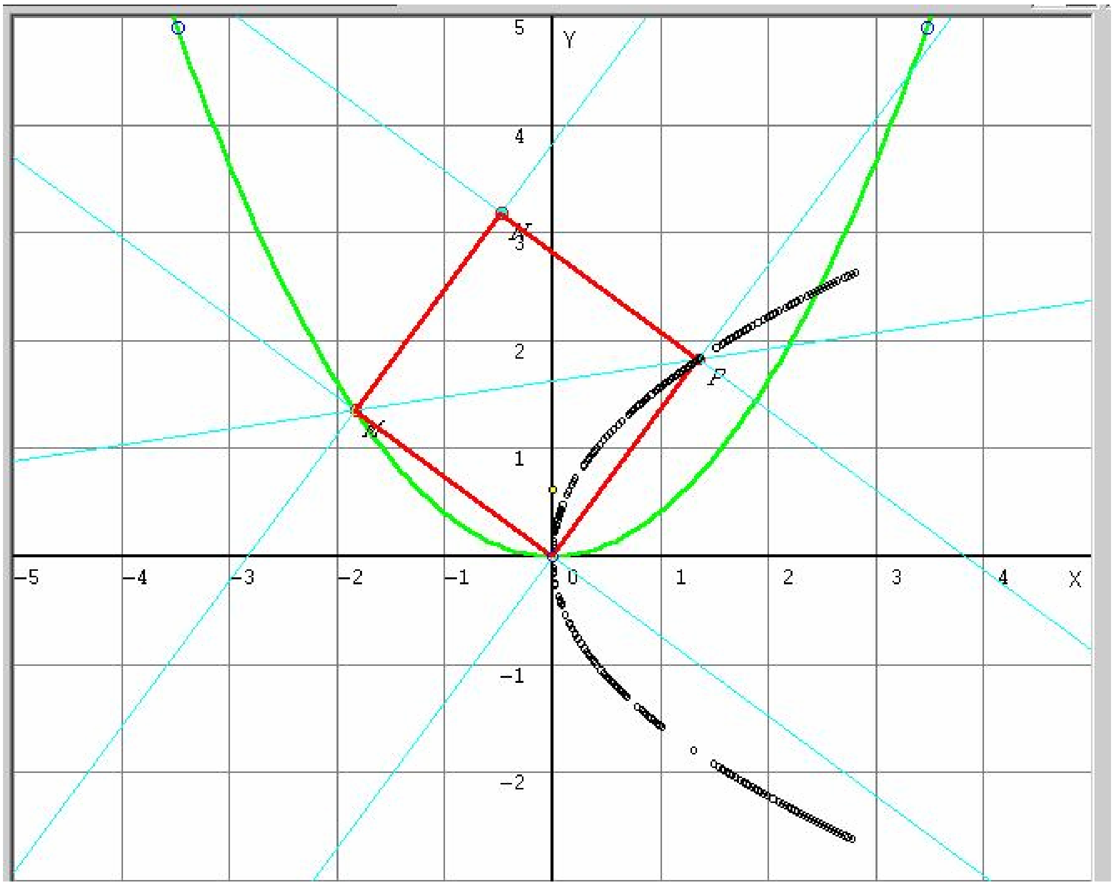
Example 6: The locus of change. C is a point can be moved in the curve of quadratic. O is the origin of coordinate. OM is the edge of square OMNP. Observe locus of A when M is moved. See illustration.

Step1: Plot quadratic

Step2: Determine the point of M. Click quadratic (Select it)→ Click "Selection" button in "Tool Manu". "Select Point" box is displayed→ Enter –1 in x (you can enter any number. The point can be moved in quadratic) in "Point".

Step3: Plot line OM (plot line with tow points). Select "Mutil" in "Selection"→ click "Ellipse". Select "3 points" in "list box"→ Click M and O separately→ click "New Line" in "Solution" in "Manu" to plot line OM.

Step4: Plot vertical lines (with line OM) going through M and O separately. Select "Single" in "Selection"→ Click "New Line" in "Solution" in "Manu". "New Line" box is displayed→ Click point M with right button. The number of M in coordinate is displayed (if not, click it again)→ Enter 90 (vertical) in angle box. Click "Enter". The vertical line going through M is plotted automatically→ Plot the vertical line going through O similarly;



Step5: Determine point P with OP=OM. Click "New Line" in "Solution" in "Manu". "New Line" box is displayed→ Click point M with right button (the value of M in coordinate is displayed in X and Y)→ Enter 45 in angle box. Click "Enter". The line with line OM in 45^{O} is plotted automatically→ Select "Mutil" in "Selection". Click line OP and OM→ Click "Intersection" in "Tool Bar" or "Intersection" in "Solution" in "Manu". Point P is displayed (determined). Mark it P;

Step6: Determine point N and make square OMNP. Click line MN and NP--> Click "Intersection" in "Tool Bar" or "Intersection" in "Solution" in "Manu". Point N is displayed.

Step7: Link OM, MN, OP and NP with line segments. In order to make image looks good, make the color of line OP, OM, MN and PN is white.

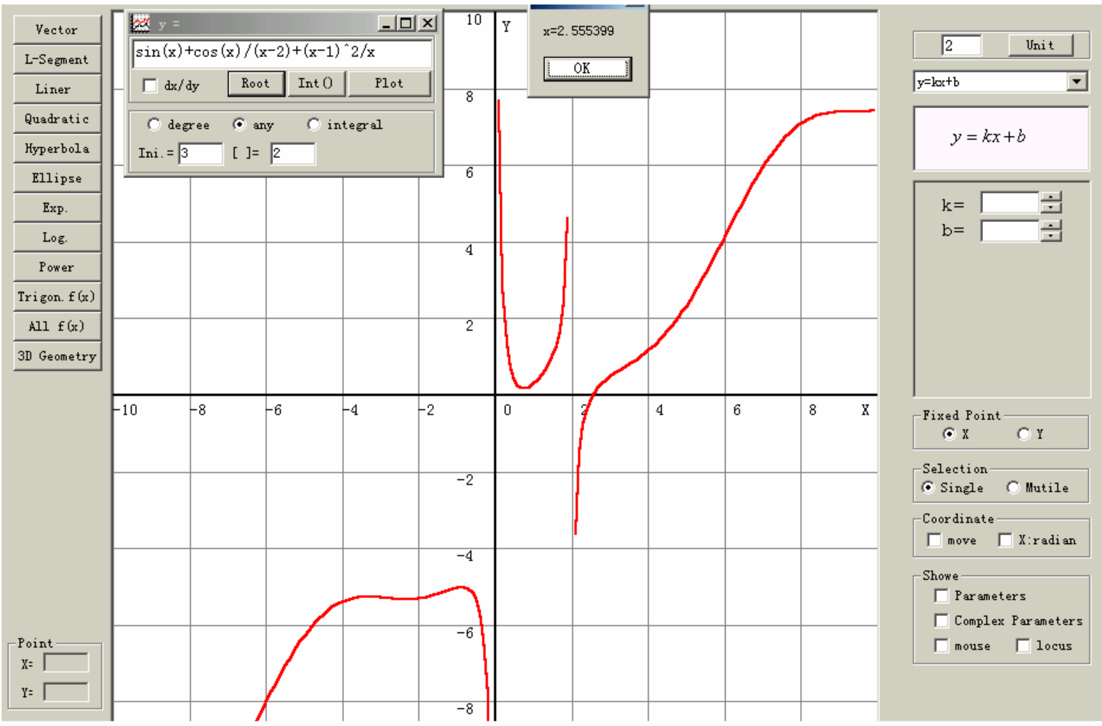
Step8: Move point M. Select "Single" in "Selection"--> Select "Locus" in "Show". Click point A (a black point is displayed in point A)→ Click quadratic curve. Move mouse pointer to point M and the pointer change to cross. Press down left button and move the point C in quadratic curve. The locus is displayed.

