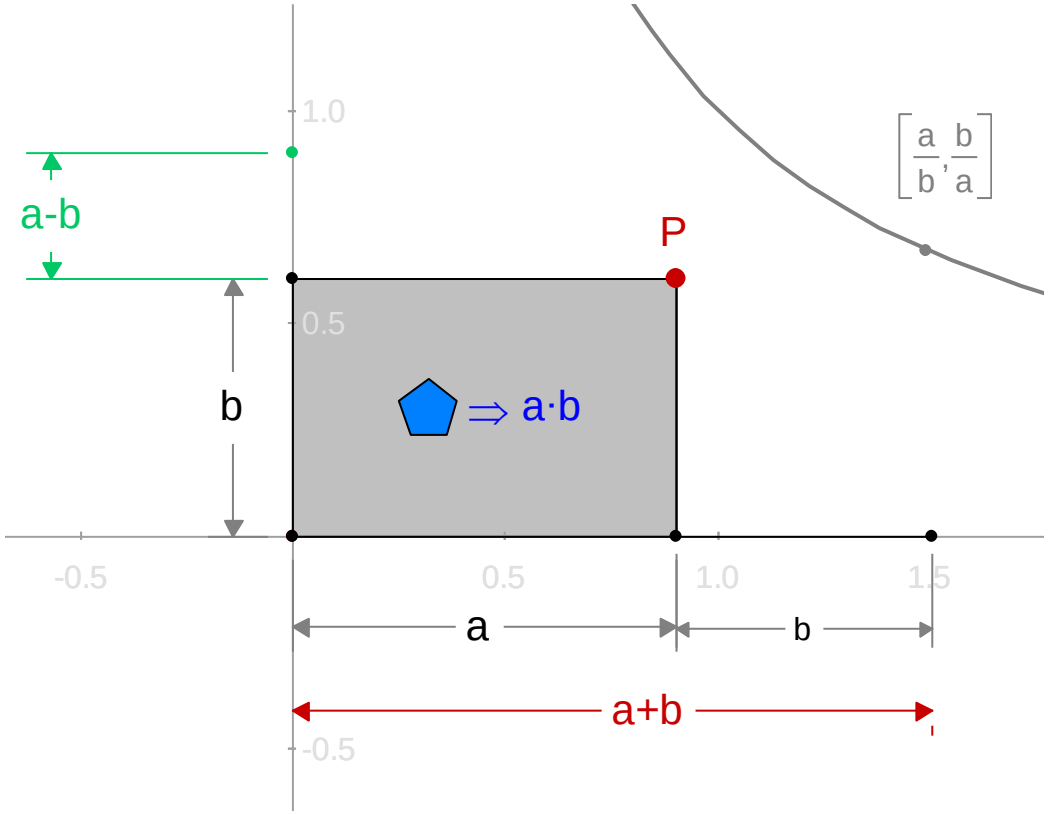
Learning Calculus With Geometry Expressions™

by L. Van Warren



Lecture 0: Warm-Up

Learning Calculus with Geometry Expressions™

Written by L. Van Warren

Edited by Hannah Todd and Heather Duggan

How To Use This Book

"Line upon line, precept upon precept."

This is a fun book.
When you tire, take a break and return.
Work the examples, one at a time,
checking them off when you're done.

Early examples feature "Gray Box Help".
Follow the numbered steps, one at a time until you understand.

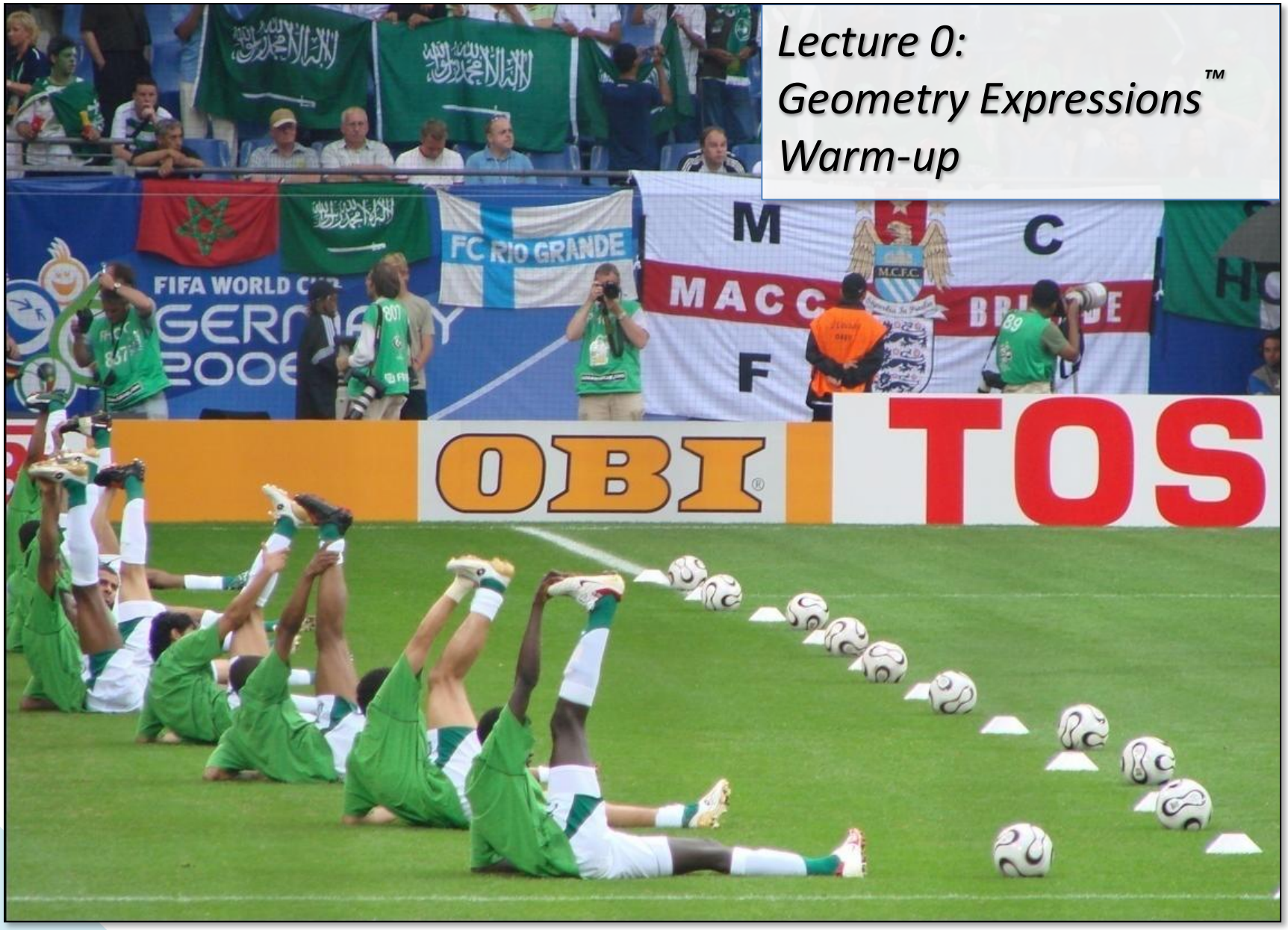
Gray Box Help
1) Continue reading.
2) When finished, turn page.

At first, we will construct the examples for you.
Later, you will construct them for yourself.

