

SUMMER EXPERIENCE in ENGINEERING DESIGN

Engineering Bootcamp

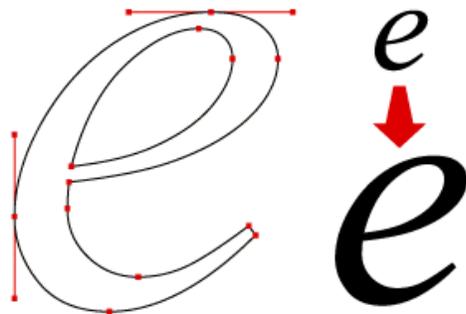
Crash Course: Adobe Illustrator for Laser Cutting

Made by: Mikaela Juzswik

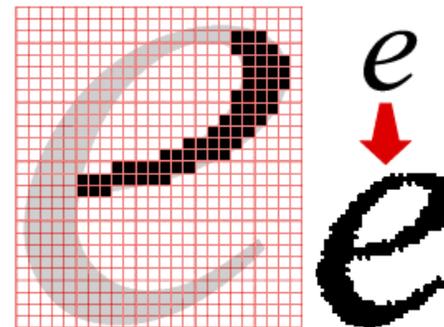
What is Adobe Illustrator?

- ▶ A powerful editing software that specializes in **vector graphics**
 - ▶ **Vector image:** an image format based on vectors, which go through locations called nodes (or control points) to create clean, resizable images
 - ▶ **Raster image:** an image format based on pixels stored in a rectangular image matrix, typically used for photo storage
- ▶ Although both formats have their strengths and weaknesses, vector graphics are superior when sending commands to machines such as the laser cutter or plasma cutter

VECTOR GRAPHICS



BITMAPPED (RASTER) GRAPHICS



What are we learning?

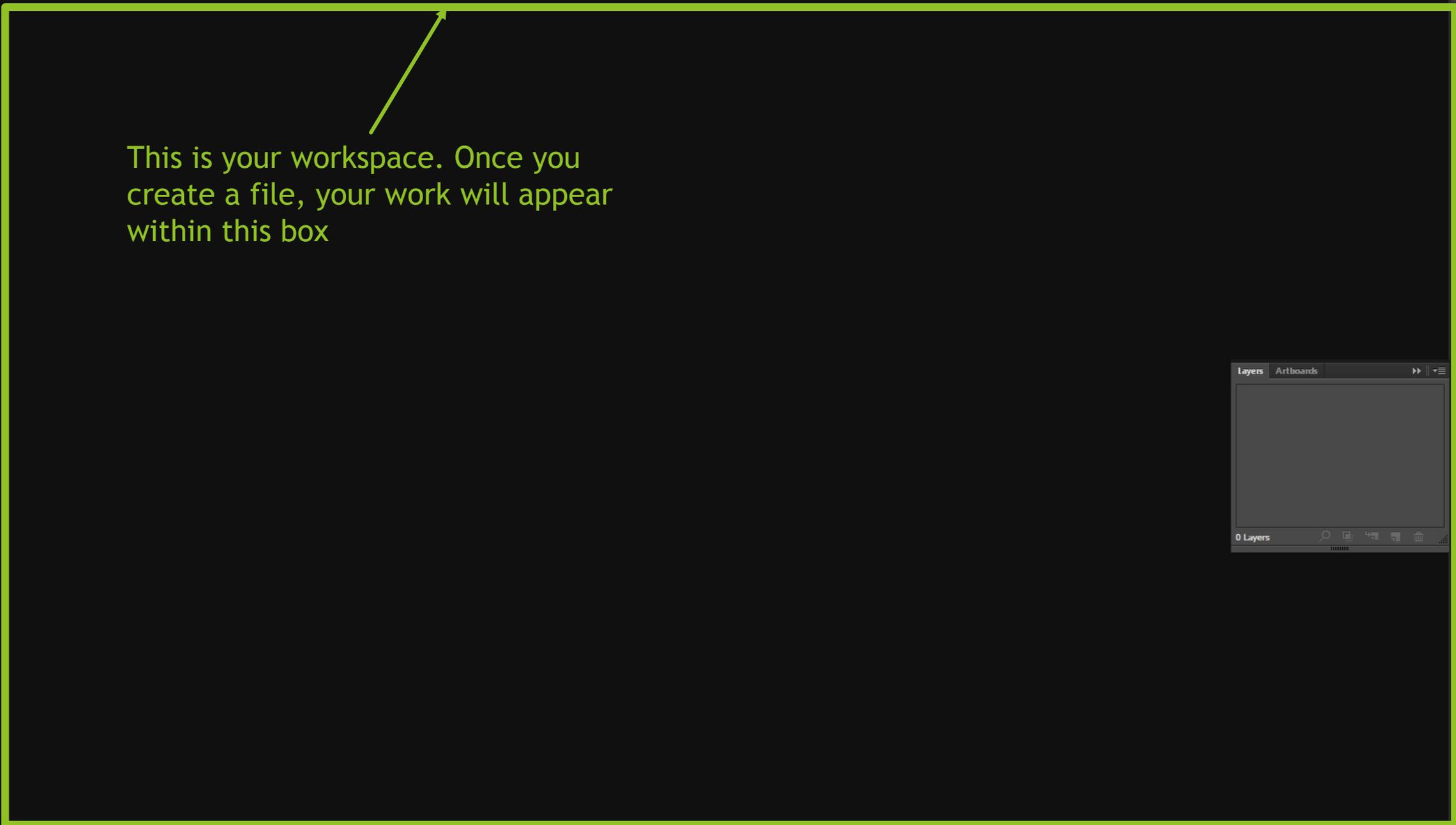
- ▶ Adobe Illustrator is actually a very versatile program with a wide variety of functions and applications
- ▶ However, we'll only consider uses that are most-commonly needed in the OEDK:
 - ▶ **Basic Illustrations:** combining simple shapes to create proof-of-concept
 - ▶ **2D CAD** (computer-aided design): creating files that can be used with the lasercutter or plasma cutter
 - ▶ **Hotkeys:** making a file that needs to be done yesterday? Using hotkeys is weird at first, but can make your CAD'ing experience much faster:
 - ▶ CAD with two hands: right hand on the mouse (selecting) and left hand on the keyboard (hotkeys)
- ▶ That being said, Adobe Illustrator is a hugely versatile tool that you may consider studying in greater detail:
 - ▶ <https://helpx.adobe.com/illustrator/how-to/what-is-illustrator.html>

The Super-Basics

- ▶ Creating a file
- ▶ Adjusting units
- ▶ Artboards
- ▶ Navigating a file
- ▶ Layers

Getting Started





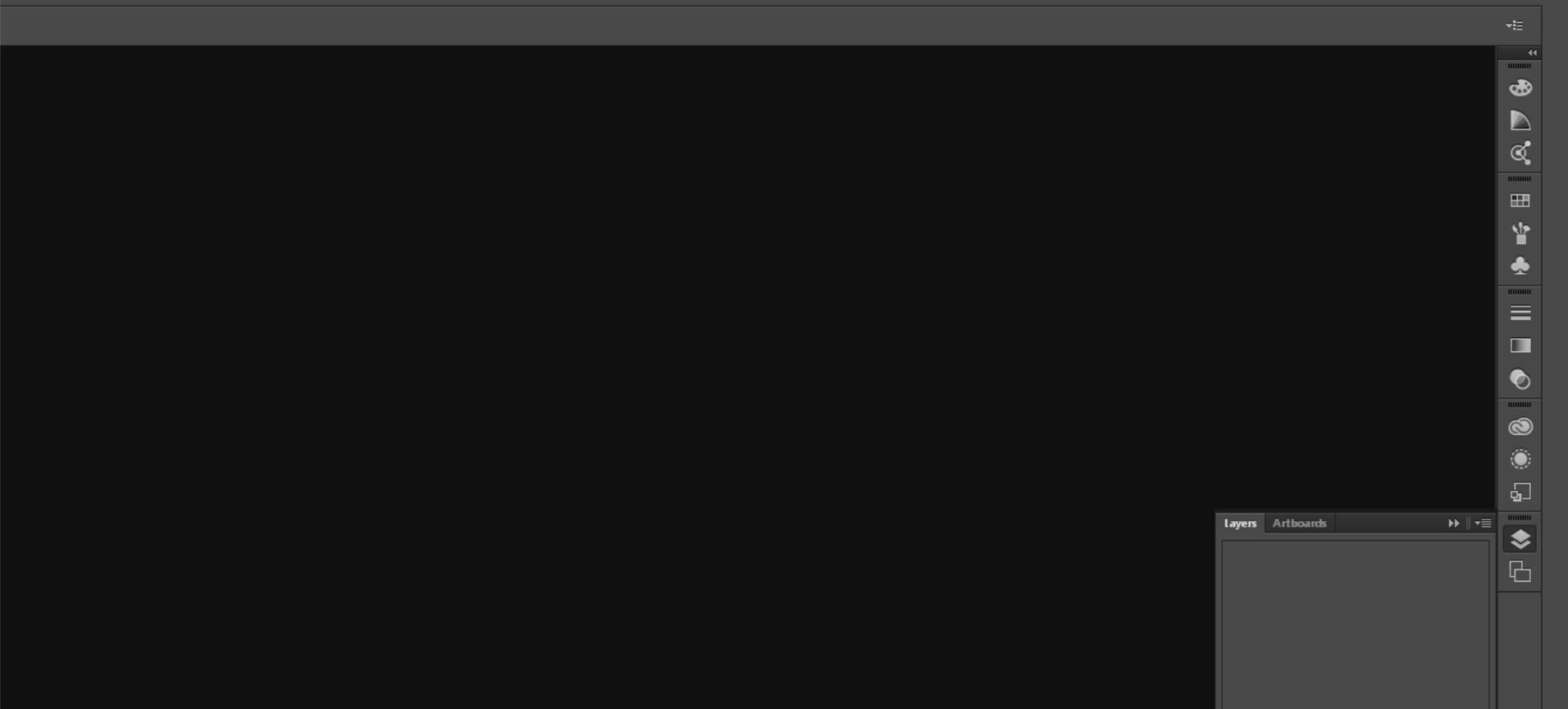
This is your workspace. Once you create a file, your work will appear within this box



Layers Artboards

The Layers panel is a window on the right side of the interface. It has tabs for 'Layers' and 'Artboards'. The 'Layers' tab is active, and the panel shows '0 Layers'. It includes a search icon, a refresh icon, and a trash icon at the bottom.

- New... Ctrl+N
- New from Template... Shift+Ctrl+N
- Open... Ctrl+O
- Open Recent Files ▶
- Browse in Bridge... Alt+Ctrl+O
- Close Ctrl+W
- Save Ctrl+S
- Save As... Shift+Ctrl+S
- Save a Copy... Alt+Ctrl+S
- Save as Template...
- Save for Web... Alt+Shift+Ctrl+S
- Save Selected Slices...
- Revert F12
- Search Adobe Stock...
- Place... Shift+Ctrl+P
- Save for Microsoft Office...
- Export...
- Share on Behance...
- Package... Alt+Shift+Ctrl+P
- Scripts ▶
- Document Setup... Alt+Ctrl+P
- Document Color Mode ▶
- File Info... Alt+Shift+Ctrl+I
- Print... Ctrl+P
- Exit Ctrl+Q



Layers Artboards

0 Layers



New Document

Name: SEED 2016 Tutorial

Profile: Print

Number of Artboards: 1

Spacing: 20 pt Columns: 1

Size: Letter

Width: 612 pt

Height: 792 pt

Orientation: Portrait

Bleed: Top 0 pt Bottom 0 pt Left 0 pt

Units: Points

- Points
- Picas
- Inches
- Millimeters
- Centimeters
- Pixels

Color Mode: CMYK, PPI: 300, Align to Pixel Grid: No

Templates... OK Cancel

Layers Artboards

0 Layers

You can adjust units here as necessary, or you can change them later without rescaling your file.



New Document

Name: SEED 2016 Tutorial

Profile: [Custom]

Number of Artboards: 1

Spacing: 0.28 in Columns: 1

Size: Letter

Width: 8.5 in Units: Inches

Height: 11 in Orientation: [Portrait]

Bleed: Top 0 in Bottom 0 in Left 0 in Right 0 in

Advanced

Color Mode: CMYK

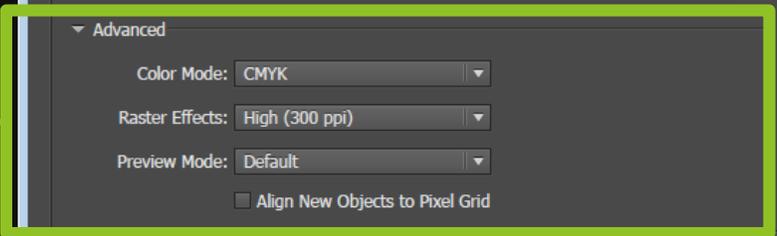
Raster Effects: High (300 ppi)

Preview Mode: Default

Align New Objects to Pixel Grid

Templates... OK Cancel

If you're doing graphics work, you can mess with the color and render settings here. For our uses here, we can leave them on their defaults.



Layers Artboards

0 Layers





New Document

Name: SEED 2016 Tutorial

Profile: [Custom]

Number of Artboards: 1

Spacing: 0.28 in Columns: 1

Size: Letter

Width: 8.5 in Units: Inches

Height: 11 in Orientation: [Portrait]

Bleed: Top 0 in Bottom 0 in Left 0 in Right 0 in

Advanced

Color Mode: CMYK

Raster Effects: High (300 ppi)

Preview Mode: Default

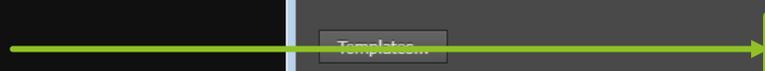
Align New Objects to Pixel Grid

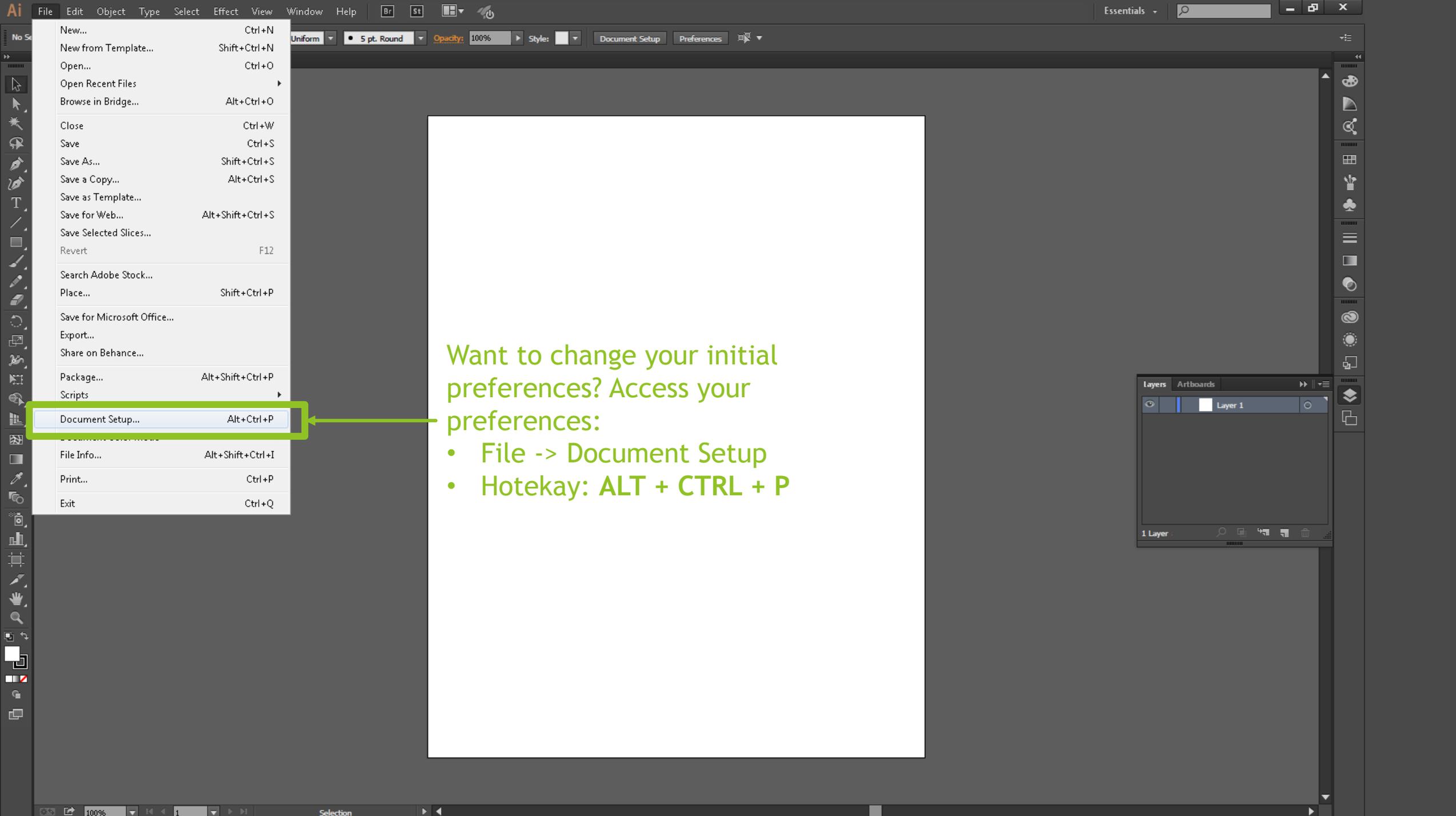
Templates... **OK** Cancel

Layers Artboards

0 Layers

Click "OK" to create a new file.





Want to change your initial preferences? Access your preferences:

- File -> Document Setup
- Hotekay: **ALT + CTRL + P**

Change units if needed:



Document Setup

General Type

Units: Inches

Edit Artboards

Bleed: Top Bottom Left Right

0 in 0 in 0 in 0 in

Show Images In Outline Mode

Highlight Substituted Glyphs

Transparency and Overprint Options

Grid Size: Medium

Grid Colors: Light

Simulate Colored Paper

Preset: [Medium Resoluti...]

Custom...

Discard White Overprint in Output

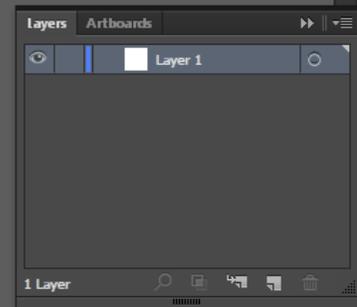
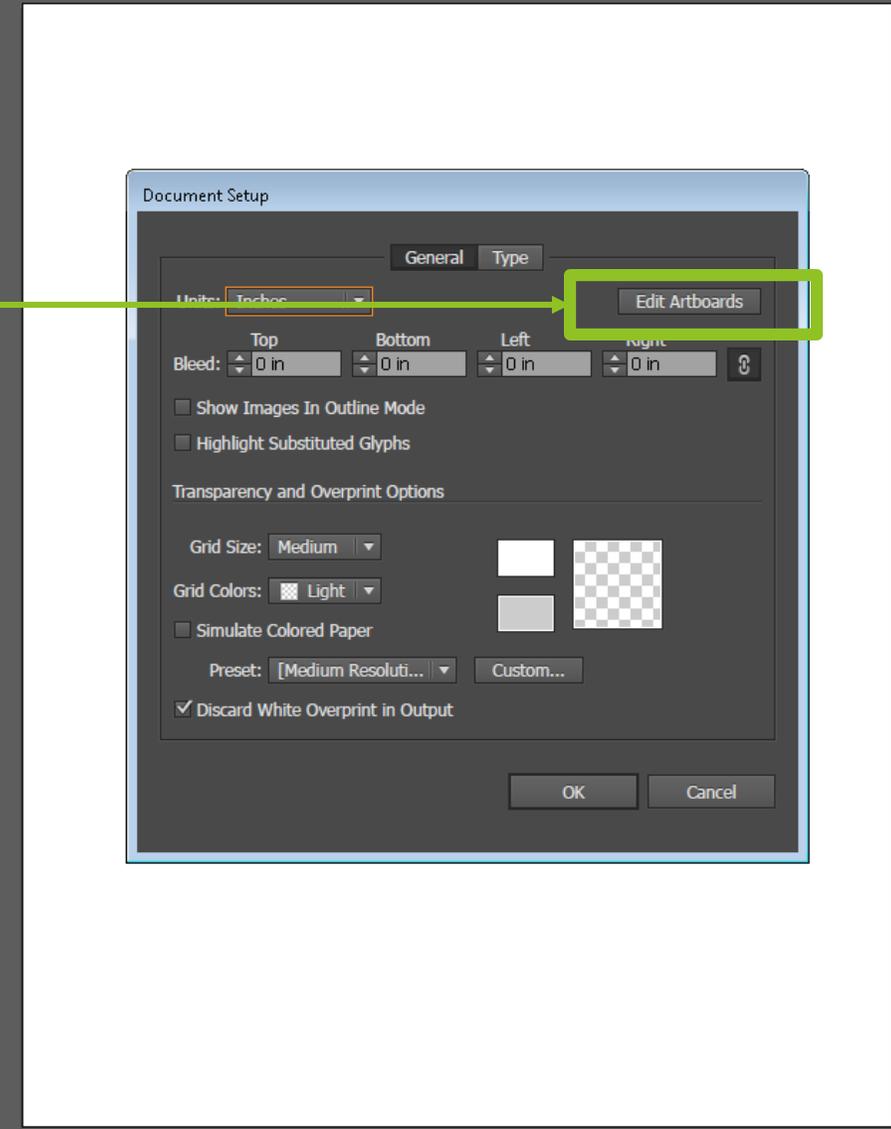
OK Cancel

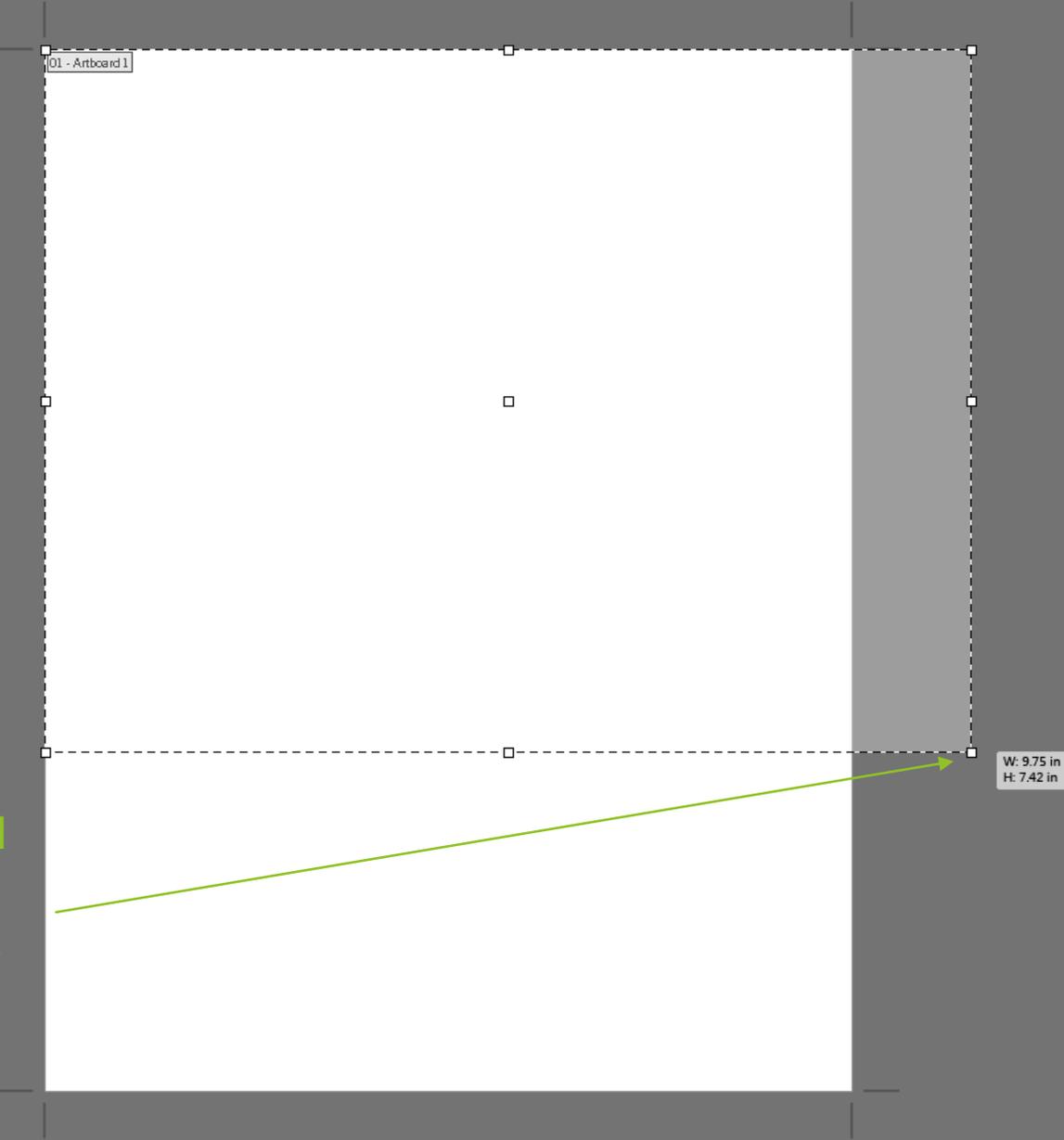
Layers Artboards

Layer 1

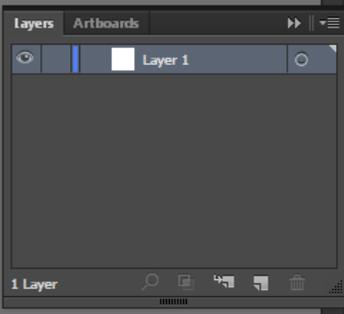
1 Layer

Let's resize our workspace. You can alter how big your canvas is through the Artboards function:

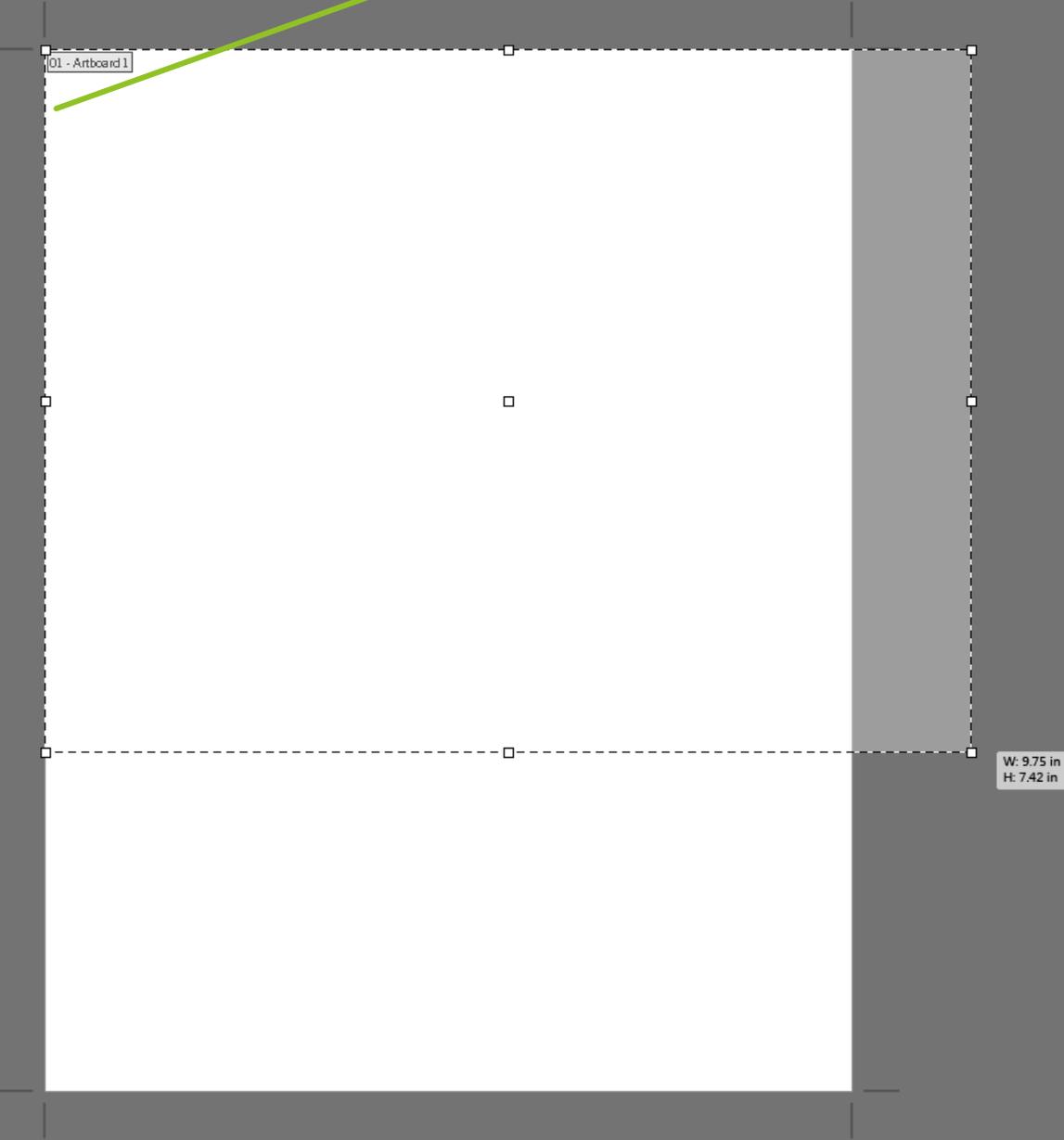




You can resize the Artboard by clicking and dragging on the corner handles to get a rough shape.



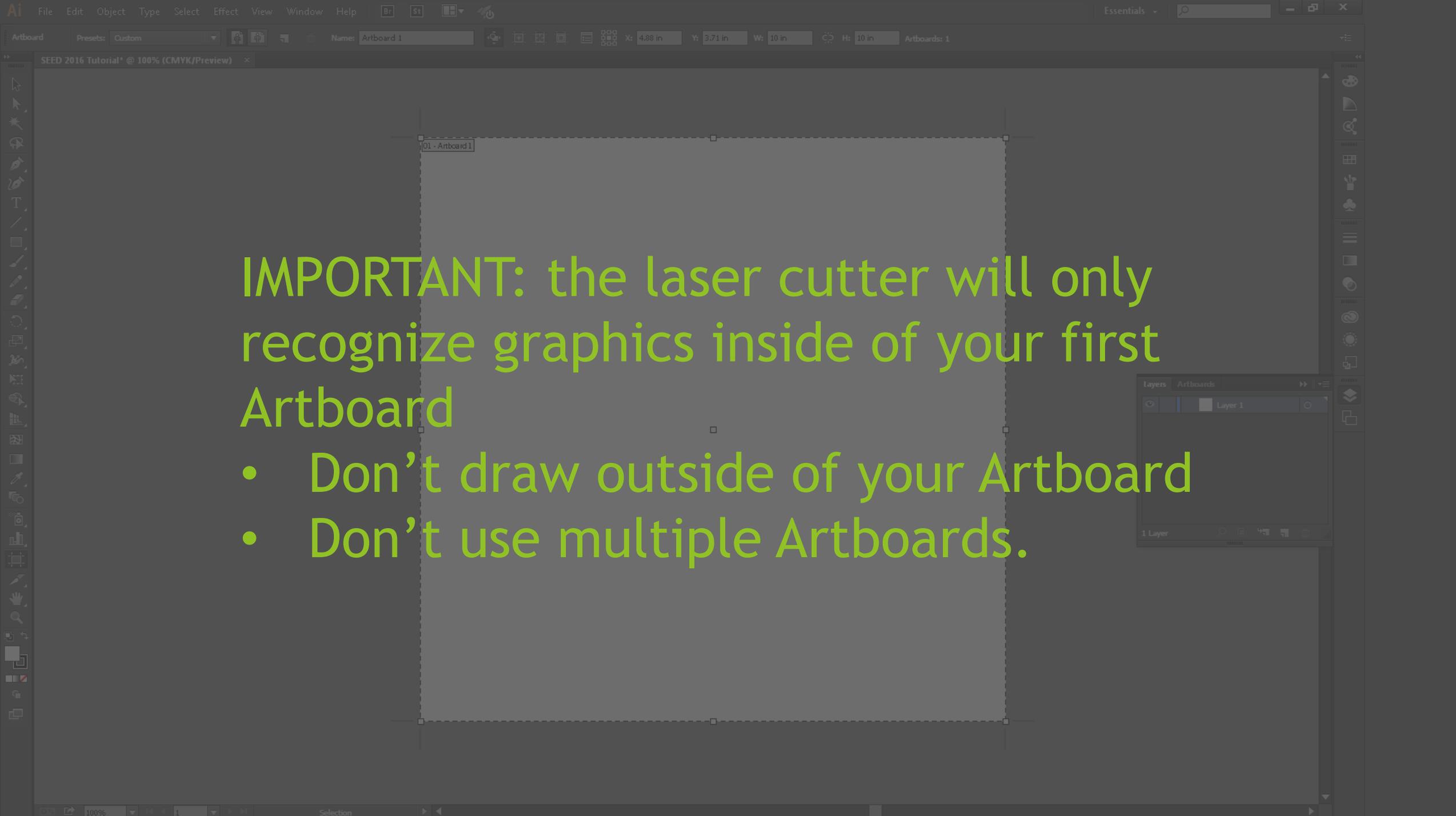
Or you can enter in the exact size you want in the W/H (width and height) boxes.



Layers Artboards

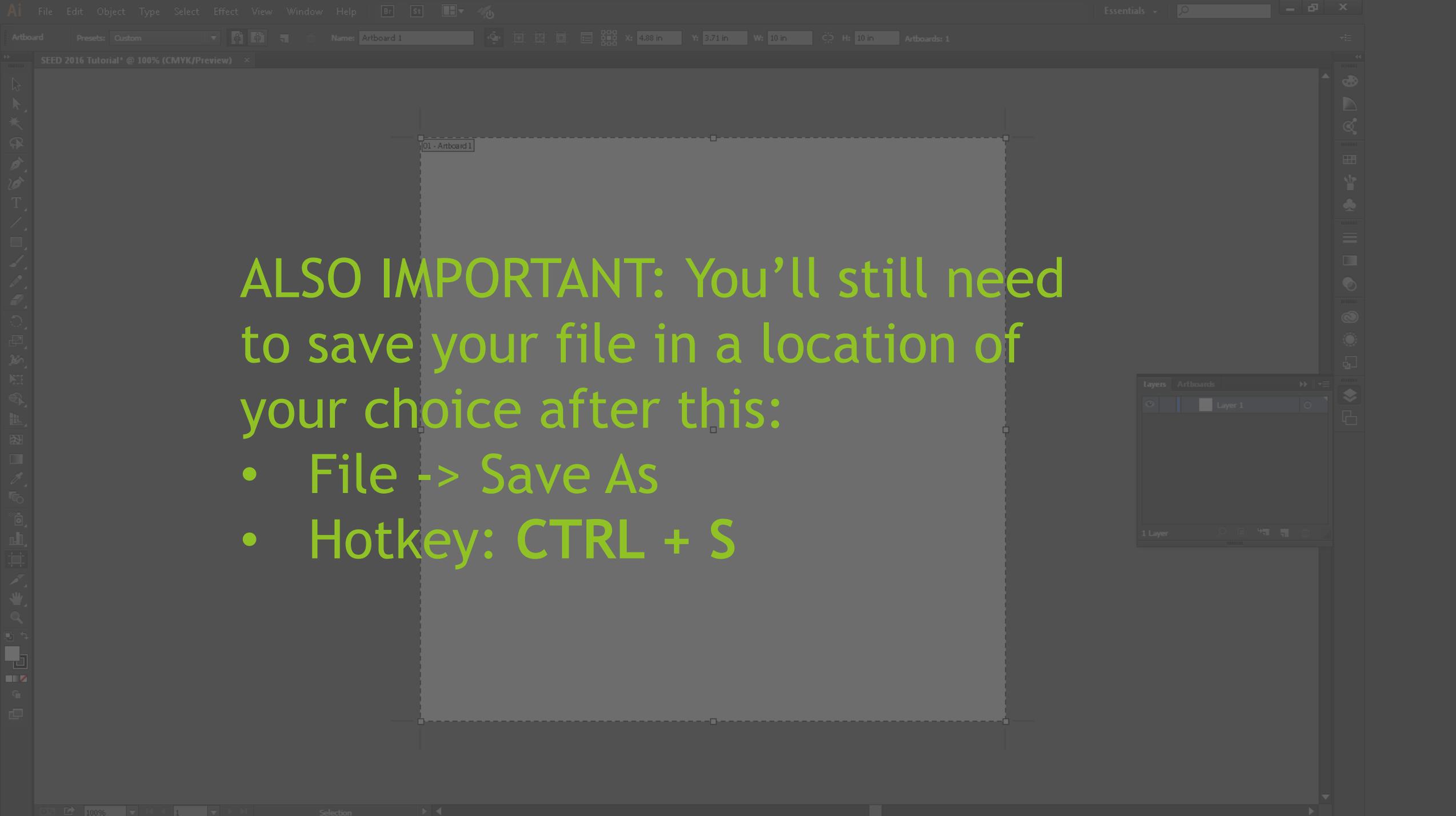
- Layer 1

1 Layer

The image is a screenshot of the Adobe Illustrator interface. At the top, the menu bar includes File, Edit, Object, Type, Select, Effect, View, Window, and Help. Below the menu bar, the 'Artboard' panel shows 'Presets: Custom' and 'Name: Artboard 1'. The main workspace displays a single artboard with a dashed border and a label '01 - Artboard 1' in the top-left corner. The artboard dimensions are shown as X: 4.88 in, Y: 3.71 in, W: 10 in, and H: 10 in. A large, semi-transparent text overlay in the center of the artboard reads 'IMPORTANT: the laser cutter will only recognize graphics inside of your first Artboard'. To the right, the 'Layers' and 'Artboards' panels are visible, showing 'Layer 1' and '1 Layer' respectively. The bottom status bar shows '100%' zoom and 'Selection' tool.