<u>Example 7</u>: Plot the function you want with entering formula. Example: $y = \sin x + \frac{\cos x}{(x-2)} - \frac{(x-1)^2}{x}$. You can extract the root and do differential and definite integral.

Step1: Click "f(x),f(x, y)" button, the "Enter formula box" is displayed. See illustration→

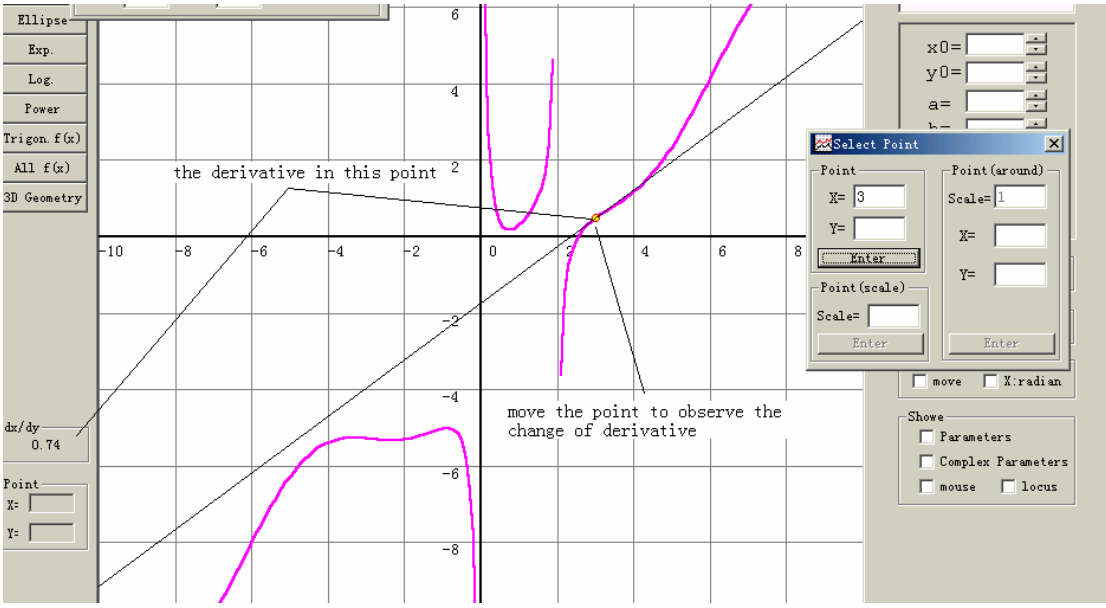
Enter formula sin(x)+cos(x)/(x-2)-(x-1)^2/x. Click "Plot" button.

Step2: Extract the root. Select "any". The selection of "degree" is for the kind of $y = x^7 - 5x^5 - 10x^4 + x^2 + 2x - 5$. Click the curve. The color of curve changes to cyan (selected)--> Click "Root" button -->Enter initial value and region value. Example: "initial" is 3 and "region" is 2. Roots are looked for in [1, 5]. If there are some roots in this region, they can be extracted automatically. The bigger region is, the more time to for calculate take.



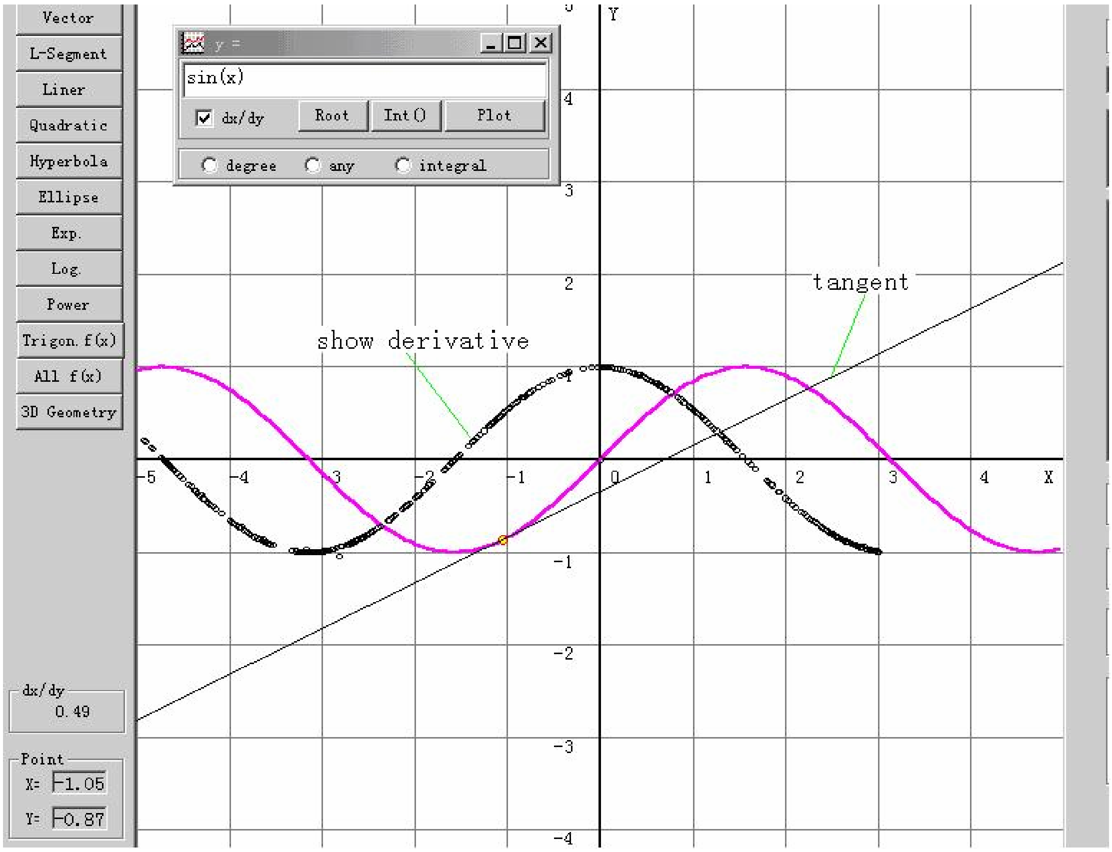
Step3: Show dx/dy. Click "Select point" in tool bar. Set the point. Enter the number in x (the derivative of this point). Click "Enter" button. The point is displayed→ Select "dx/dy"→ Move mouse pointer in the point. Press down left button and move the point by dragging mouse. The change of derivative can be show in box of "dx/dy";

Step4: Definite integral. Click "Int()" button .Enter tow points of region. Example: [= 2.5,] = 4. Click "Int()" button. The value of definite integral in this region can be calculated.