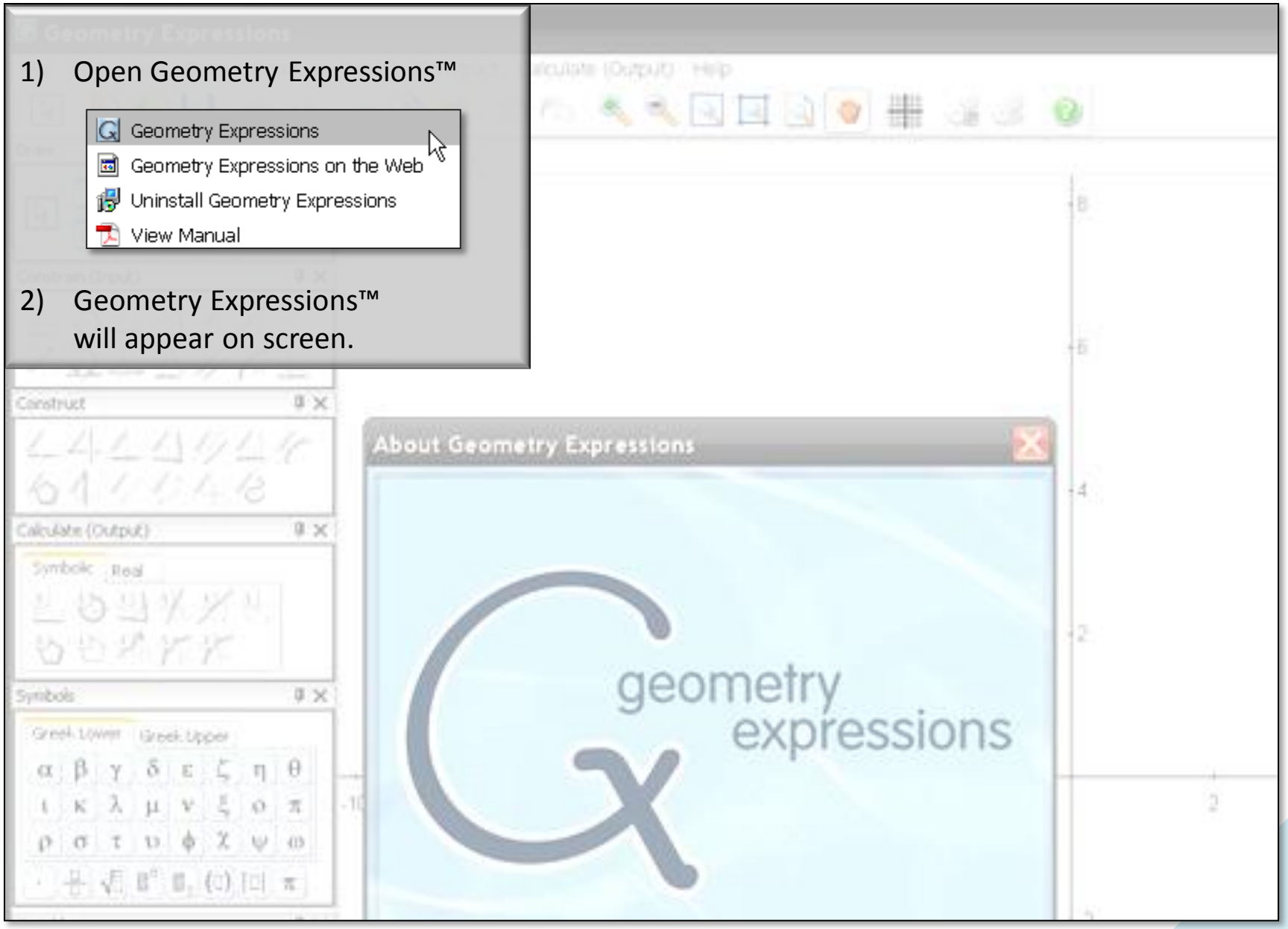
Bit by bit, line by line…

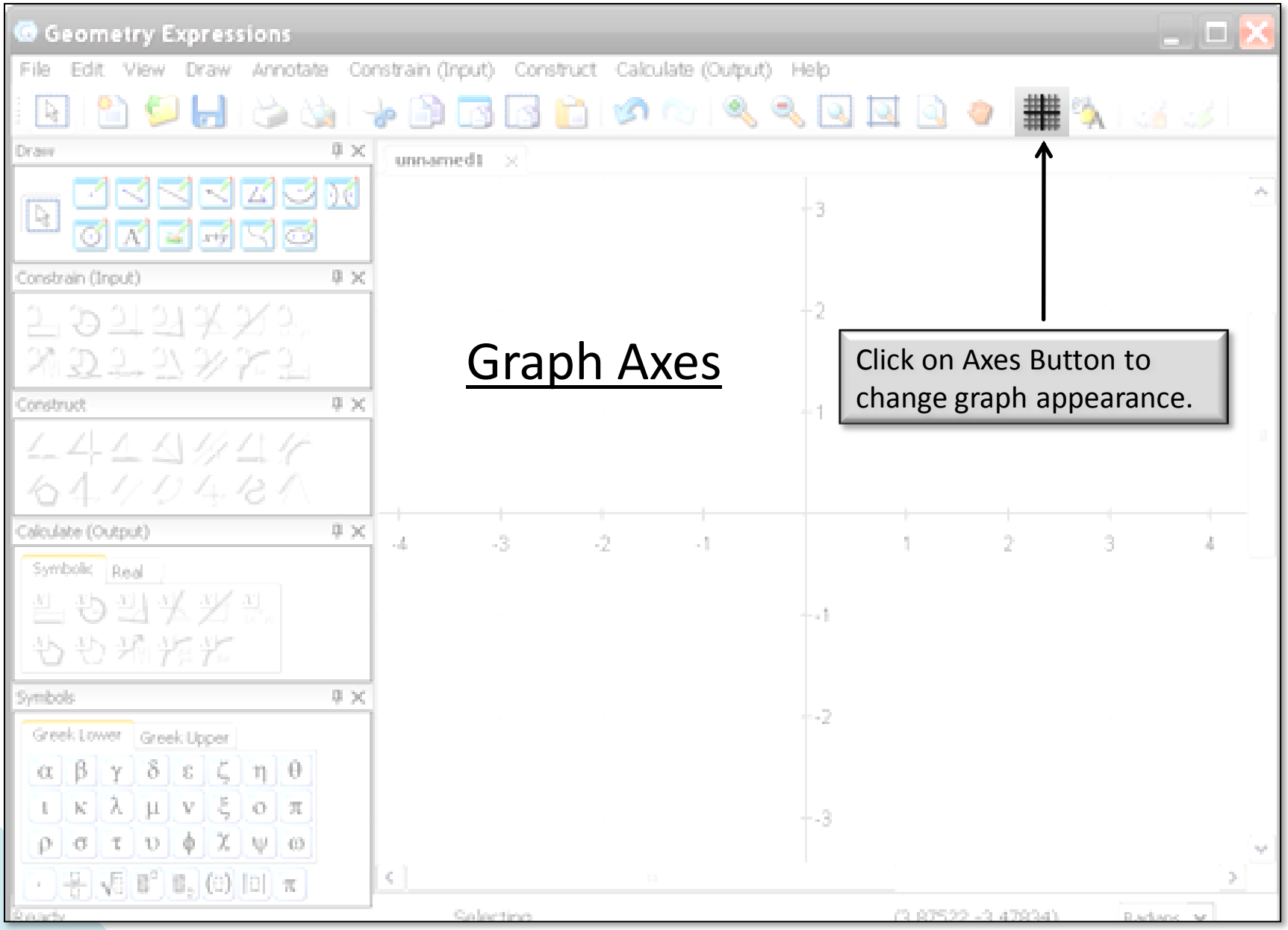
Chapter 1: Functions and Equations

Lecture	Topic
0	**Geometry Expressions™ Warm-up**
1	Explicit, Implicit and Parametric Equations
2	A Short Atlas of Curves
3	Systems of Equations
4	Invertibility, Uniqueness and Closure

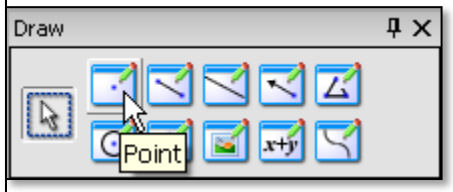


Lecture 0: Geometry Expressions™ Warm-up


1) Open Geometry Expressions™
Geometry Expressions
Geometry Expressions on the Web
Uninstall Geometry Expressions
View Manual
2) Geometry Expressions™ will appear on screen.
About Geometry Expressions
geometry expressions

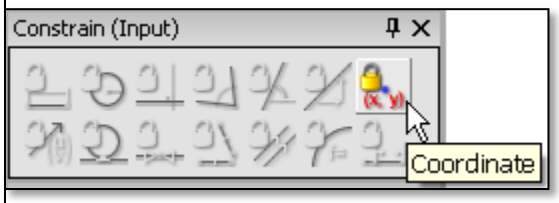

Geometry Expressions
File Edit View Draw Annotate Constrain (Input) Construct Calculate (Output) Help
Draw
Constrain (Input)
Construct
Calculate (Output)
Symbolic Real
Symbols
Greek Lower Greek Upper
unnamed1
Graph Axes
Click on Axes Button to change graph appearance.