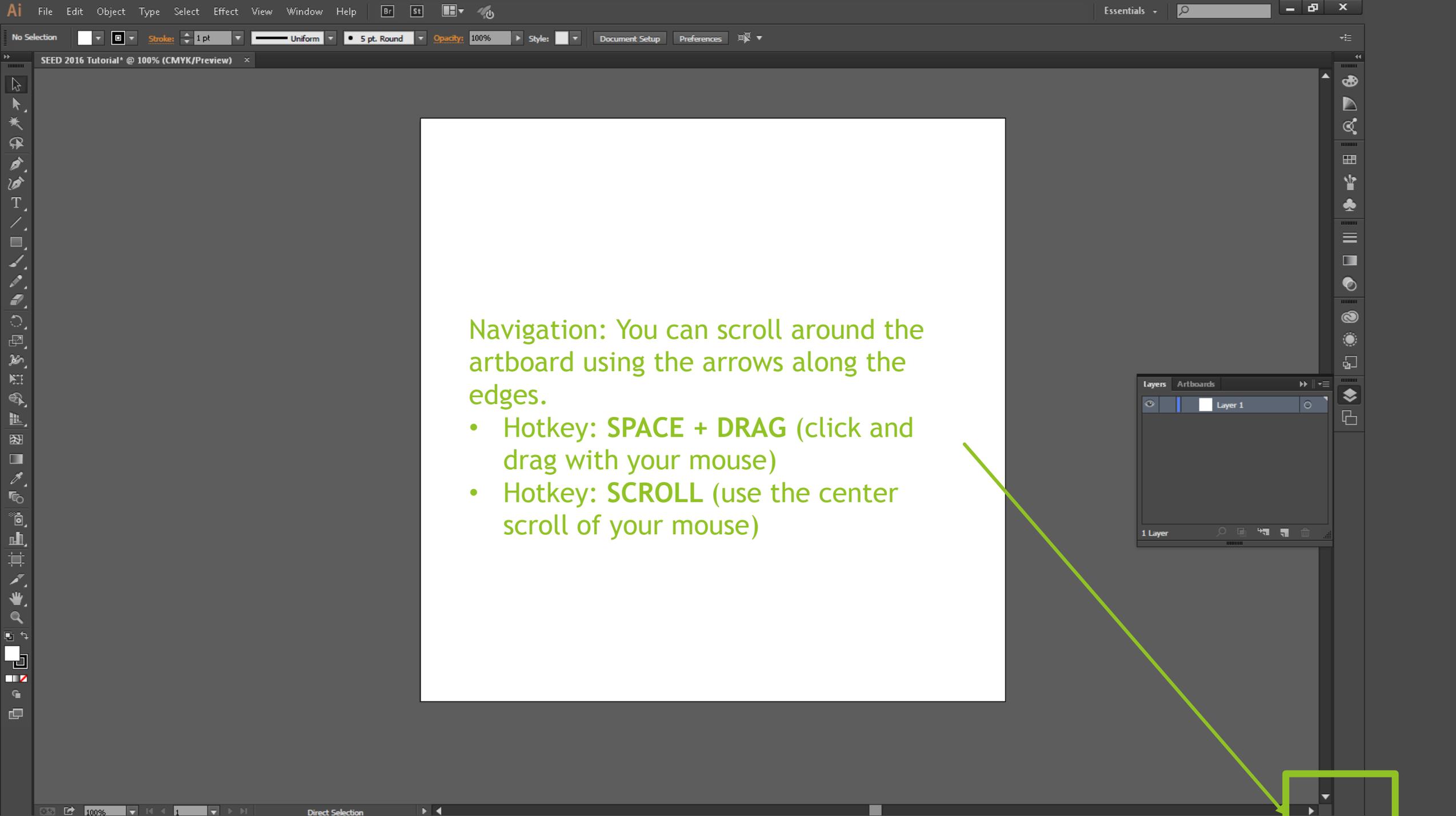
IMPORTANT: the laser cutter will only recognize graphics inside of your first Artboard

- Don't draw outside of your Artboard
- Don't use multiple Artboards.

A screenshot of the Adobe Illustrator interface. The main workspace is a grey artboard with a dashed border. The text '01 - Artboard 1' is visible in the top-left corner of the artboard. A large, semi-transparent text overlay is centered on the artboard. The top of the interface shows the menu bar (File, Edit, Object, Type, Select, Effect, View, Window, Help) and the top toolbar. The right side shows the Layers and Artboards panels. The bottom status bar shows '100%' zoom and 'Selection' tool.

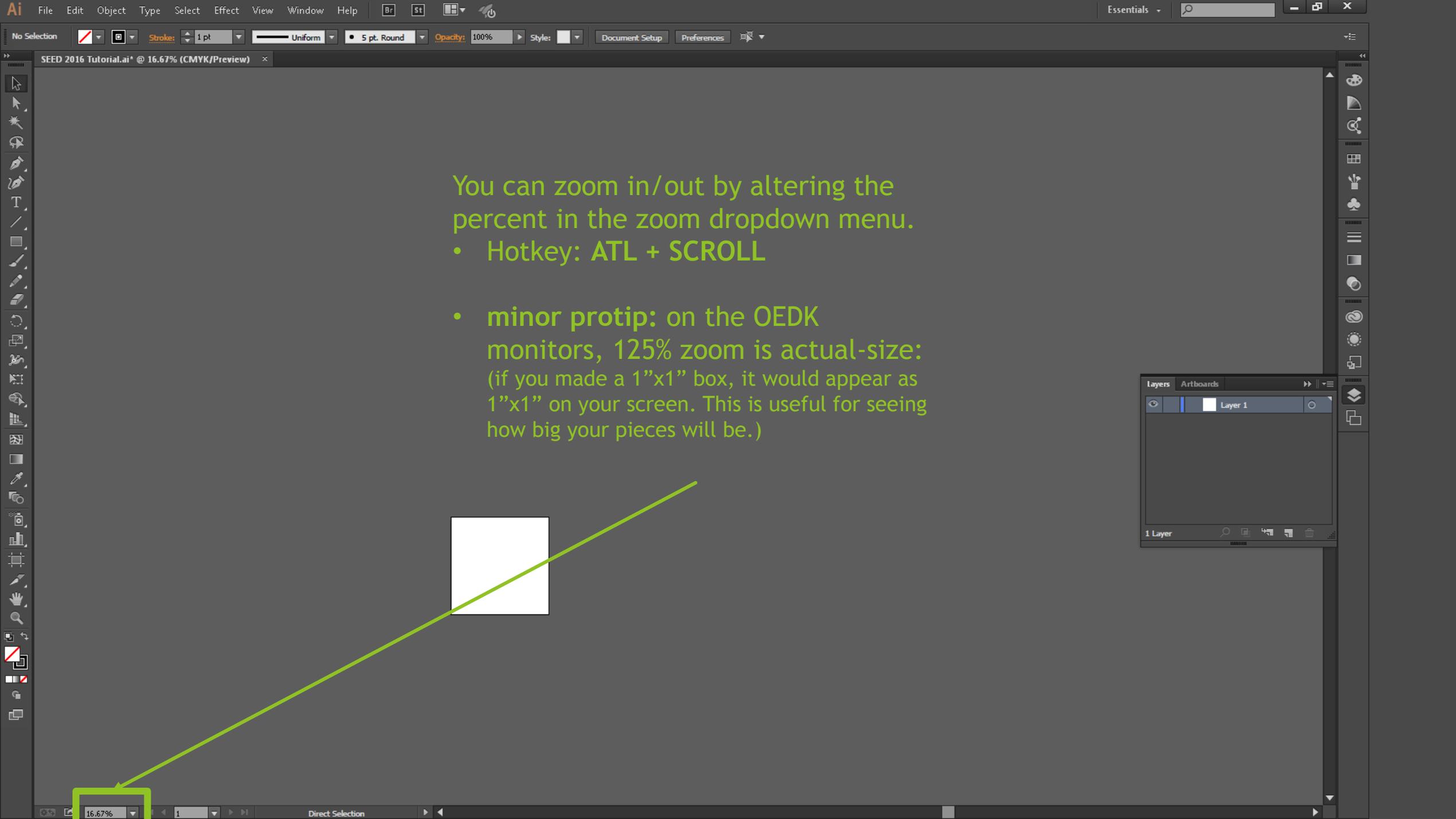
ALSO IMPORTANT: You'll still need to save your file in a location of your choice after this:

- File -> Save As
- Hotkey: CTRL + S



Navigation: You can scroll around the artboard using the arrows along the edges.

- Hotkey: **SPACE + DRAG** (click and drag with your mouse)
- Hotkey: **SCROLL** (use the center scroll of your mouse)

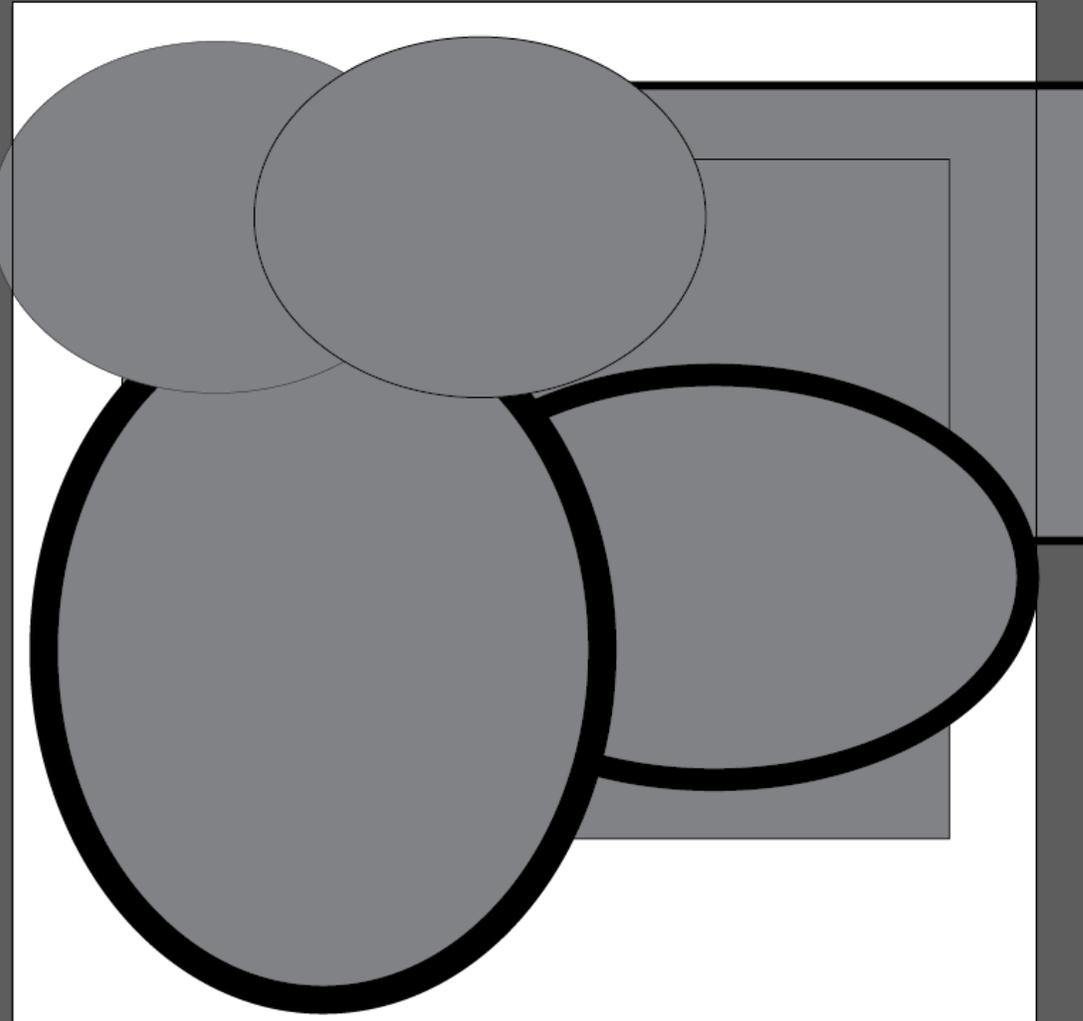


You can zoom in/out by altering the percent in the zoom dropdown menu.

- Hotkey: ATL + SCROLL
- minor protip: on the OEDK monitors, 125% zoom is actual-size: (if you made a 1"x1" box, it would appear as 1"x1" on your screen. This is useful for seeing how big your pieces will be.)

There are two useful views in Illustrator: **Preview** and **Outline**.

- Preview shows all shape colors/fills, and also shows shape order (more on that later)



Layers Artboards

Layer 1

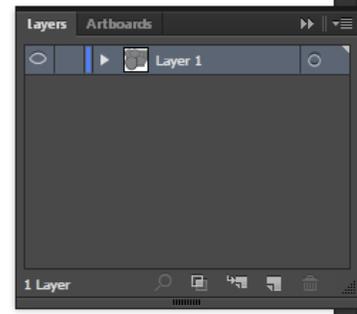
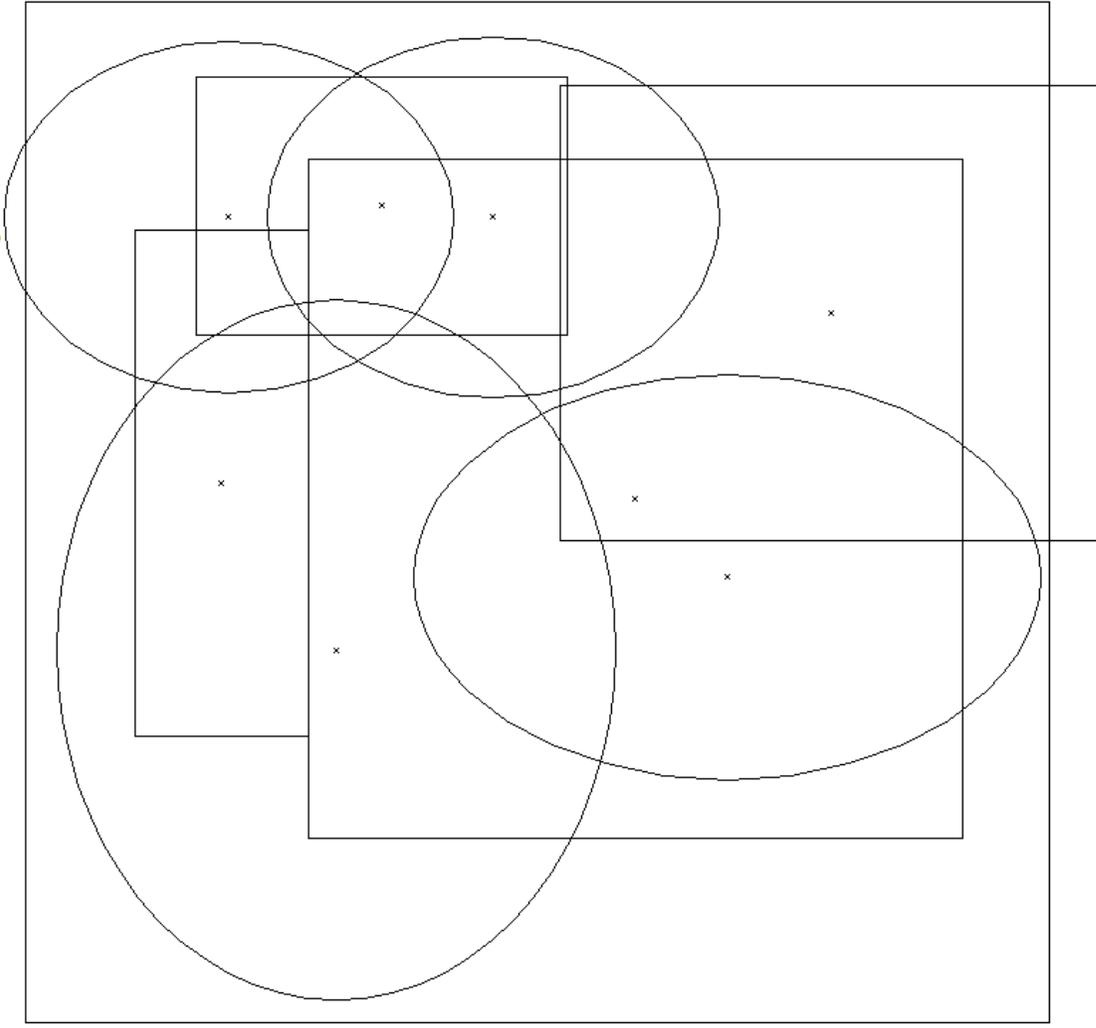
1 Layer

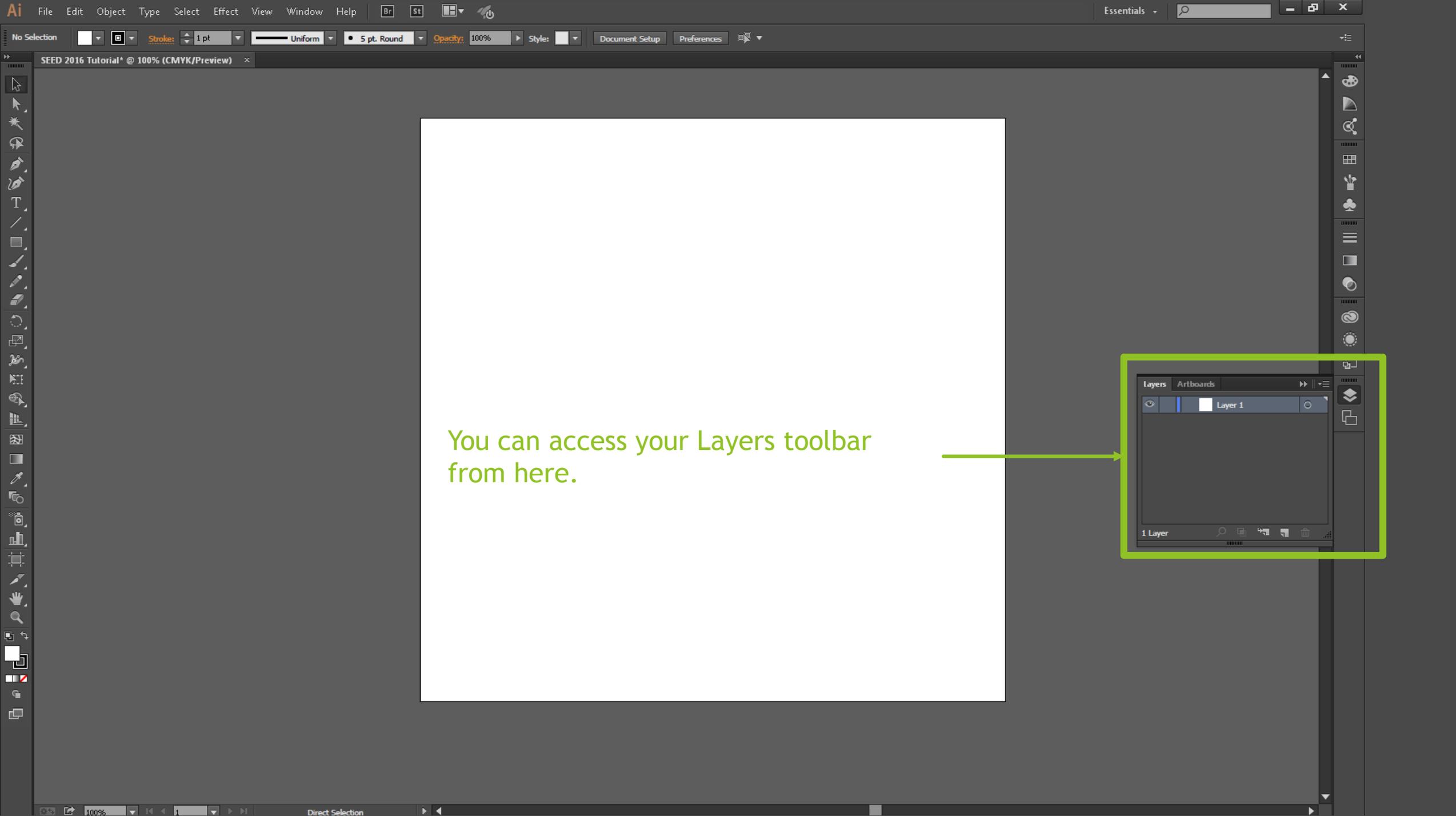
There are two useful views in Illustrator: **Preview and Outline.**

- Outline erases all colors/outlines, hides shape order, and shows the center point of shapes.

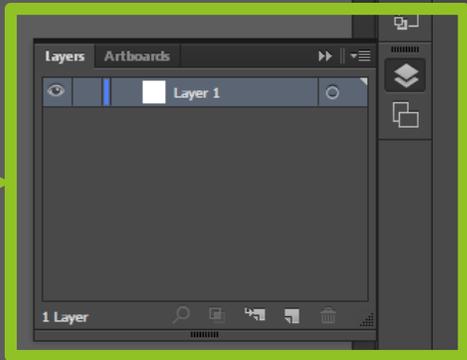
Switching between modes:

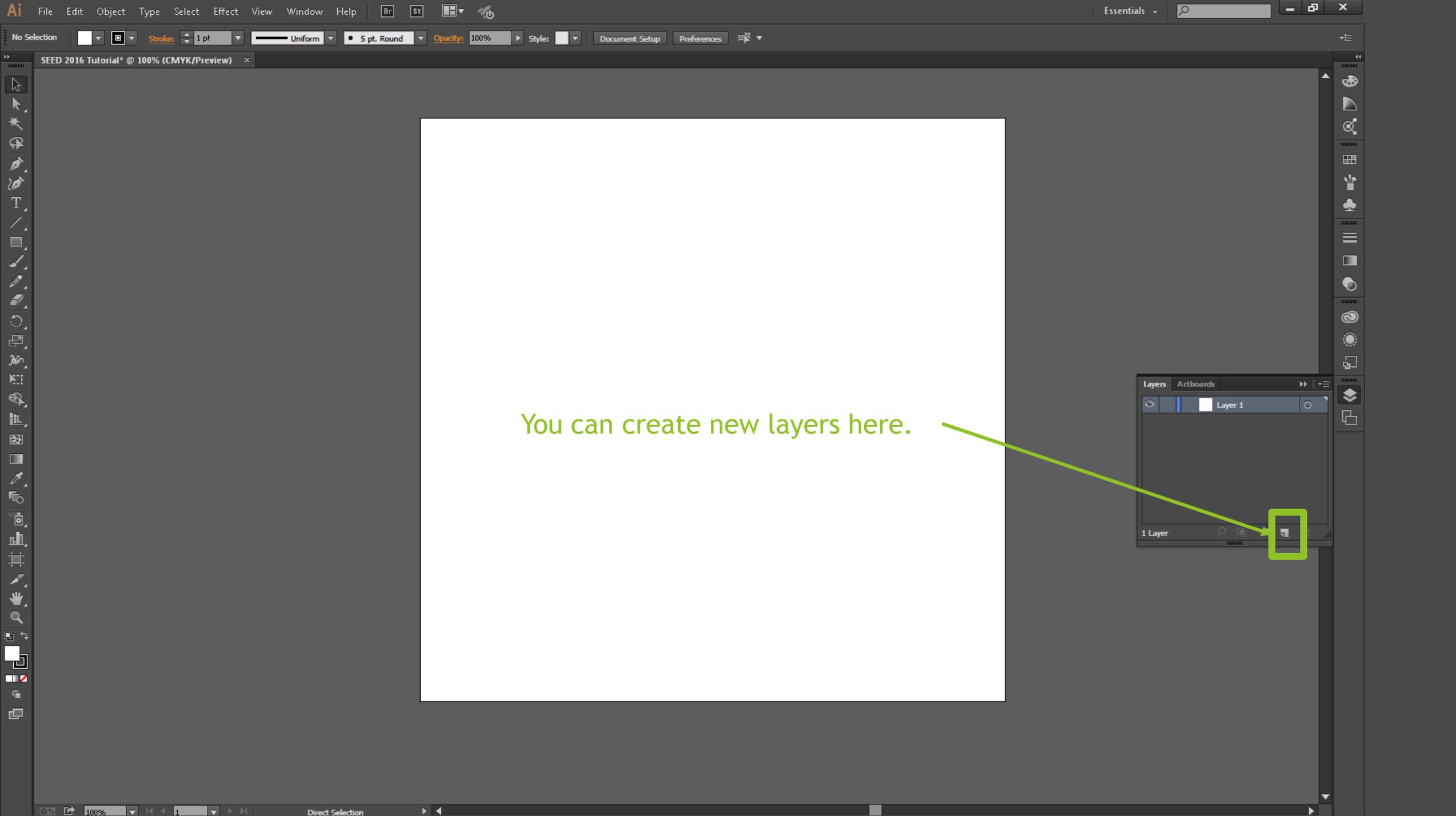
- Hotkey: **CTRL+Y**
- View -> Preview





You can access your Layers toolbar from here.



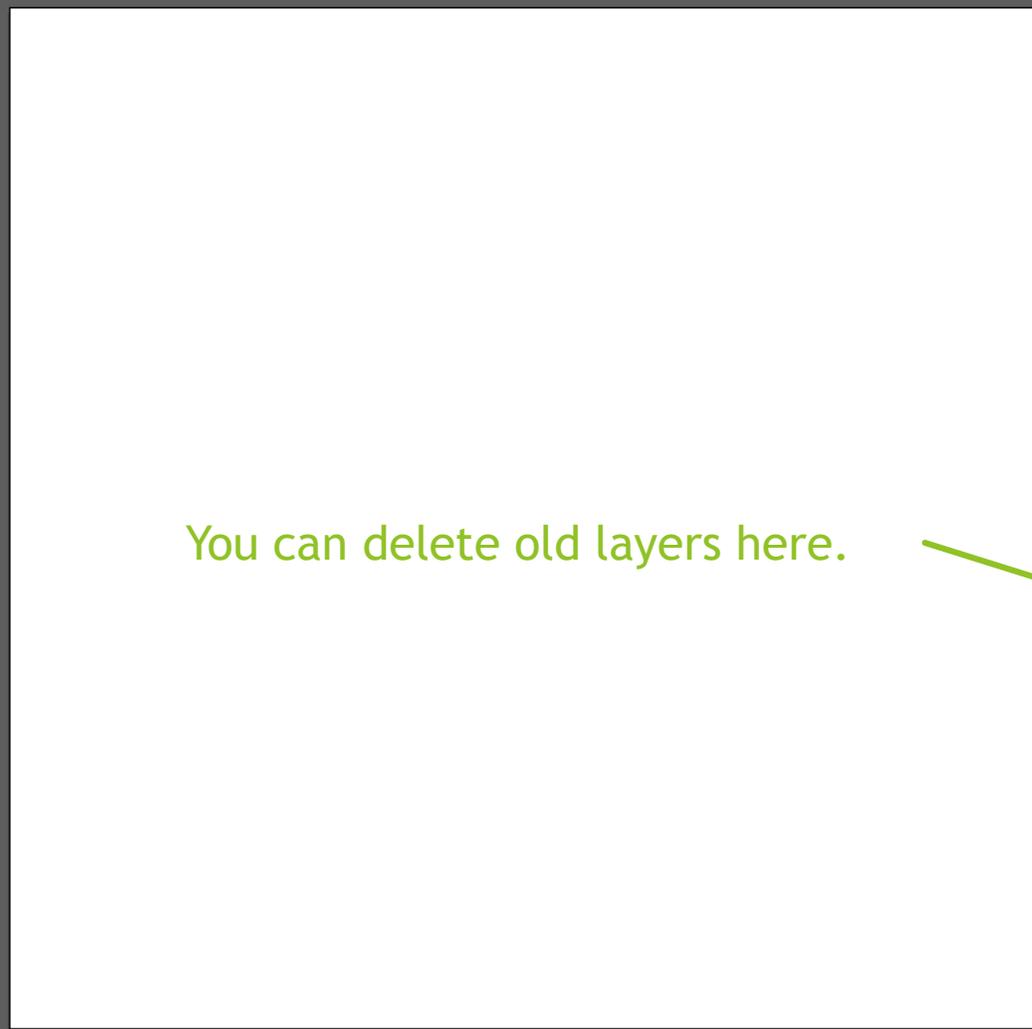


You can create new layers here.

Layers Artboards

Layer 1

1 Layer

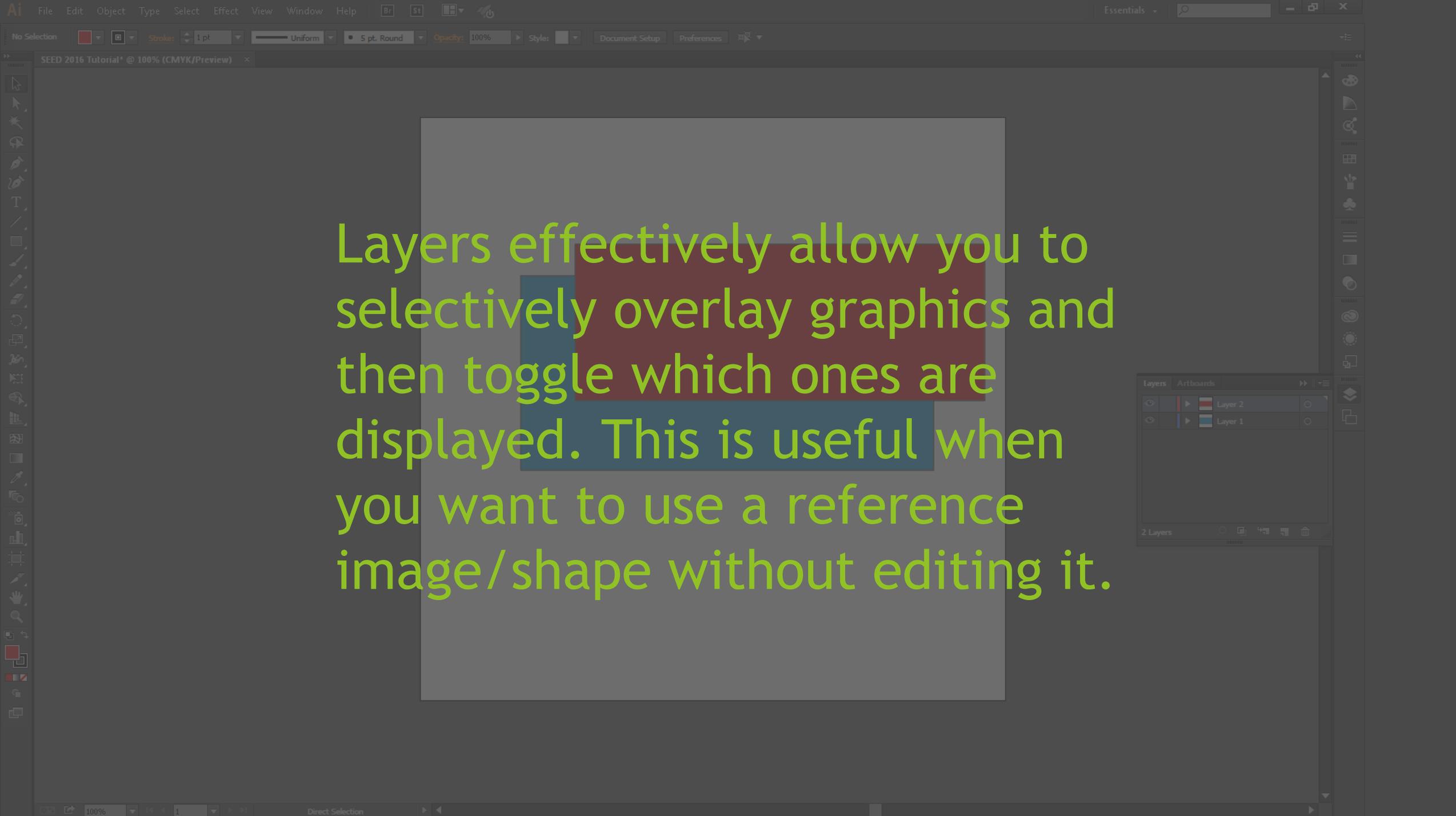


You can delete old layers here.

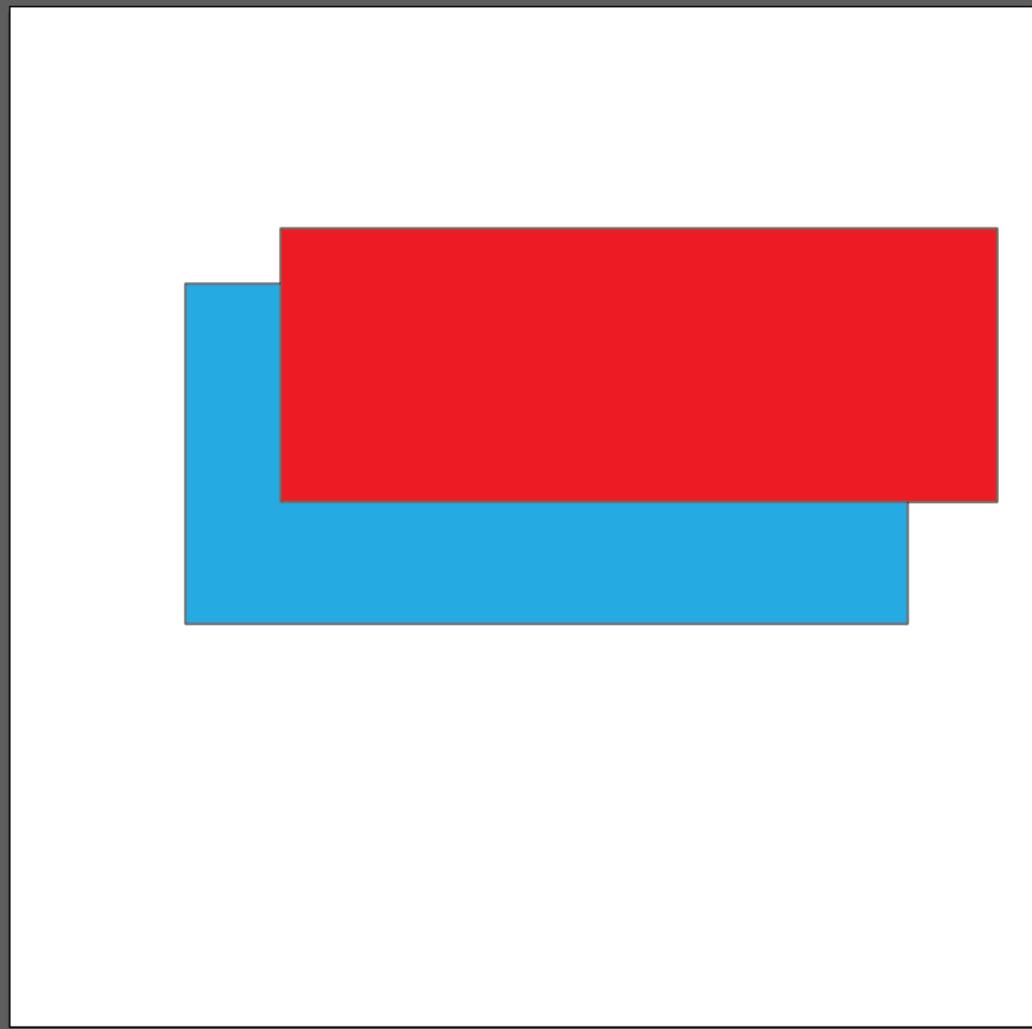
Layers Artboards

Layer 1

1 Layer

The image is a screenshot of the Adobe Illustrator software interface. The top menu bar includes 'File', 'Edit', 'Object', 'Type', 'Select', 'Effect', 'View', 'Window', and 'Help'. Below the menu is a toolbar with various tools like selection, lasso, and eraser. The main workspace is a dark gray area with a light gray rectangular background. In the center, there are two overlapping shapes: a dark red rectangle on top of a blue rectangle. Overlaid on these shapes is a large, semi-transparent green text box containing the text: 'Layers effectively allow you to selectively overlay graphics and then toggle which ones are displayed. This is useful when you want to use a reference image/shape without editing it.' On the right side of the workspace, there is a 'Layers' panel. It has two tabs: 'Layers' and 'Artboards'. Under the 'Layers' tab, there are two entries: 'Layer 2' with a red square icon and 'Layer 1' with a blue square icon. The 'Layer 2' entry is selected. At the bottom of the interface, there is a status bar showing '100%' zoom, '1' page, and 'Direct Selection' tool.

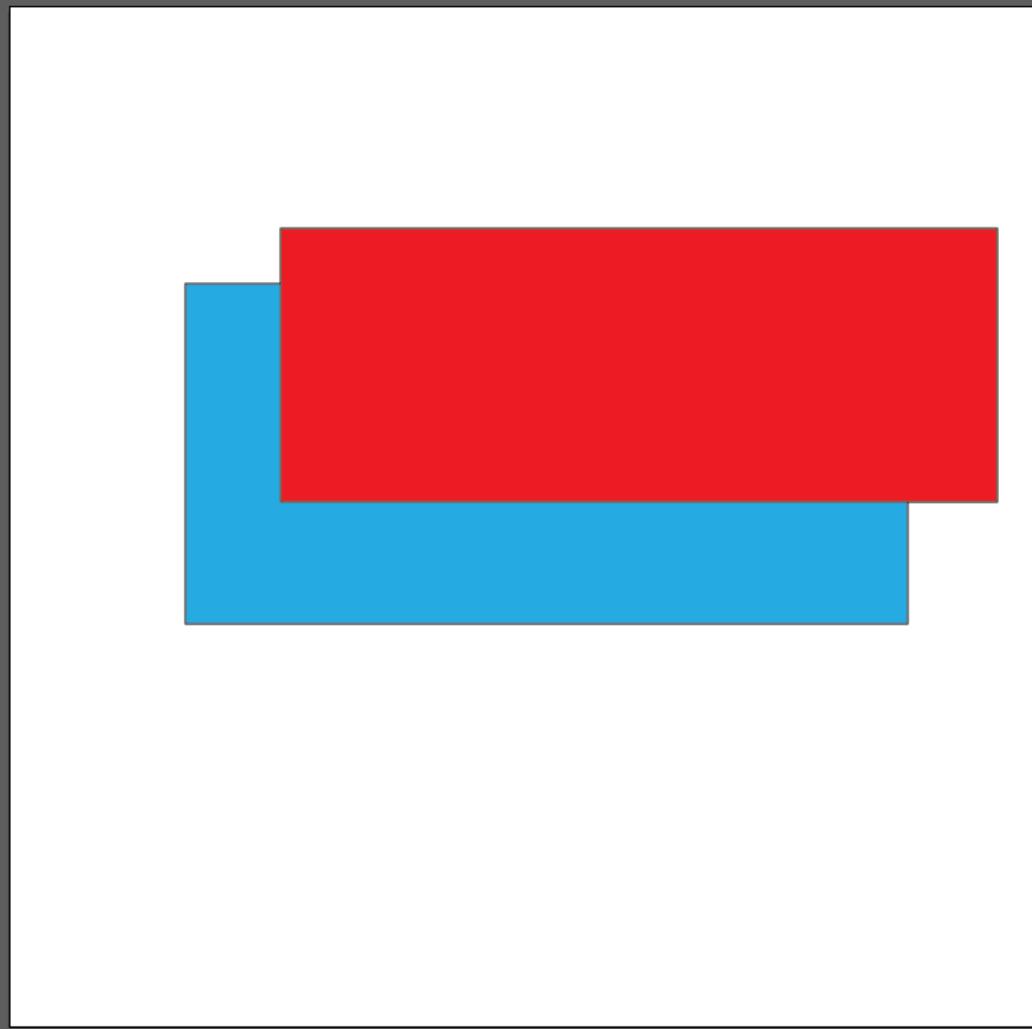
Layers



Both the red and blue layers are active

The Layers panel is open on the right side of the interface. It shows two layers: 'Layer 1' with a blue icon and 'Layer 2' with a red icon. Both layers have a small white triangle icon to their left, indicating they are active. A green box highlights the entire panel, and a green arrow points from the text above to the active icons.