Example 8: Show the derivative of arbitrary function you enter.

Step1: Click “f(x), f(x, y)” button. Enter the formula and plot.



Step2: Click the curve (selected). Click “Set point” button in Tool bar and enter a number to set a point in curve→ select “dx/dy” and “Trace”.

Setp3: Move pointer to the point. Press down lift button and move the point. See illustration.

Example 9: Plot vector.

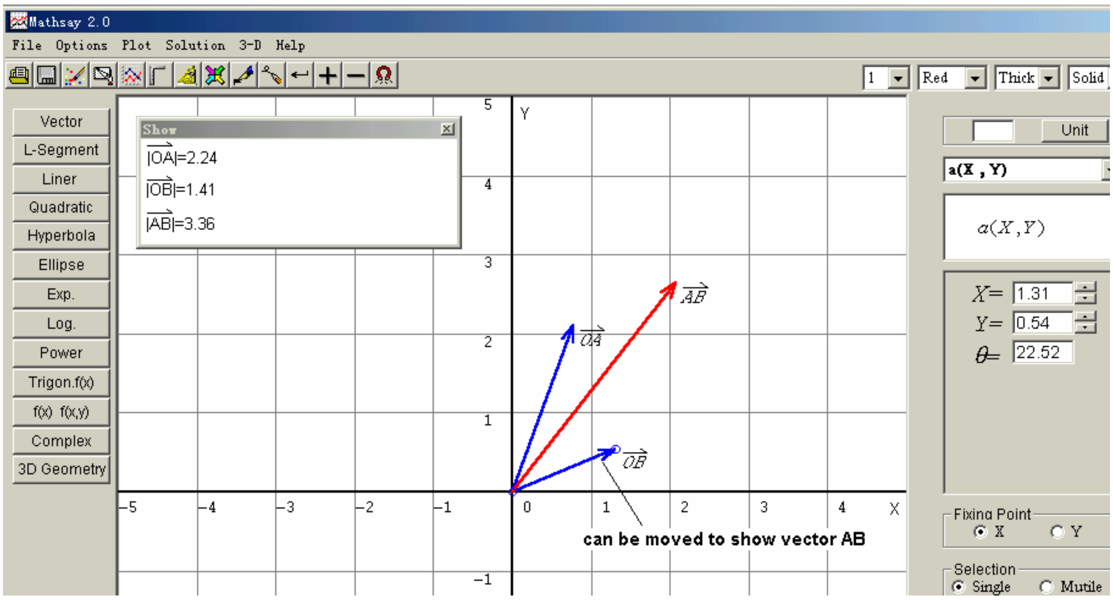
Plot vector in $a(X,Y)$ and $\vec{a} = m\vec{b}$

Linking the tow points to create a new vector in “New vector”.

1.Step1: Plot the component of tow vectors. Click “Vector” button in “Button of Function”-->Enter numbers in “X” and “Y” box. Click “Plot” in tool bar or press “F6”. Mark it $O\vec{B}$. Plot anther vector in same way.

Step2: Ploy the resultant of tow vectors. Select “Mutil” in “Selection”→ Click tow vectors separately (select them meanwhile)→ Click “Sum of Vectors” in tool bar or “Sum of Vectors” in “Solution” in menu. A resultant vector ($\overrightarrow{AB}$) that is sum of those tow vectors is plotted.

Step3: Select “Single” in “Selection”--->Click one of tow component vectors-→Select “Complex Parameters” in “Show” and a window is displayed to show the parameters of vectors”→ Click $\overrightarrow{OA}, \overrightarrow{OB}, \overrightarrow{AB}$ and parameters are displayed→ Move mouse pointer to the arrow of $O\vec{B}$ or $O\vec{A}$. Pointer changes slanting arrow. Press down left button and move to rotate the component vector to show change of the resultant vector.



2.Step1: Plot a point in “Point” or click tow points in the curve you want to plot vector (the point clicked first is origin)→ Click “New Vector” in “Plot” list in menu and A window is displayed→ move pointer to the point and click it with right button. The value of X and Y is displayed in boxes→ click “Enter” and a vector that is from origin to the point.

Step2: Plot a vector that is from point (not origin) to a point. Select “O point” in the window→click the point you want it is origin with left button→click anther point with right button. The value of X and Y is displayed in boxes→ click “Enter” and a vector that is from a point to anther point.

Step3: Make locus. Select “locus” in “Show”. Click the arrow point of the resultant vector (a small block point in the point)→ click the curve the point is in and move it in the curve. The locus of the change of component vector is showed when the component vector changes with arrow point moving in the curve. Or click the point that is made with “Point” in “List Box” and pointer change to cross arrow when selected. Press left button and drag it to anywhere in coordinate.

Example 10: Circle C pass through point A (0,p), p>0. The center of the circle is C. C moves in curve x^2=2py. MN is the chord of C which is cut by X axis. Dynamically show the length of MN.

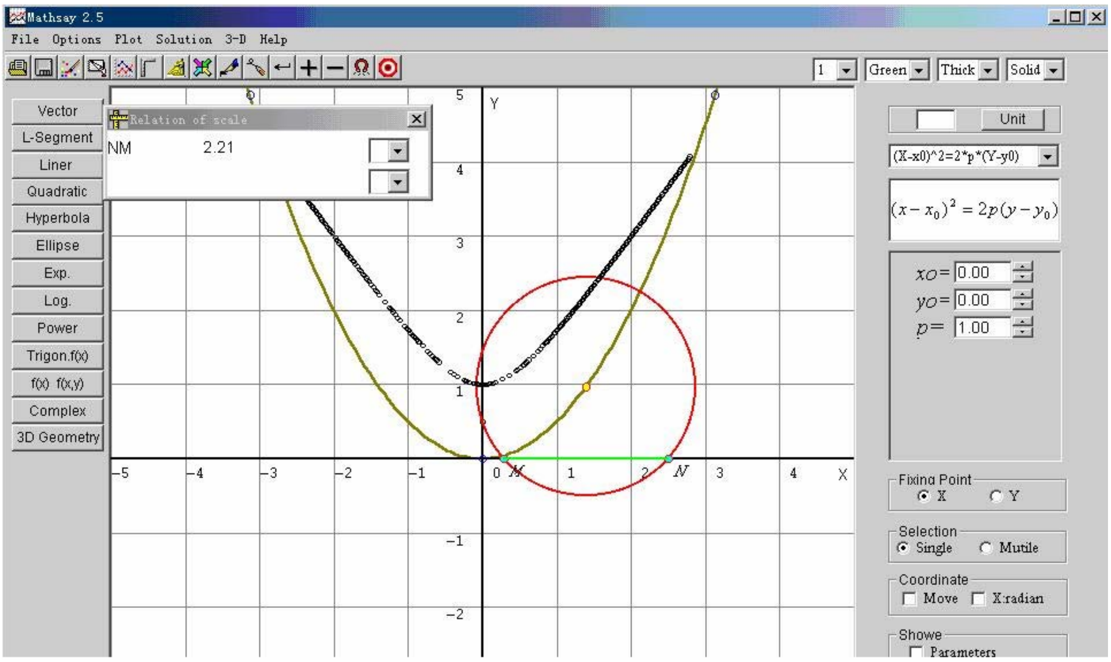
Step1: Plot quadratic x^2=2py. Set a point on it and Mark it C.