Making Points



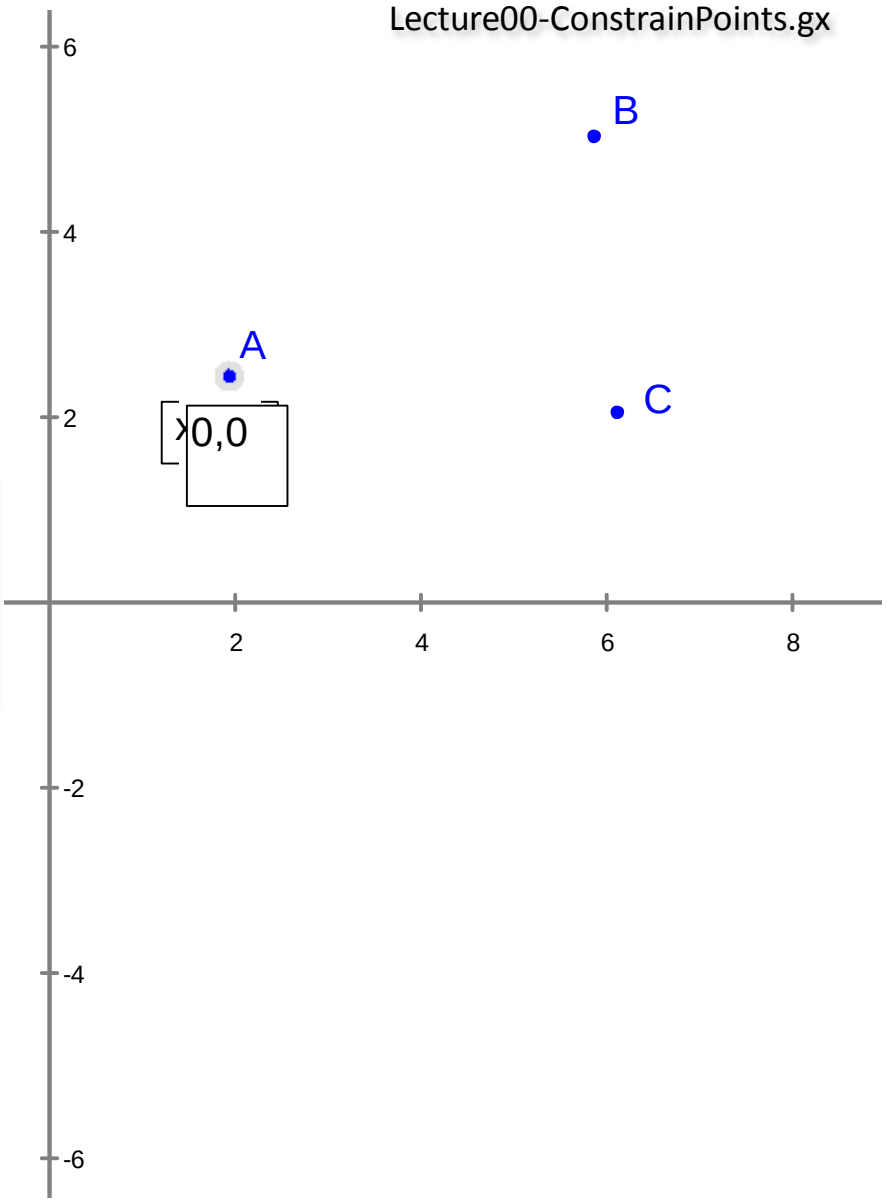
Steps to Draw Points
1) Click File→New Menu
2) Click Draw→Point Button
3) Click Mouse to Create Points
4) Press ESC to escape from drawing points mode.

Constraining Points



Steps to Constrain Point Coordinates

i. Click on Point A, it will highlight.
ii. Click Constrain→Coordinate.
iii. Type 0,0 and Press ENTER key.



Constraining Points

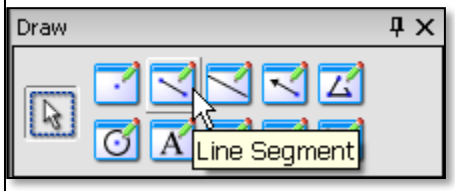
Constraining Points Cont'd

iv. Point **A** will jump to (0,0)
Repeat the process for Points B and C

v. Constrain B to (4,2)

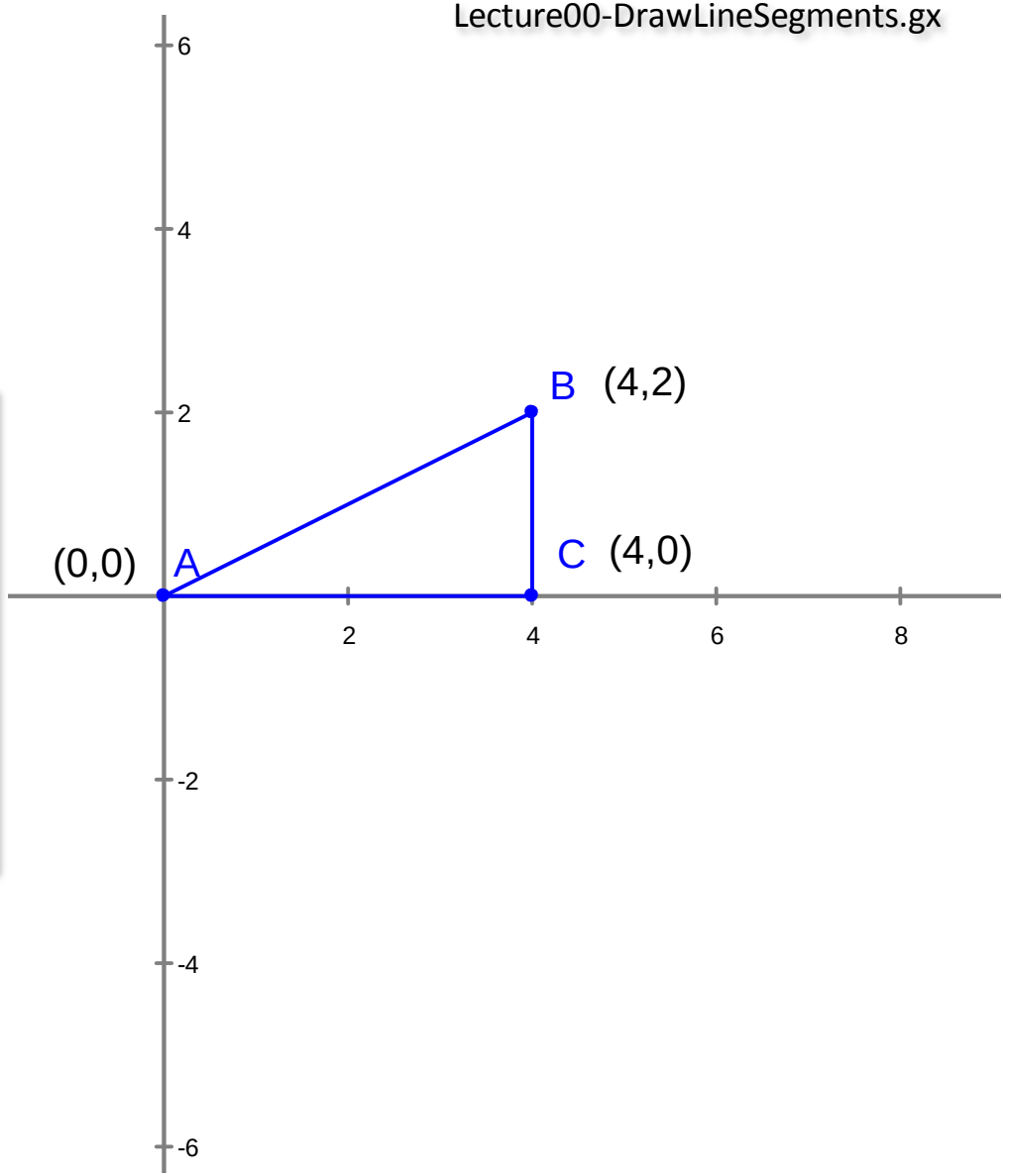
vi. Constrain C to (4,0)

Drawing the Line



Drawing Line Segments

1) Click Draw→Line Segment
2) Click Point A then B.
   Segment appears.
3) Repeat for Points B and C.
4) Repeat for Points C and A.
5) Press ESC to escape from line drawing mode.