Layers



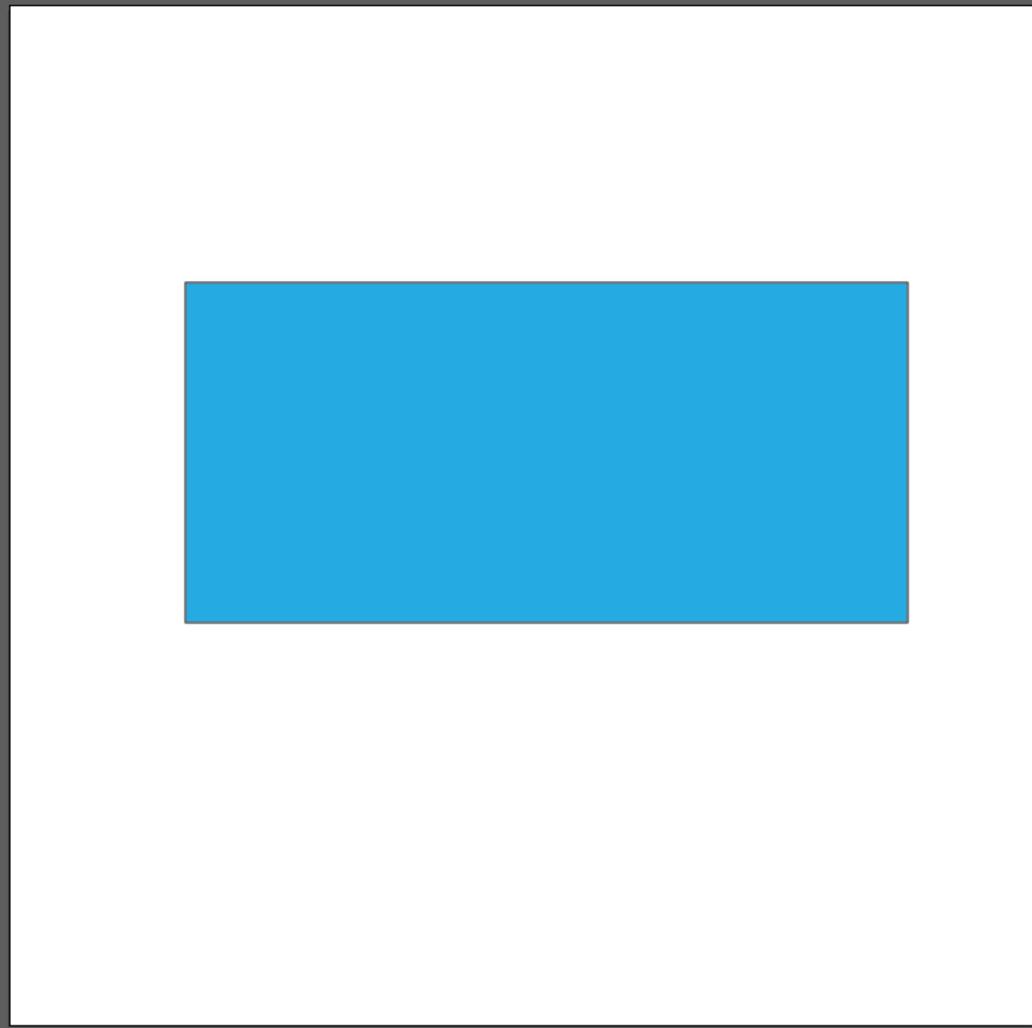
Clicking on the eye next to a layer allows you to toggle its visibility

Artboards

<input checked="" type="checkbox"/>	Layer 2	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Layer 1	<input type="checkbox"/>

2 Layers

Layers

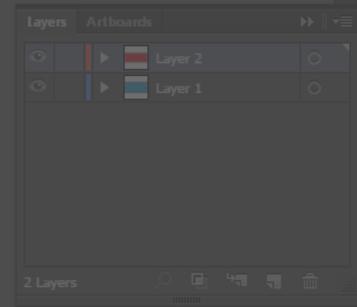


Clicking on the eye next to a layer allows you to toggle its visibility

The Layers panel is open, showing two layers: Layer 1 and Layer 2. Layer 1 is selected and has a blue fill. Layer 2 is below it and has a red fill. Both layers have a visibility icon (an eye) to their left. A green box highlights the eye icon for Layer 1, and a green arrow points from the text above to this icon.

Layer	Visibility	Color
Layer 2	Visible	Red
Layer 1	Visible	Blue

NOTE: regardless of what layers are invisible/visible, the lasercutter will still cut all of them. Be aware of this.



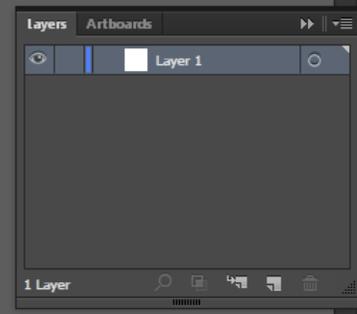
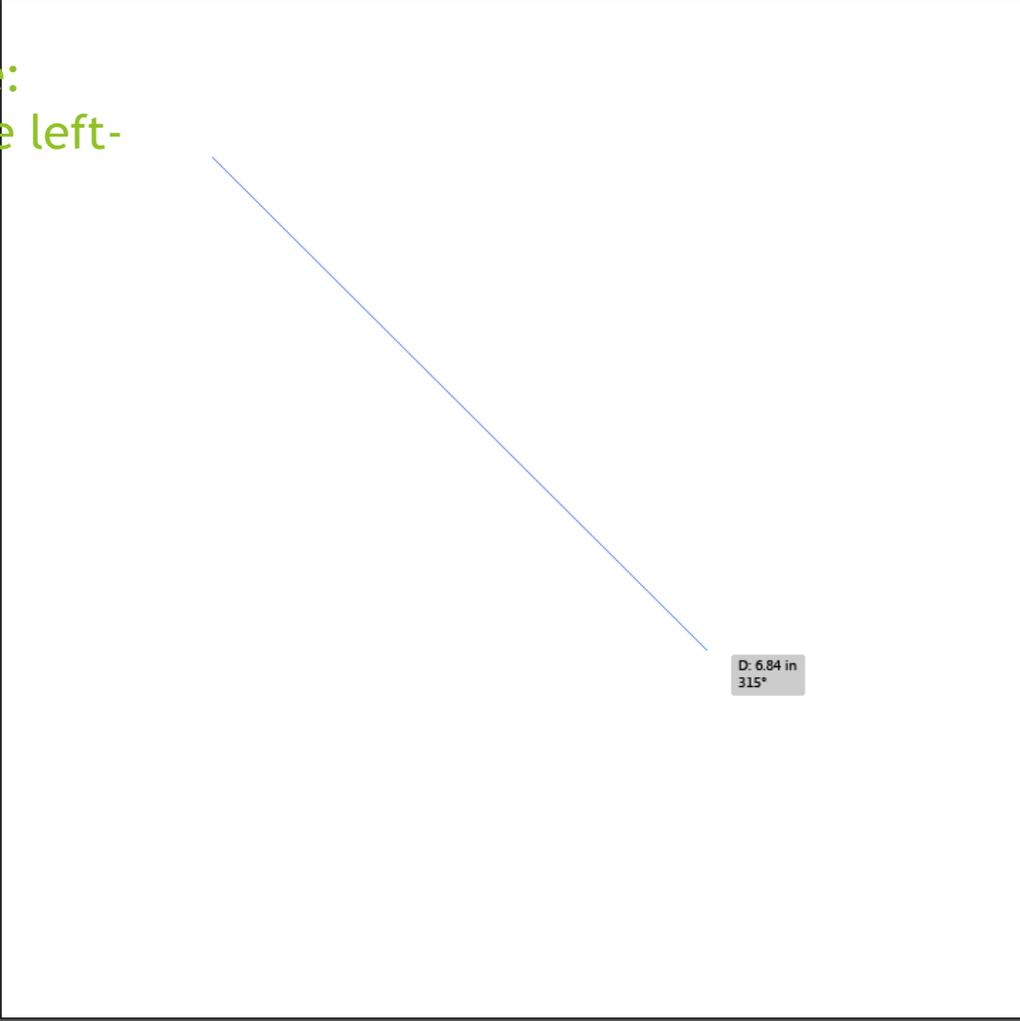
The Semi-Basics

- ▶ Shapes and Lines
- ▶ Selection
- ▶ Direct Selection
- ▶ Editing a Shape
- ▶ Shapebuilder

Lines

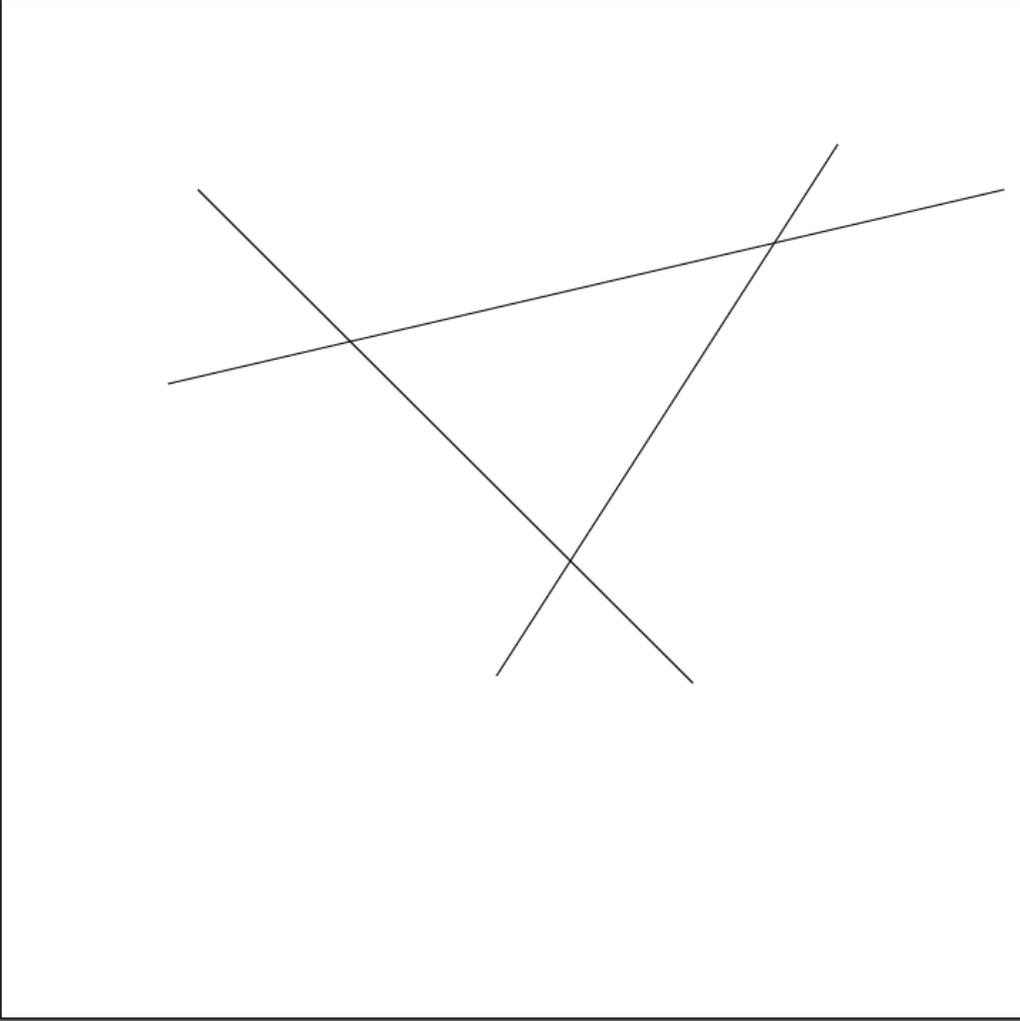
Let's start by making a line:

- Click the line tool on the left-hand toolbar
- Hotkey (backslash):\



Lines

You can use the line tool to freely create lines, but they don't combine easily into shapes and aren't very useful to us at the moment. We'll come back to this in a bit.



Layers Artboards

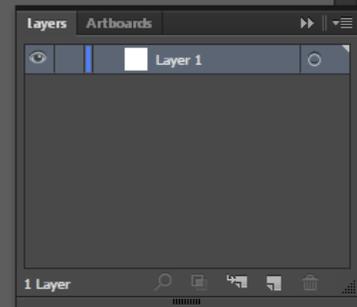
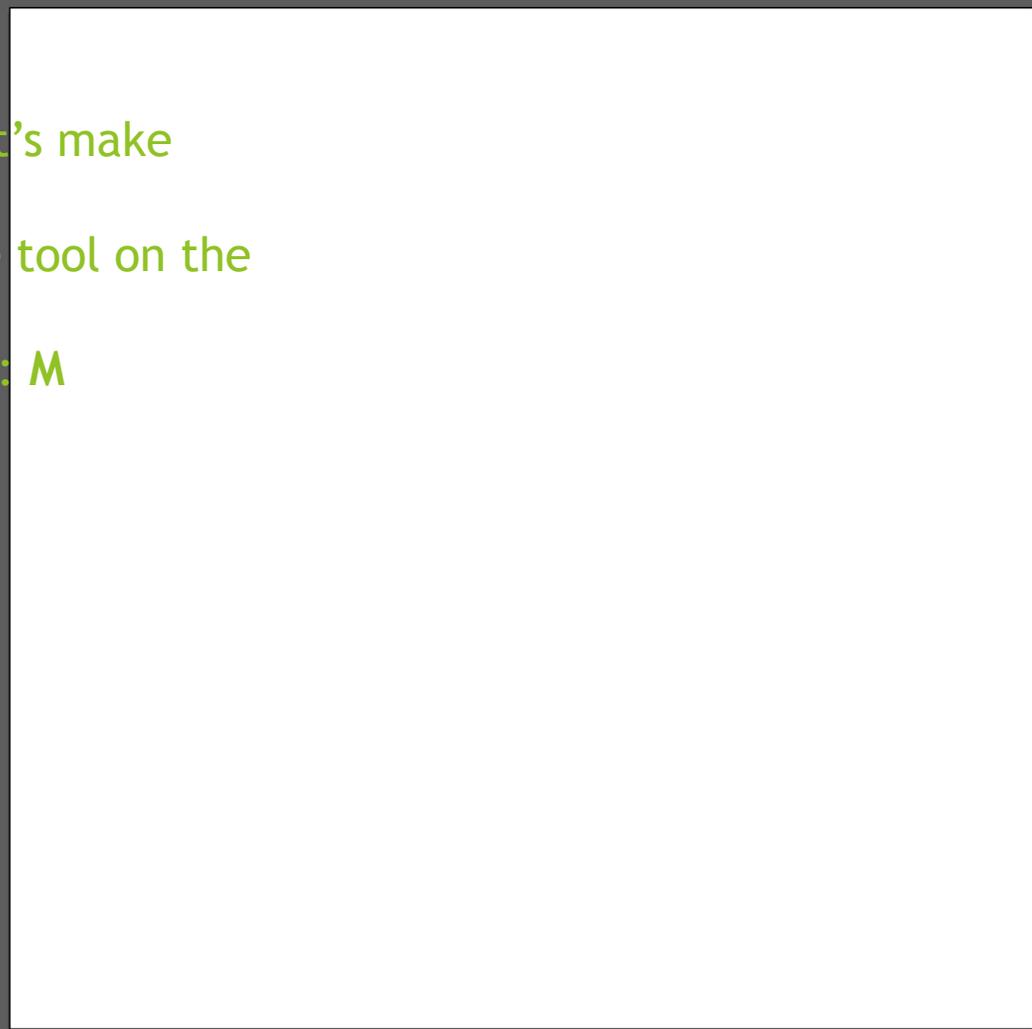
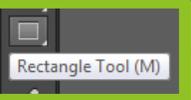
- Layer 1

1 Layer

Shapes

Lines are cool, but let's make shapes:

- Click the rectangle tool on the left-hand toolbar
- Hotkey (rectangle): **M**



Shapes

- Rectangle Tool (M)
- Rounded Rectangle Tool
- Ellipse Tool (L)
- Polygon Tool
- Star Tool
- Flare Tool

You can also select different shapes by holding down your left-mouse key and clicking on a new shape.

- Hotkey (ellipse): L
^mnemonic: eLLipse

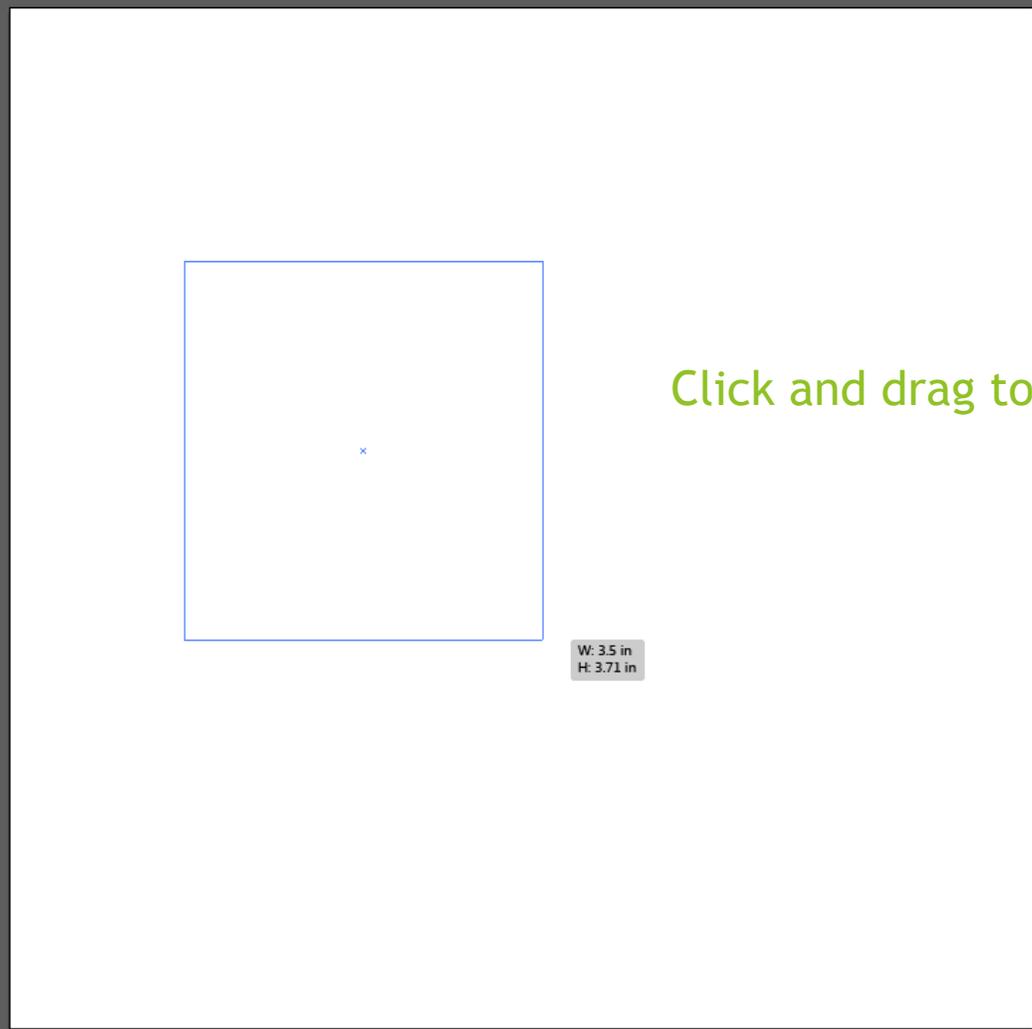


Layers Artboards

Layer 1

1 Layer

Shapes



Click and drag to create a shape.

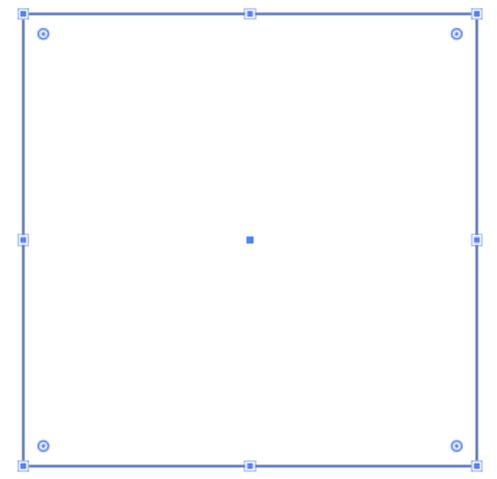
Layers Artboards

Layer 1

1 Layer

Shapes

After creating the shape, you can precisely alter its dimensions here.



Layers Artboards

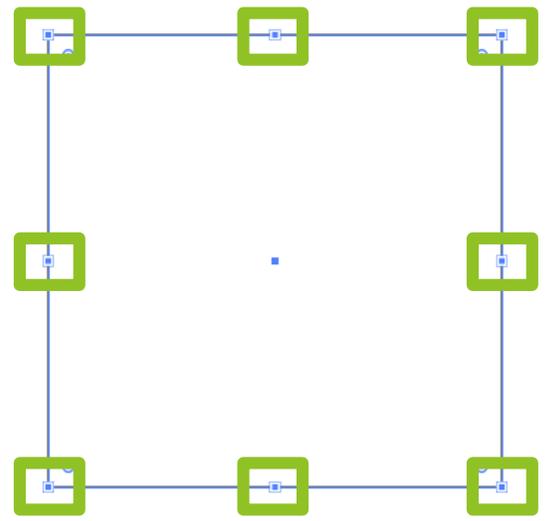
Layer 1

1 Layer

The Layers panel is located in the bottom right corner of the workspace. It has a tab labeled 'Layers' and another labeled 'Artboards'. Under the 'Layers' tab, there is a single layer named 'Layer 1'. The layer is represented by a small square icon with a blue border and a white fill. Below the layer name, there are several icons for layer management, including a magnifying glass, a square, a double square, a trash can, and a lock icon.

Shapes

Or you can freely resize it by using the corner/edge boxes:



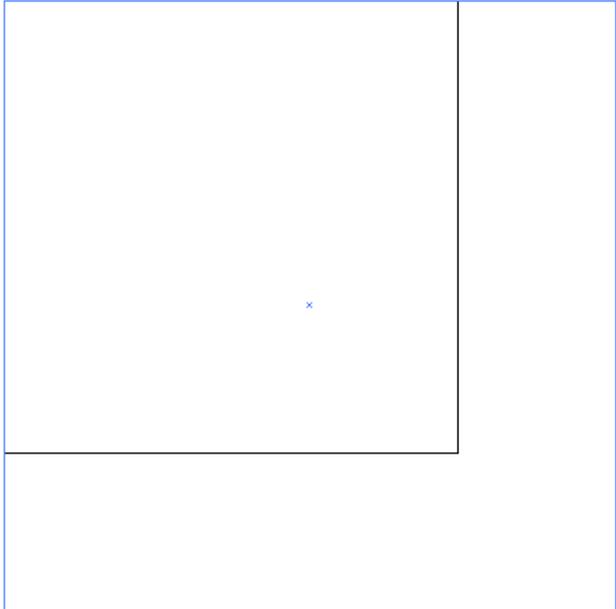
Layers Artboards

Layer 1

1 Layer

Shapes

When freely resizing, **SHIFT+DRAG** resizes while keeping dimension ratios locked,



W:5.97 in
H:5.97 in

Layers Artboards

Layer 1

1 Layer

Shapes

ALT+DRAG resizes with respect to the center point.

X: 7.44 in
Y: 9.07 in
anchor

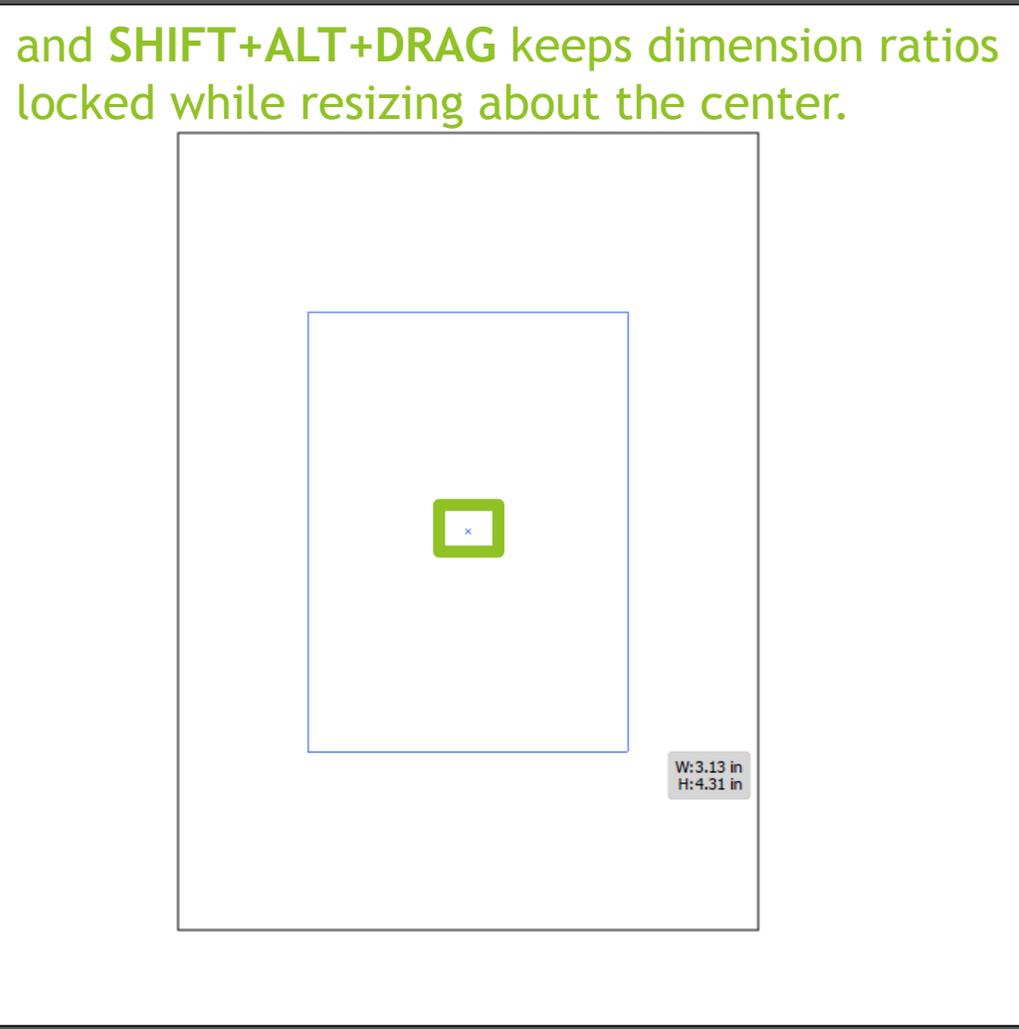
Layers Artboards

Layer 1

1 Layer

Shapes

and **SHIFT+ALT+DRAG** keeps dimension ratios locked while resizing about the center.



Layers Artboards

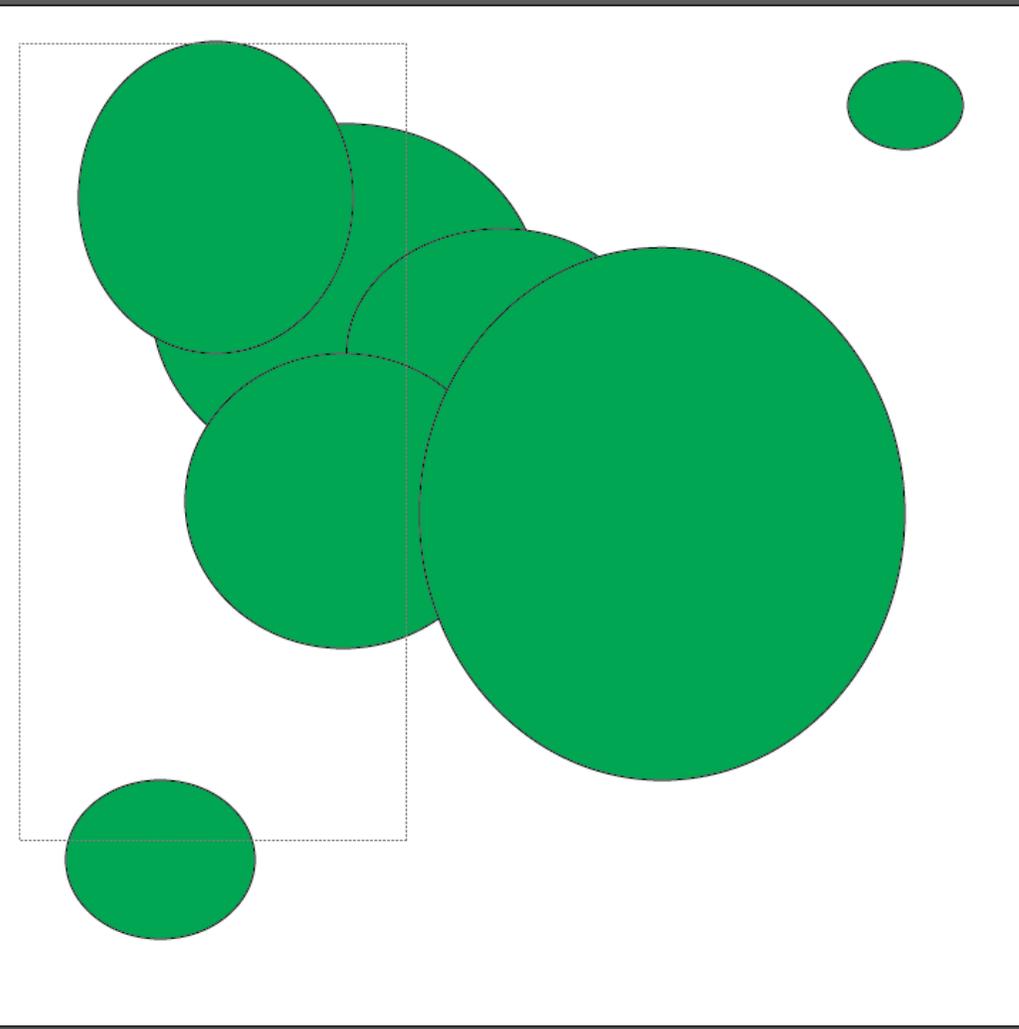
- Layer 1

1 Layer

Selection

Click and drag to select objects. Illustrator counts any object that is partially within the selection window as under your selection.

Hotkey (Select All Objects in Layer): **CTRL+A**



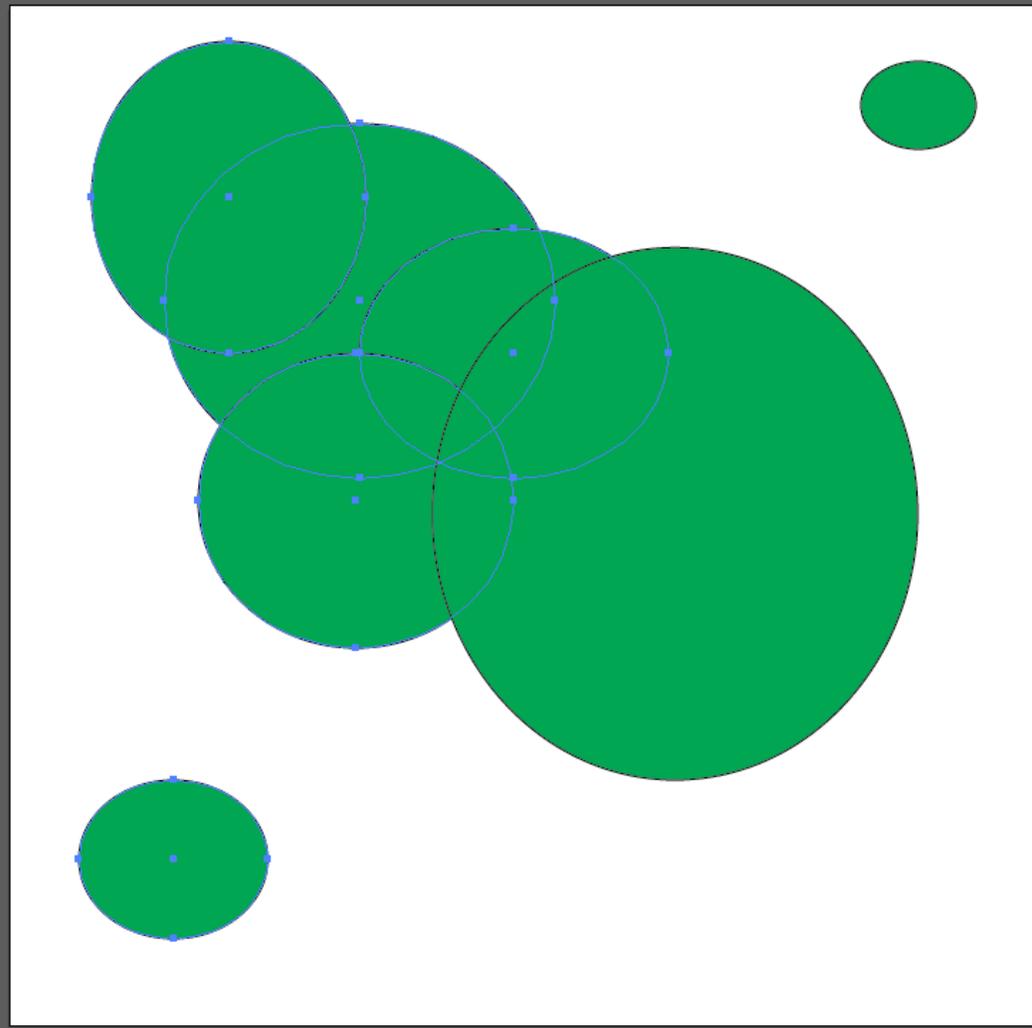
Layers Artboards

Layer 1

1 Layer

Selection

Or, **SHIFT+CLICK** to select multiple shapes at once.



Layers Artboards

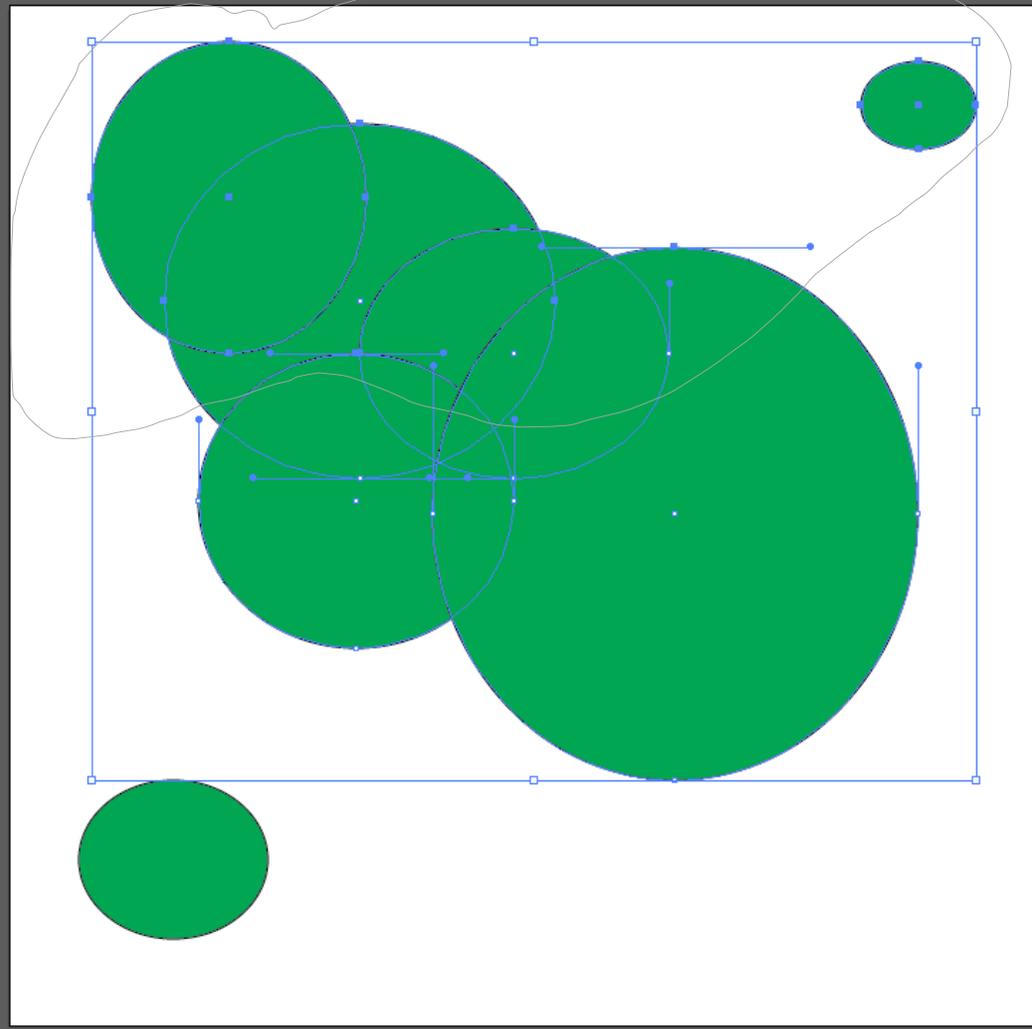
Layer 1

1 Layer

Selection

You can also use the Lasso Selection tool to create non-linear selection areas.