Step2: Plot the circle C. Select “Mutile”→click “Ellipse” button→select “3 points” in “List Box”. Click the point C (that is the centre of circle)→click A (0,p)→click "Circle" in "Plot" in Manu to plot circle.

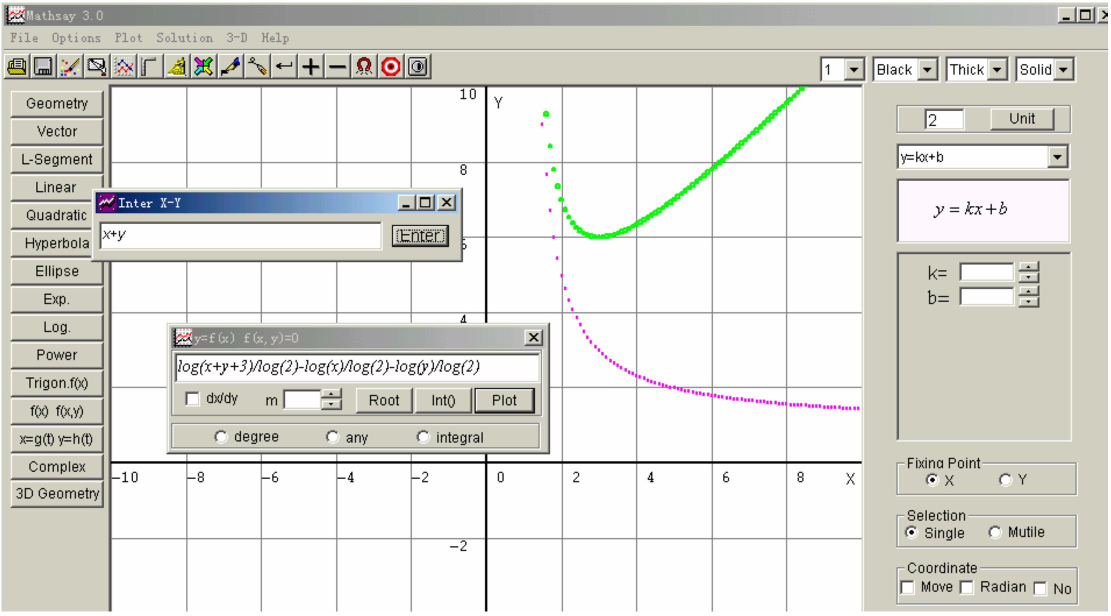
Step3: Plot a line that coincides X axis (k=0). Get points M and N.

Step4: Link M and N. Click "Relation" in "Solution". A window is displayed. Inter MN={d1→ Click line segment MN (variable d1 is the length of MN)→ Inter }=v1 (variable v1 is the value in evaluating {…})→ Select “Show” to form expression→ Select "Trace".

Step5: Click quadratic (selected)→move mouse to point A (on quadratic) put down left button and drag it to show the trace of length of MN.



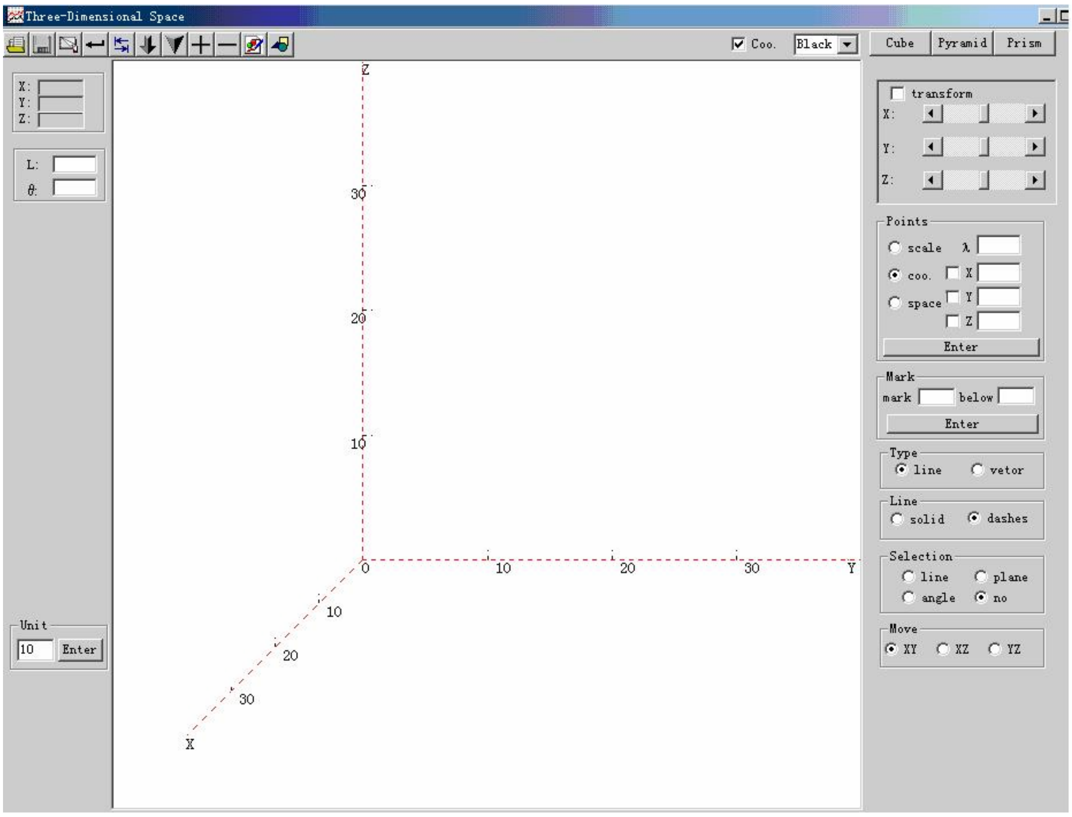
Examplex11: Equation $\log_2(x+y+3)-\log_2(x)-\log_2(y)=0$. Show the minimal value of x+y

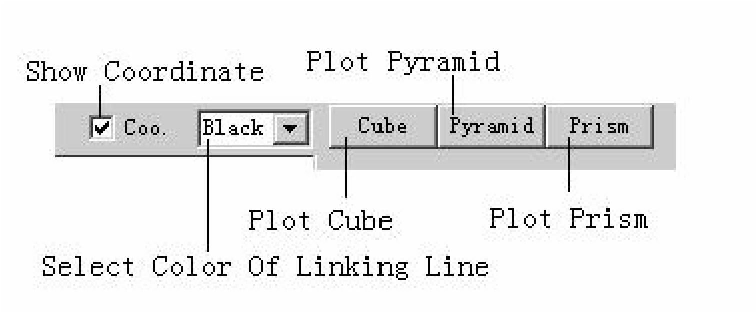


Step1: Plot $\log_2(x+y+3)-\log_2(x)-\log_2(y)=0$ → Click it to select it→ Click "Value of X+Y" in menu "Solution". A box is displayed→ Inter expression “x+y” (you can inter formula you want)→ Click "Inter" button