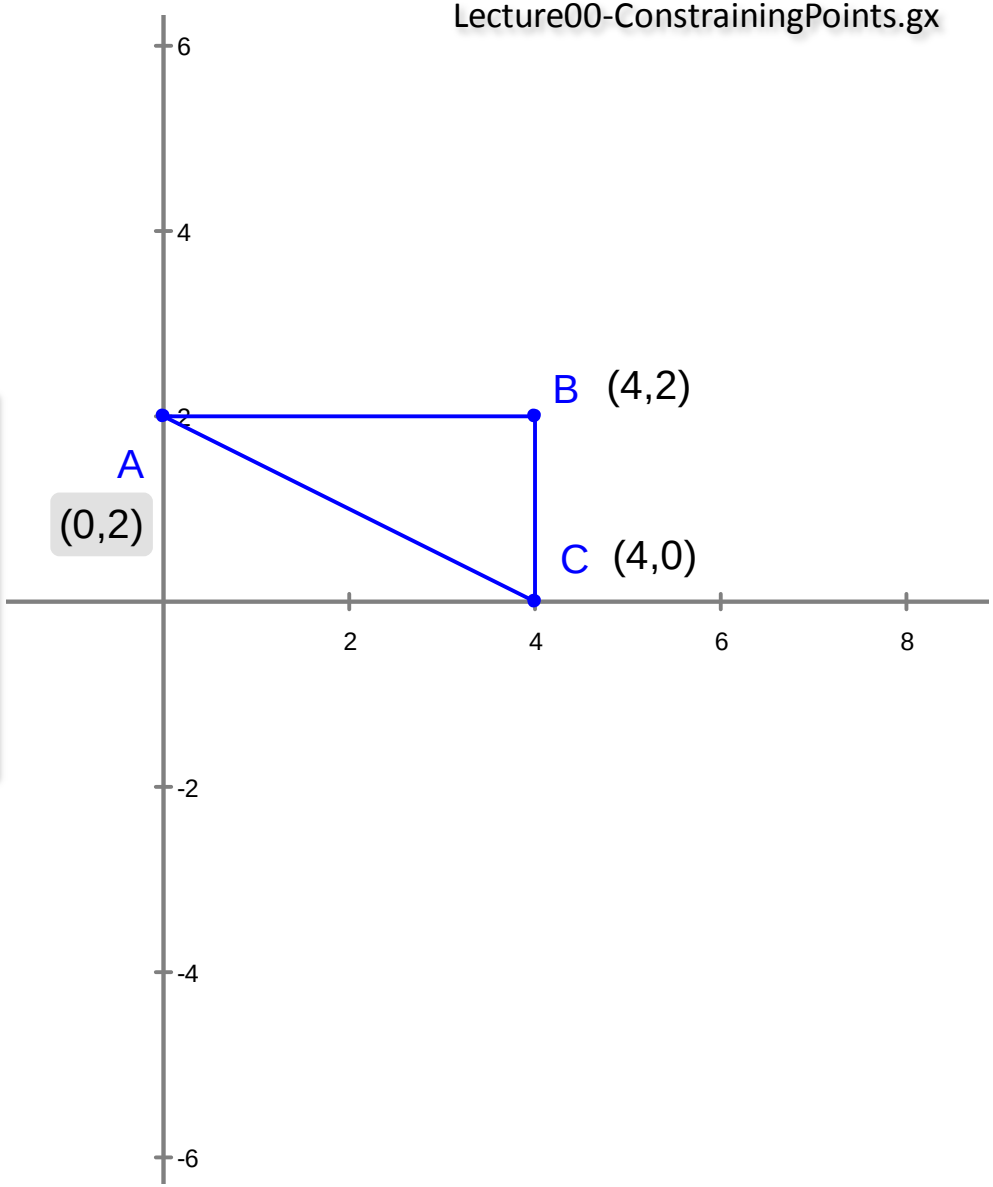


Changing Coordinates

Lecture00-ConstrainingPoints.gx

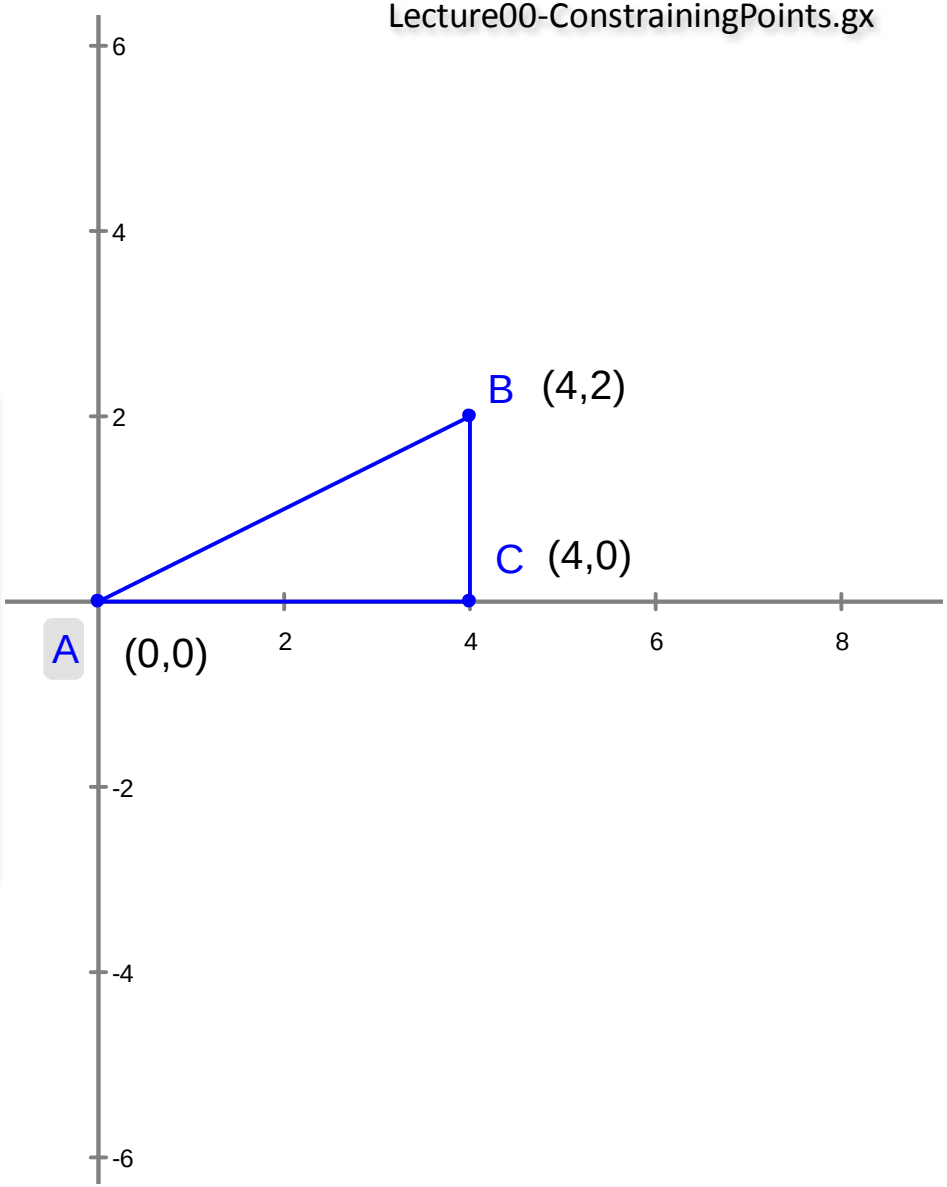
Changing Coordinates

1) Double-Click the (0,2) coordinate pair.
   It will highlight.
2) Enter some new values.
3) Press Enter Key.