- Hotkey: Q



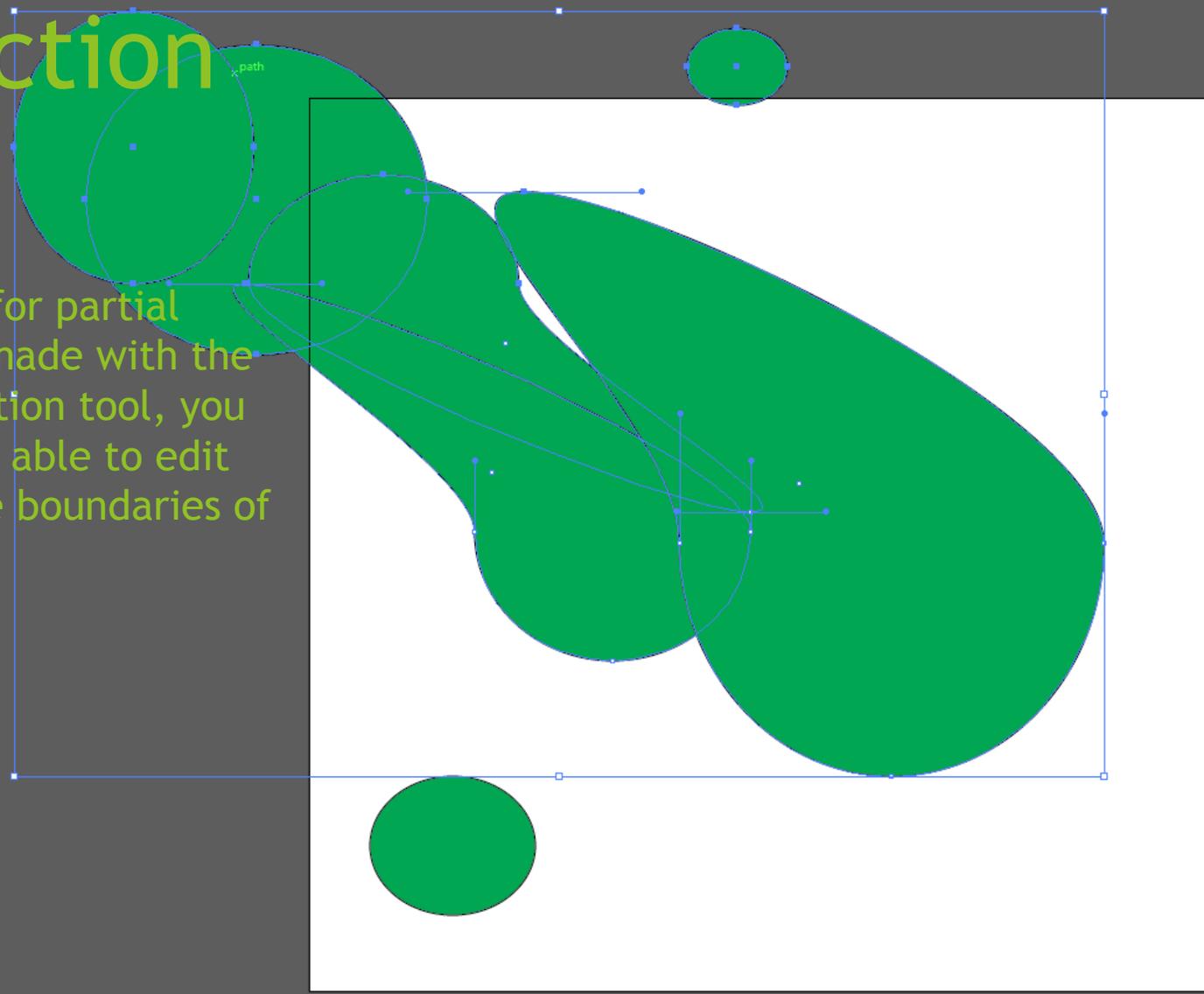
Layers Artboards

Layer 1

1 Layer

Selection

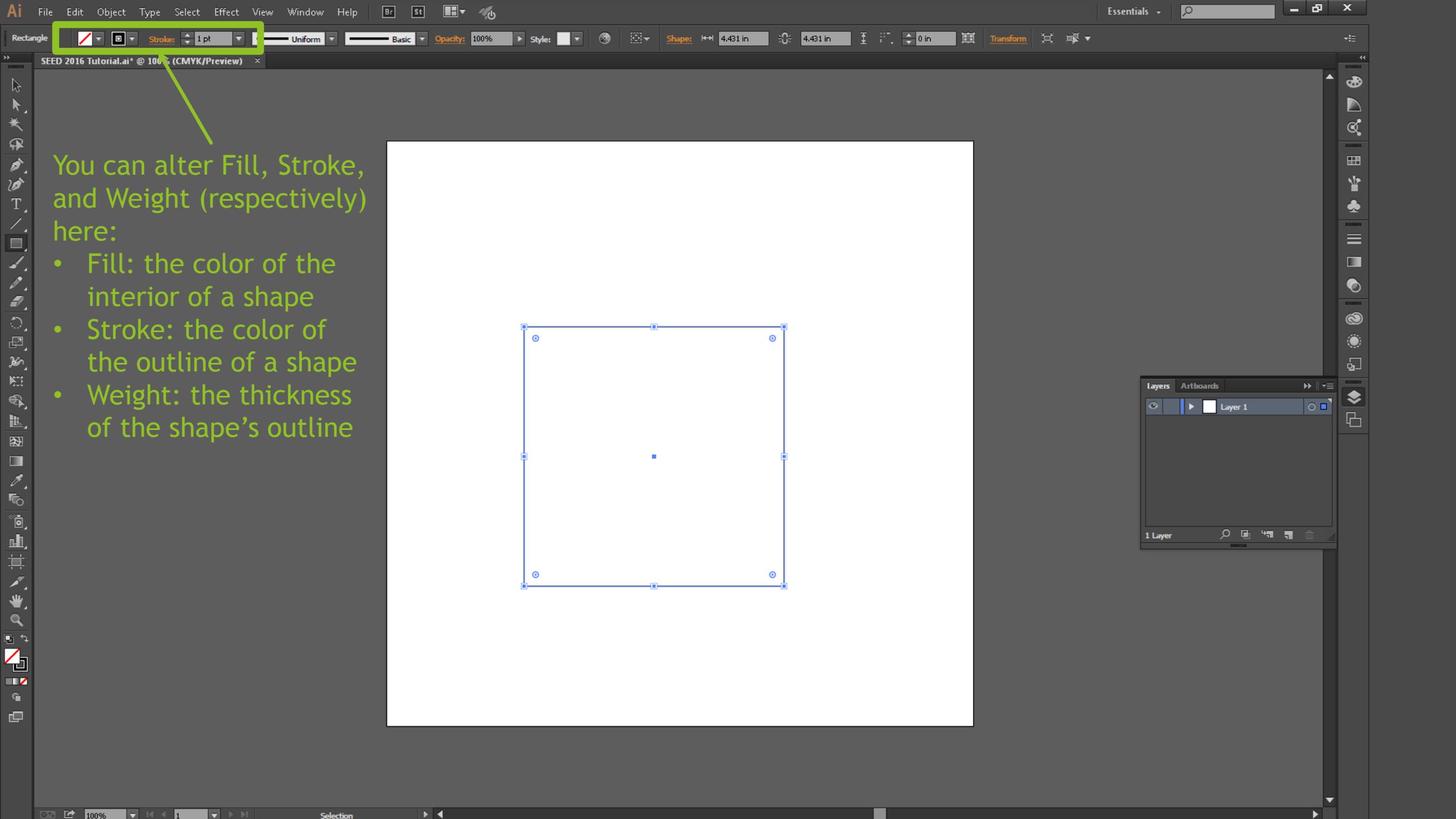
Note that, for partial selections made with the Lasso Selection tool, you will only be able to edit some of the boundaries of the shape.



Layers Artboards

Layer 1

1 Layer



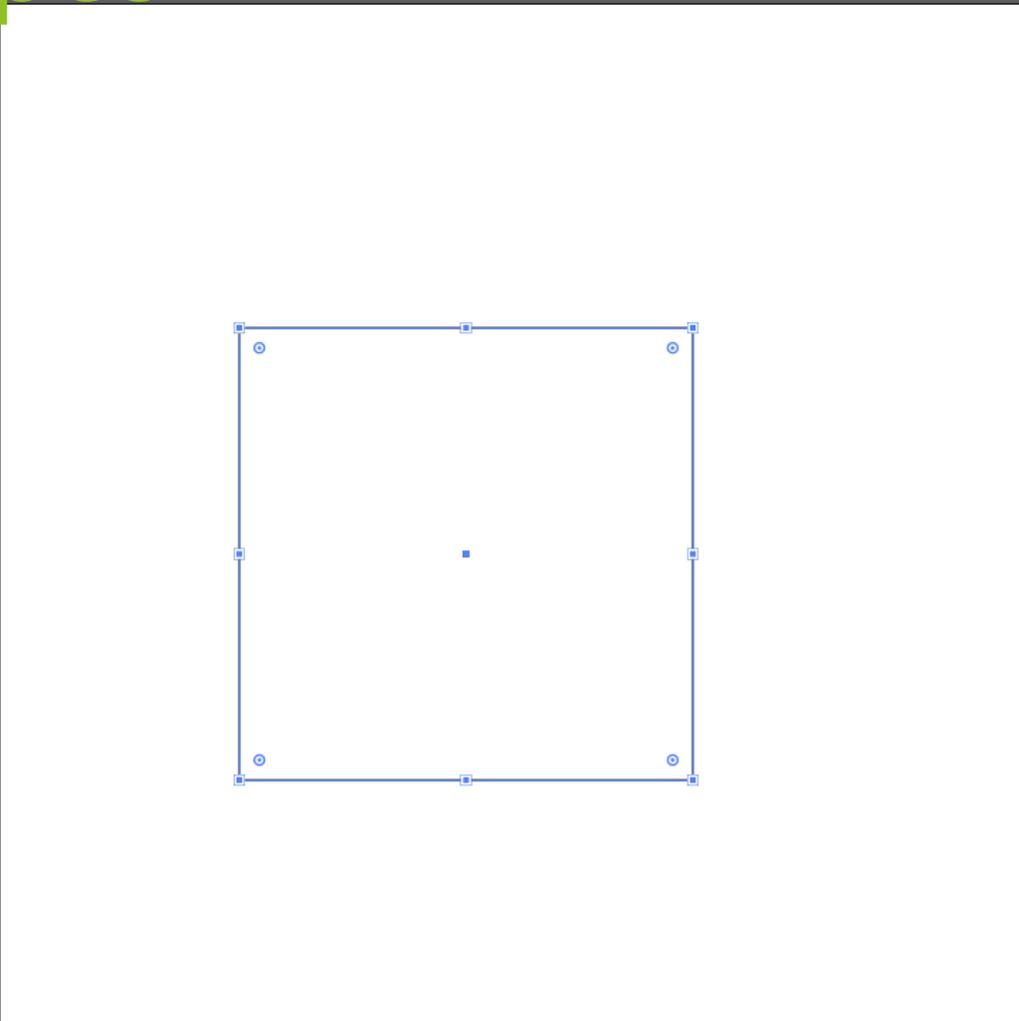
You can alter Fill, Stroke, and Weight (respectively) here:

- Fill: the color of the interior of a shape
- Stroke: the color of the outline of a shape
- Weight: the thickness of the shape's outline

Editing Shapes

You can also copy/paste shapes using traditional hotkeys:

- Hotkey (copy): CTRL + C
- Hotkey (paste): CTRL + V
- Hotkey (cut): CTRL + X



Layers Artboards

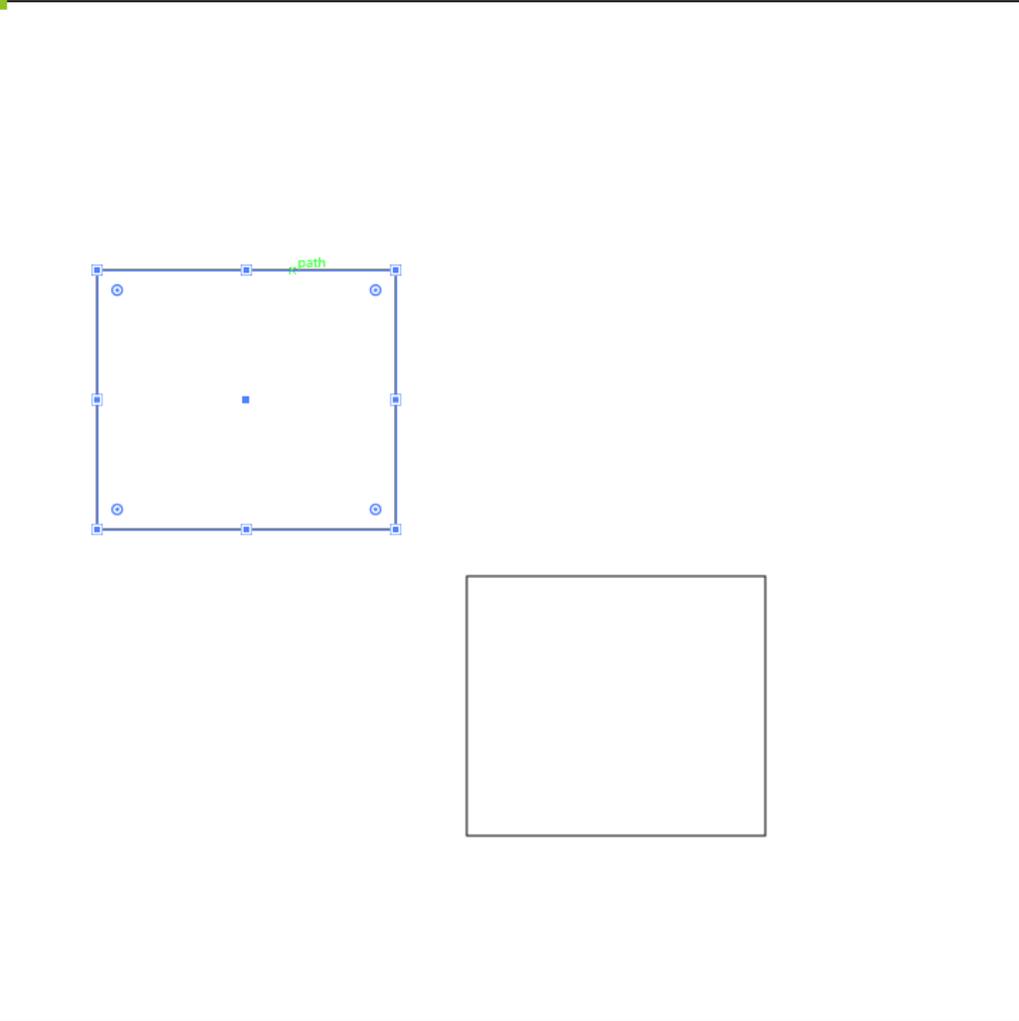
Layer 1

1 Layer

 The Layers panel is open, showing a single layer named "Layer 1" with a square icon next to it. The panel includes standard layer controls like visibility, lock, and selection.

Editing Shapes

ALT+DRAG places a copy of the shape in the location that you drag your mouse.

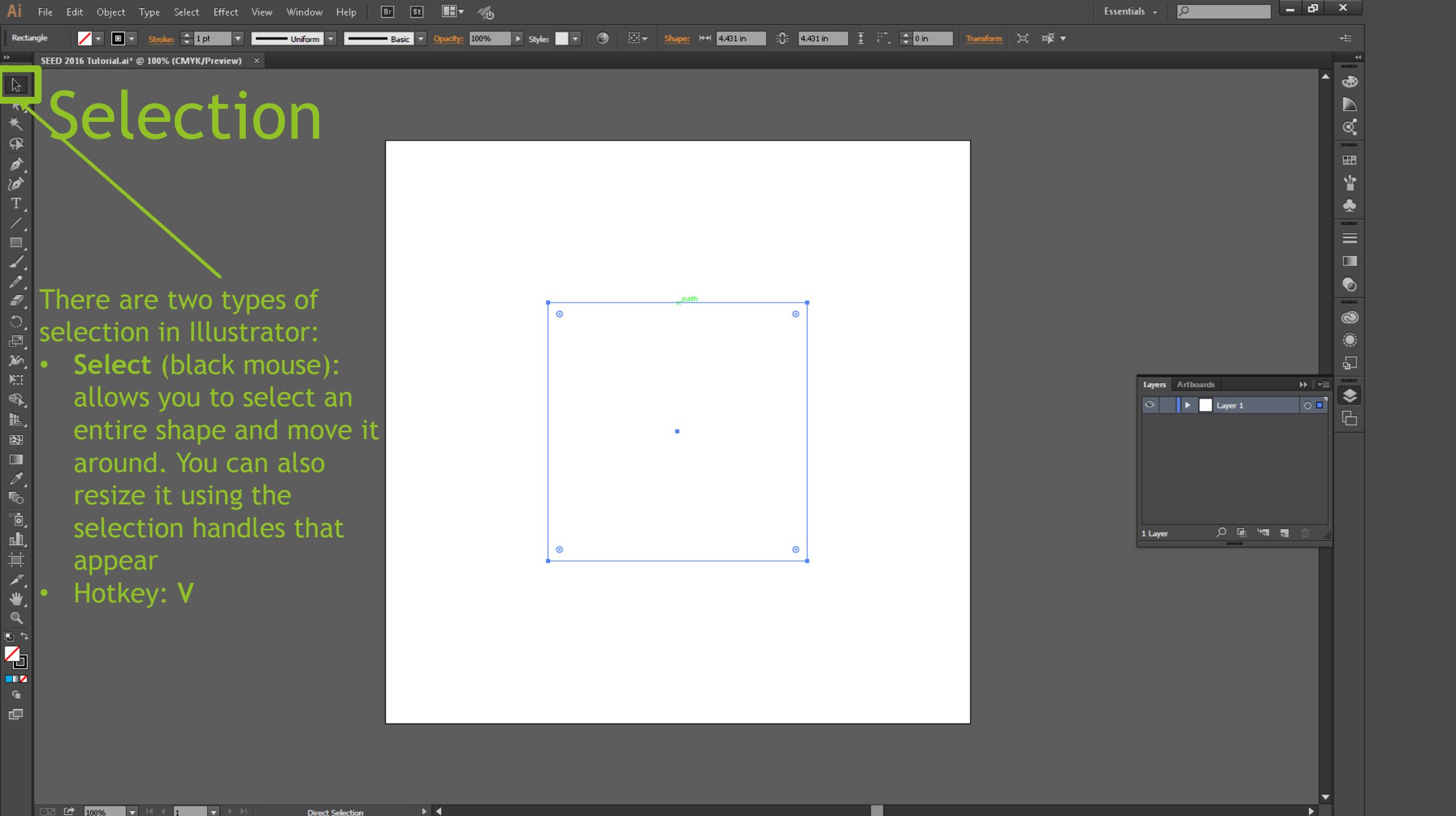


Layers Artboards

Layer 1

1 Layer

The Layers panel is located in the bottom right corner of the workspace. It has a tab labeled "Layers" and another labeled "Artboards". Under the "Layers" tab, there is a single layer named "Layer 1" which is currently selected. The layer name is displayed in a blue bar. Below the layer name, there are several icons for layer management, including a visibility icon (an eye), a lock icon, and a fill icon. At the bottom of the panel, it indicates "1 Layer".



Selection

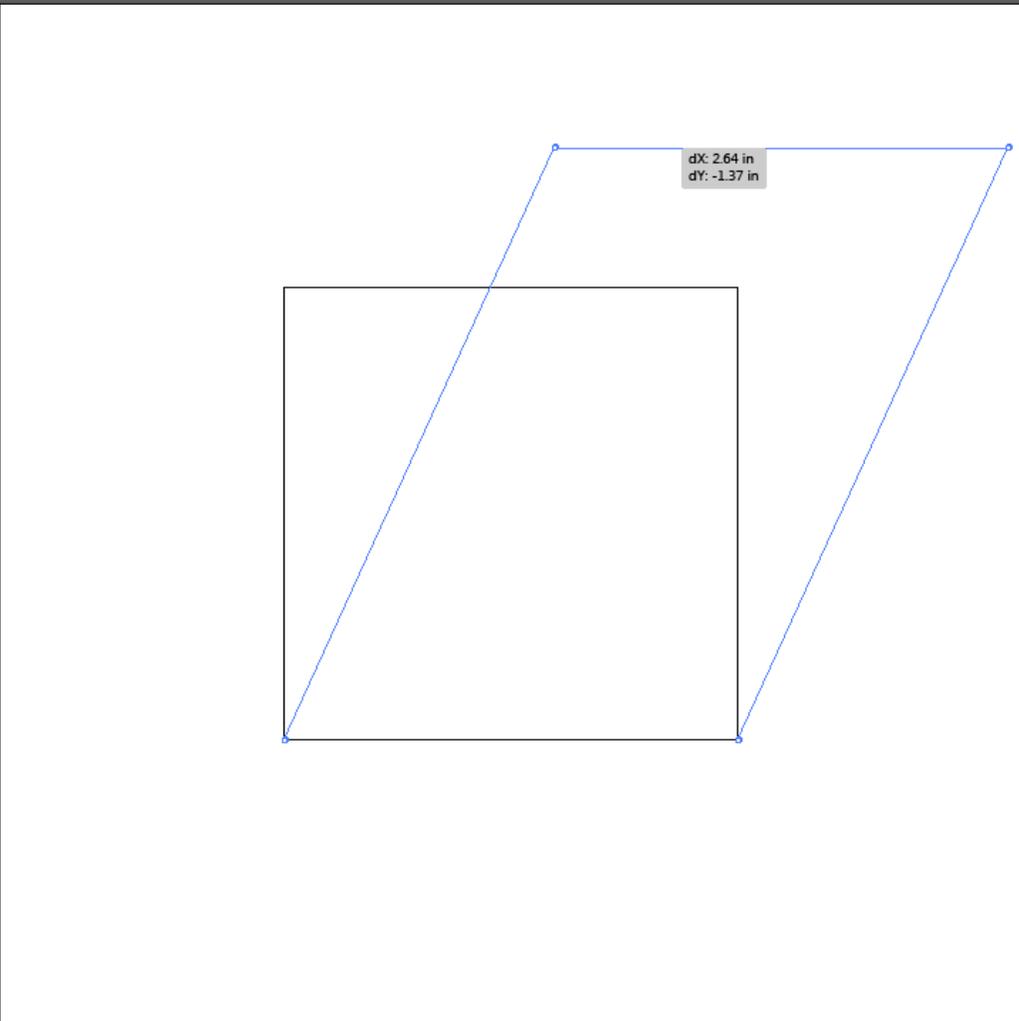
There are two types of selection in Illustrator:

- **Select** (black mouse): allows you to select an entire shape and move it around. You can also resize it using the selection handles that appear
- **Hotkey: V**

Selection

There are two types of selection in Illustrator:

- **Direct select** (white mouse): allows you to select individual pieces of a shape and move them freely
- **Hotkey: A**
- Note that this is the same kind of selection as Lasso Selection



Layers Artboards

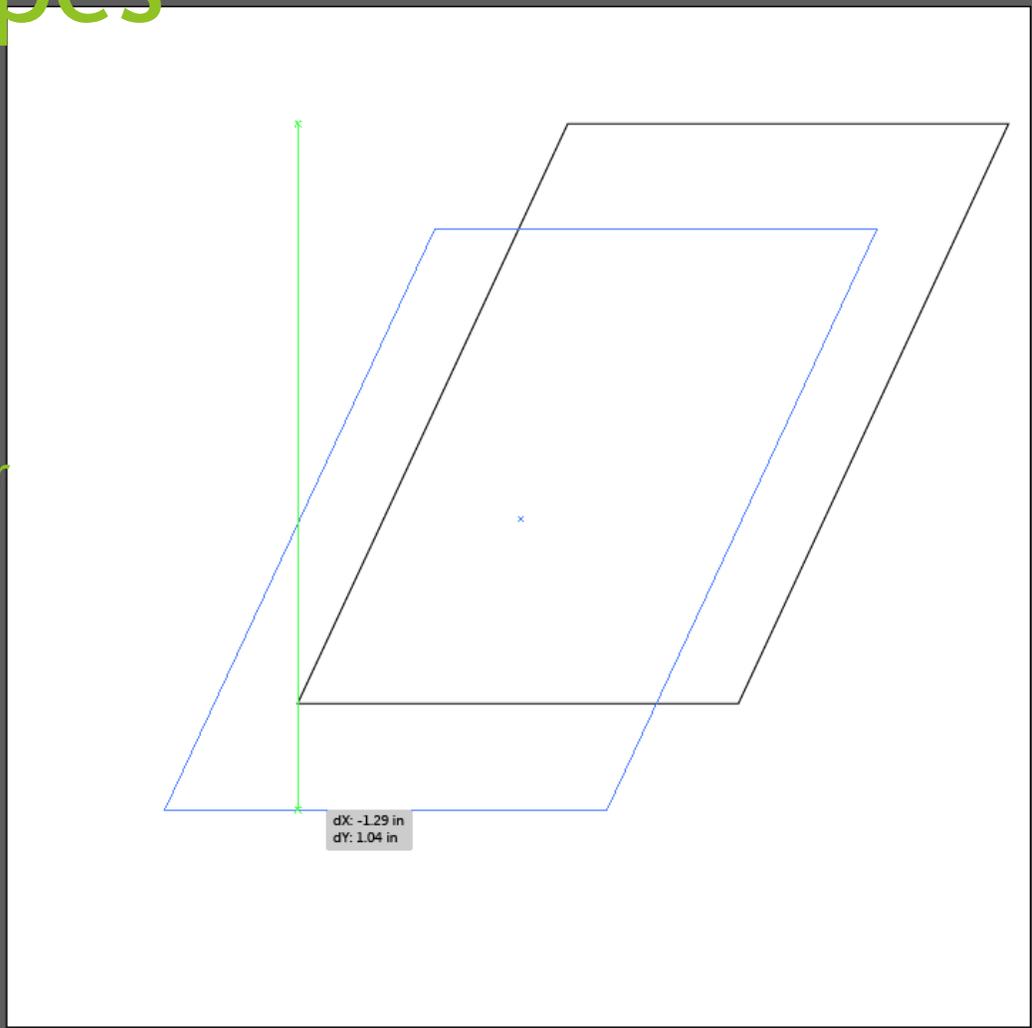
- Layer 1

1 Layer

Editing Shapes

Move shapes by clicking and dragging on their outlines.

SHIFT+DRAG constrains your movement to a single axis (only drag horizontally/vertically)



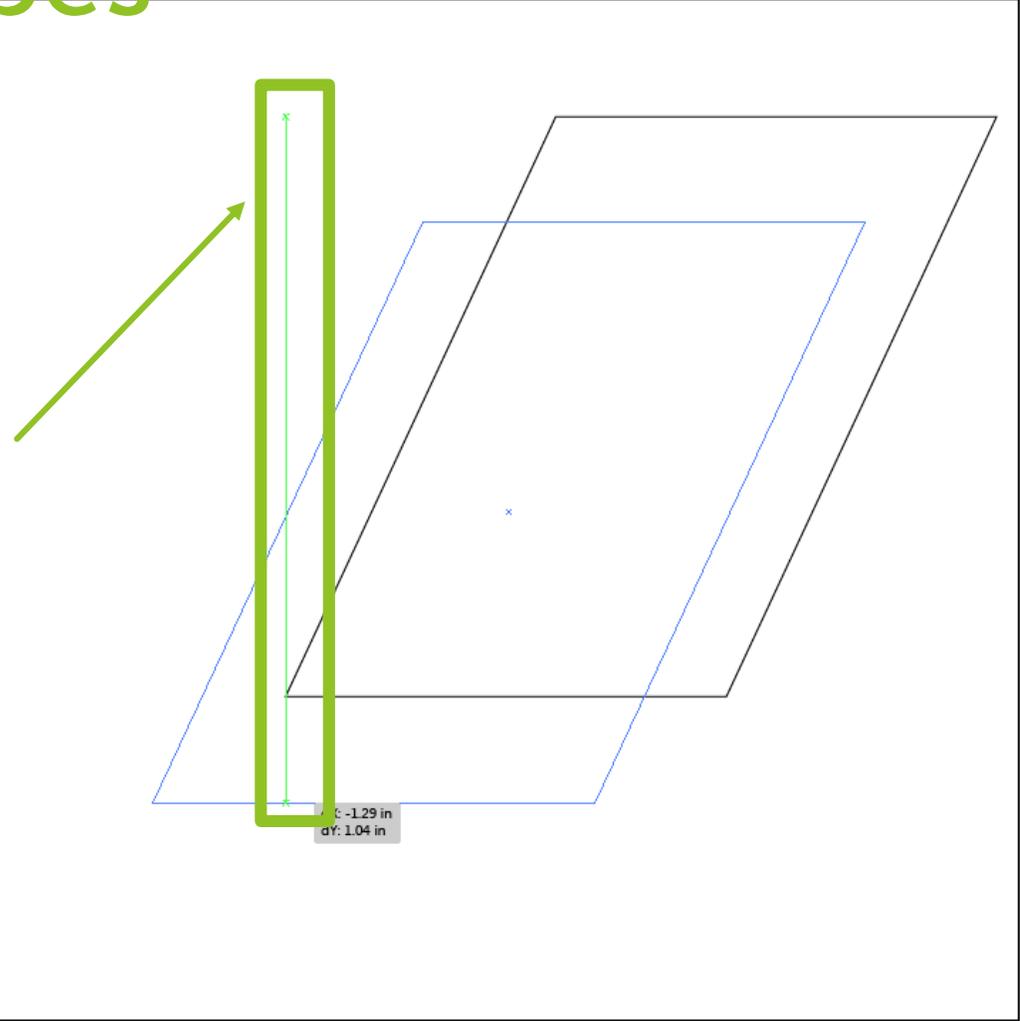
Layers Artboards

- Layer 1

1 Layer

Editing Shapes

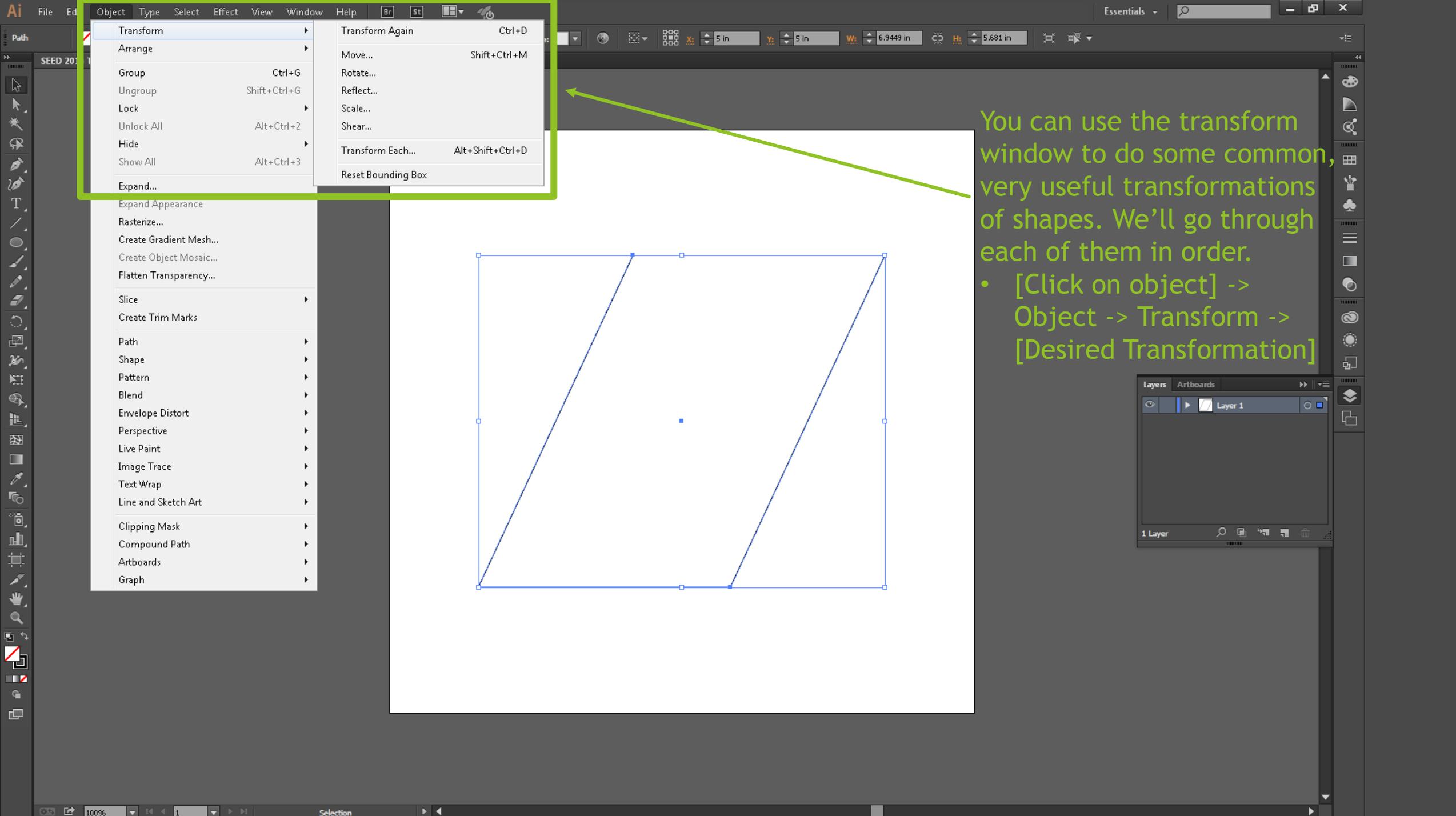
The bright green lines you see are called SmartGuides. They allow you to auto-snap onto relevant features of other shapes (centers, edges, and corners).



Layers Artboards [Icons]

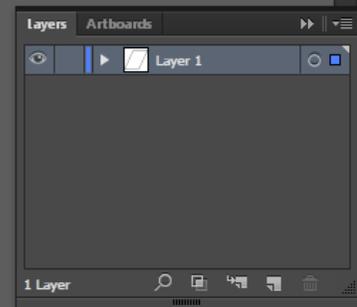
Layer 1 [Icons]

1 Layer [Icons]



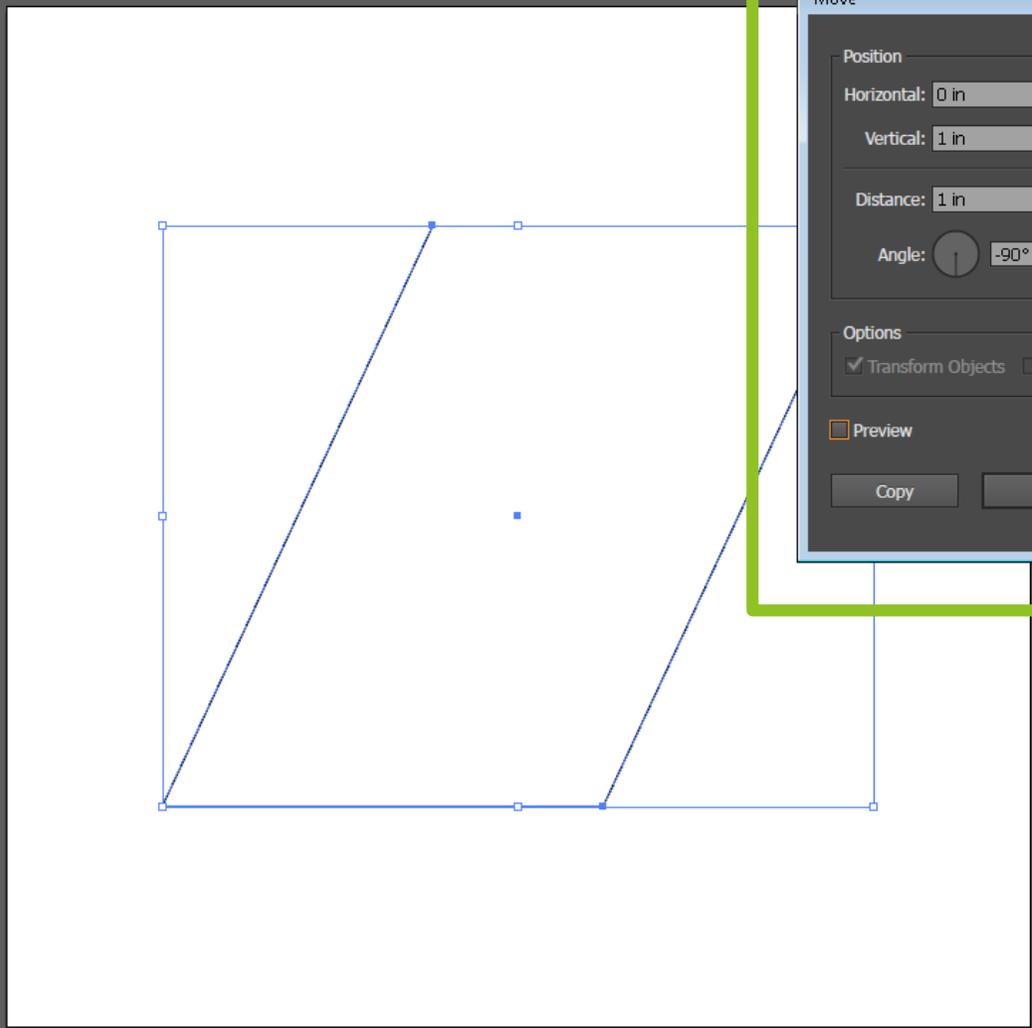
You can use the transform window to do some common, very useful transformations of shapes. We'll go through each of them in order.

- [Click on object] -> Object -> Transform -> [Desired Transformation]



Move

“Move” offers a more precise version of clicking and dragging a shape around the workspace.



Move

Position

Horizontal: 0 in

Vertical: 1 in

Distance: 1 in

Angle: -90°

Options

Transform Objects Transform Patterns

Preview

Copy OK Cancel

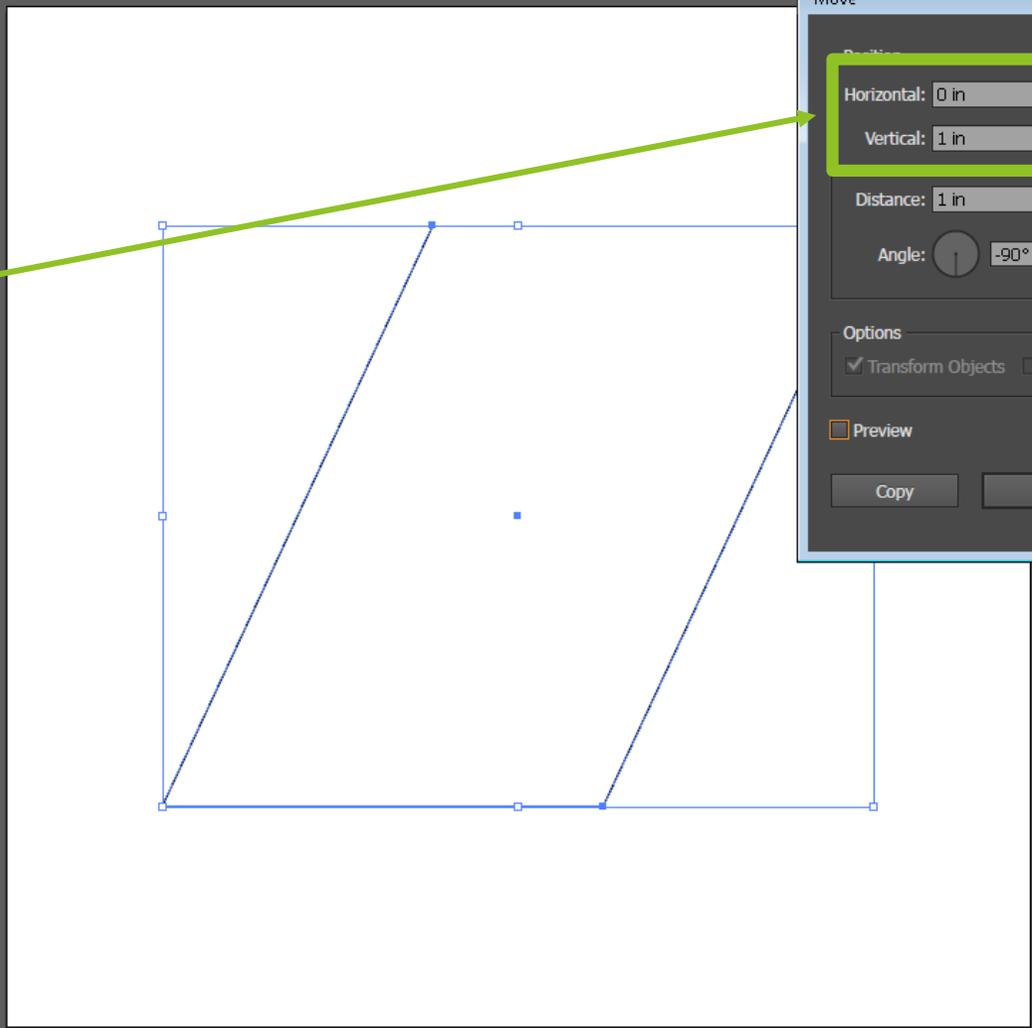
Layers Artboards

Layer 1

1 Layer

Move

You can control the horizontal/vertical displacements of the shape in this window.