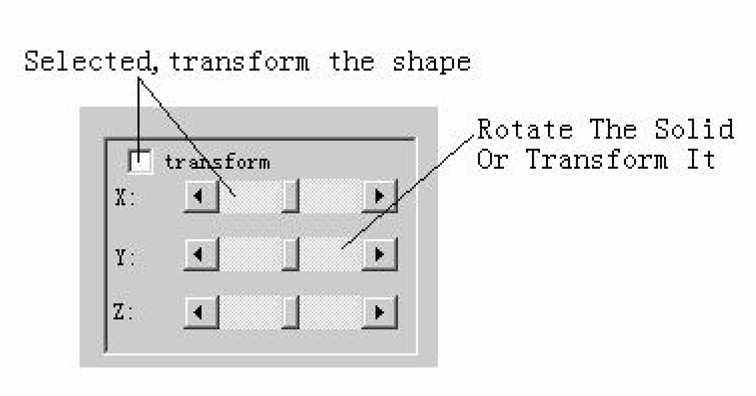
Step2: Click the equation (the curve). Green curve is the trace of the value of x+y.

5.13 3D-Geometry

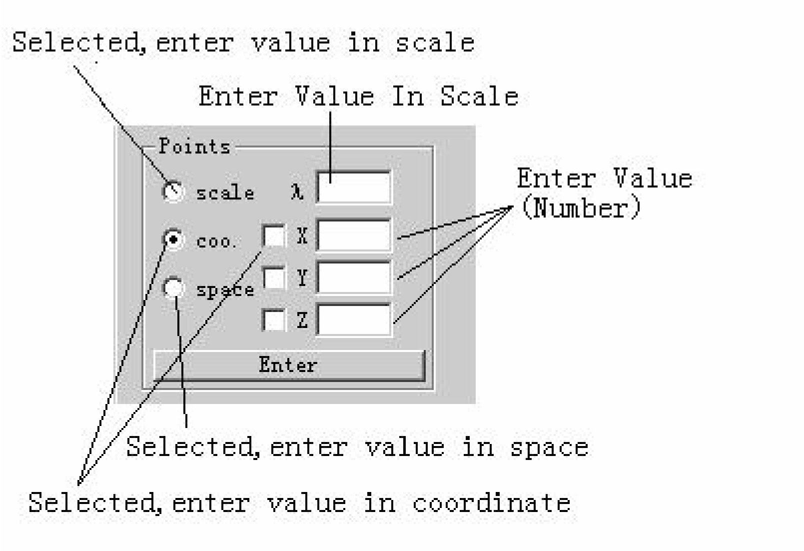




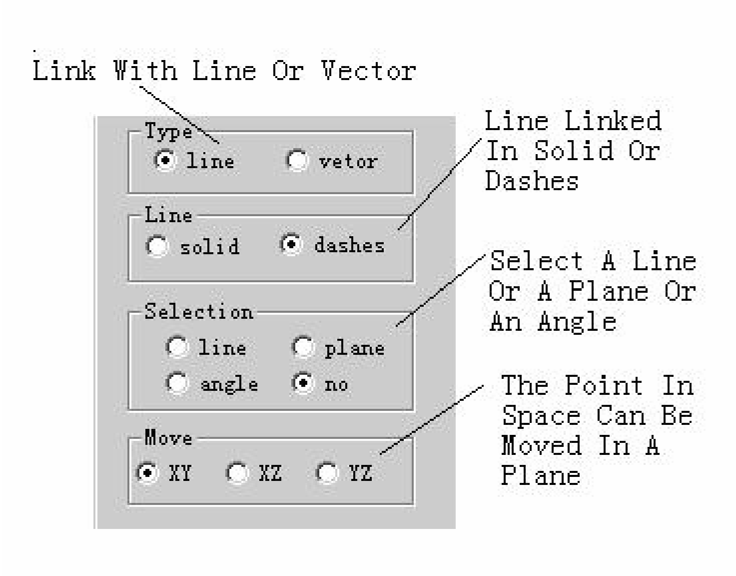
Show Coordinate
Plot Pyramid
Coo.
Black
Cube
Pyramid
Prism
Plot Cube
Plot Prism
Select Color Of Linking Line

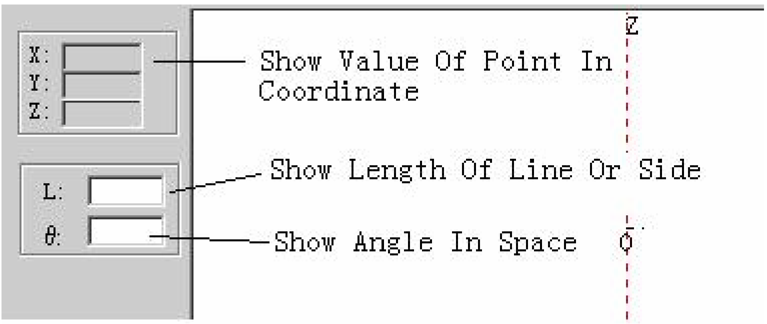


Selected, transform the shape
transform
Rotate The Solid
Or Transform It
X:
Y:
Z:

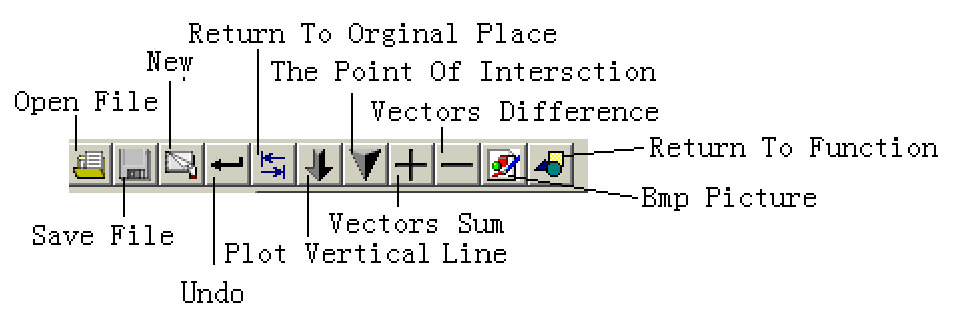


Selected, enter value in scale
Enter Value In Scale
Points
scale
λ
coo.
space
X
Y
Z
Enter Value
(Number)
Enter
Selected, enter value in space
Selected, enter value in coordinate





5.1.6 Tool Bar



Open: Open a new file;

Save: Save the file;

New: Clean the screen;

Undo: Cancel previous option. All operations can be canceled in sequence.

Return: Return to original place after rotating the solid;

Plot Vector Line: Plot vector line that is point to plane and point to line (side);

Point Of Intersection: Determine the point where line intersects a plane at;

Sum Of Vectors: Plot the resultant vector that is sum of tow vectors;

Deference Of Vectors: Plot the resultant vector that is deference of tow vectors;

Bmp Picture: Save graph to bmp picture so as it can be inserted in word file or other files;

Exit: Exit solid geometry.