Adjusting Labels

Lecture00-ConstrainingPoints.gx



Moving and Renaming Labels

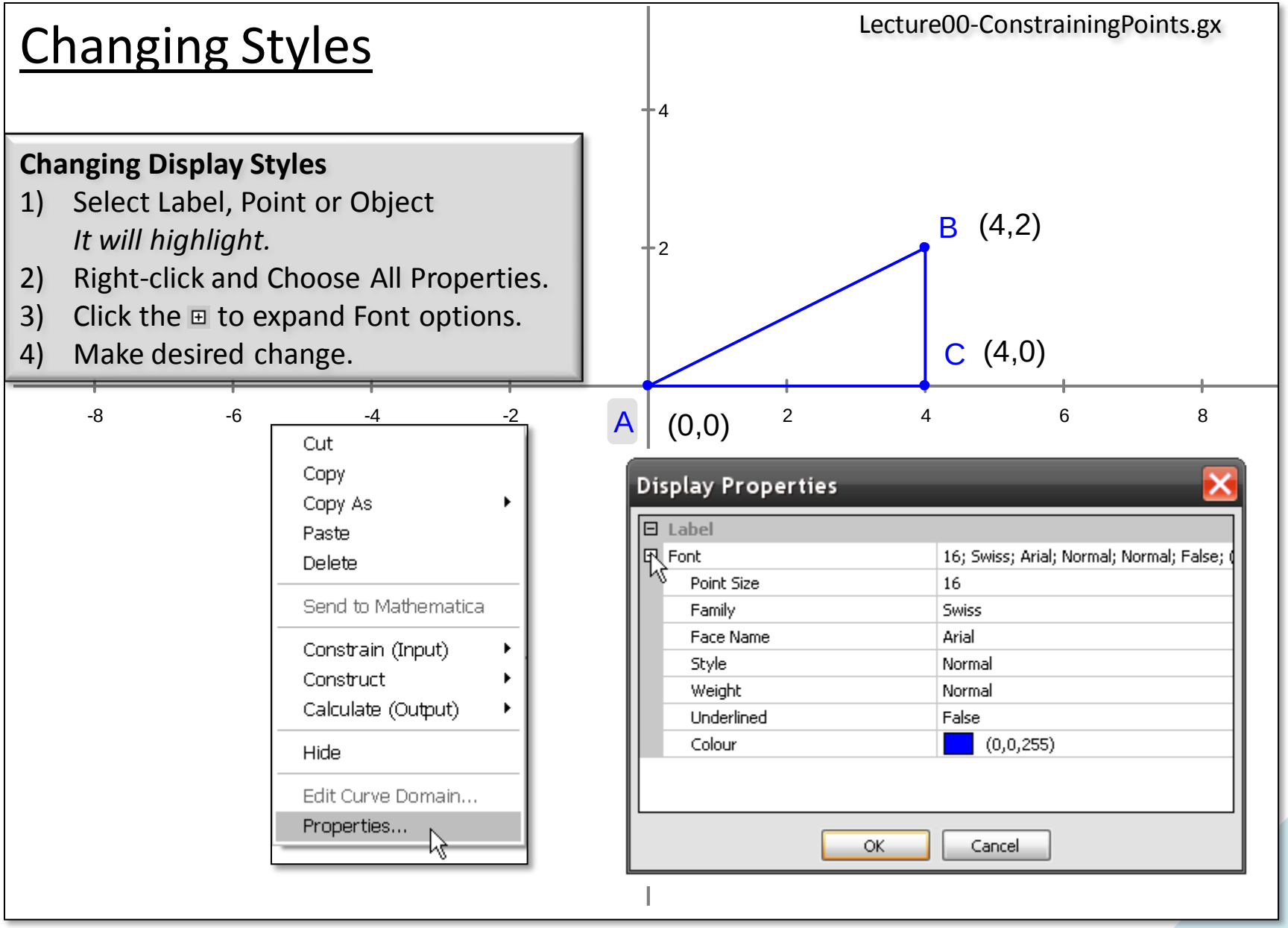
1) Select label for Point A
   It will highlight.
2) Drag it to a new location
3) Press ESC.
   This works for coordinate pairs also.
4) Double-click label A to change name.

Changing Styles

Lecture00-ConstrainingPoints.gx

Changing Display Styles

1) Select Label, Point or Object
   It will highlight.
2) Right-click and Choose All Properties.
3) Click the ⊞ to expand Font options.
4) Make desired change.