Move

Horizontal: 0 in
Vertical: 1 in

Distance: 1 in
Angle: -90°

Options
 Transform Objects Transform Patterns

Preview

Copy OK Cancel

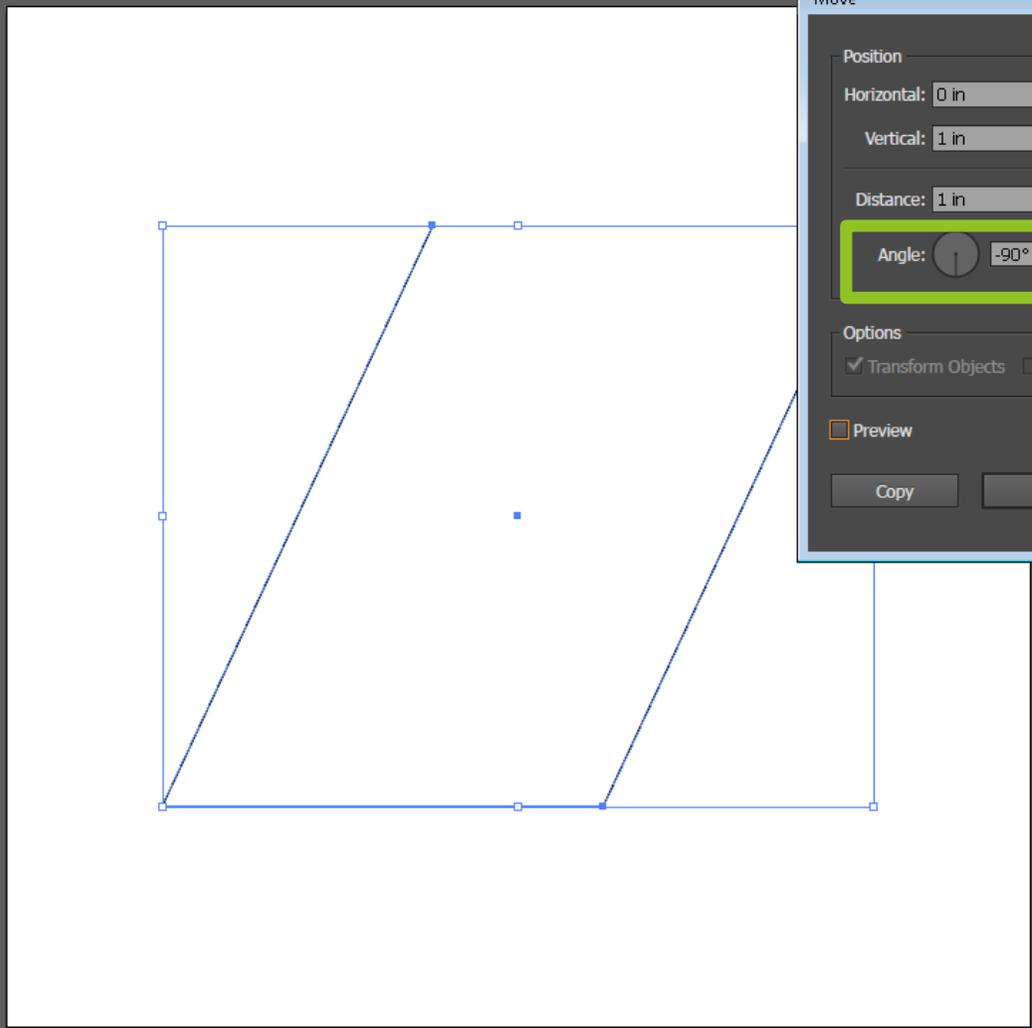
Layers Artboards

Layer 1

1 Layer

Move

If you get confused about where the shape will go, this line is a good indicator...



Move

Position

Horizontal: 0 in

Vertical: 1 in

Distance: 1 in

Angle:

Options

Transform Objects Transform Patterns

Preview

Copy OK Cancel

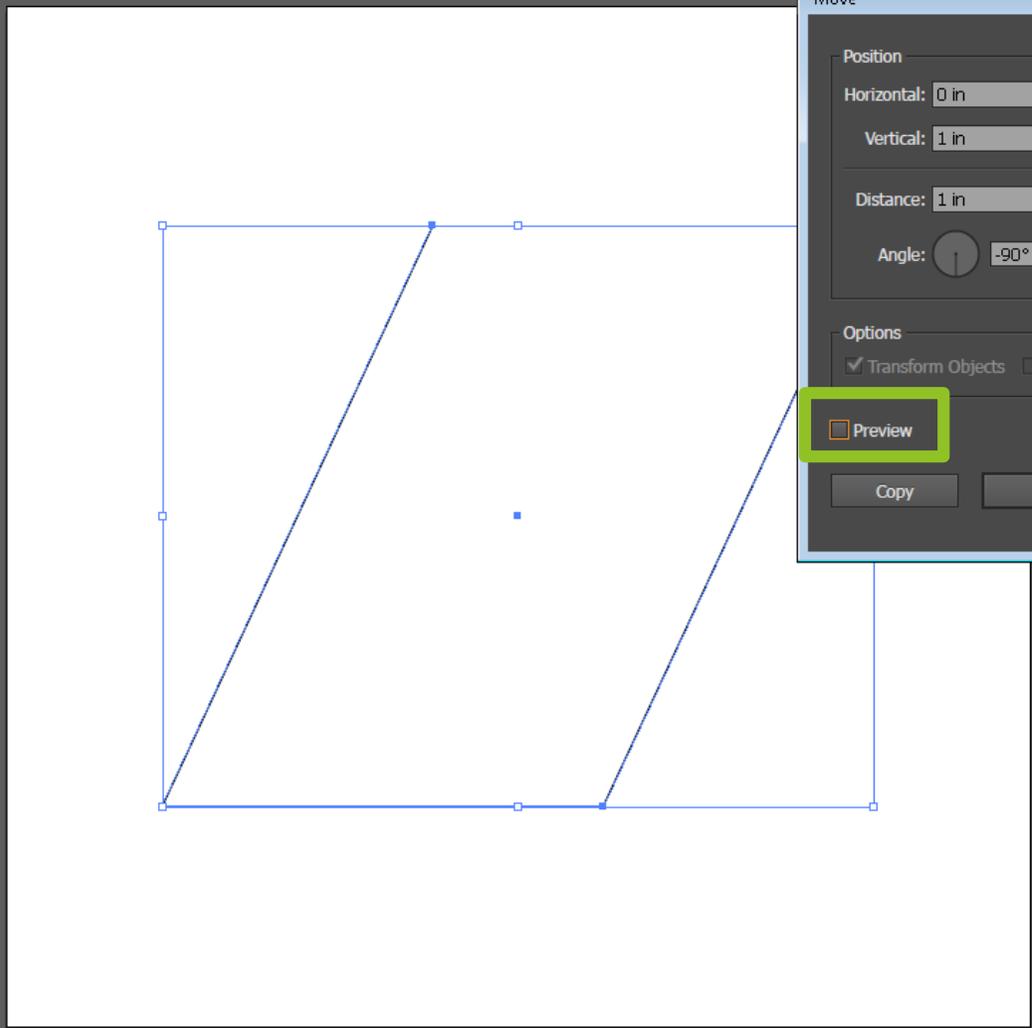
Layers Artboards

Layer 1

1 Layer

Move

...as is the "Preview" button.



Move

Position

Horizontal: 0 in

Vertical: 1 in

Distance: 1 in

Angle: -90°

Options

Transform Objects Transform Patterns

Preview

Copy OK Cancel

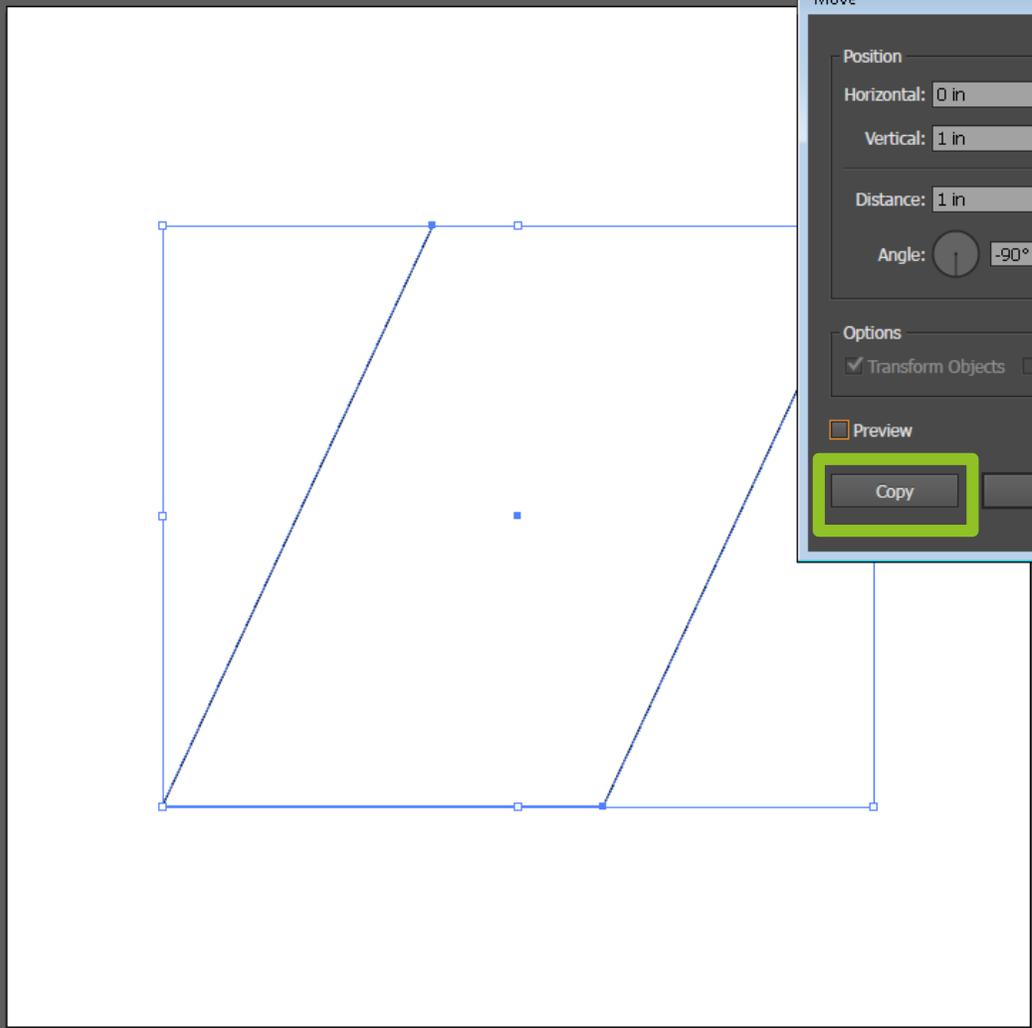
Layers Artboards

Layer 1

1 Layer

Move

The "Copy" button allows you to create a copy of the shape in the desired location rather than just moving it.



Move

Position

Horizontal: 0 in

Vertical: 1 in

Distance: 1 in

Angle: -90°

Options

Transform Objects Transform Patterns

Preview

Copy OK Cancel

Layers Artboards

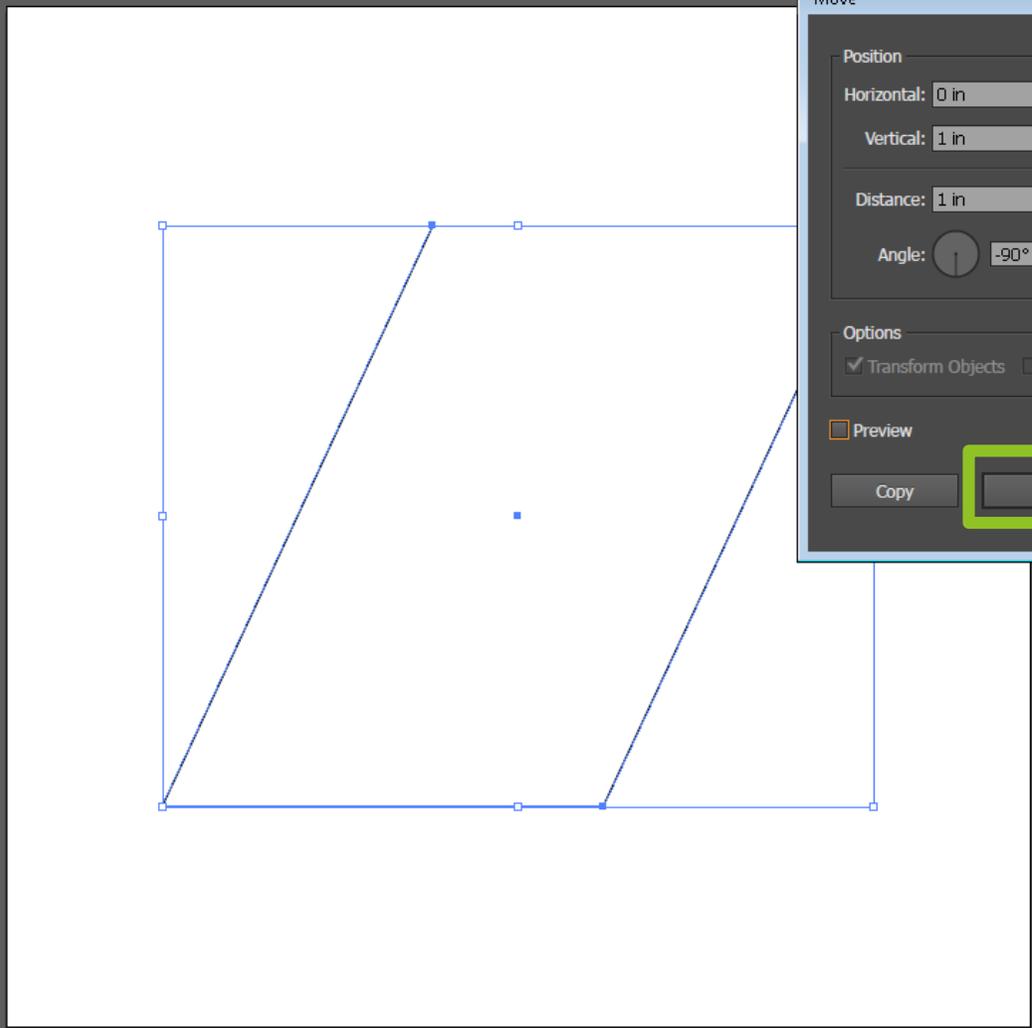
Layer 1

1 Layer

Move

Otherwise, press "Okay" or the ENTER key to move your object.

- Hotkey: CTRL+SHIFT+M



Move

Position

Horizontal: 0 in

Vertical: 1 in

Distance: 1 in

Angle: -90°

Options

Transform Objects Transform Patterns

Preview

Copy OK Cancel

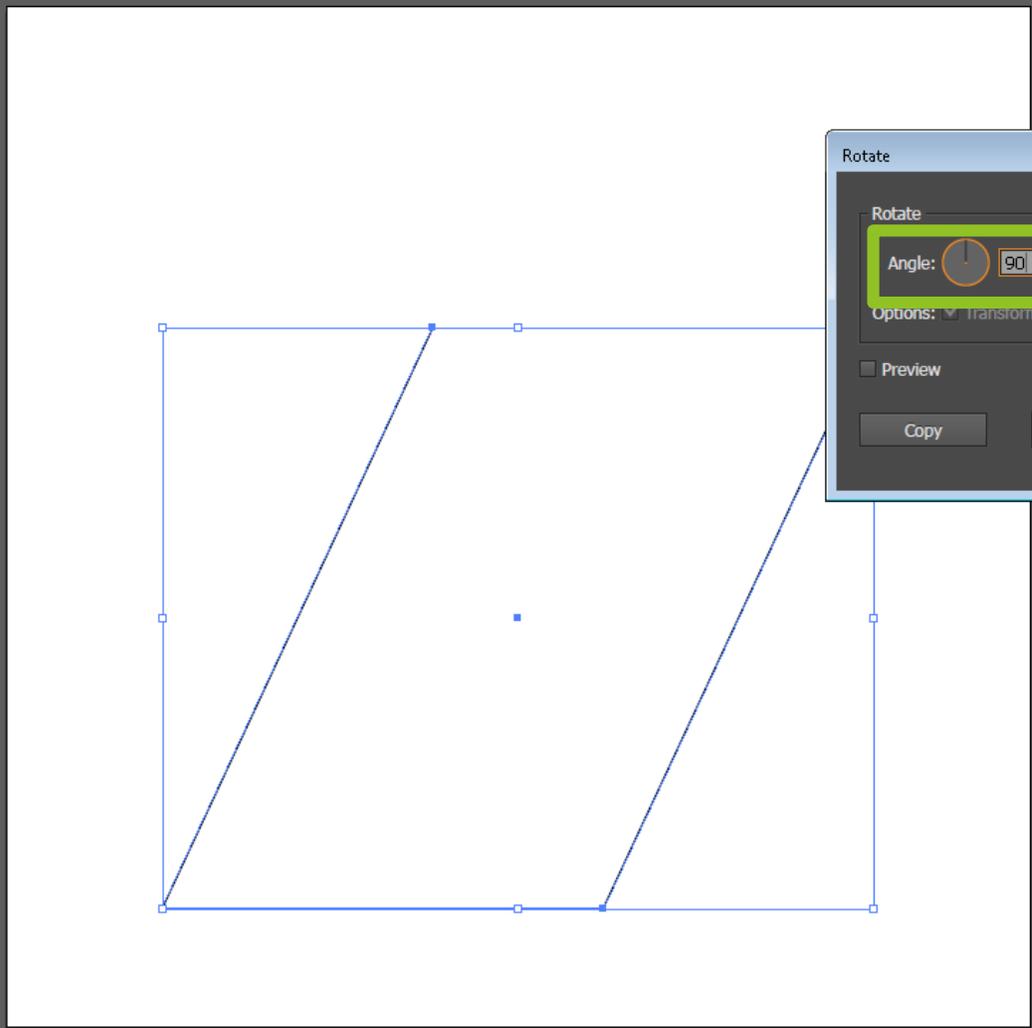
Layers Artboards

Layer 1

1 Layer

Rotate

The Rotate option has essentially identical options (Preview, Copy, and Transform), but for rotations about the center of an object.



Rotate

Rotate

Angle:

Options: Transform Objects Transform Patterns

Preview

Copy OK Cancel

Layers Artboards

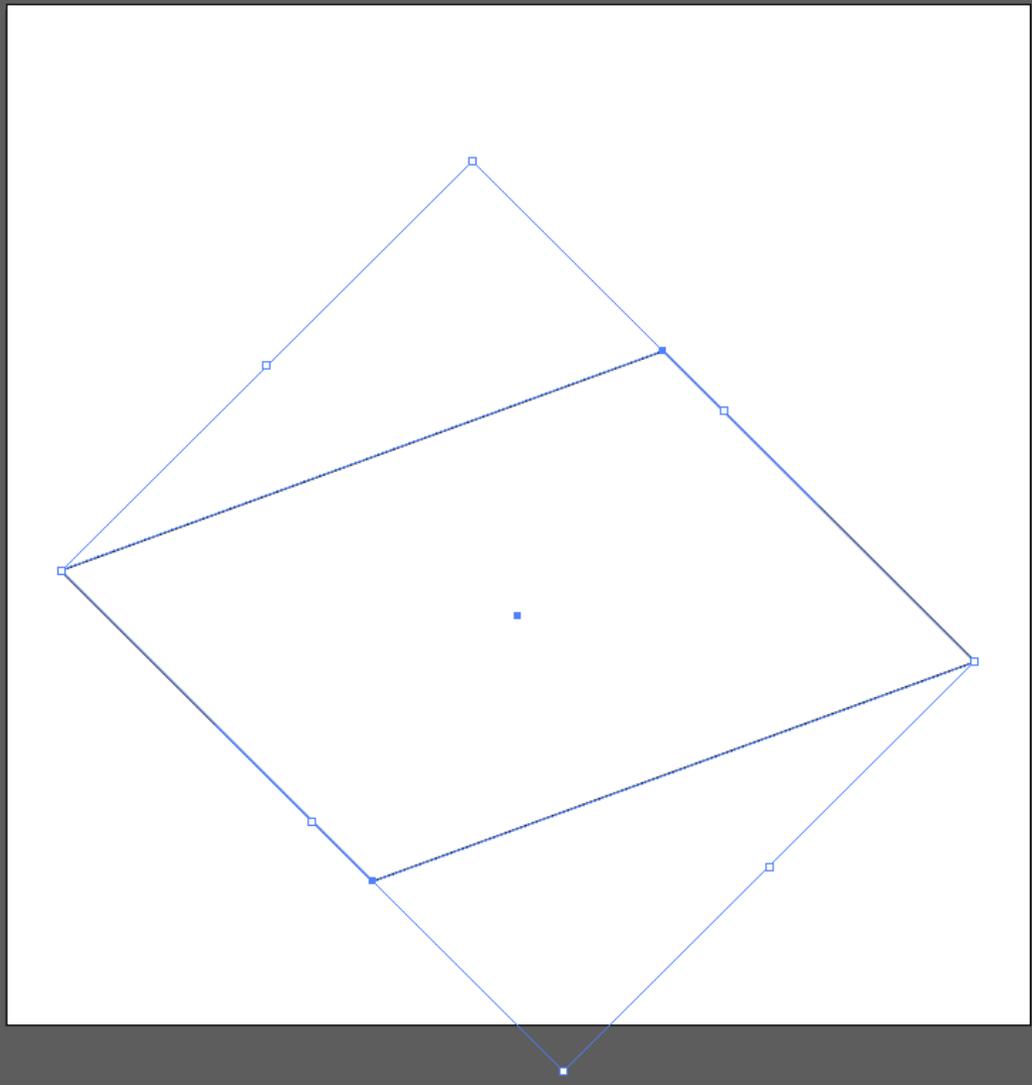
Layer 1

1 Layer

Rotate

You can also Rotate a shape by hovering over a corner of the shape and clicking the arrows that appear.

- Hotkey: **SHIFT+DRAG** rounds your rotation to the nearest 45°



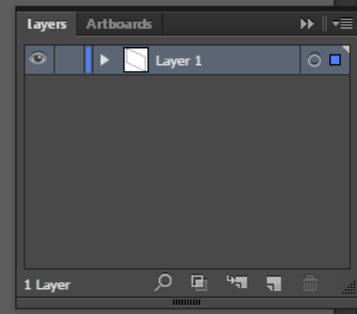
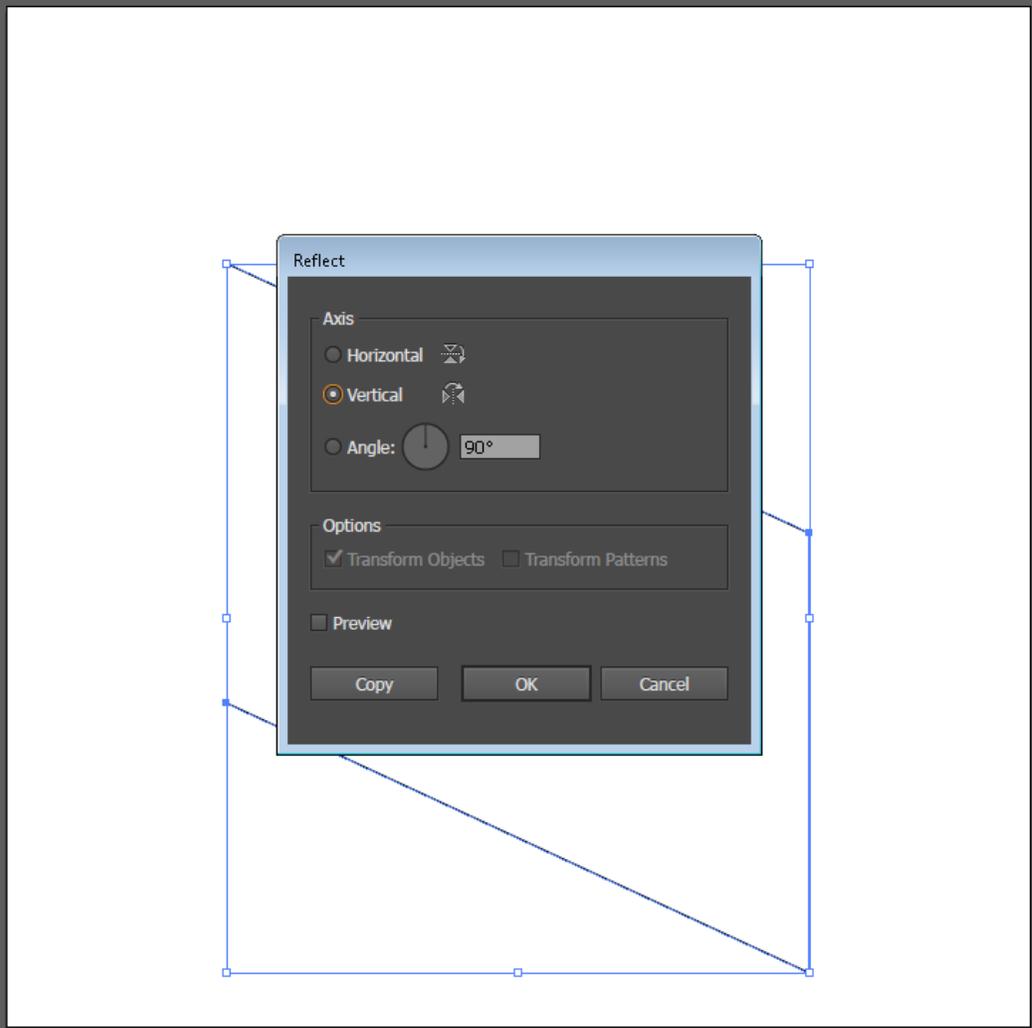
Layers Artboards

Layer 1

1 Layer

Reflect

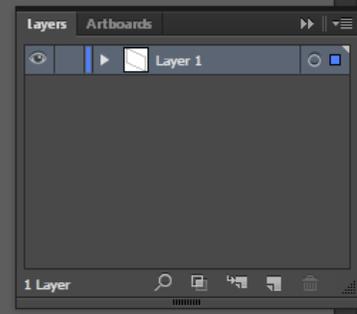
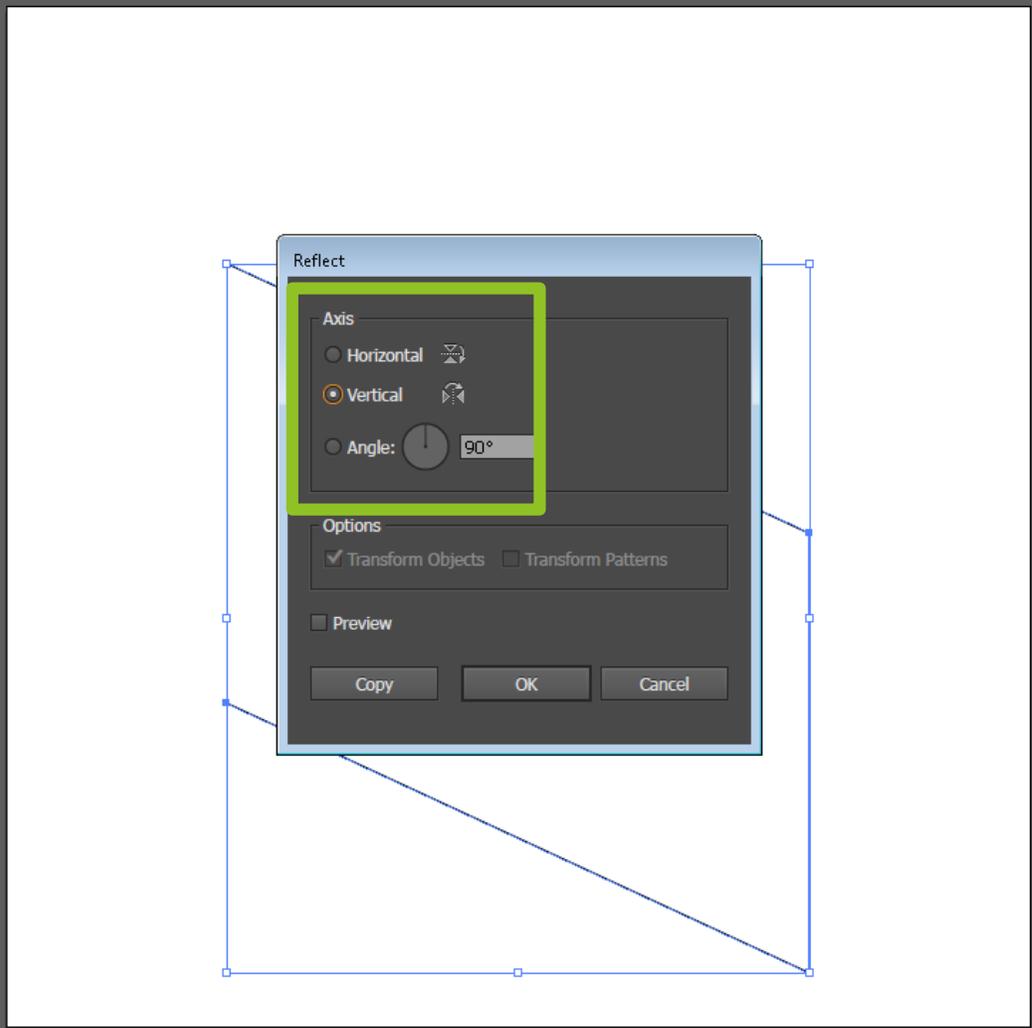
...as does the Reflect window.



Reflect

Note that you can choose the axis of reflection: the horizontal axis, the vertical axis, or an axis at an angle of your choice.

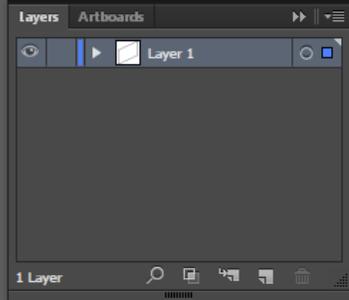
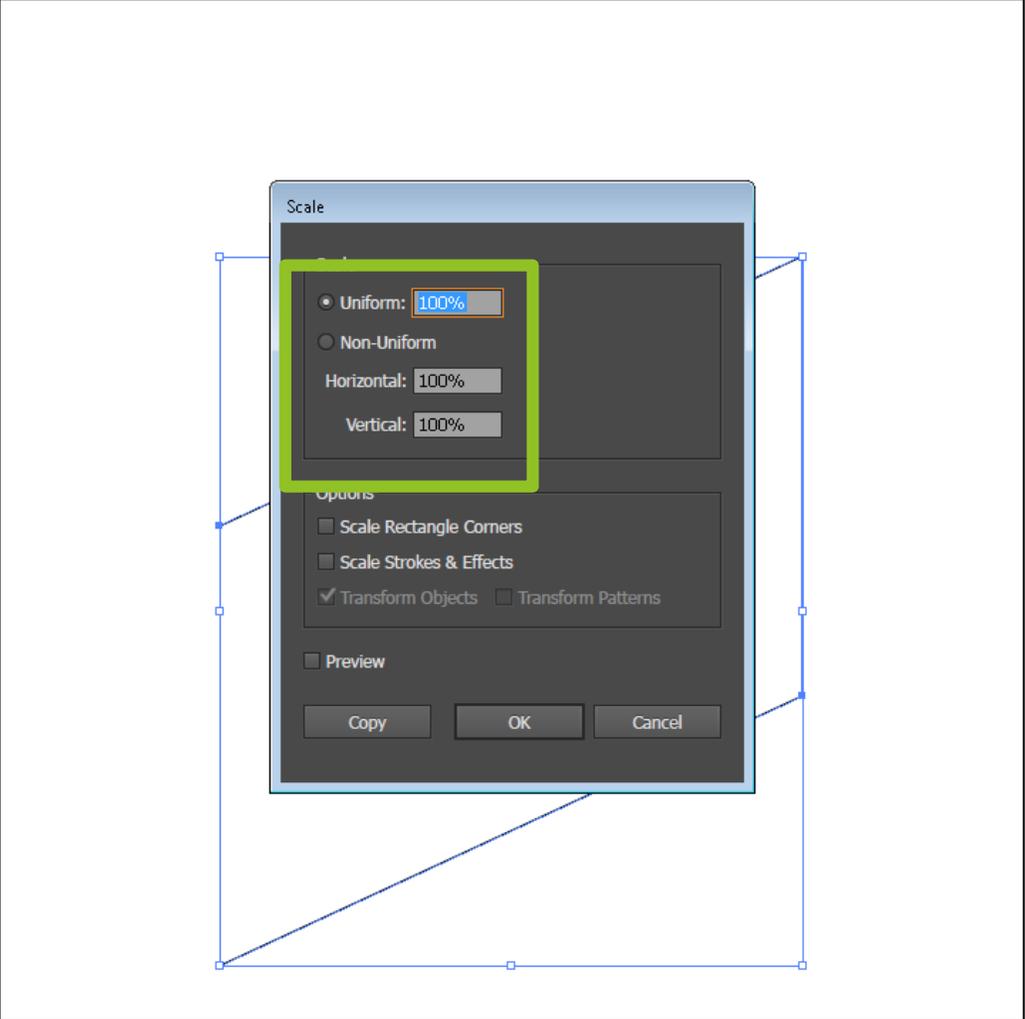
- Hotkey: O



Scale

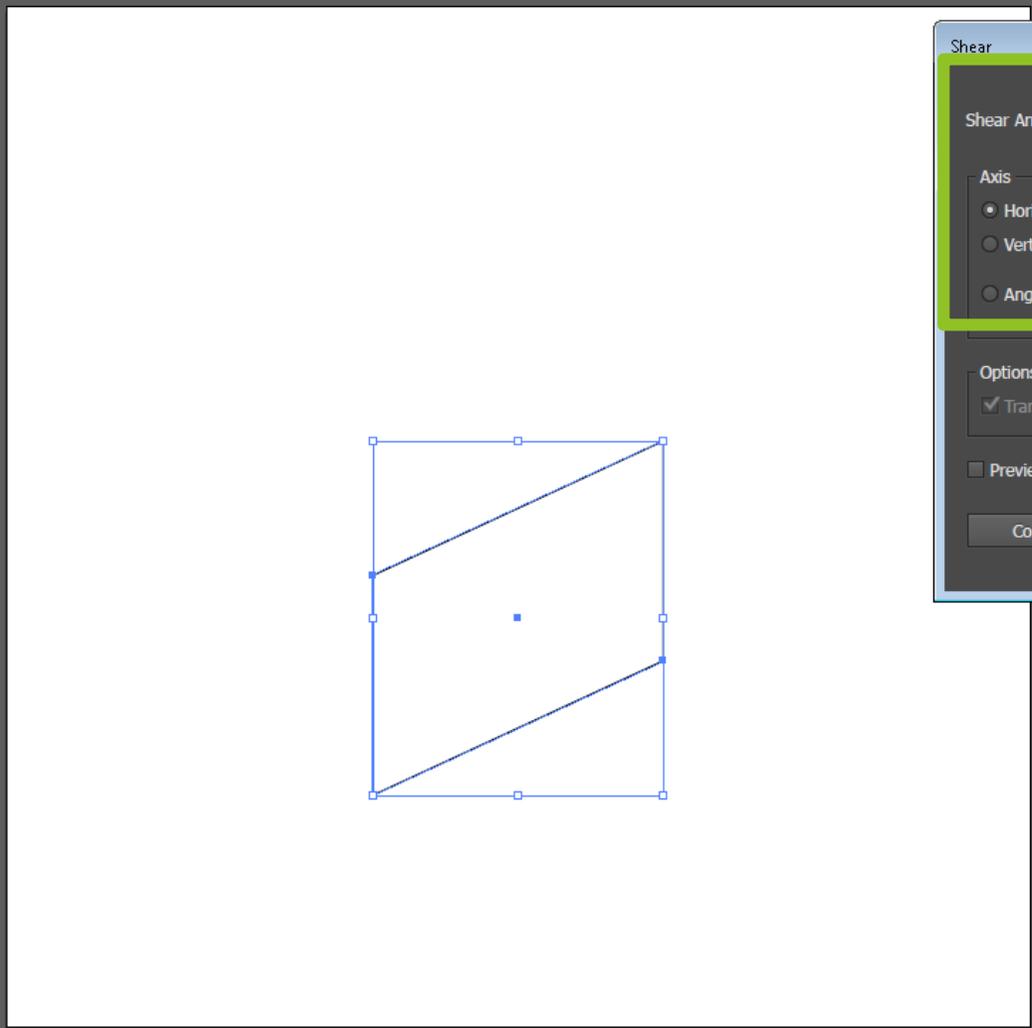
Scale allows you to resize the object precisely (Uniform), or to stretch the horizontal/vertical dimensions independently of one another (Non-Uniform).

- Hotkey: S



Shear

The Shear window is a little tricky, but it's also rarely used. You effectively distort an object at a given angle with respect to a chosen axis.



Shear

Shear Angle: 15

Axis

- Horizontal
- Vertical
- Angle: 0°

Options

Transform Objects Transform Patterns

Preview

Copy OK Cancel

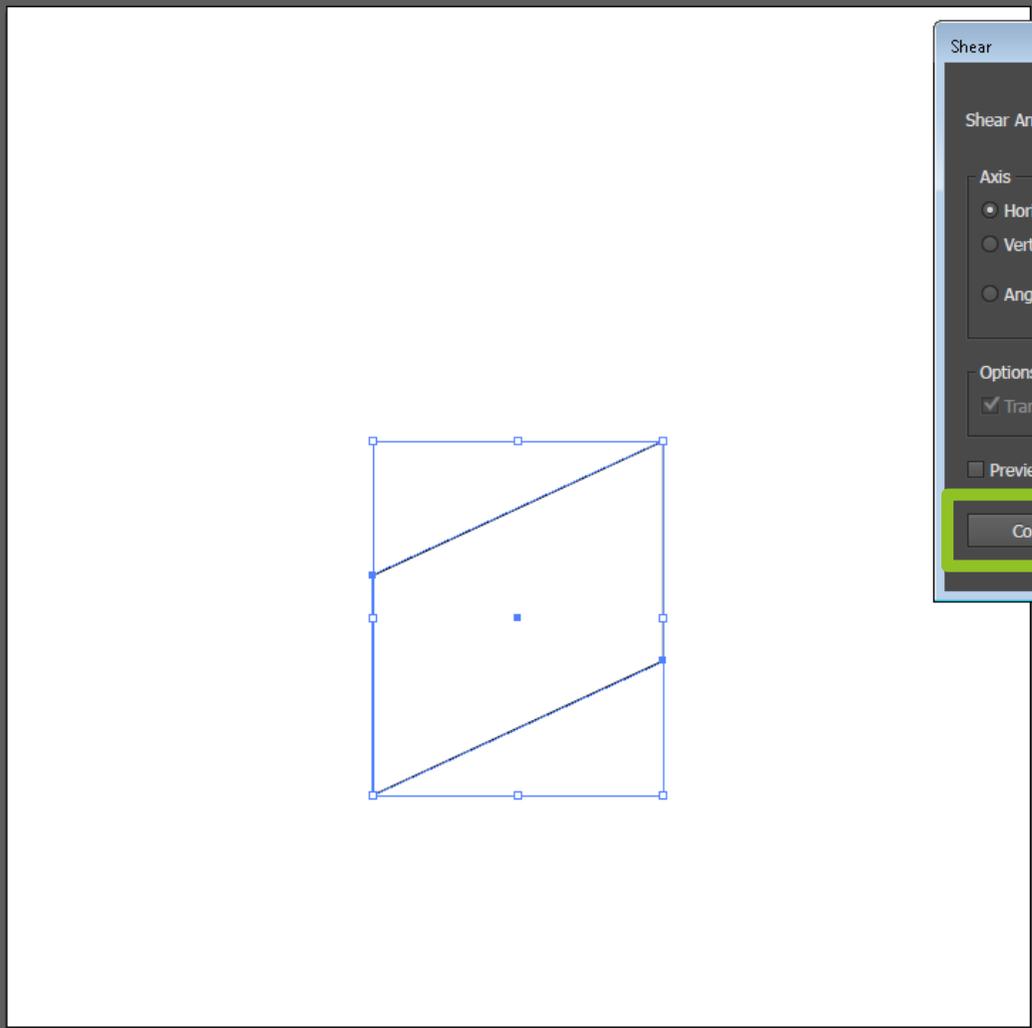
boards

Layer 1

1 Layer

Shear

Let's go ahead and make a copy so that we can compare a sheared and unsheared shape.