5.1.7 Selection

Line: Selected. Select the line or side by clicking tow ends of side. Used in plotting vertical line linking a point to the side selected and measuring the length of side.

Plane: Selected. Plotting vertical line linking a point to the plane. Select the plane by clicking three points on it or three vertexes in plane.

Angle selected: Measure angle in space. Click three points (middle point is apex).

5.1.8 Example

<u>Example1</u>: Plot cube.

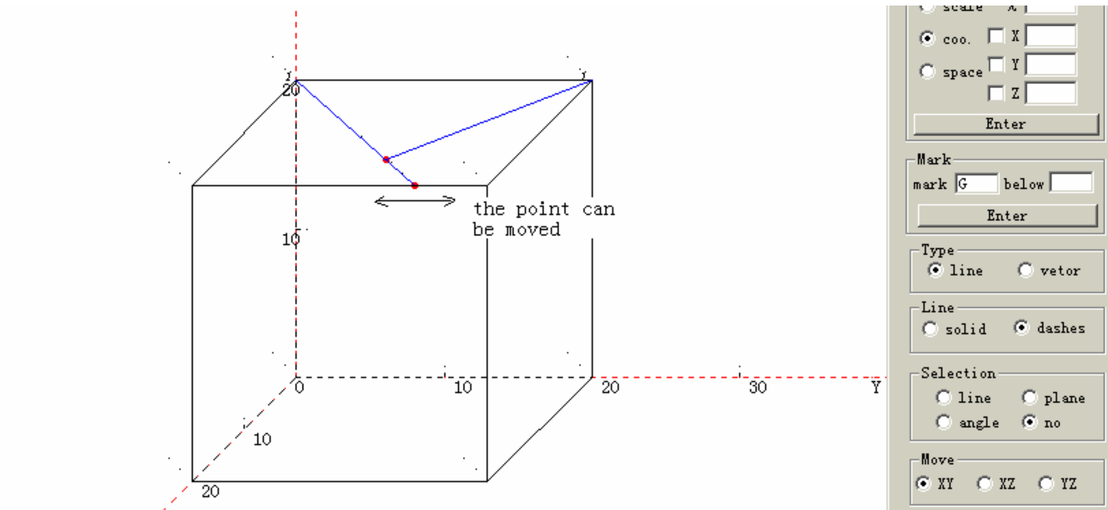
Step1: Click “Cube” button.

Step2: Transform it. Select “Transform” in “Slider box”→ you can move sliders to transform it in x, in y and in z.

Step2: Link point and side. Move mouse pointer to one of apex and press down left button--->press down “Shift” button and move mouse (a line is displayed) to a point or a side--->loosen button, then loosen “Shift” button (if new line is linked).

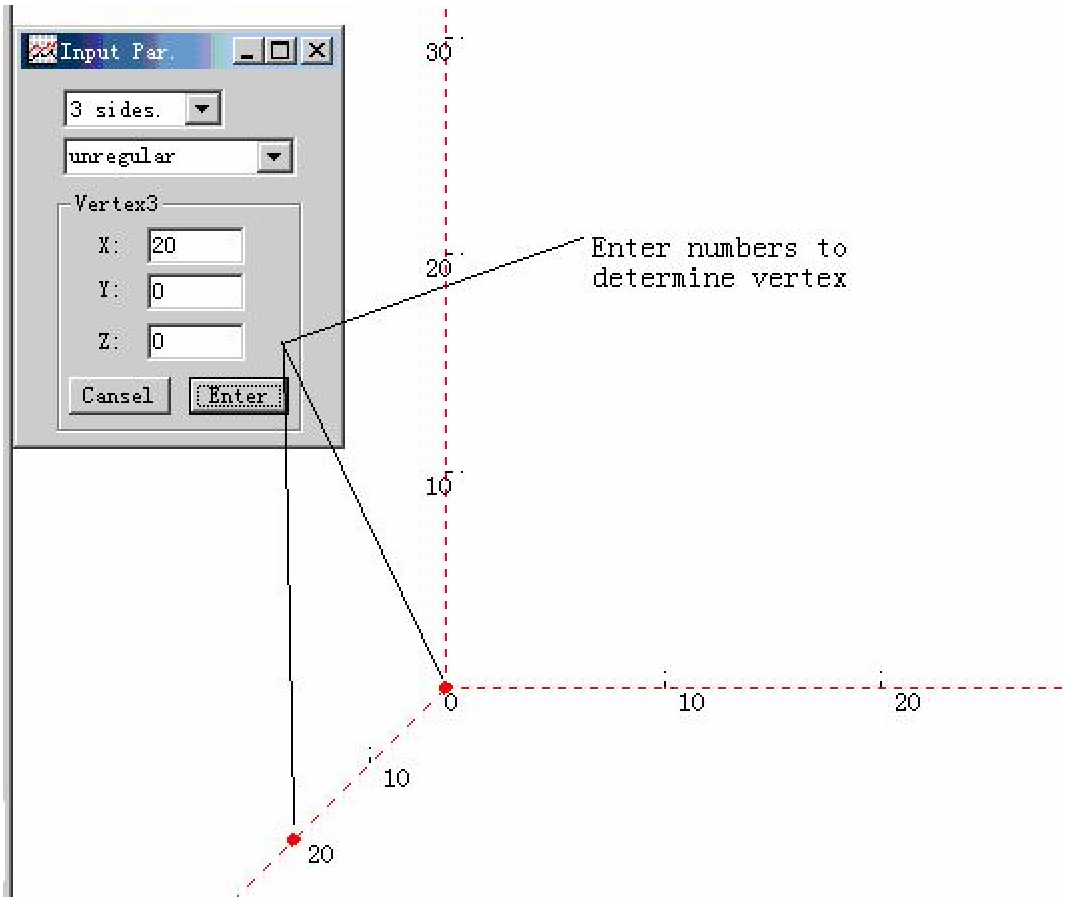
Step3: Move point. Click the point (intersection) with left button (a red circle around the point, if selected)→ press down right button and move mouse in side;

Step4: You can repeat “step2” to link a point or apex to the new line.