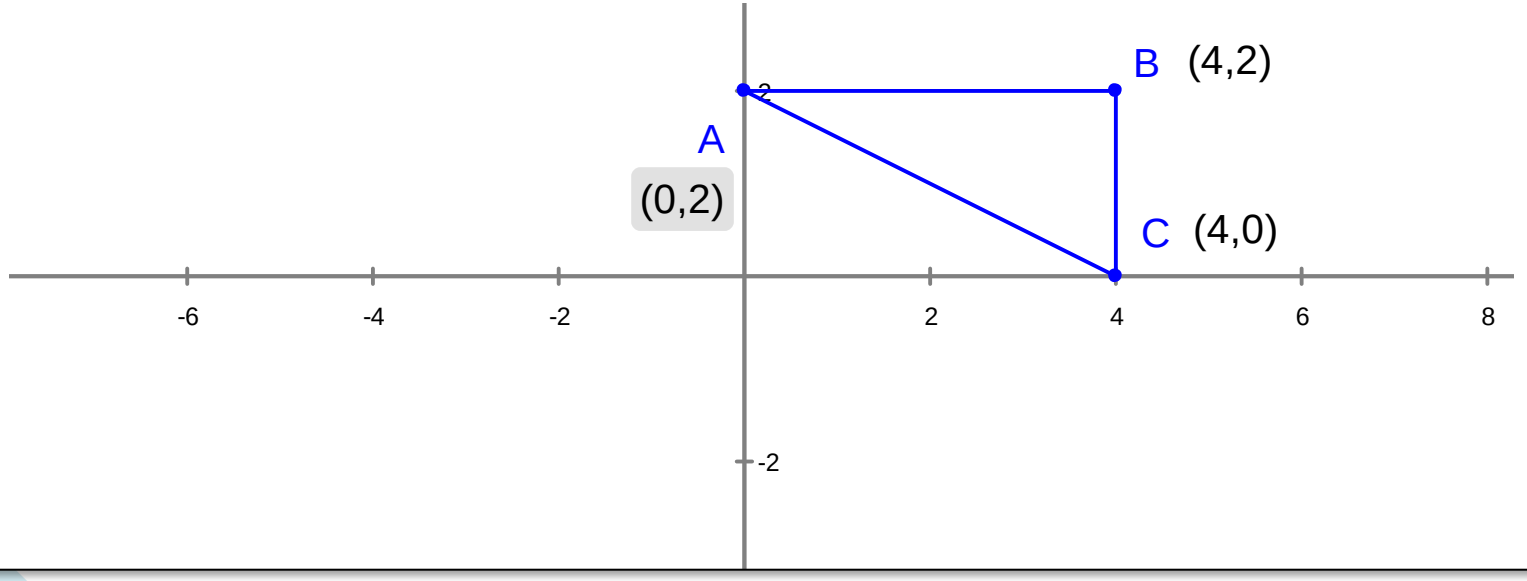


Viewing

Lecture00-ConstrainingPoints.gx

Zooming and Panning

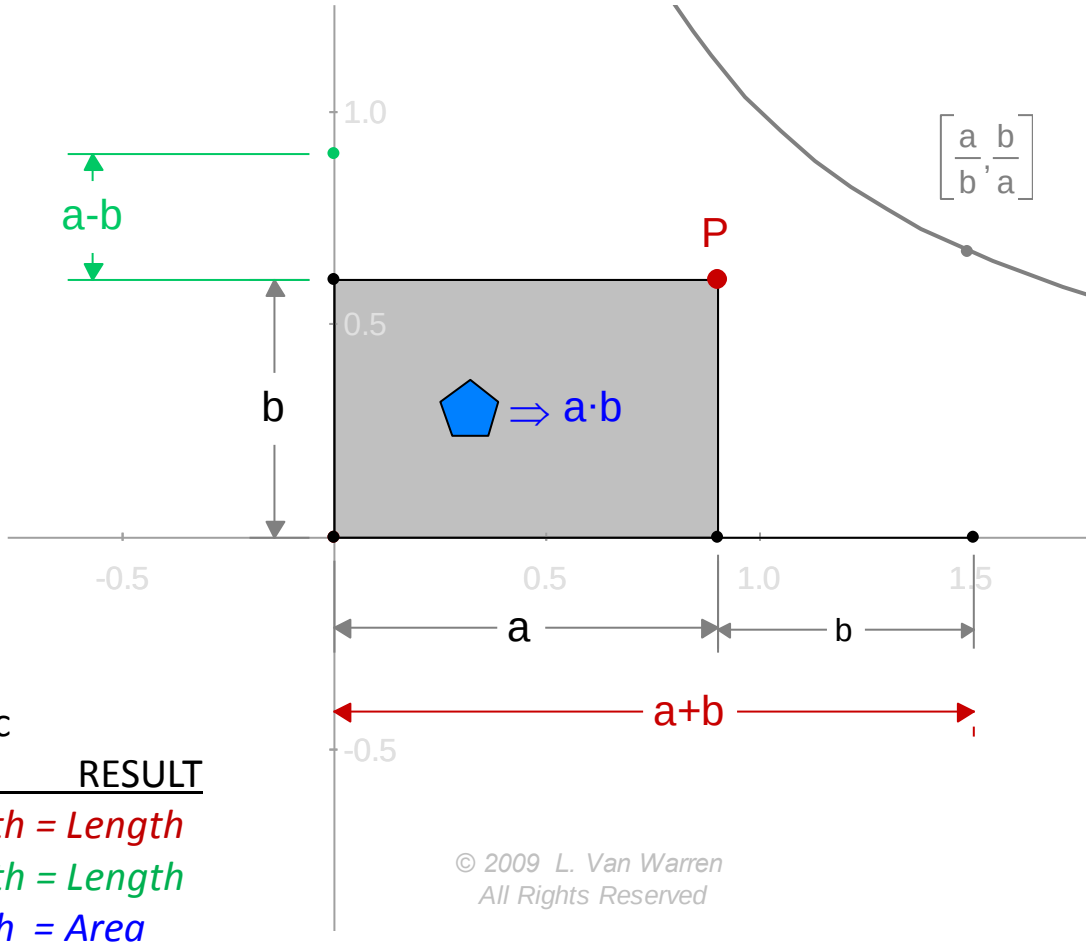
1) Locate the zoom and pan buttons at screen top.
2) The + magnifier zooms in once per click.
3) The – magnifier zooms out once per click.
4) The dashed magnifier zooms to selection.
5) The boxed magnifier zooms scales page to fit geometry.
6) The page magnifier zooms to page.
7) The hand moves (pans) the whole drawing.
8) Press ESC when finished panning.



Arithmetic

File→Open→Lecture00-Arithmetic.gx

Exercises:
1) Open the example file.
2) Drag the dot for Point P.
3) Write the coordinates of P.



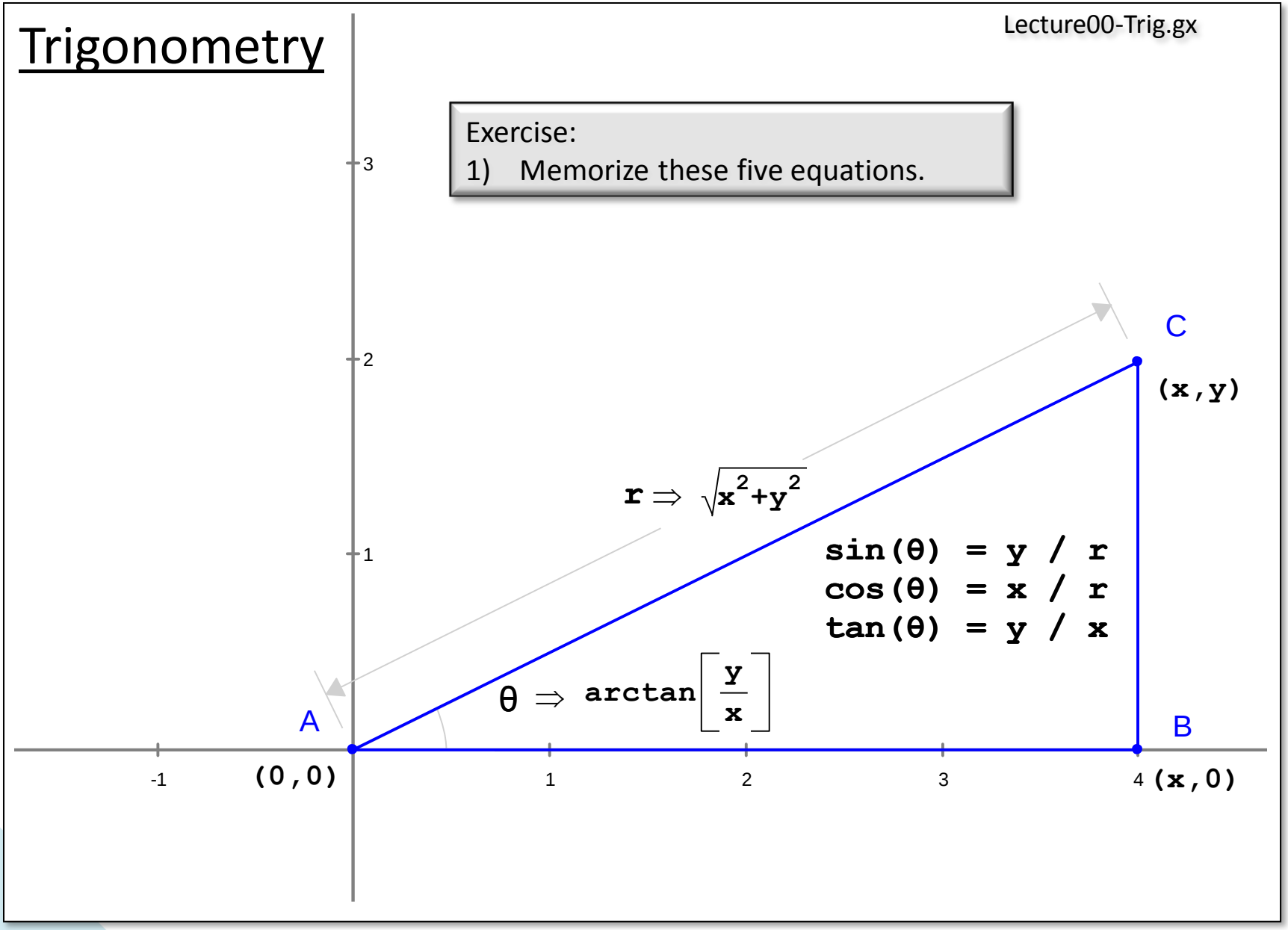
Dimensional Analysis of Arithmetic

	OPERATOR	DIMENSIONS	RESULT
1)	*Add*	*Length + Length*	*= Length*
2)	*Subtract*	*Length – Length*	*= Length*
3)	*Multiply*	*Length · Length*	*= Area*
4)	*Divide*	*Length ÷ Length*	*= Dimensionless*