Shear

Shear Angle: 15

Axis

- Horizontal
- Vertical
- Angle: 0°

Options

- Transform Objects
- Transform Patterns

Preview

Copy OK Cancel

boards

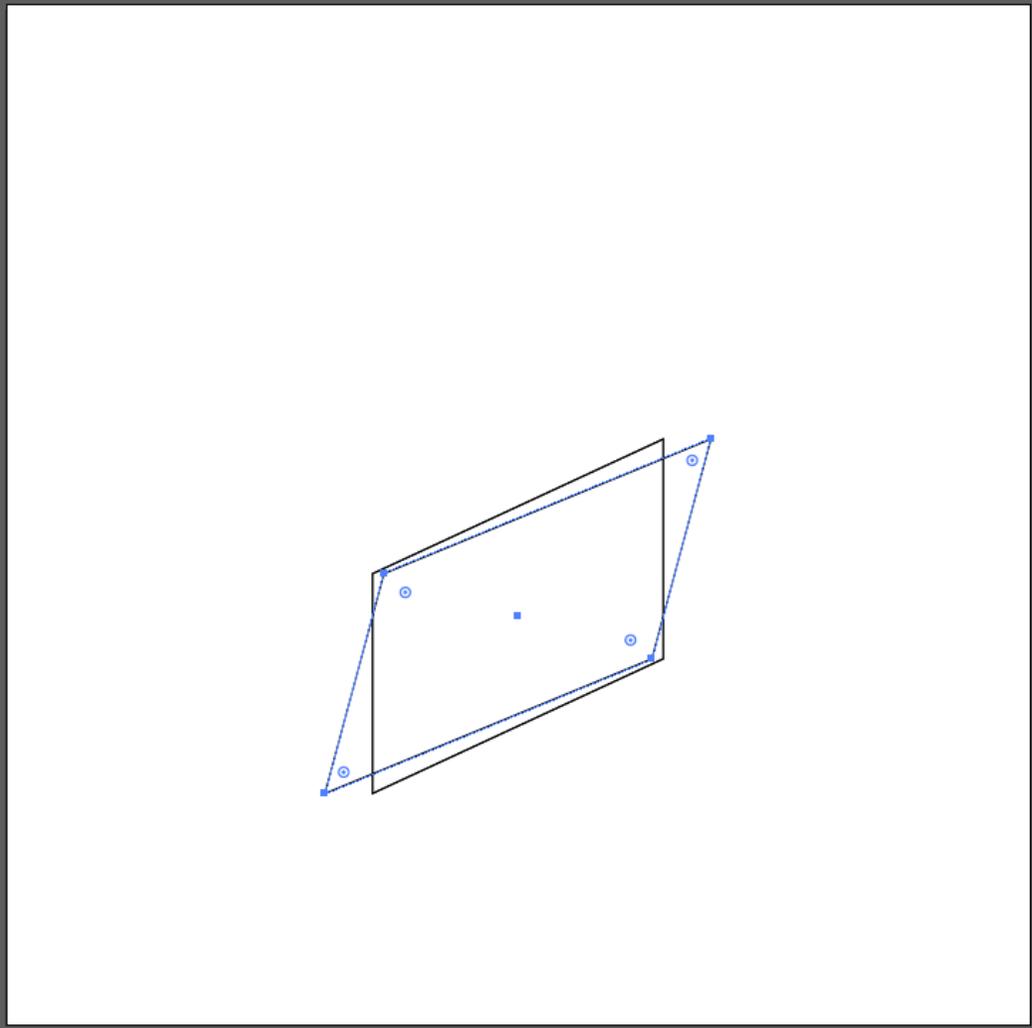
Layer 1

1 Layer

Shear

To repeat a the last transformation used:

- Object -> Transform -> Transform Again
- Hotkey: CTRL+D



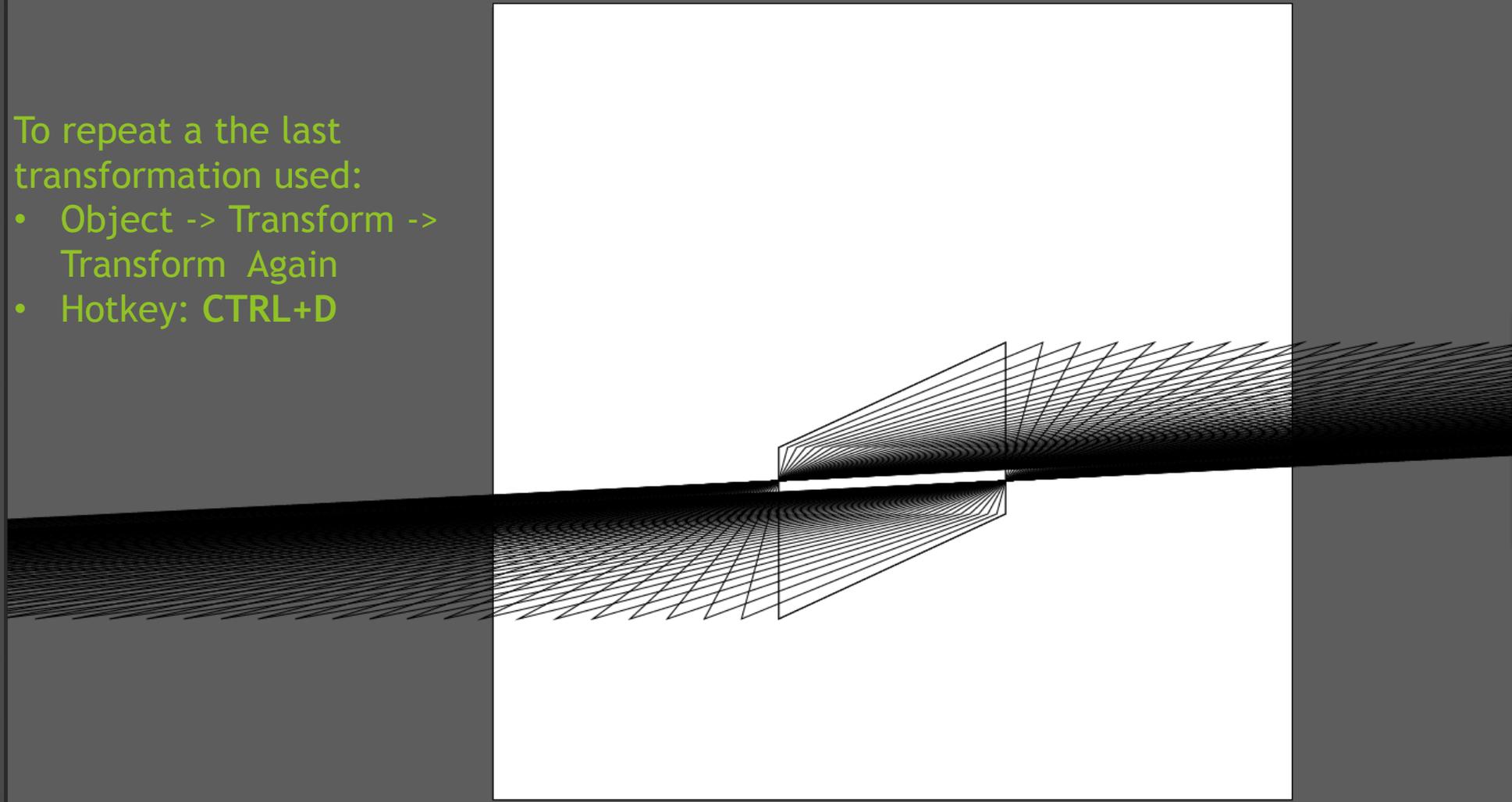
Layers Artboards

Layer 1

1 Layer

Shear

- To repeat a the last transformation used:
- Object -> Transform -> Transform Again
 - Hotkey: CTRL+D

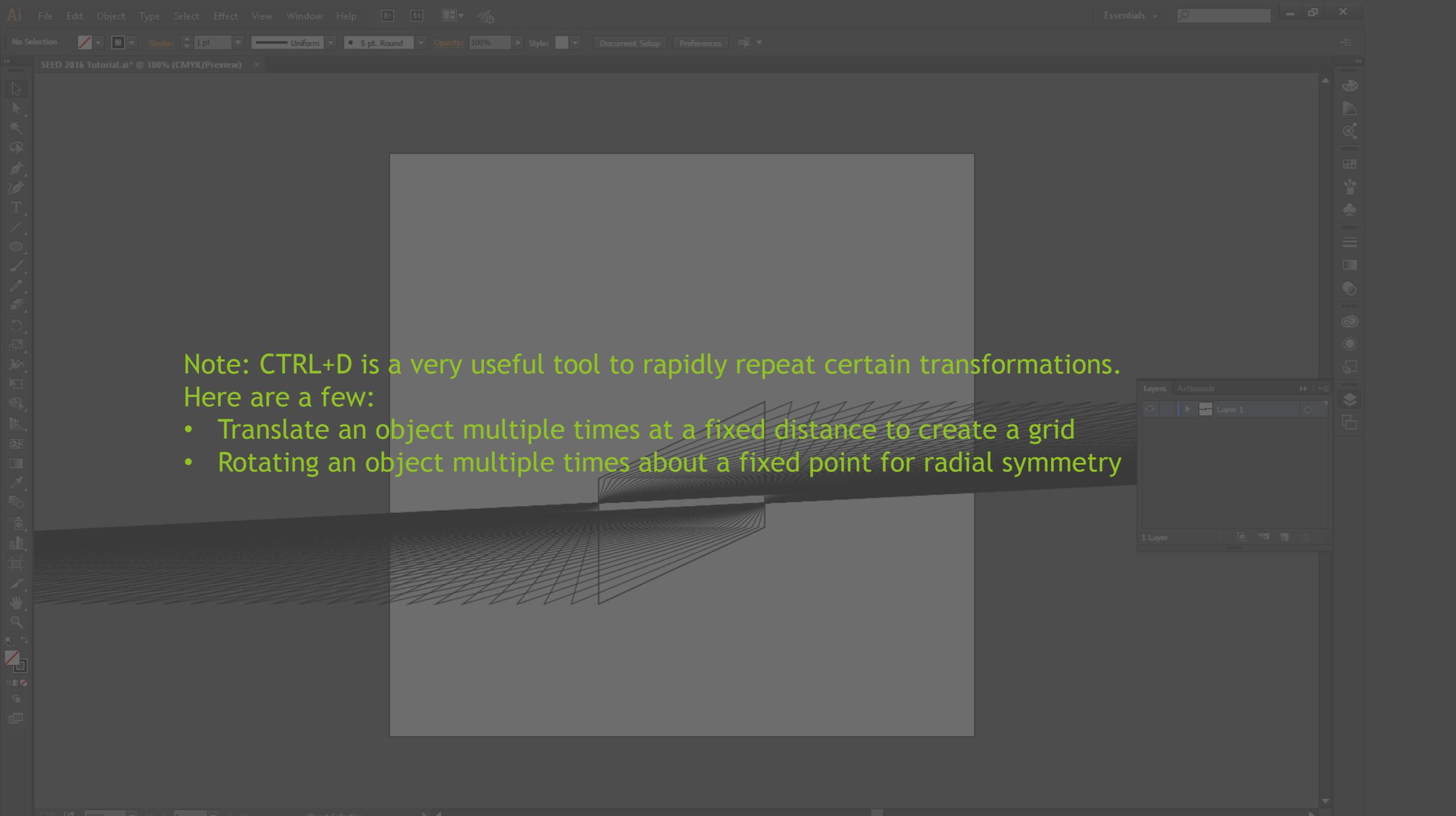


Layers Artboards

Layer 1

1 Layer





Note: CTRL+D is a very useful tool to rapidly repeat certain transformations. Here are a few:

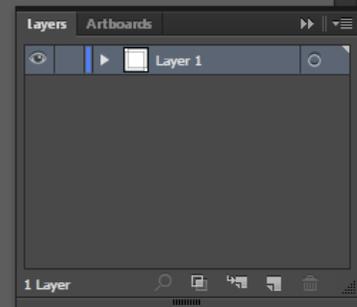
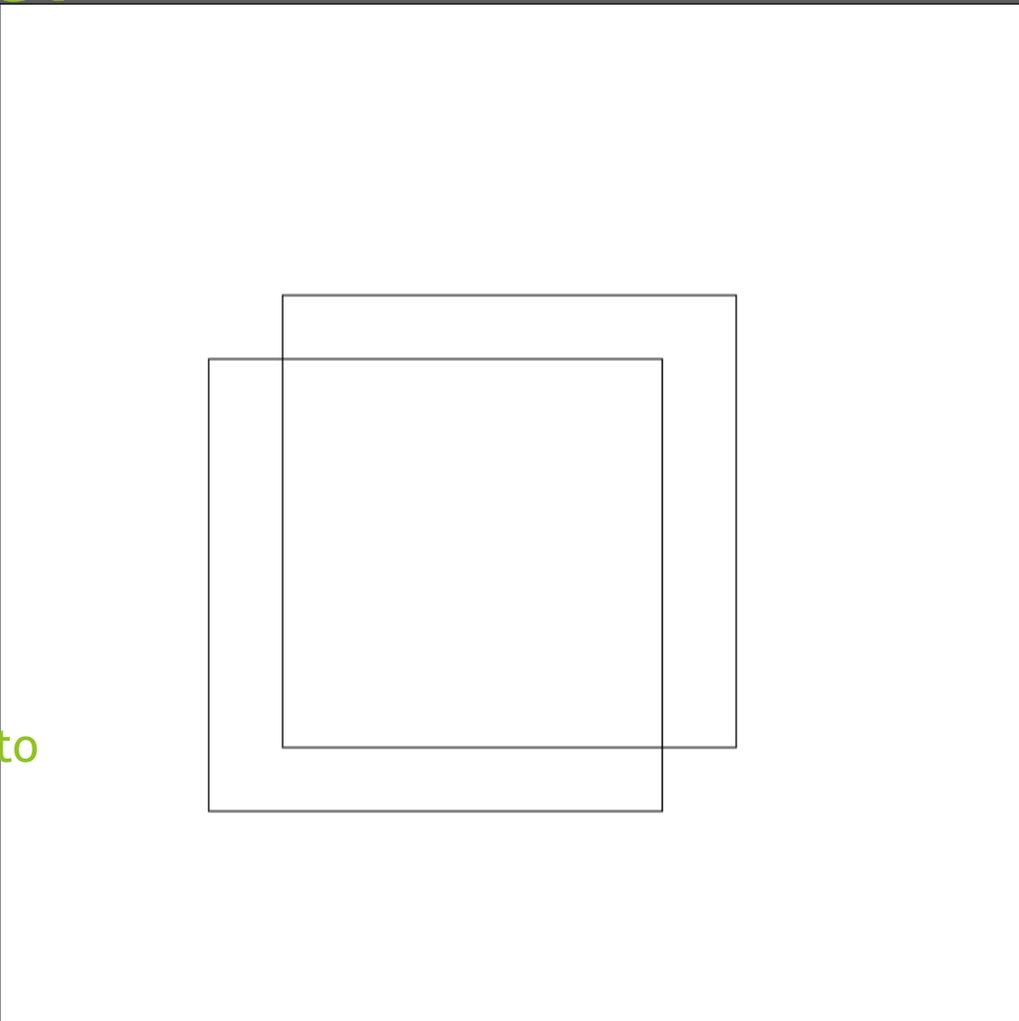
- Translate an object multiple times at a fixed distance to create a grid
- Rotating an object multiple times about a fixed point for radial symmetry

Shapebuilder

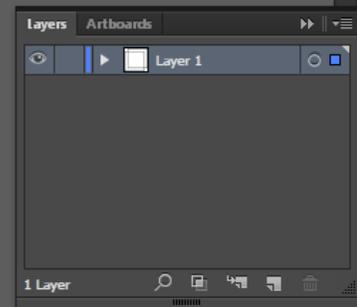
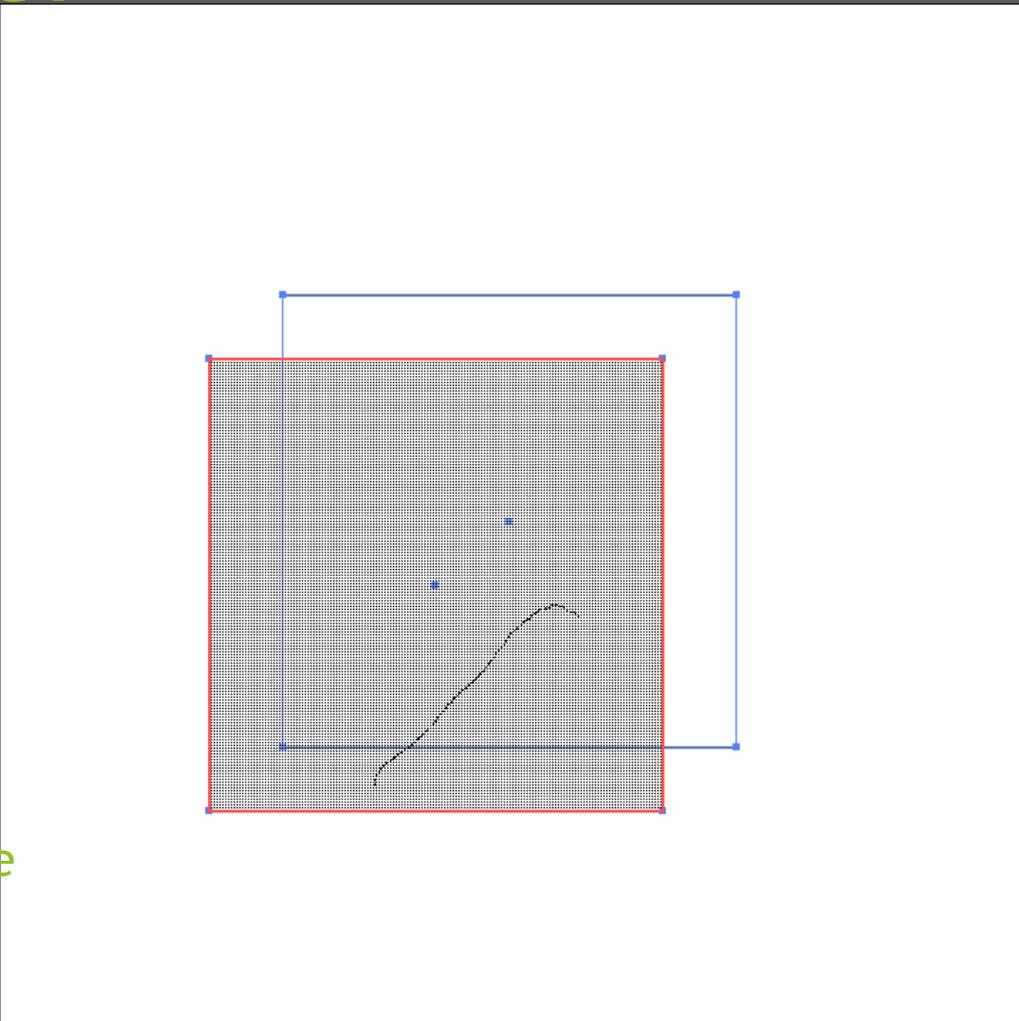


Shapebuilder is a powerful tool that allows you to combine multiple shapes into a single shape.

- Hotkey: **SHIFT + M**

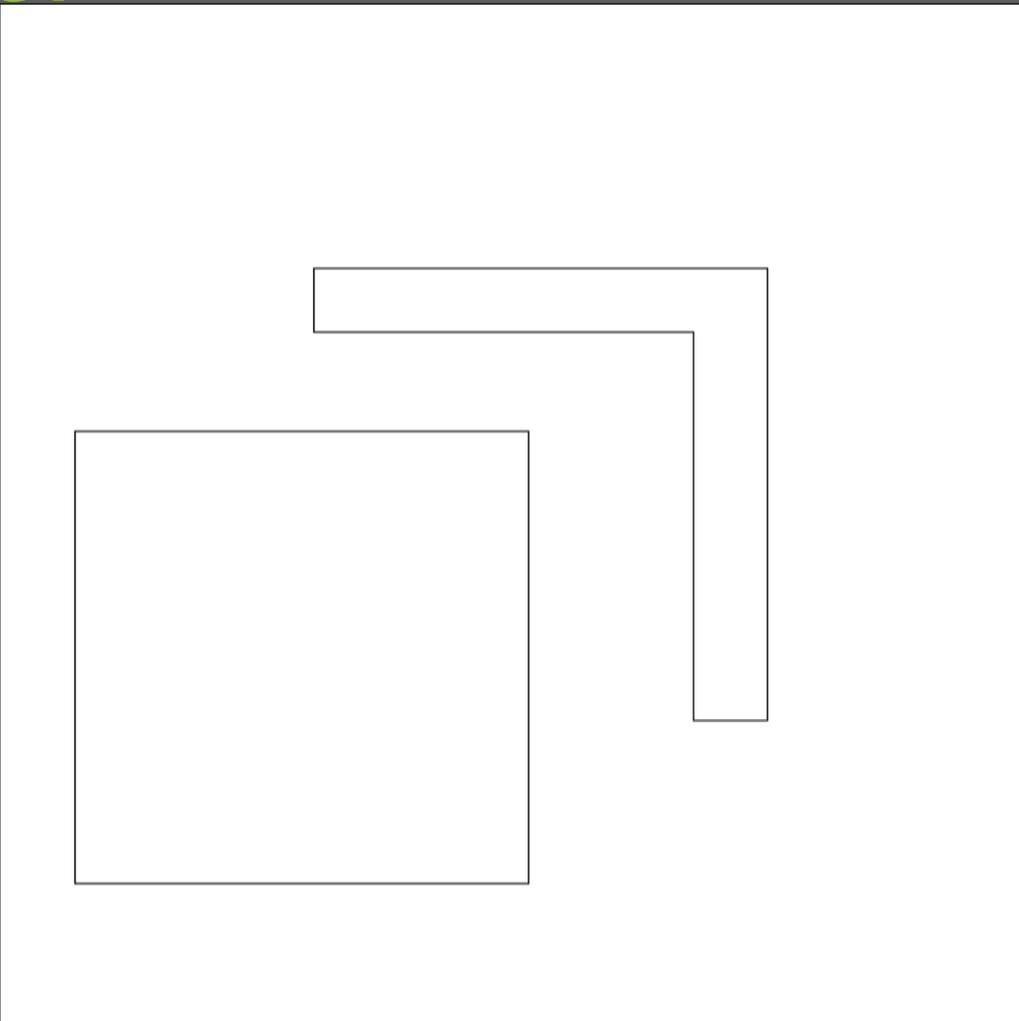


Shapebuilder

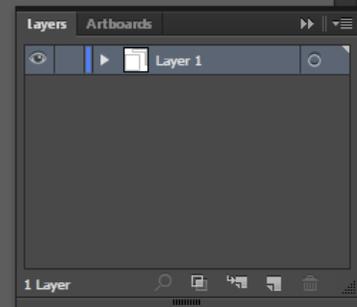


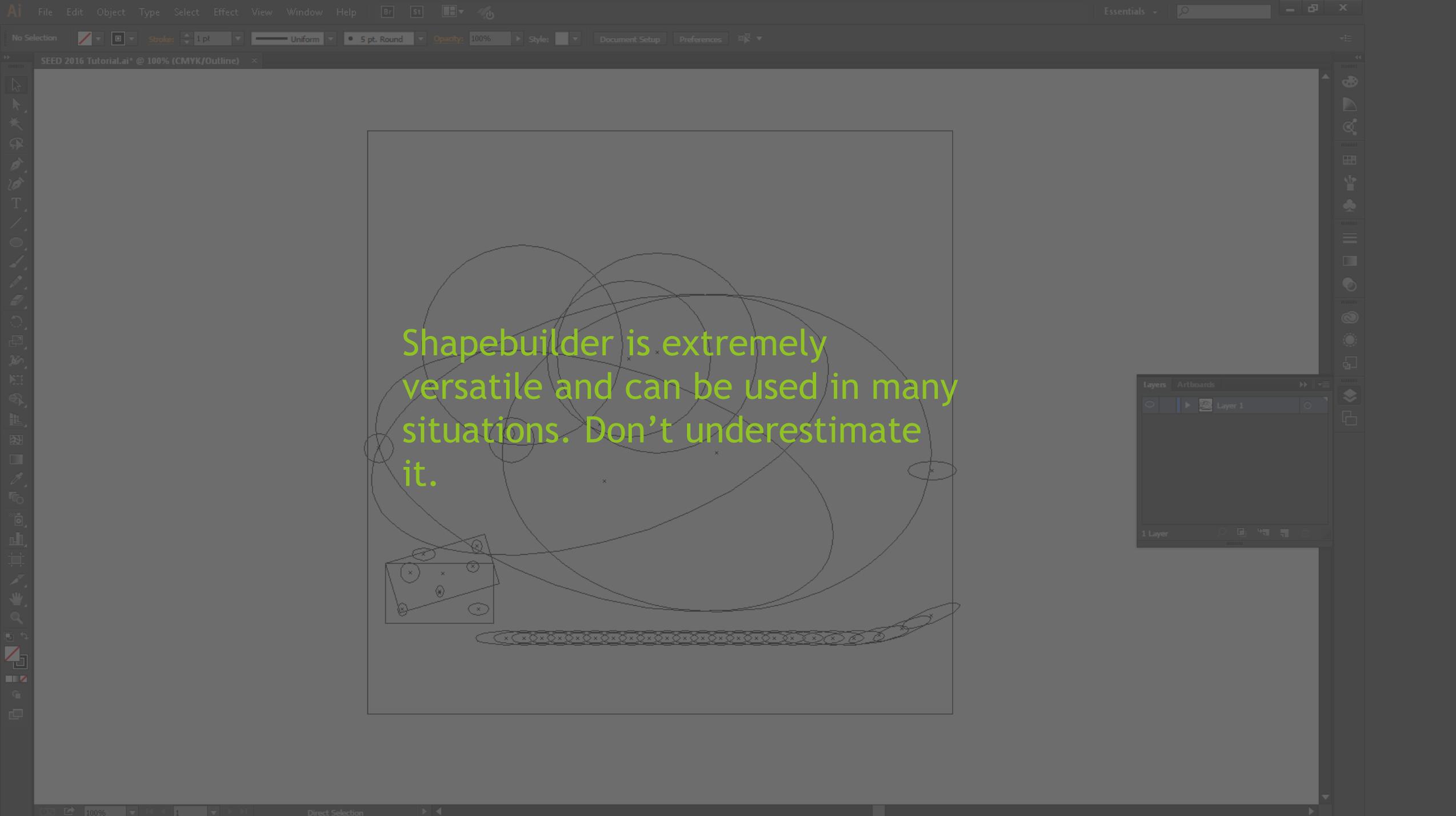
1. Select the shapes you want to combine using Select (Black Mouse/V)
2. Activate Shapebuilder
3. Click and drag across the shape areas you want to merge

Shapebuilder



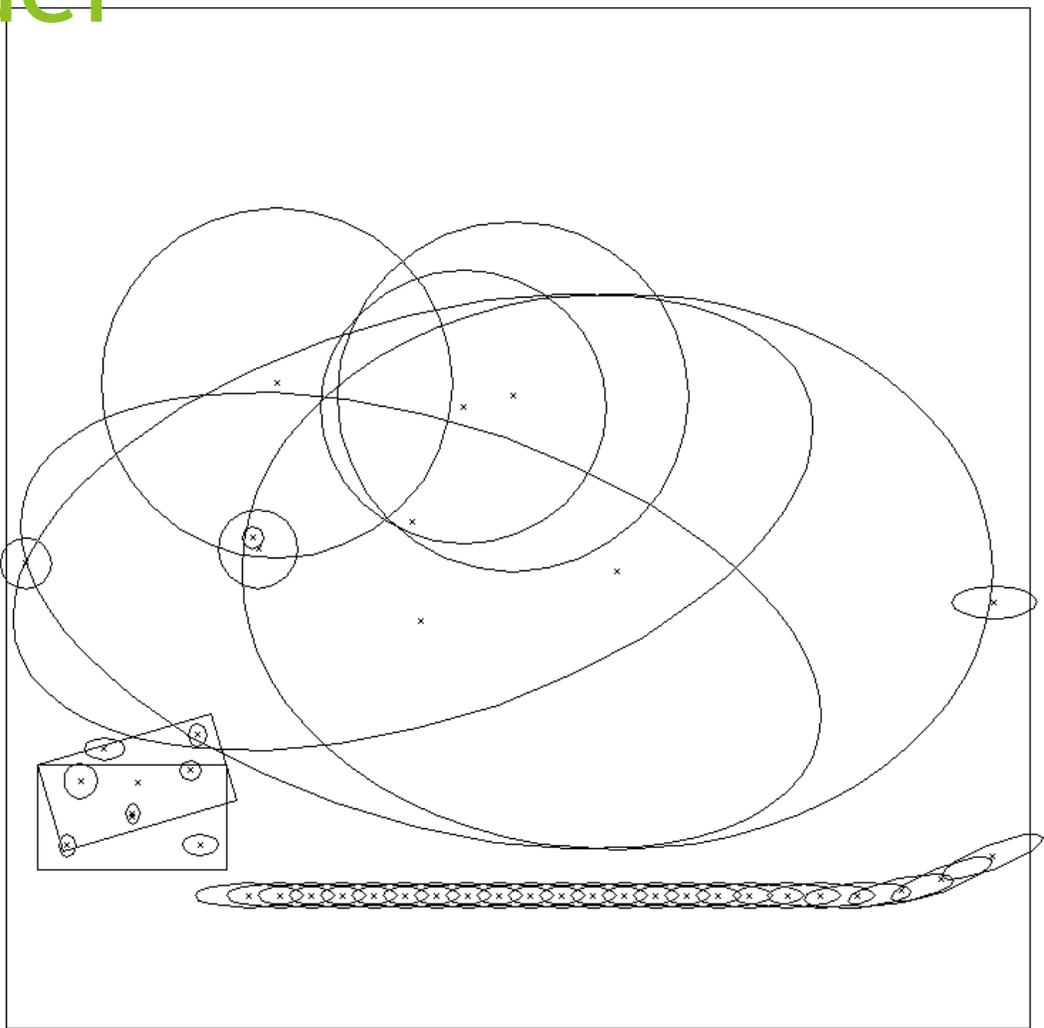
The desired areas are now unique shapes.





Shapebuilder is extremely versatile and can be used in many situations. Don't underestimate it.

Shapebuilder

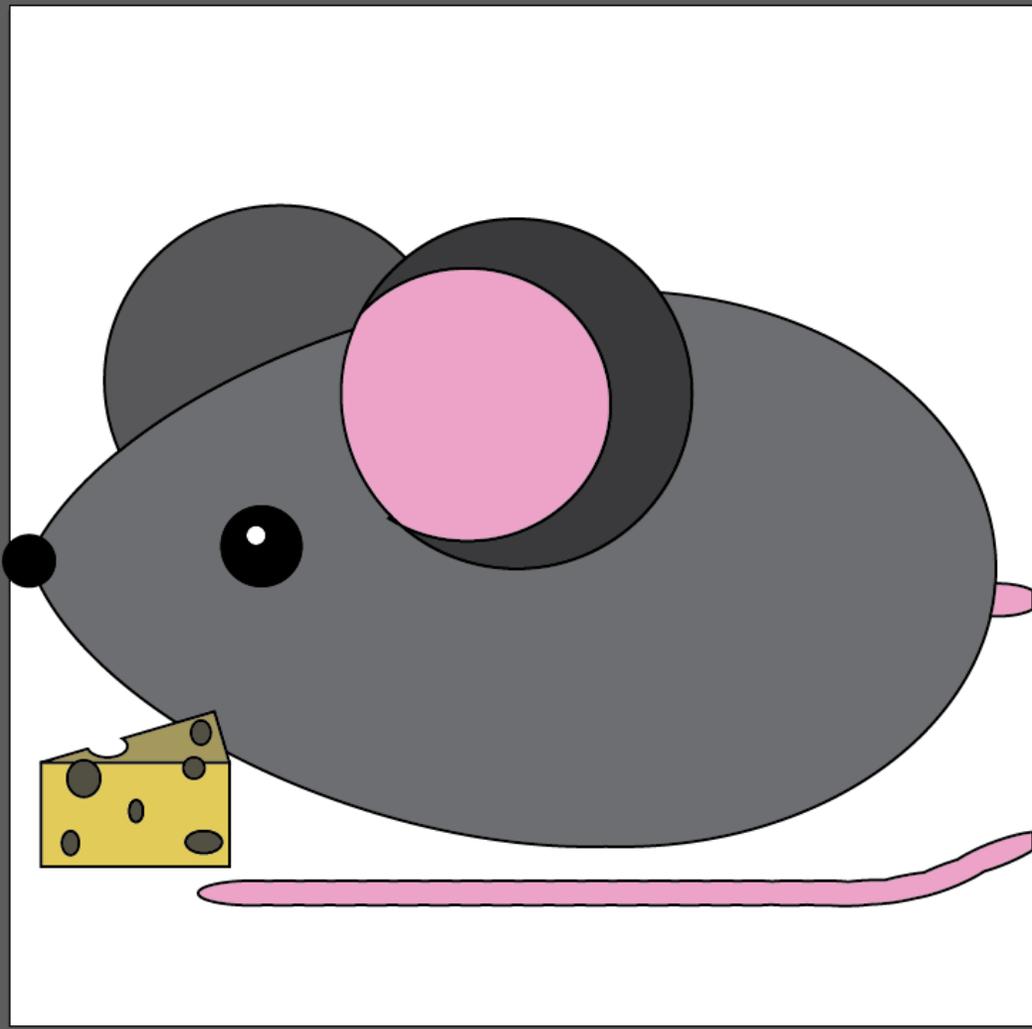


Layers Artboards

- Layer 1

1 Layer

Shapebuilder



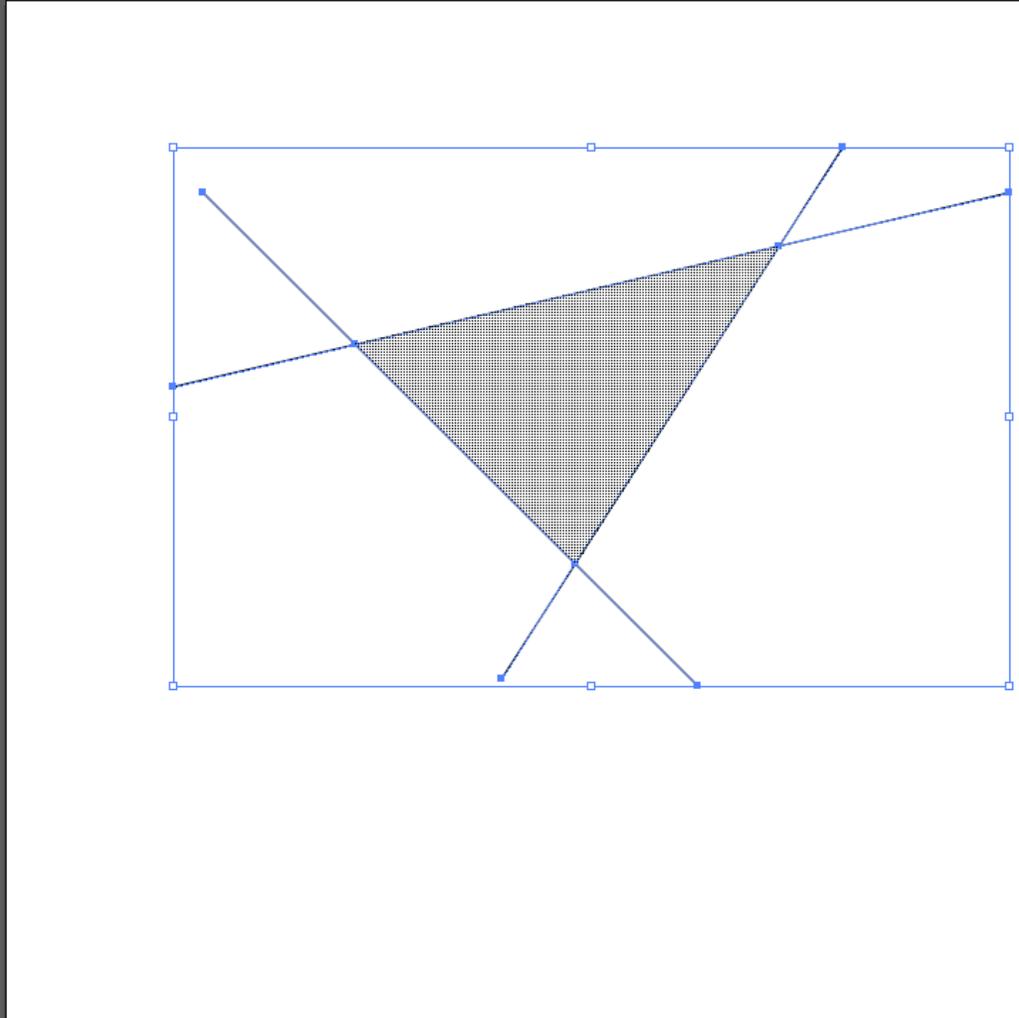
Layers Artboards

- Layer 1

1 Layer

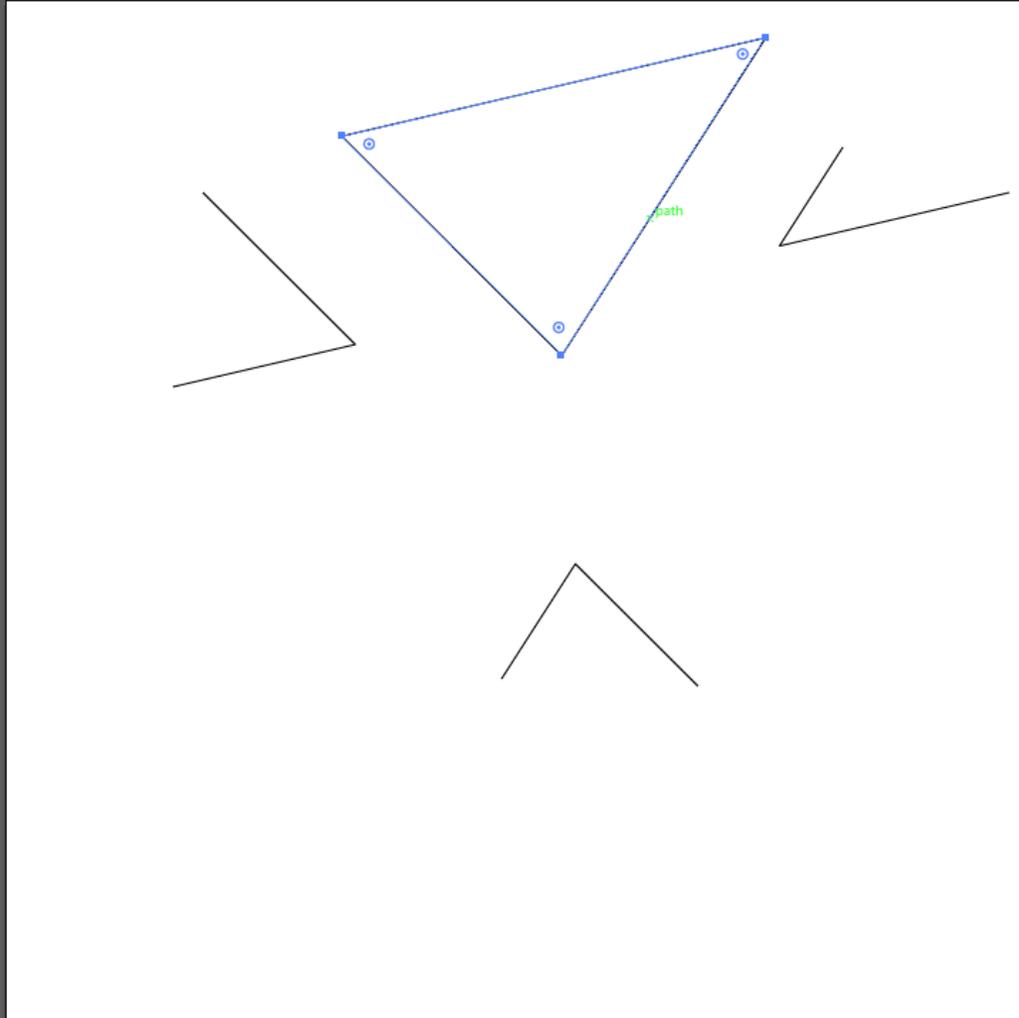
Shapebuilder

Remember the not-so-useful lines from before? You can also use those to make shapes now.