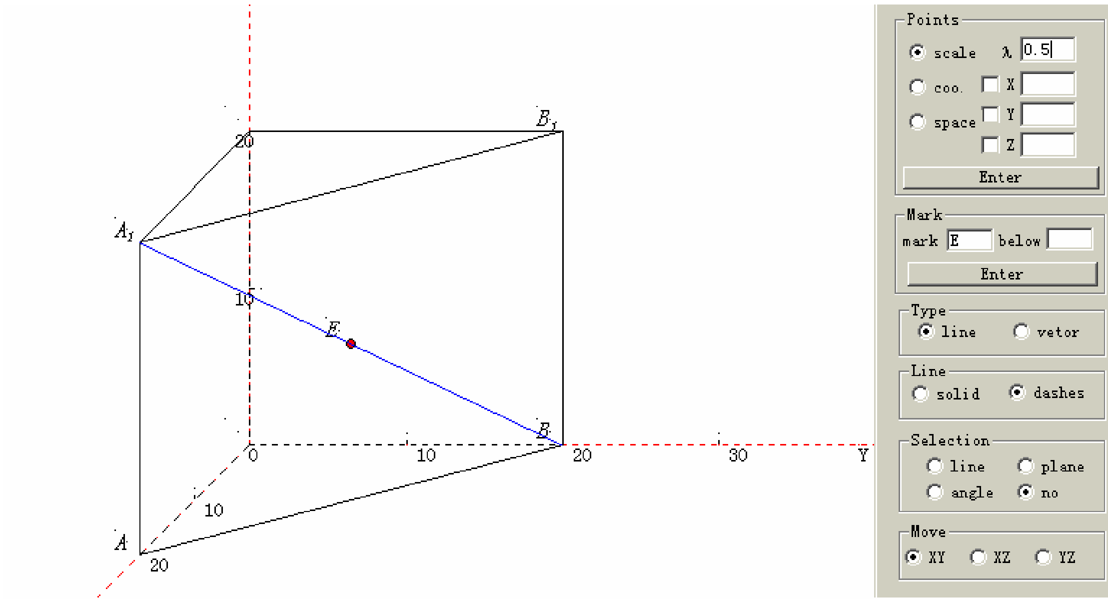
<u>Example2</u>: Plot Prism.

Step1: Click “Prism” button. A list box is displayed. Click “Unregular”→ a dialog box is displayed. See illustration→ Enter points in three-dimensional space coordinate system (vertexes, high and gradient) and click “Enter” button separately. See illustration.



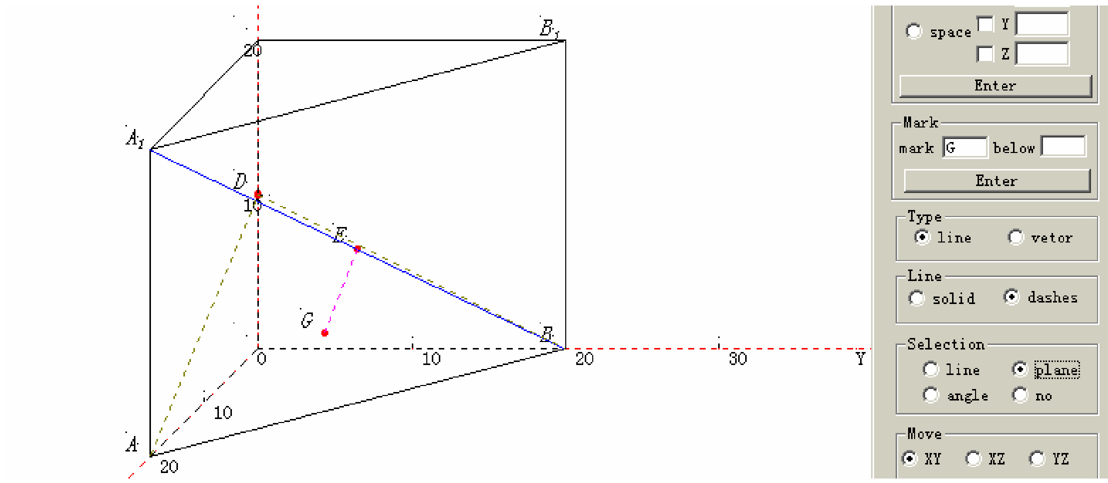
Step2: Link points with line and make some planes in three-dimensional space. Select color→ Click A1 (a small circle is displayed). Press down left button and press down "Shift" button at same time→ Drag mouse to B (a line is displayed). Loosen left button, then loosen "Shift" button (if line A_1B is formed).

Step3: Determine middle point E of A_1B. Select "Line" in "selection"→ Click A_1 and B (a small circle is displayed. If not, Please click them again.)→ Select "Scale" in "Points". Enter 0.5 in "λ box" (middle point). Click "Enter". The point is displayed. Mark the point to E.



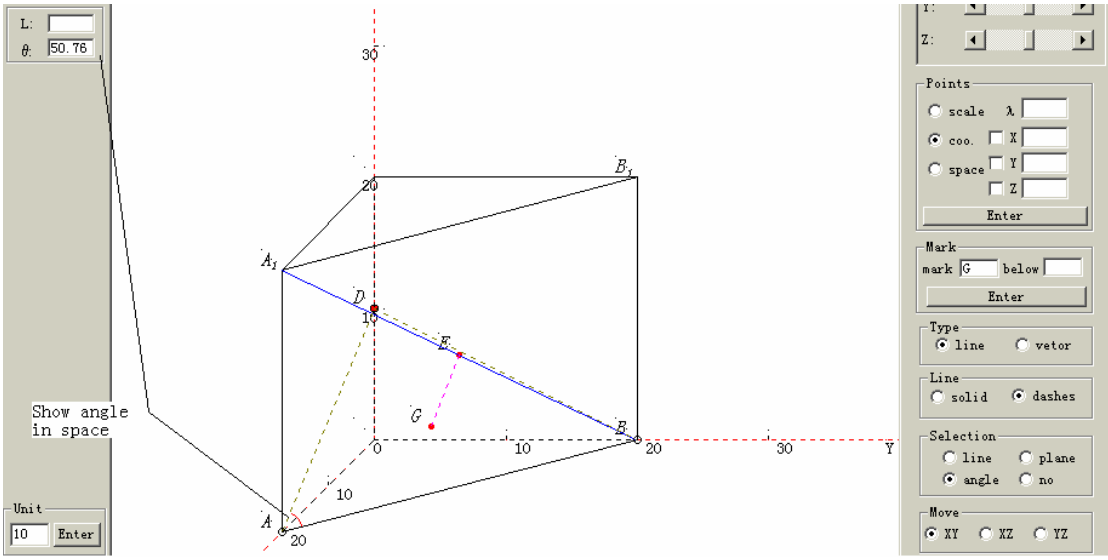
Step4: Make a plane. Determine the middle point D of side. Repeat step4→ Repeat step3. Link A to D and B to D. The plane ABD is formed--->Select "Plane" in "Selection". Click A, B and D (no sequence)--->Click "Plot Vertical Line" button in tool bar→ Click point E. The vertical line of plane ABD is plotted automatically;

Step5: You can plot vertical line that is from a point to a line (side). Select "Line" in "Selection"→ Click the ends of side AB (selected)→ Click "Point of Intersection" in tool bar→ Click point G. The vertical line that is point G to side AB is plotted automatically.



Step6: You can move sliders in "Slider box" to rotate the solid so that to observe them.