Trigonometry

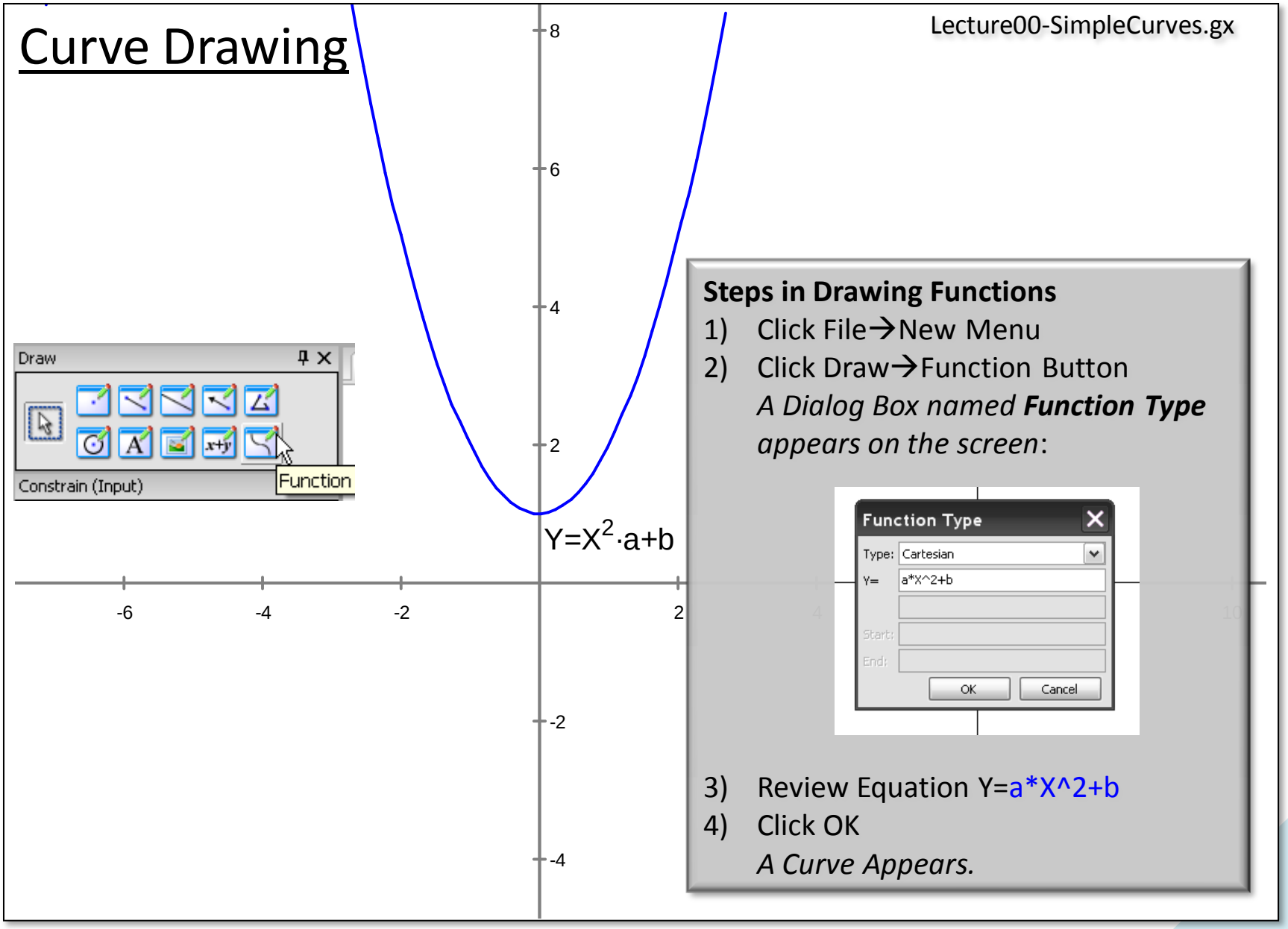
Lecture00-Trig.gx

Exercise:
1) Memorize these five equations.



Curve Drawing

Lecture00-SimpleCurves.gx



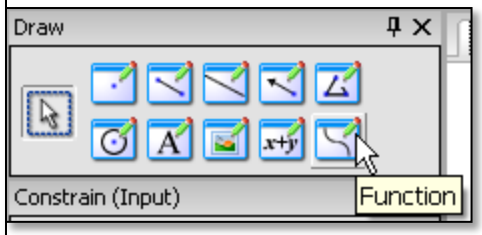
Steps in Drawing Functions

1) Click File→New Menu
2) Click Draw→Function Button
   A Dialog Box named ***Function Type*** *appears on the screen*:

3) Review Equation Y=a*X^2+b
4) Click OK
   A Curve Appears.

Line Drawing

Lecture00-Lines.gx



1) File→New
2) Draw→Function
3) Enter Y=a*X:

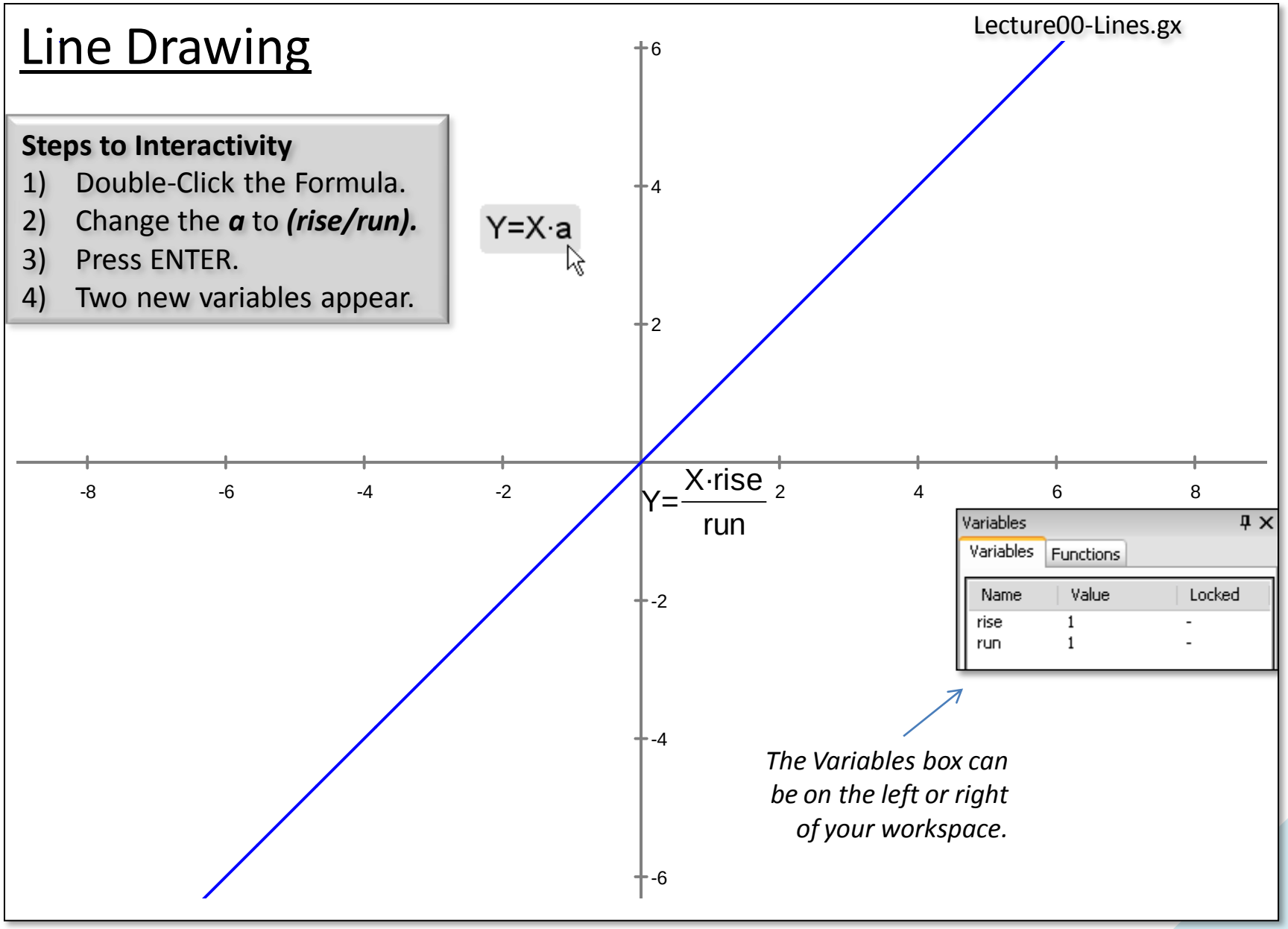
4) Click **OK**.
A Line and Formula appears.

Line Drawing

Lecture00-Lines.gx

Steps to Interactivity

1) Double-Click the Formula.
2) Change the ***a*** to ***(rise/run).***
3) Press ENTER.
4) Two new variables appear.



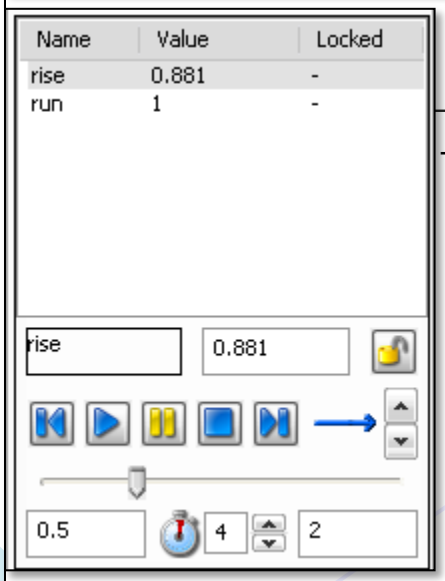
The Variables box can be on the left or right of your workspace.