Shapebuilder

Remember the not-so-useful lines from before? You can also use those to make shapes now. This is great for making sure that you've created a continuous path.

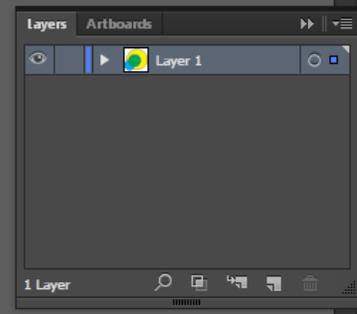
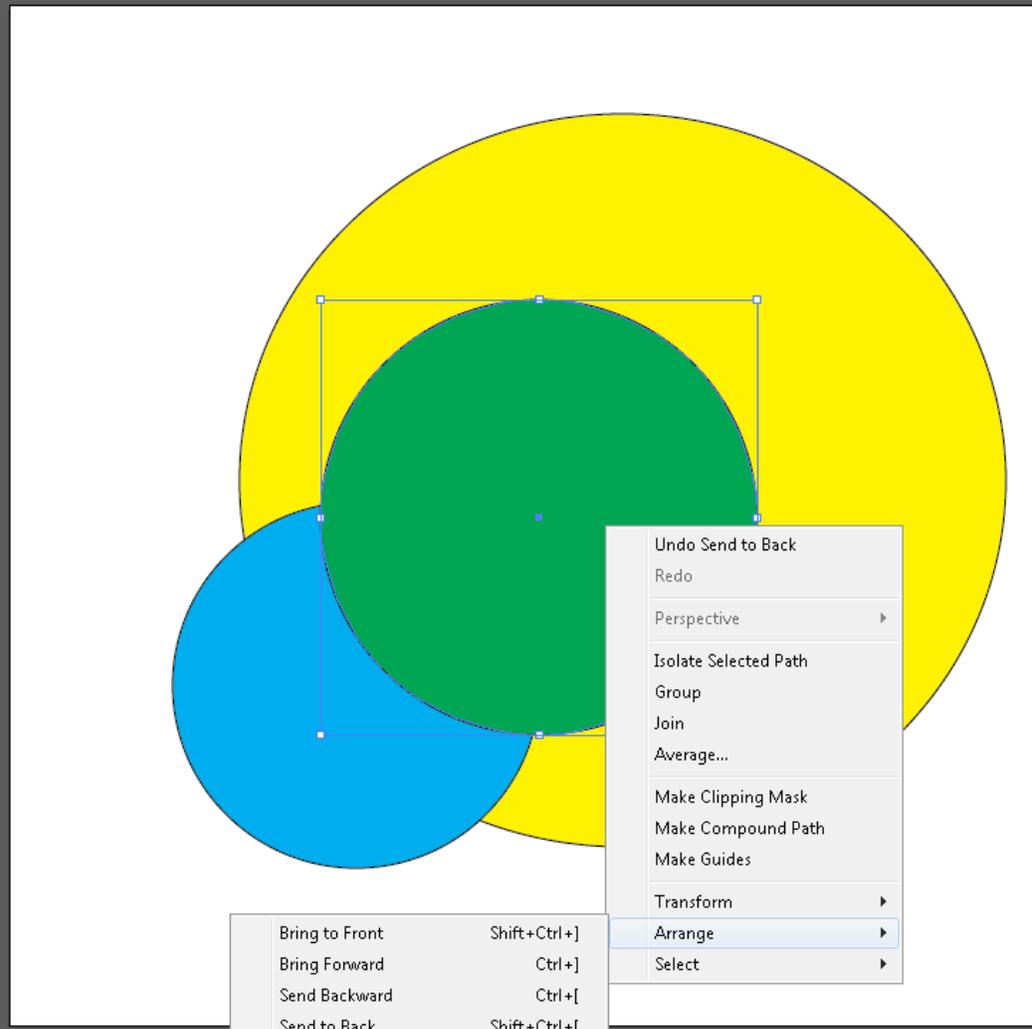


The More Advanced Basics

- ▶ Order
- ▶ Grouping
- ▶ Editing Paths
- ▶ Image Trace
- ▶ Outlines
- ▶ Non-Centered Rotation

Order

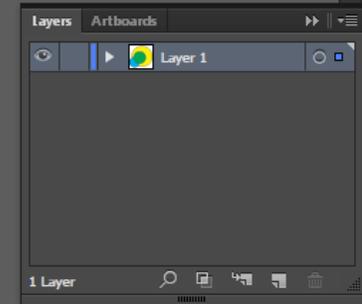
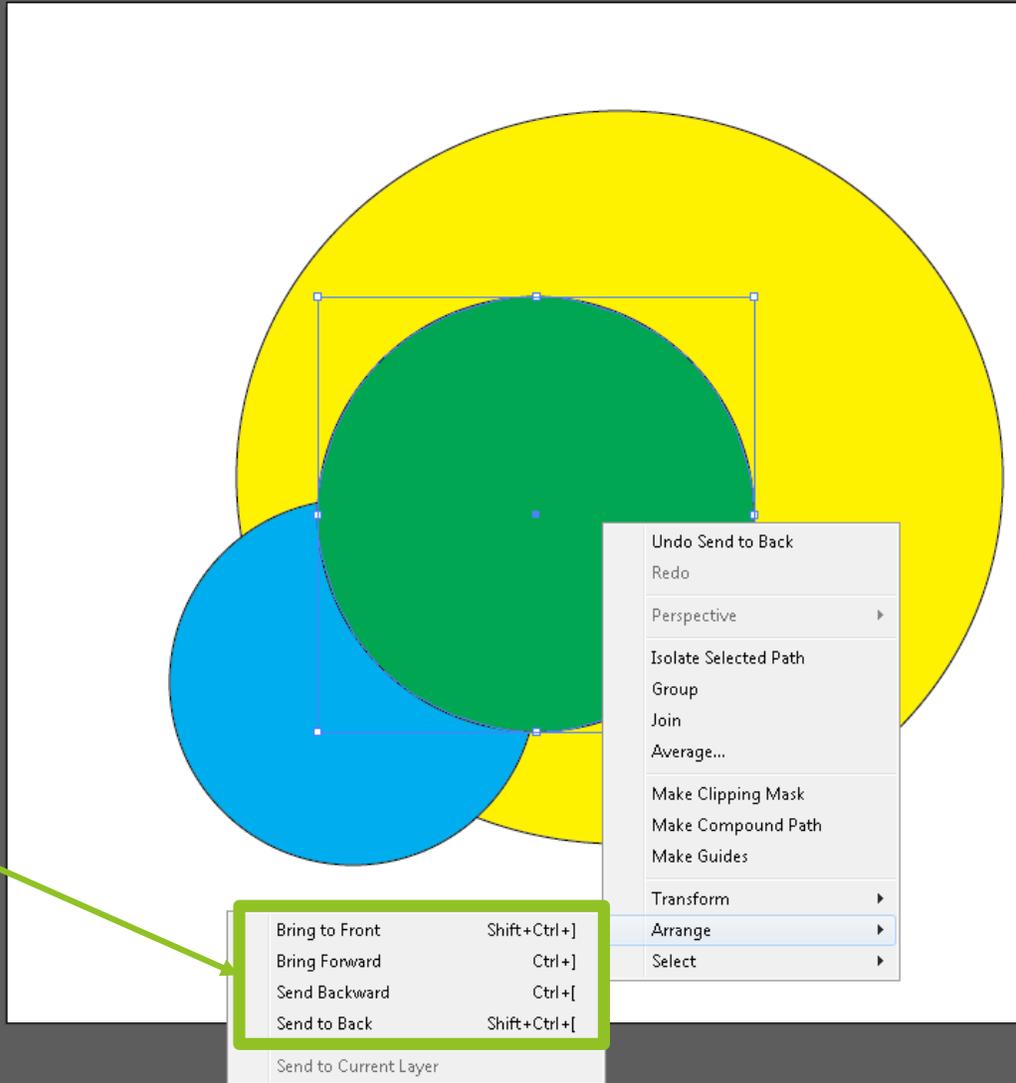
Order allows you to sort which shapes go on top of one another. Although it's most easily demonstrated with colors/for graphics purposes, Illustrator defaults to selecting the shape that is the closest to the "front," which you may need to change.



Order

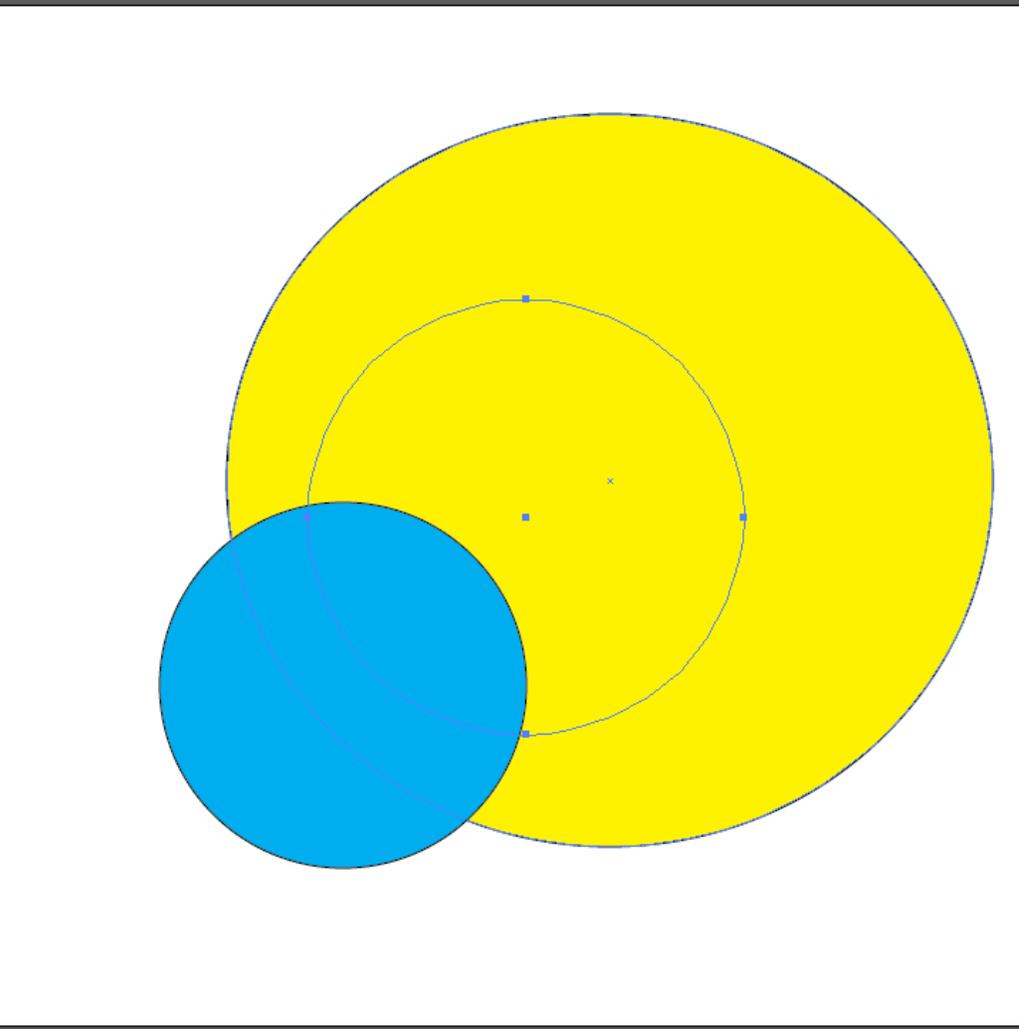
Select the object you wish to arrange and right-click it. Think of your objects in a stack:

- Bring Forward/Send Backward moves the object one space
- Send to Back/Bring to Front moves objects to the extremes
- Hotkeys: shown right



Order

Whereas Send to Back/Bring to Front sends the object to the back/front of the stack.



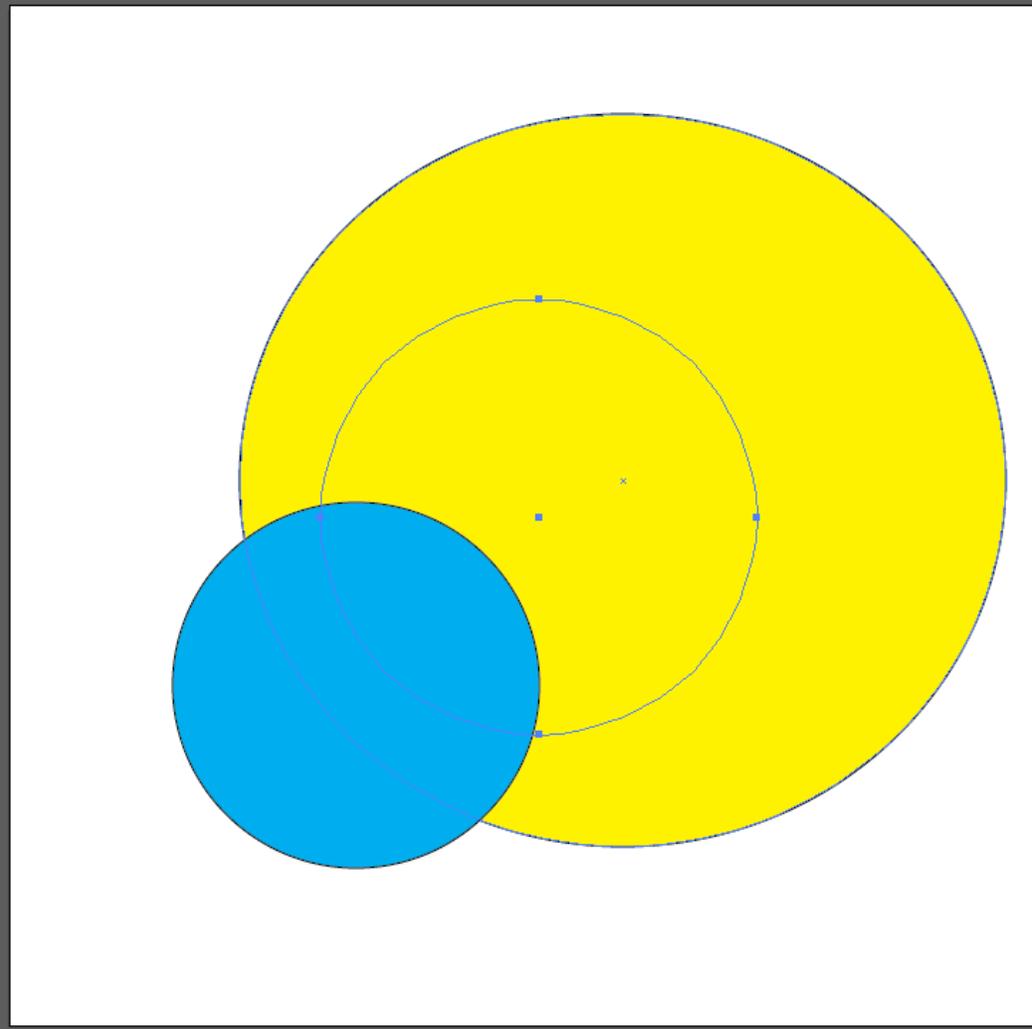
Layers Artboards

- Layer 1

1 Layer

Grouping

Grouping is a convenient way to manage multiple objects at the same time.



Layers Artboards

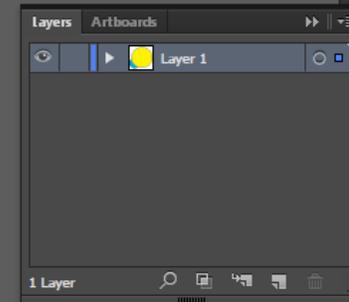
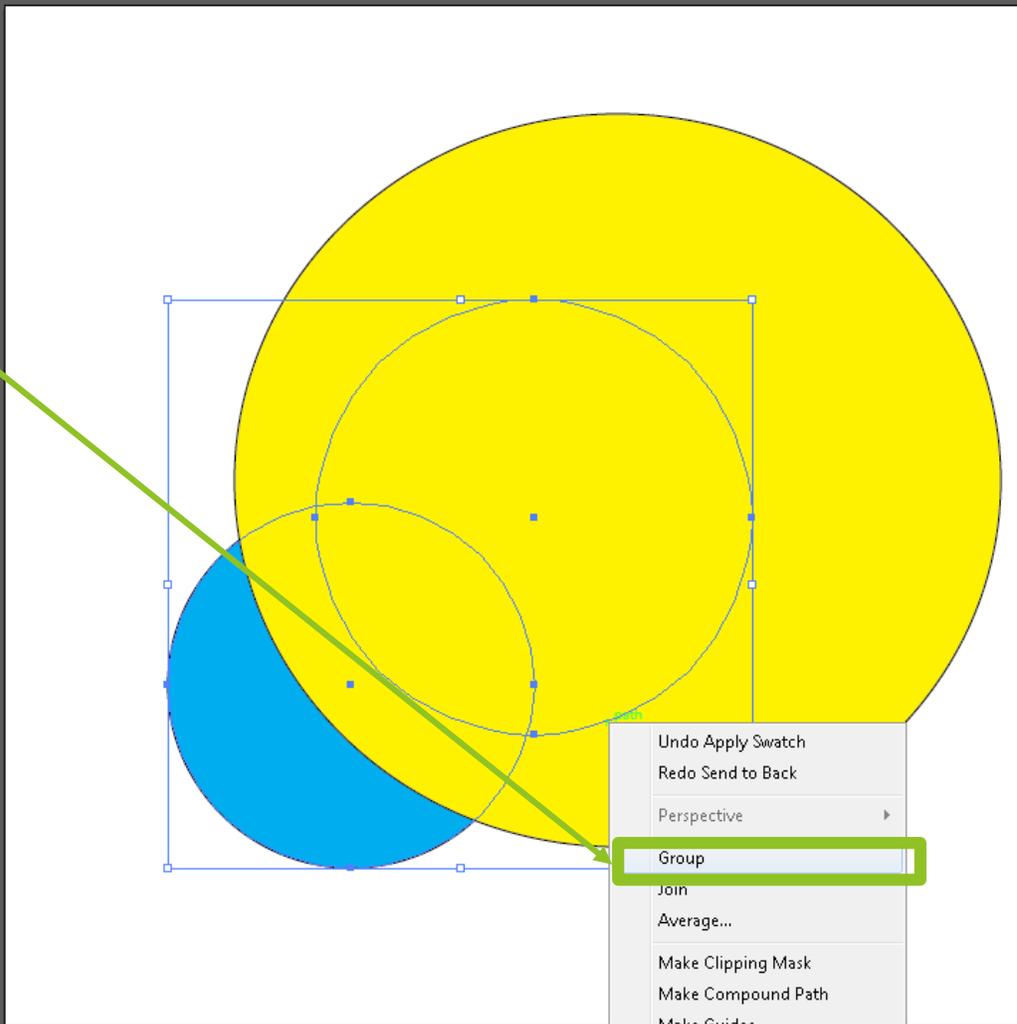
Layer 1

1 Layer

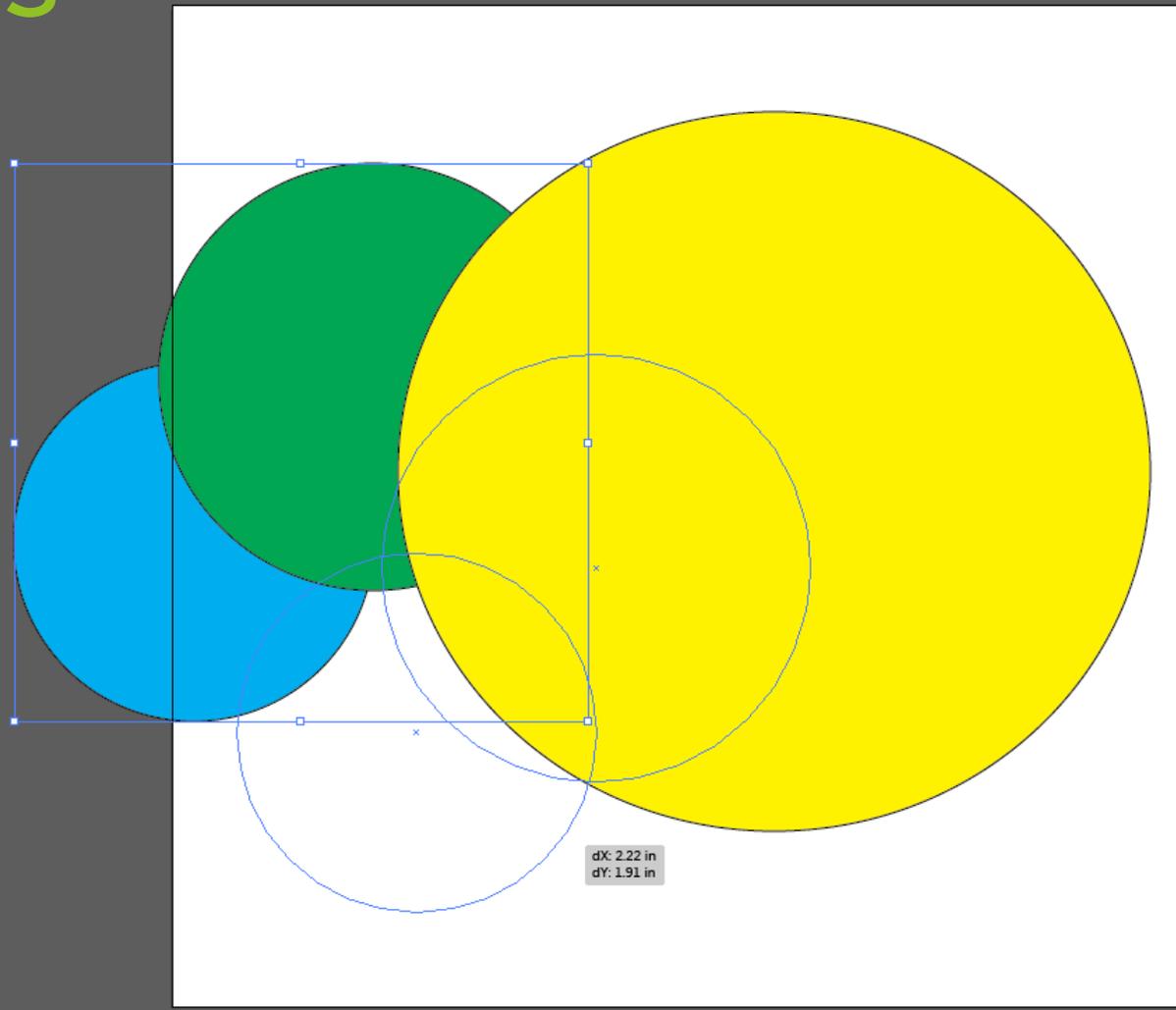
Grouping

To Group, select the objects you wish to place in a group (either with the selection tool or by **SHIFT+CLICK**):

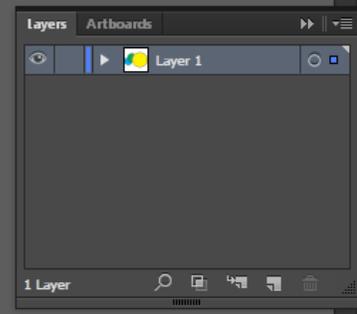
- Right Click -> Group
- Hotkey: **CTRL+G**



Grouping



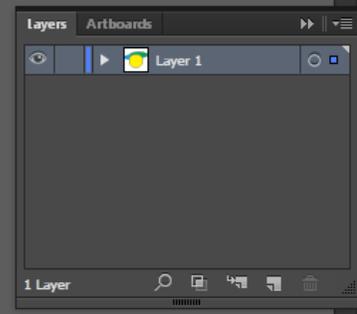
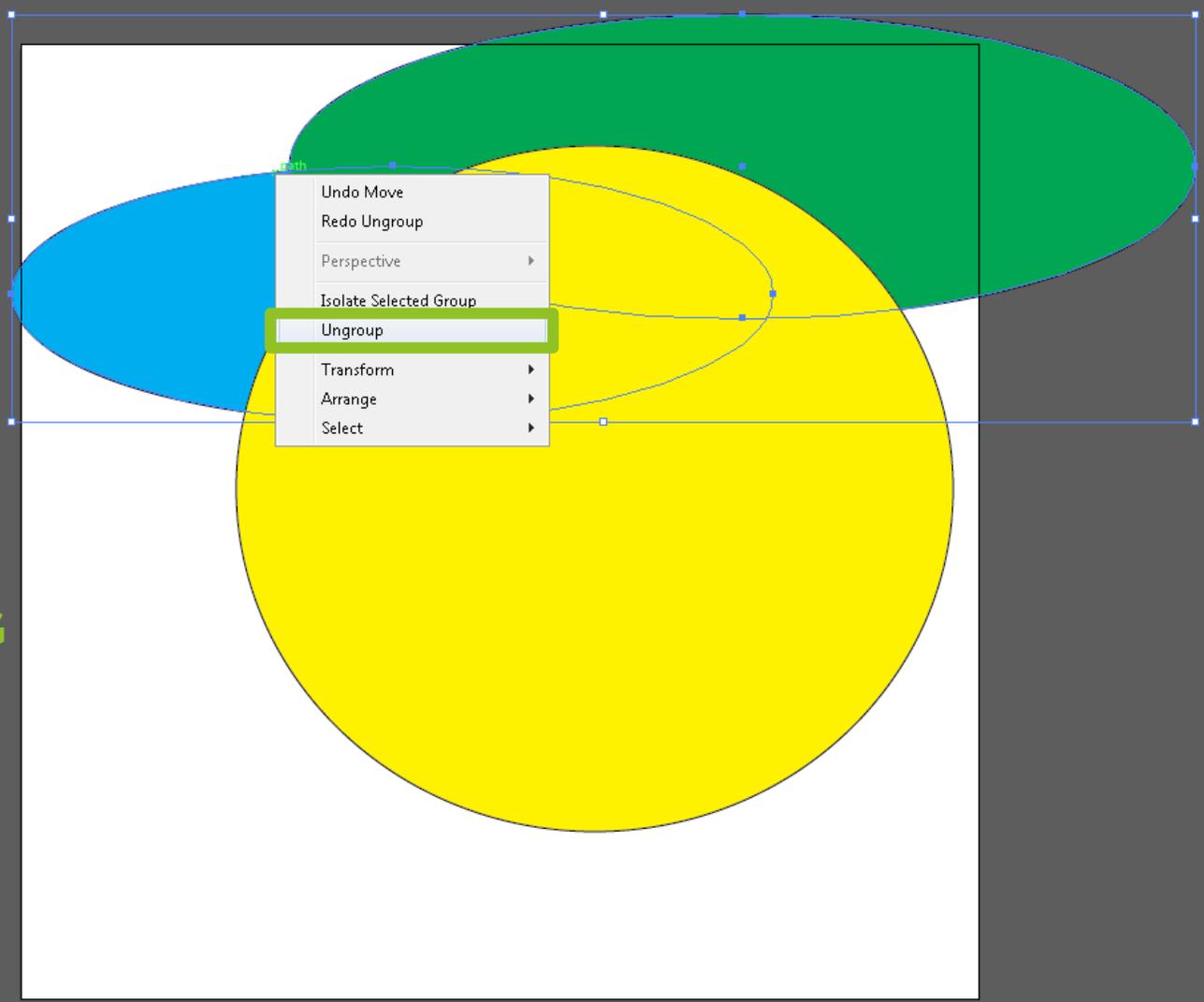
The grouped objects now behave as a single shape. You can rotate, resize, and otherwise transform them as you would a single object.



Grouping

To Ungroup:

- Select objects -> Right Click -> Ungroup
- Hotkey: CTRL+SHIFT+G

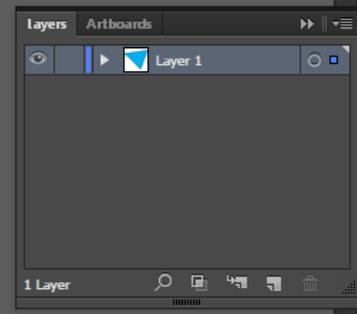
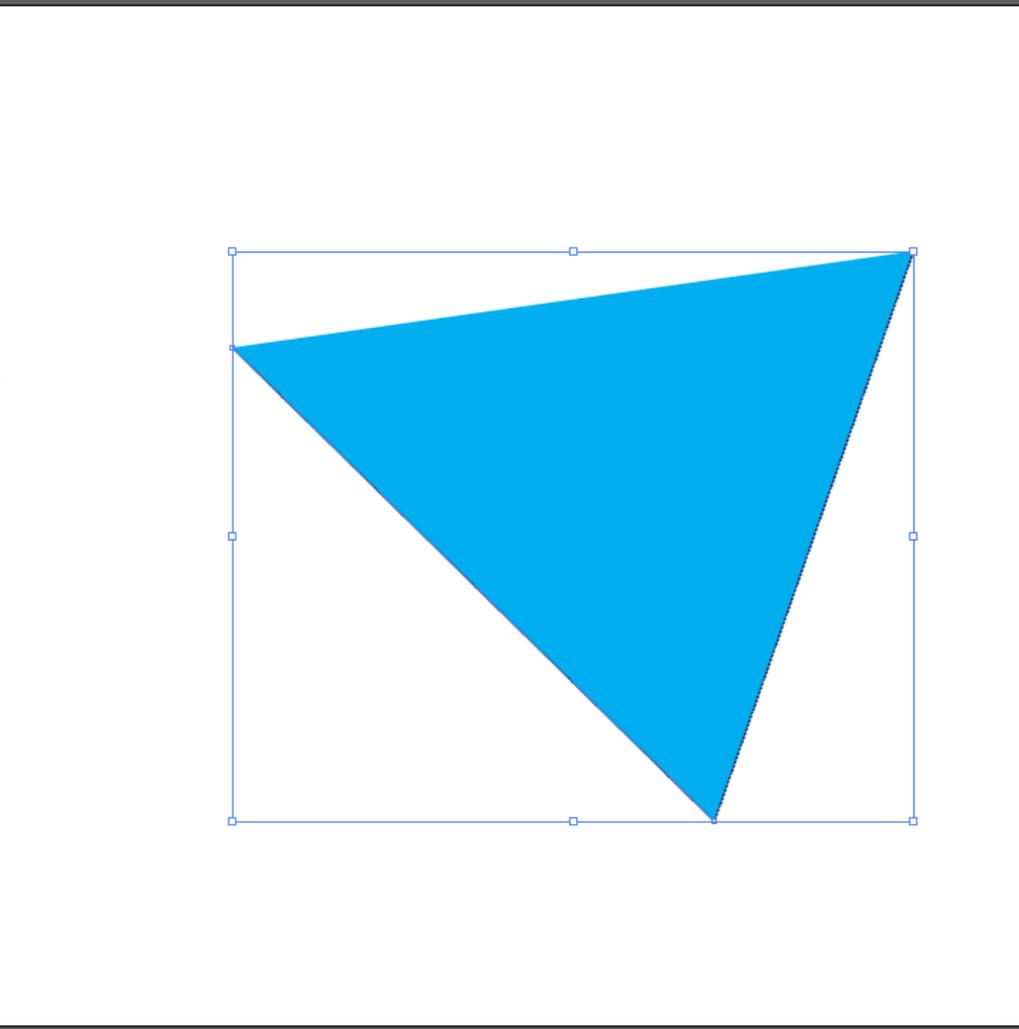


Paths



At first glance, the Pen/Path tool may seem like a fancier version of the Line tool. However, it has two major differences. To find the first, begin by selecting the Pen tool to create a shape:

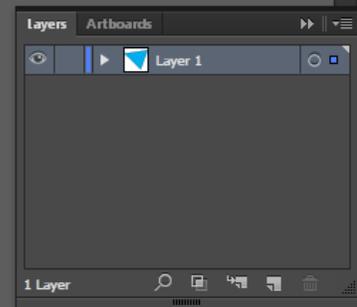
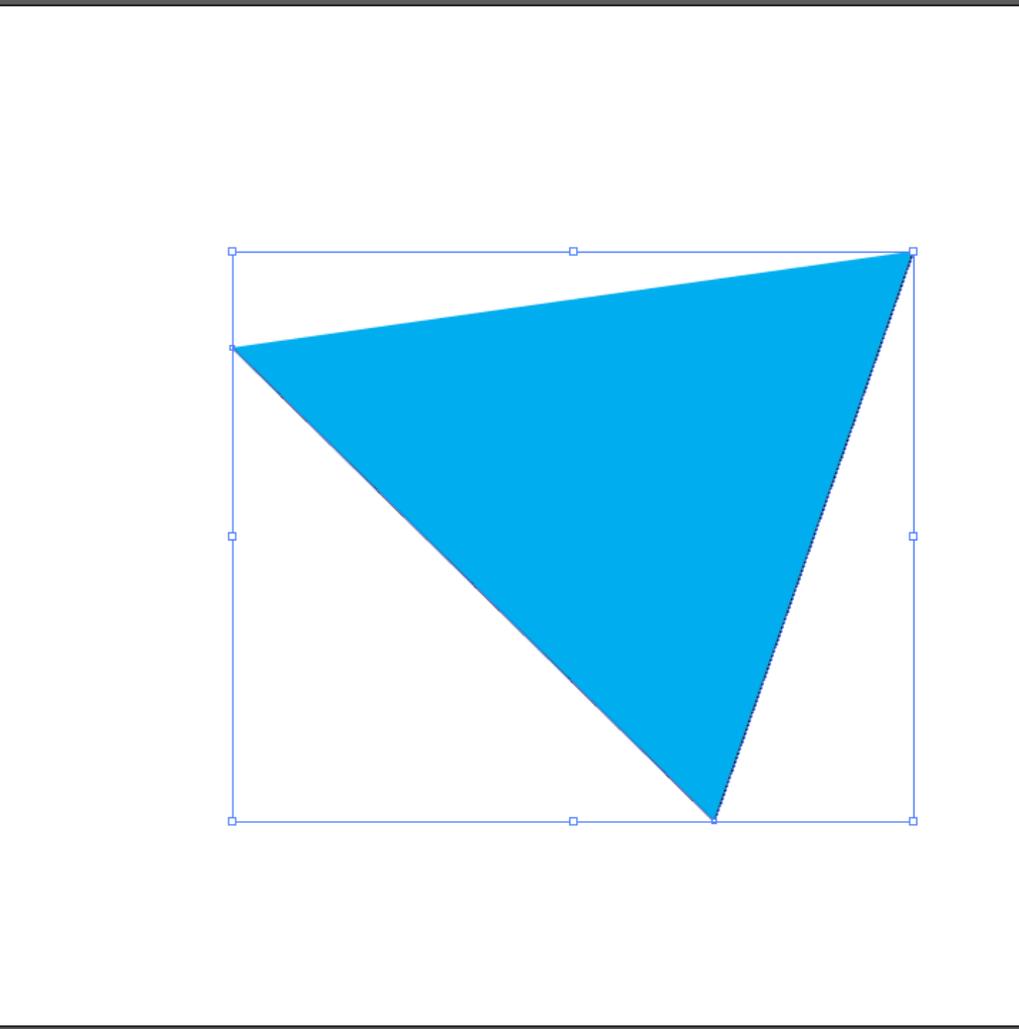
- Select Pen from the side
- Hotkey: P



Paths



The first improvement that the Pen tool offers is the ability to automatically create shapes. Clicking with the Pen tool active will create a corner of a shape (called a *node*). Clicking on the first node will close the shape.