Step6: measure the angle (∠DAB). Select "angle" in "Selection"→ Click point B, A and D or point D, A and B. The degree of the angle is displayed. See illustration

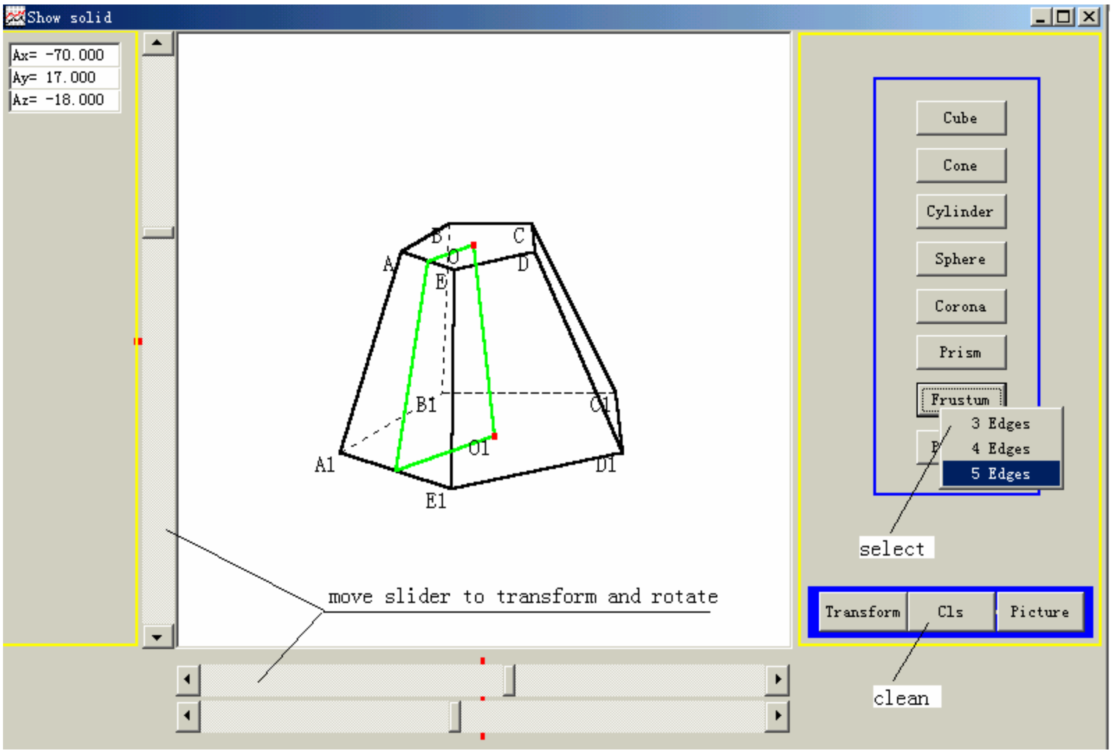


Example3: Plot vectors in three-dimensional space.

You can link points with vector instead of line. See illustration. Select "Vector" in "Line"→ Link GE→ Measure vector GE. Select "Line" in "Selection"→ Click G and then click E. The value of coordinate is showed in three-dimensional space.

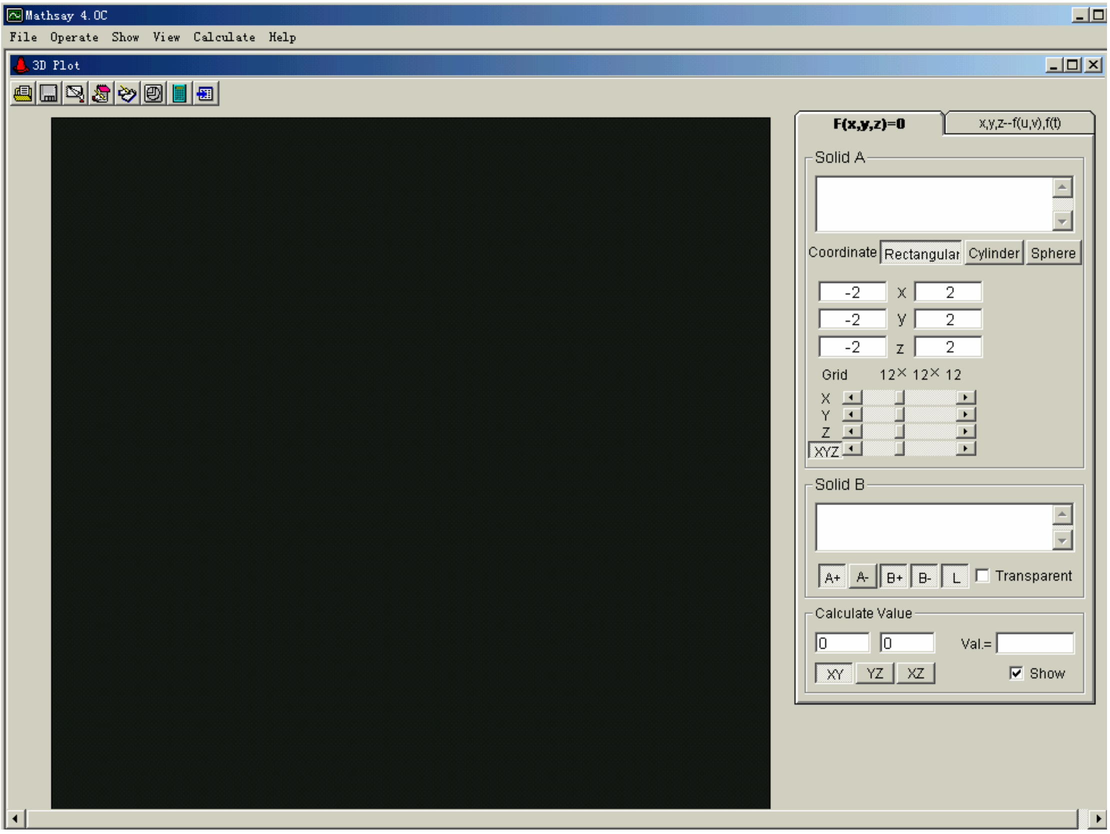
5.14 Show Solid (4.0H)

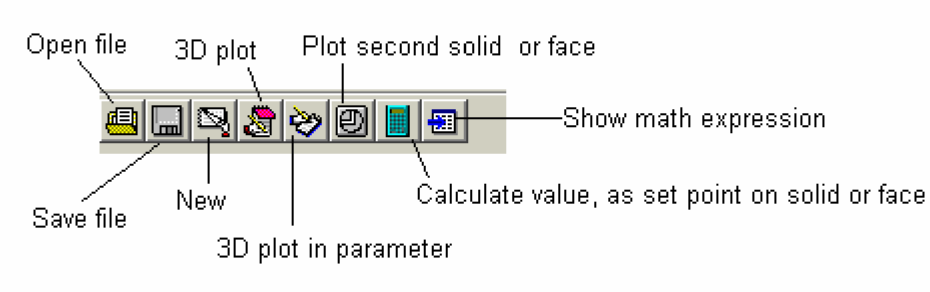
Dynamically demonstrate cylinder, cone, sphere, corona, prism (3 edges, 4 edges and 5 edges), pyramid (3 edges, 4 edges and 5 edges) and frustum (3 edges, 4 edges and 5 edges). They can be transformed and rotated by moving slider in x axis, y axis and z axis. See illustration.



Click one of solids button. List menu is displayed--->Click one of them. The solid you select is displayed--->Transformation. Click “Transformed” button--->Move sliders to transform the solid in three-dimensional space--->Rotation. Click “Rotate” button--->Move sliders to rotate the solid in three-dimensional space. Pay attention: After rotation, transformation can’t be operated.

6. 3D Plot





Before operation, see help.

Pay attention:

1. Please move “xyz” slider to left to make the number of Grid smaller if precision ploted can meet you, because it will take longer to plot making slider to right.
2. Plot in parameter, variable is u and v, or x and y, or t.