Line Drawing

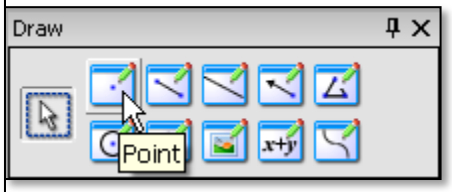
Lecture00-Lines.gx

Changing Parameters

1) Select the variable named ***rise***.
2) Adjust rise by moving slider left and right.
   The line will move. You should too!
   Great advances are being made…



Controls



Creating a Control

1) Click Draw→Point Button
2) Click to Create Point. ESC.
3) Click on Point. It will highlight.
4) Click Constrain→Coordinate. *Coordinates will appear.*
5) Change them to (rise, run). Press ENTER.
6) Click Point and move it in a circle. Rise and Run Change!

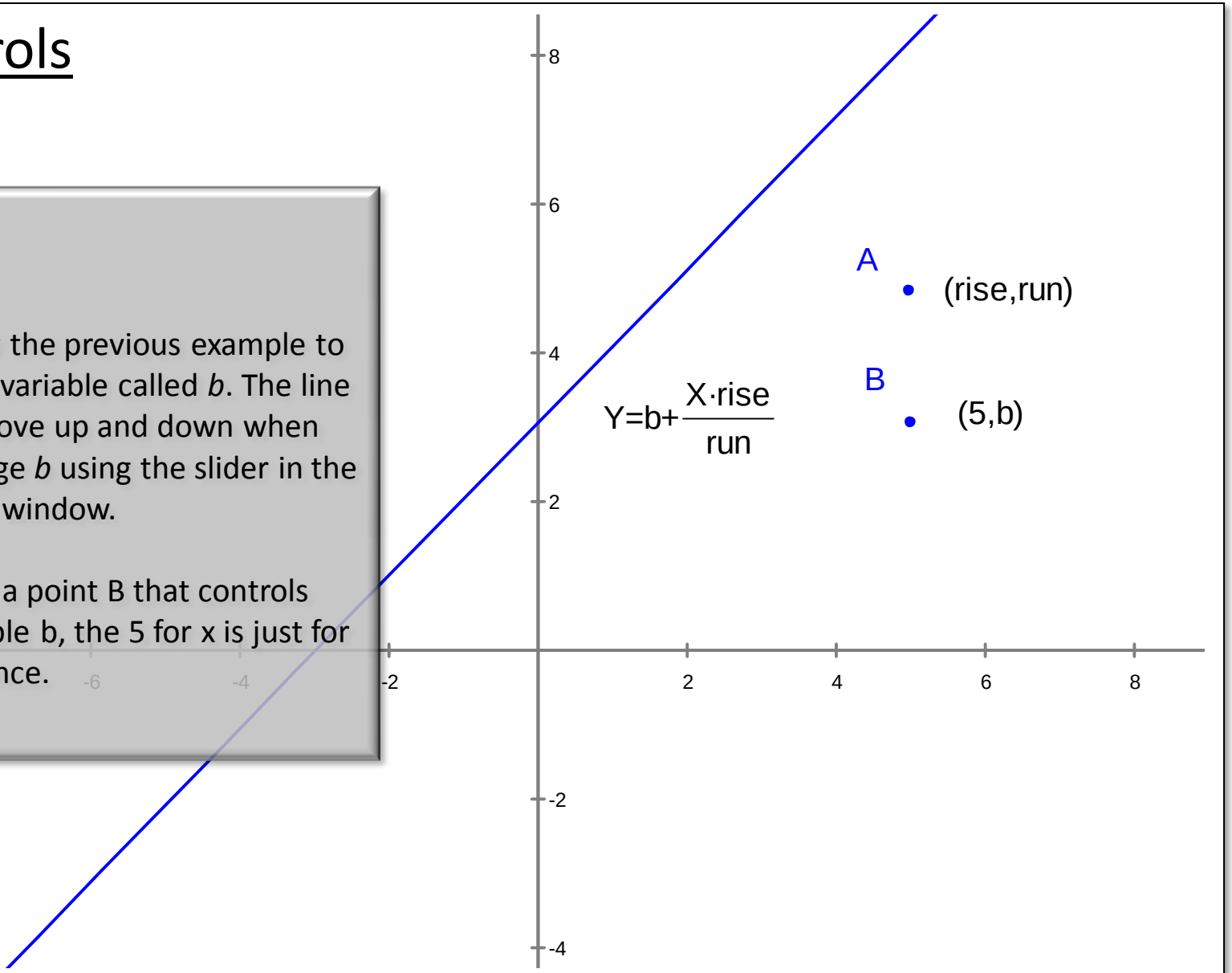
   The line rotates the opposite direction…. Why?

Controls

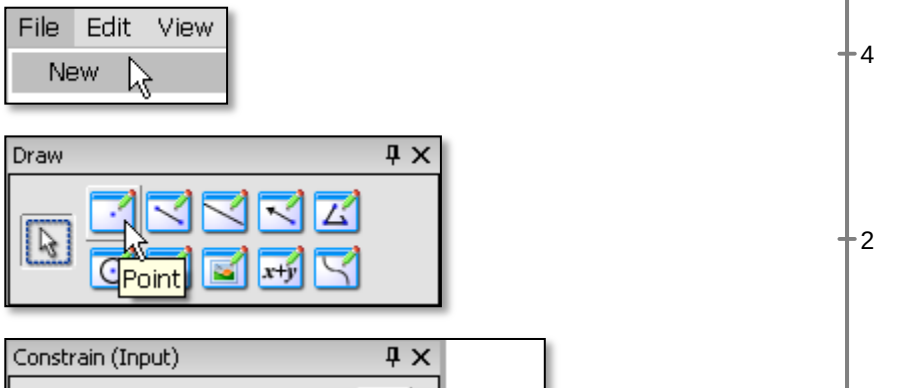
EXERCISES

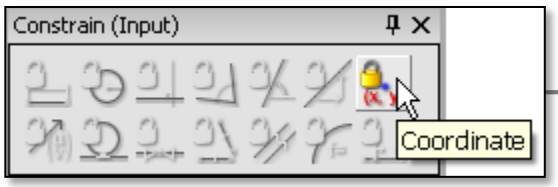
1) Modify the previous example to include a variable called *b*. The line should move up and down when you change *b* using the slider in the Variables window.

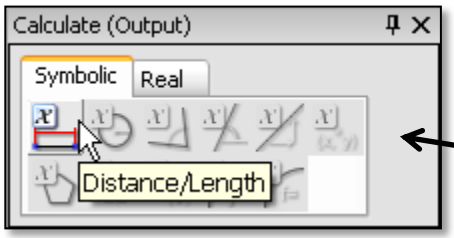
2) Create a point B that controls the variable b, the 5 for x is just for convenience.

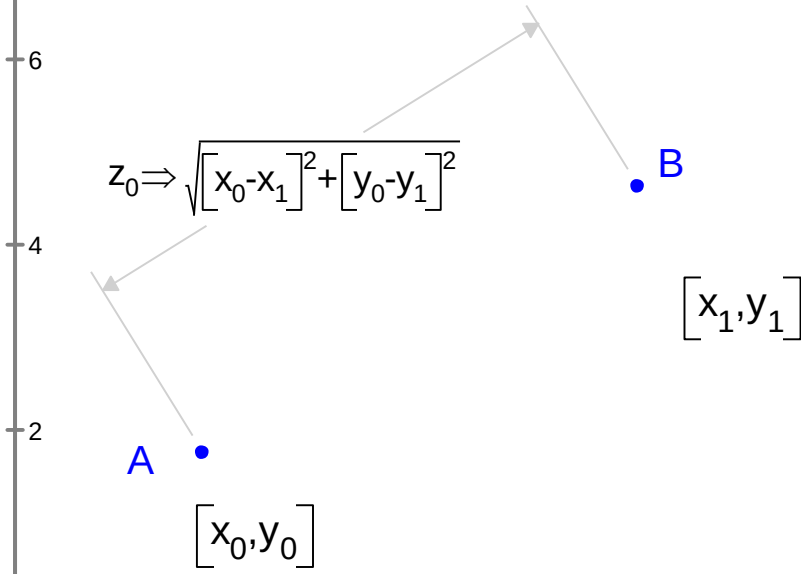


Calculation









Symbolic Distance Calculation

1) Create a new worksheet using File→New
2) Create two points, A and B, then ESCape.
3) Select the dot of Point A.
4) Click Constrain (x, y),
5) Accept Names X_0,Y_0 by pressing Enter key.
6) Repeat for B
7) Click on dot of A, Shift-click on dot of B to select both.
8) Click Calculate→Symbolic→Distance/Length
   The Distance Formula Appears

End