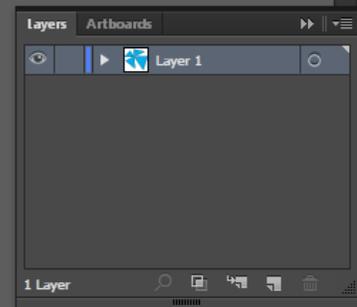
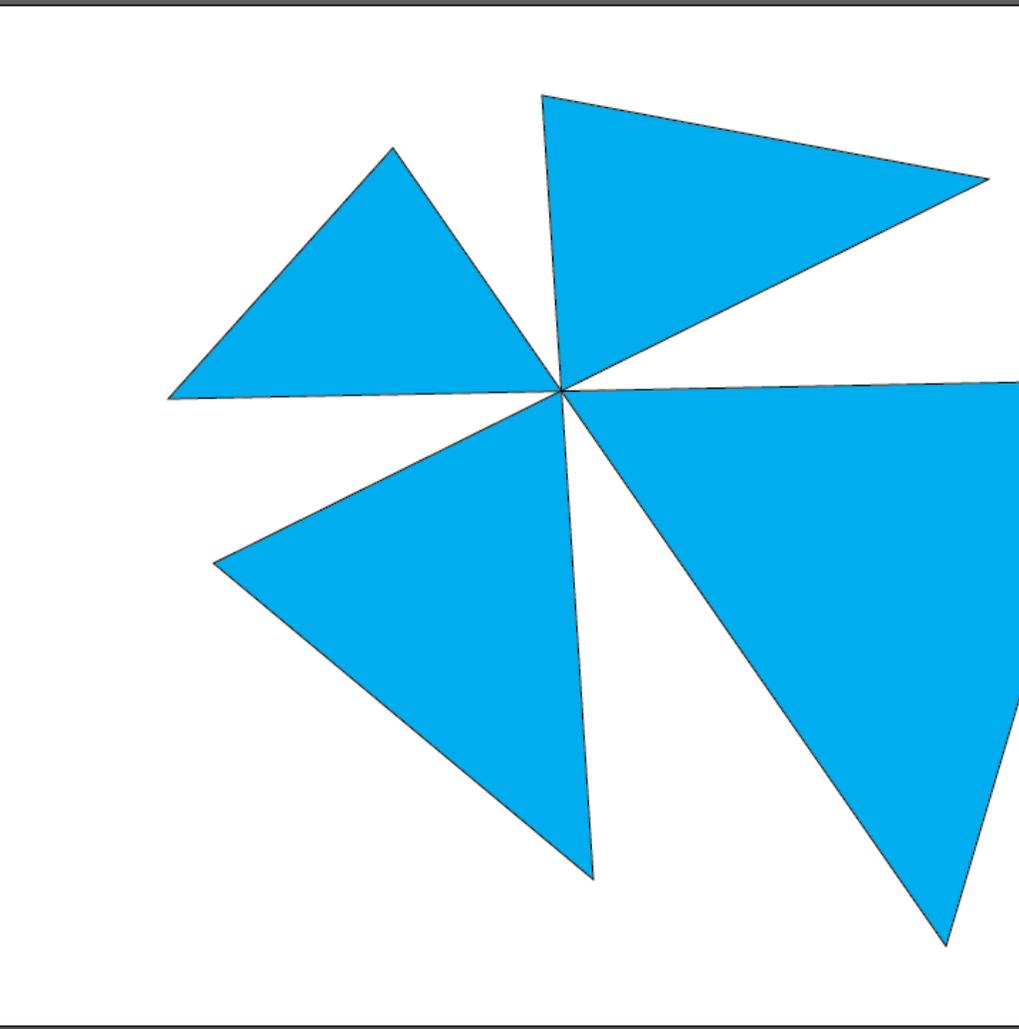


Paths



This works with non-continuous shapes as well: so long as you don't click on the first node, you will not close the shape.

This function of the Pen tool is useful for creating shapes quickly.

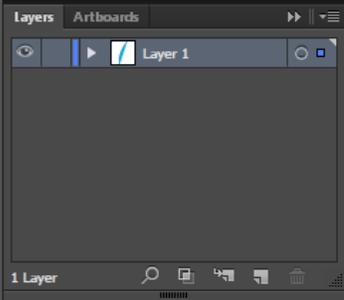
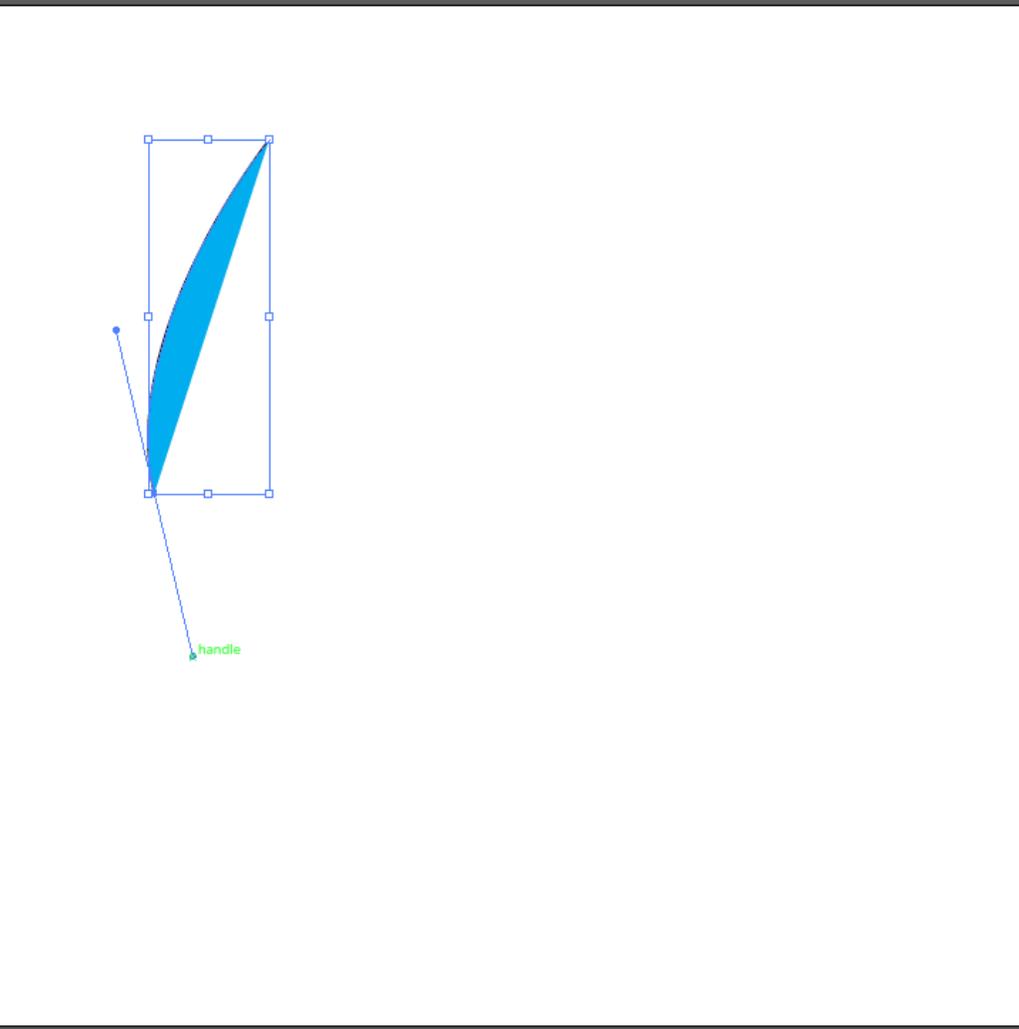


Paths



The second function is far more unique: you can create custom curves.

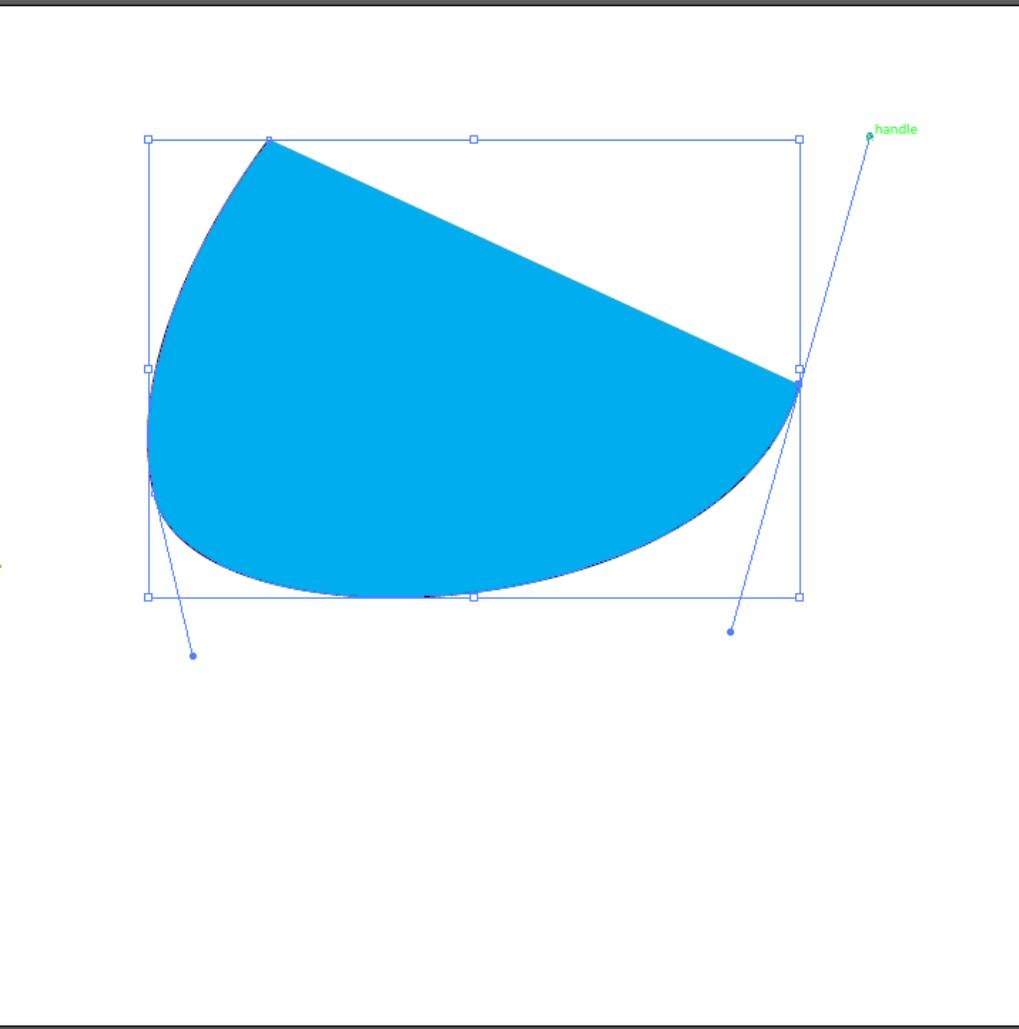
Begin by clicking on a point to start a path. However, rather than just clicking to create a second node, **CLICK+DRAG**.



Paths



This creates a chain of curved paths. Each subsequent Path attempts to maintain the curvature set by the Path before it, with the previous Node as a sort of middle ground.



Layers Artboards

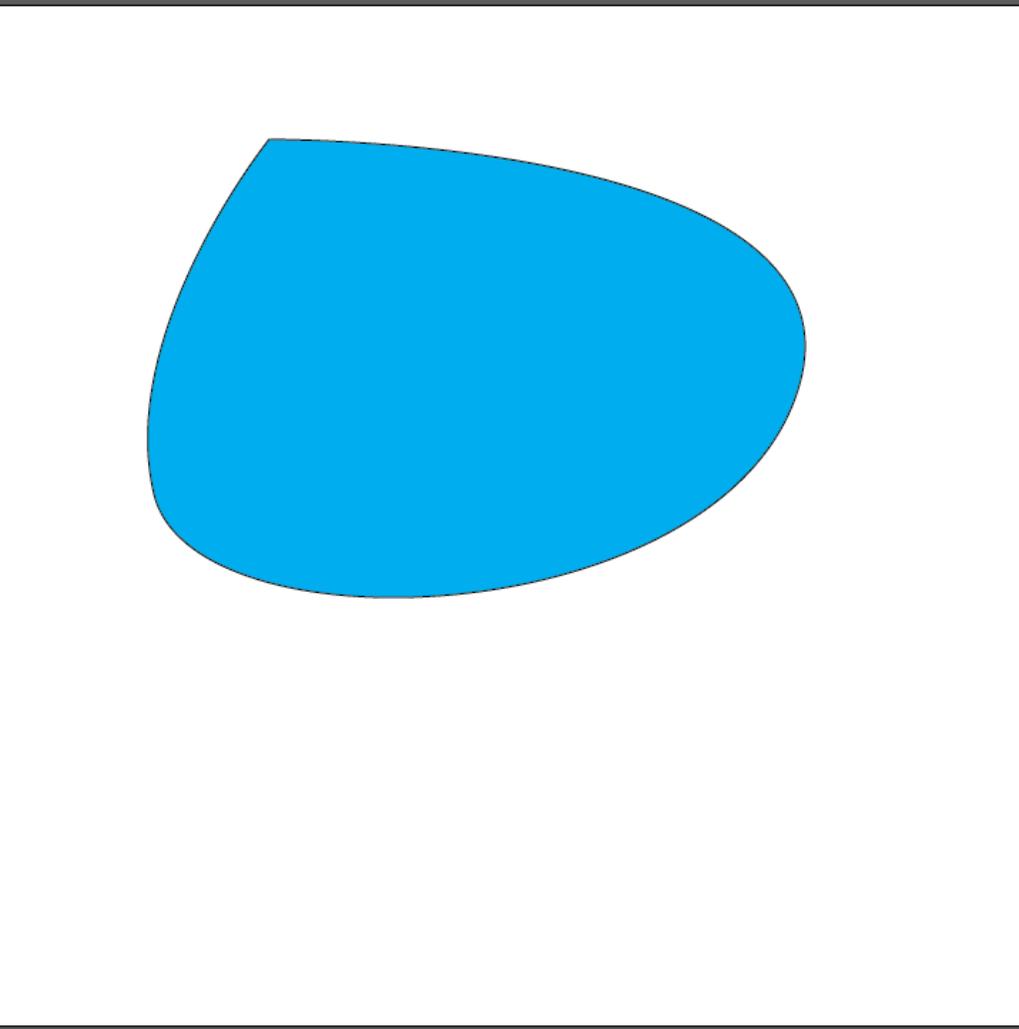
- Layer 1

1 Layer

Paths



Note how in places that we **CLICK+DRAG**, the curve appears continuous, while the nodes create discontinuities.



Layers Artboards

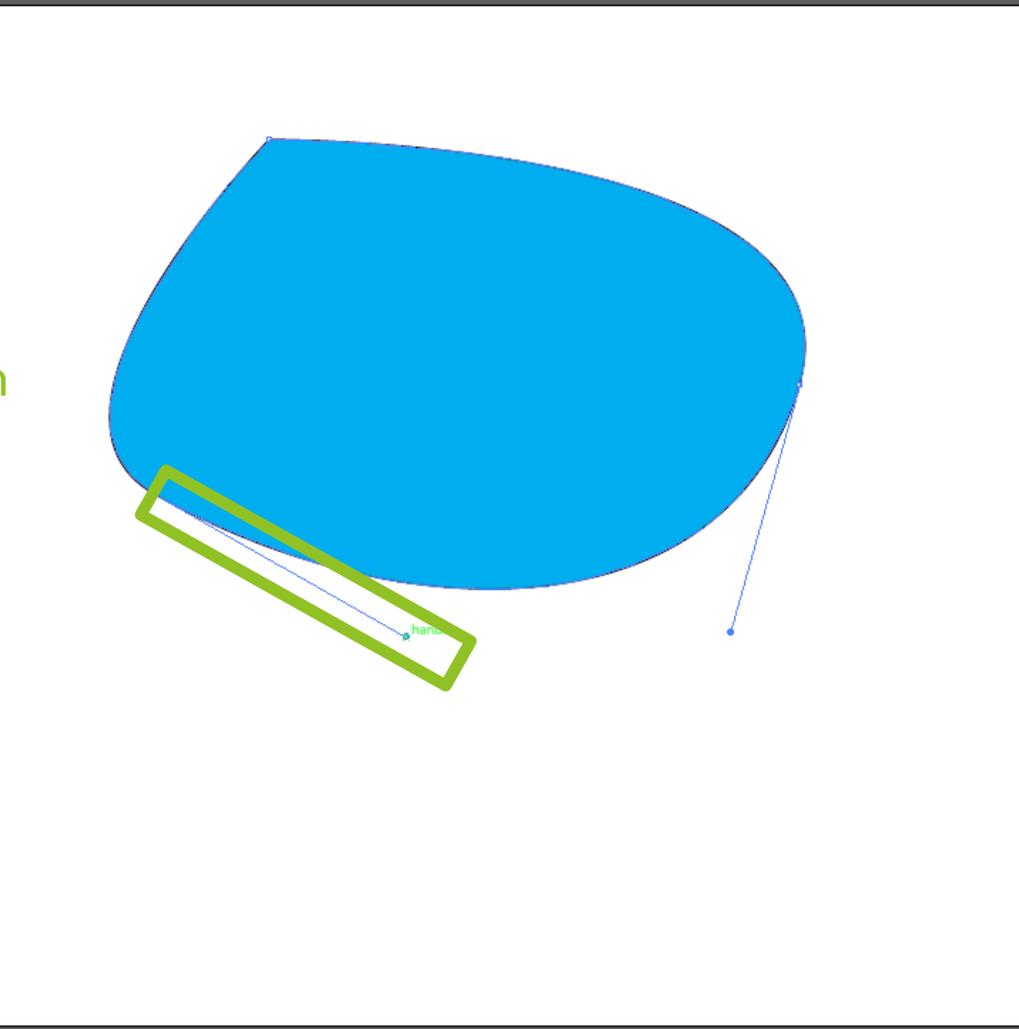
- Layer 1

1 Layer

Paths



Using the Direct Selection (white mouse/A), you can edit the curvature of a path by changing the *handles* of each node



Layers Artboards

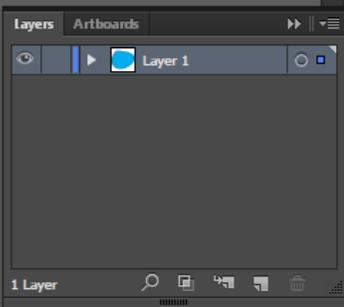
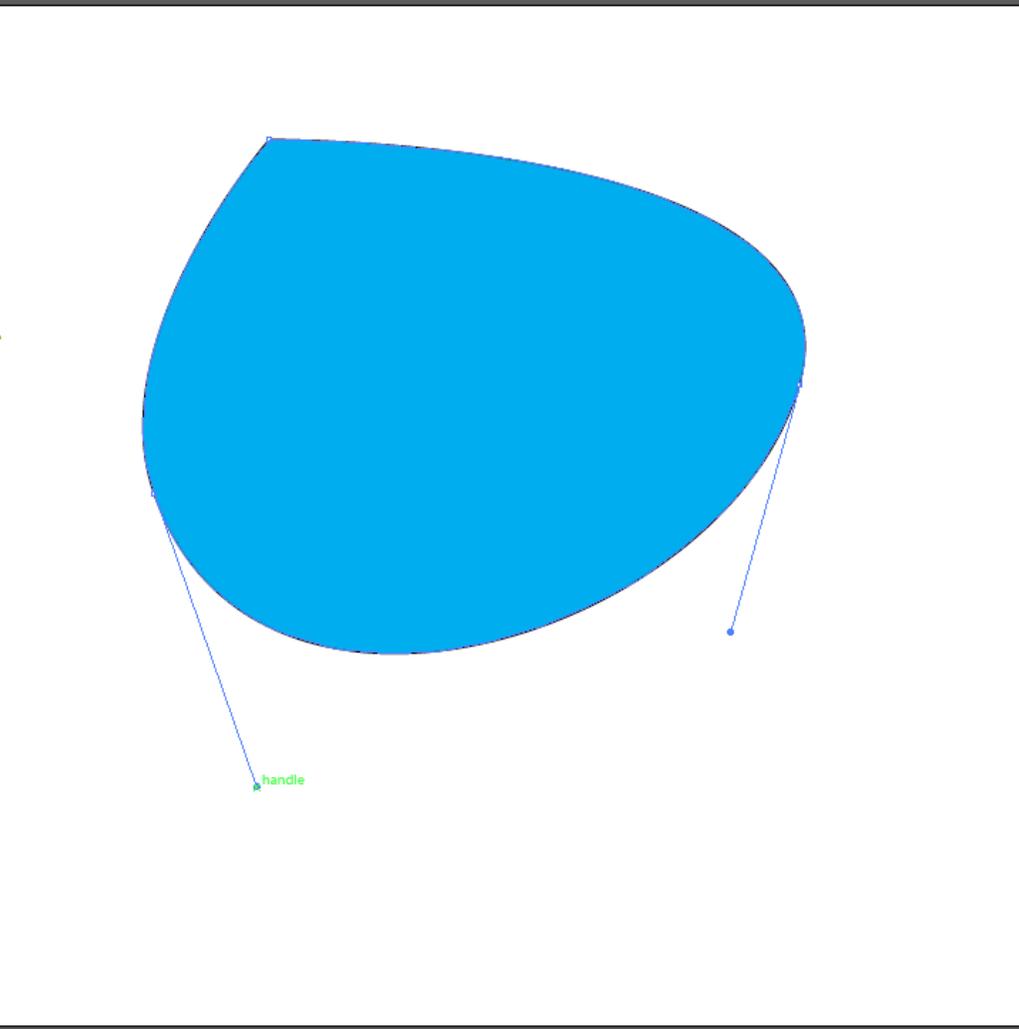
Layer 1

1 Layer

Paths



Changing the *angle* of the handle changes the tangent of the curve at the node (the handle represents the tangent)

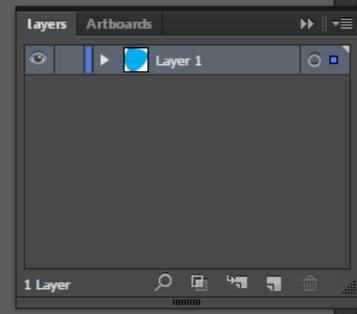
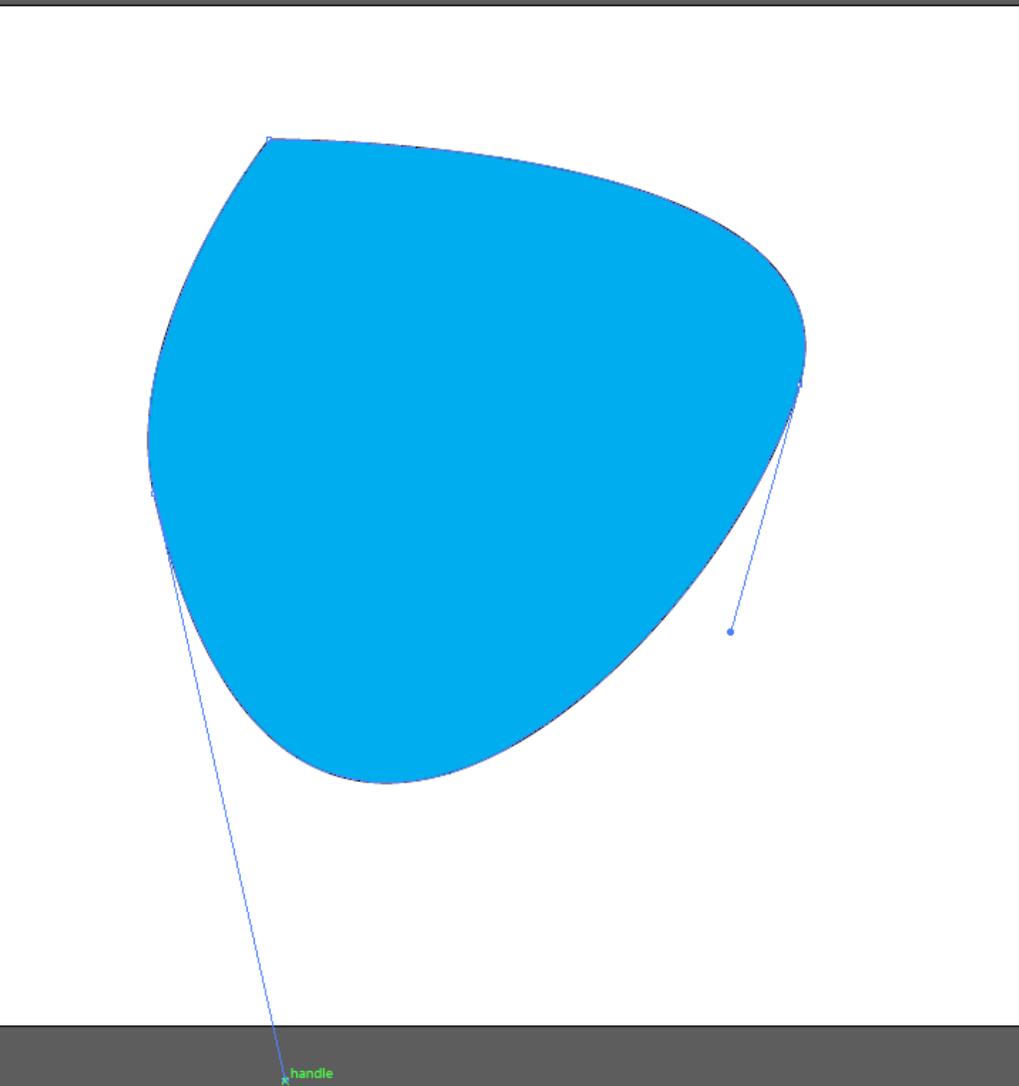


Paths



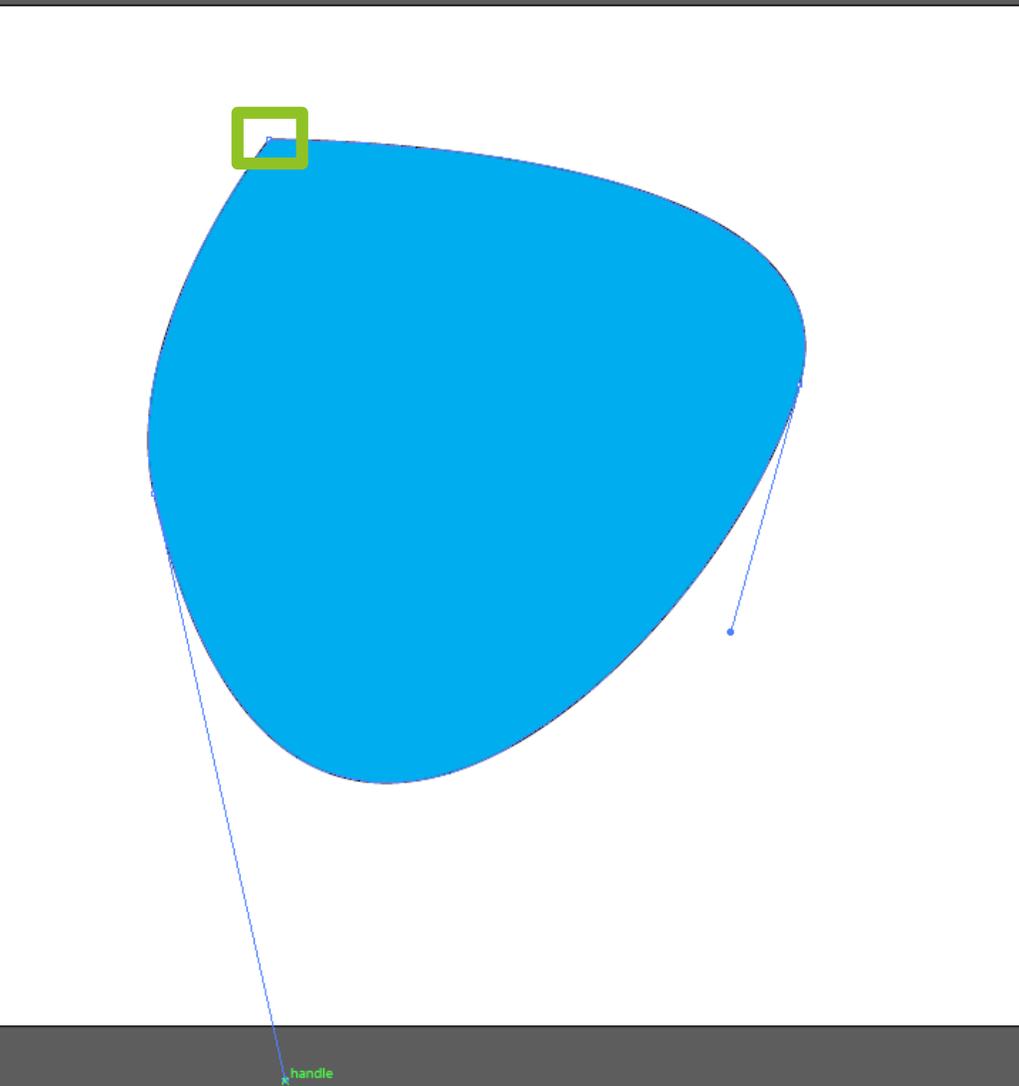
Whereas the *length* of the handle determines how long the curve will stay pointing in the same direction as the handle:

- Handle of no length = a corner
- Handle of infinite length = a line



Paths

You can also numerically determine the radius of curvature of a figure. Use Direct Select to click on a node.



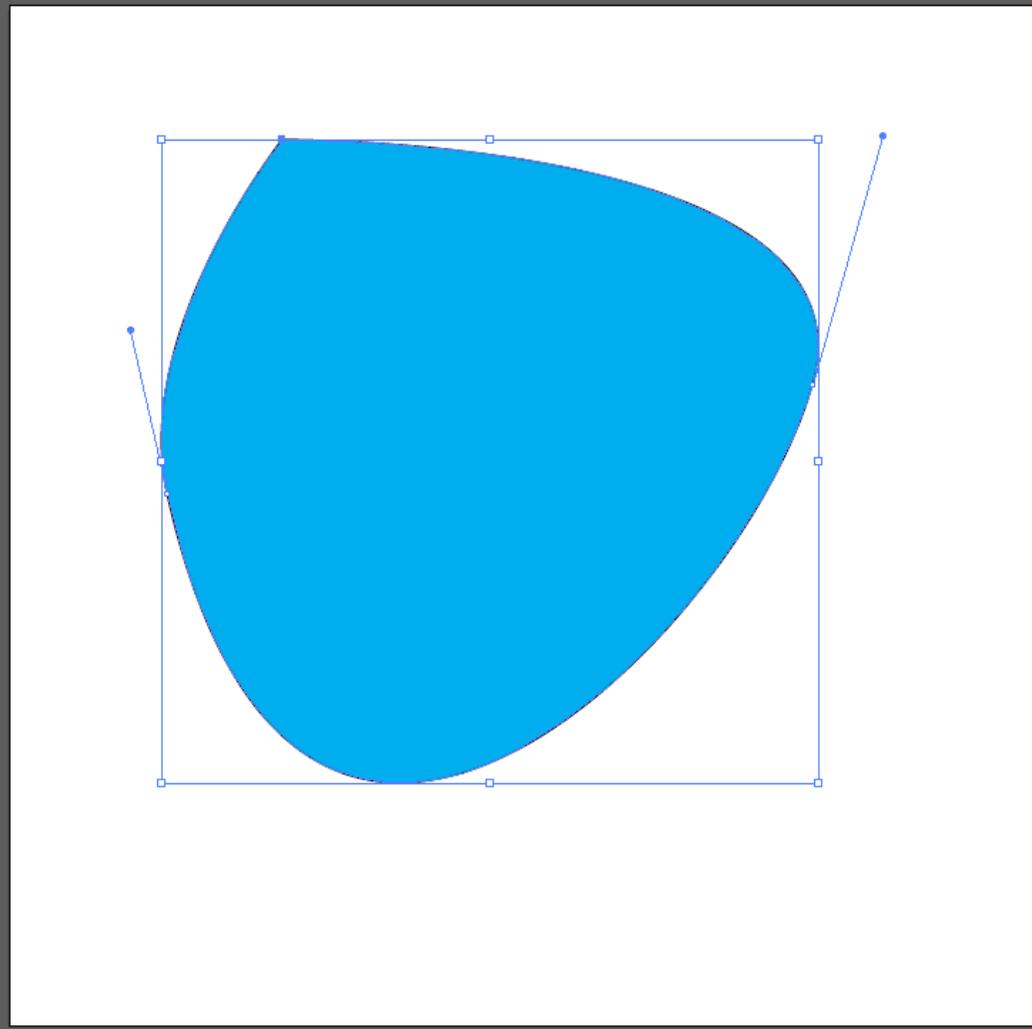
Layers Artboards

Layer 1

1 Layer

Paths

Change this value to round the edges of the corner.



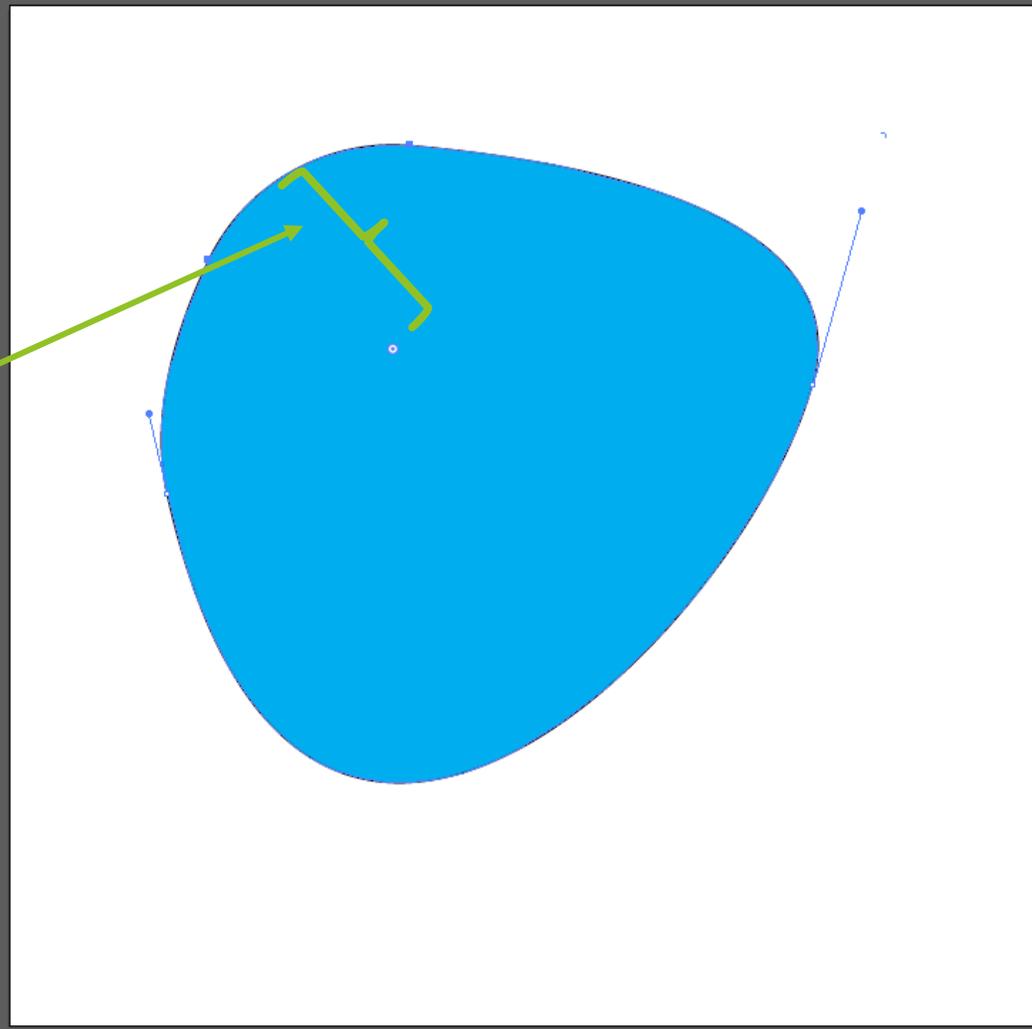
Layers Artboards

Layer 1

1 Layer

Paths

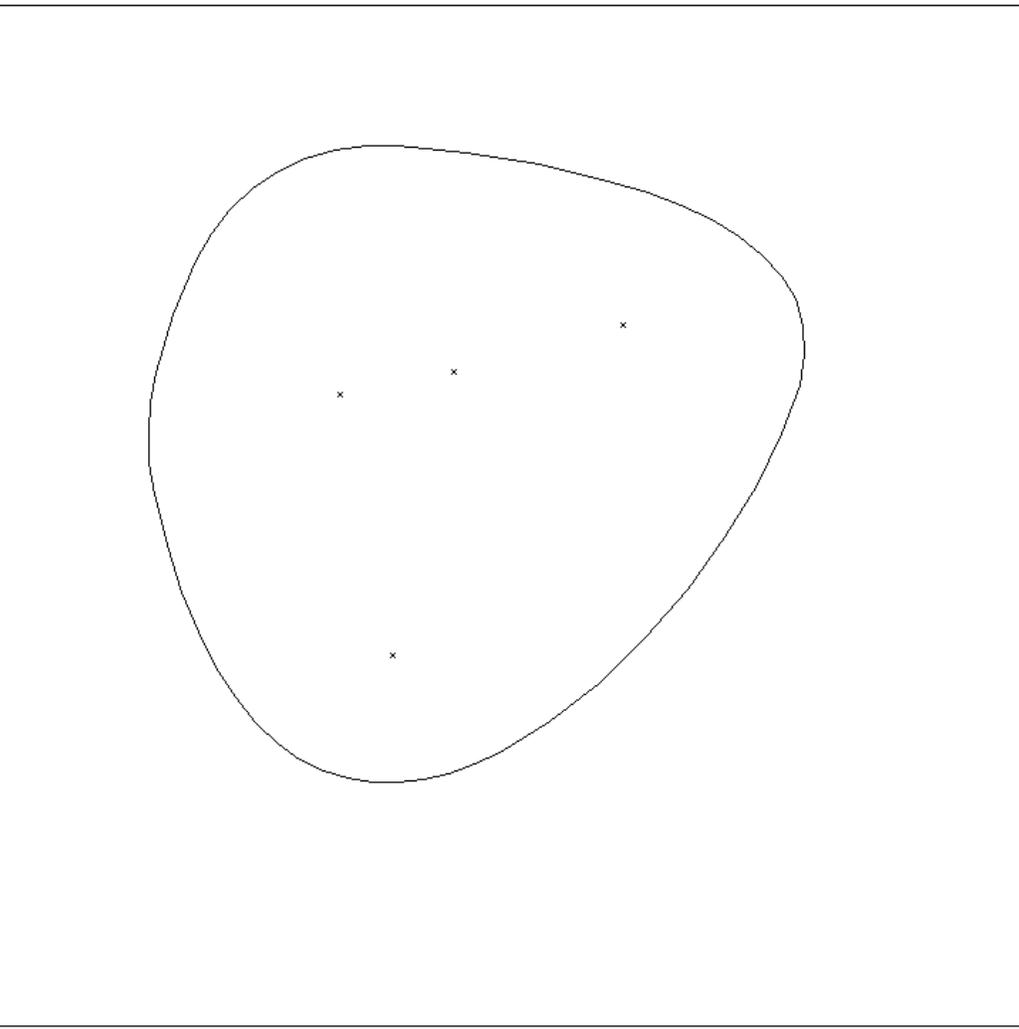
Change this value to round the edges of the corner.
(This value represents the radius of curvature)



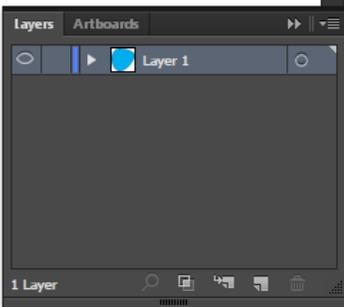
Layers Artboards
Layer 1
1 Layer

Paths

Be careful of *hanging anchors* (or nodes). This happens when you create a node that is not part of a line or a path, and you can see these nodes using the Overlay View (CTRL+Y).

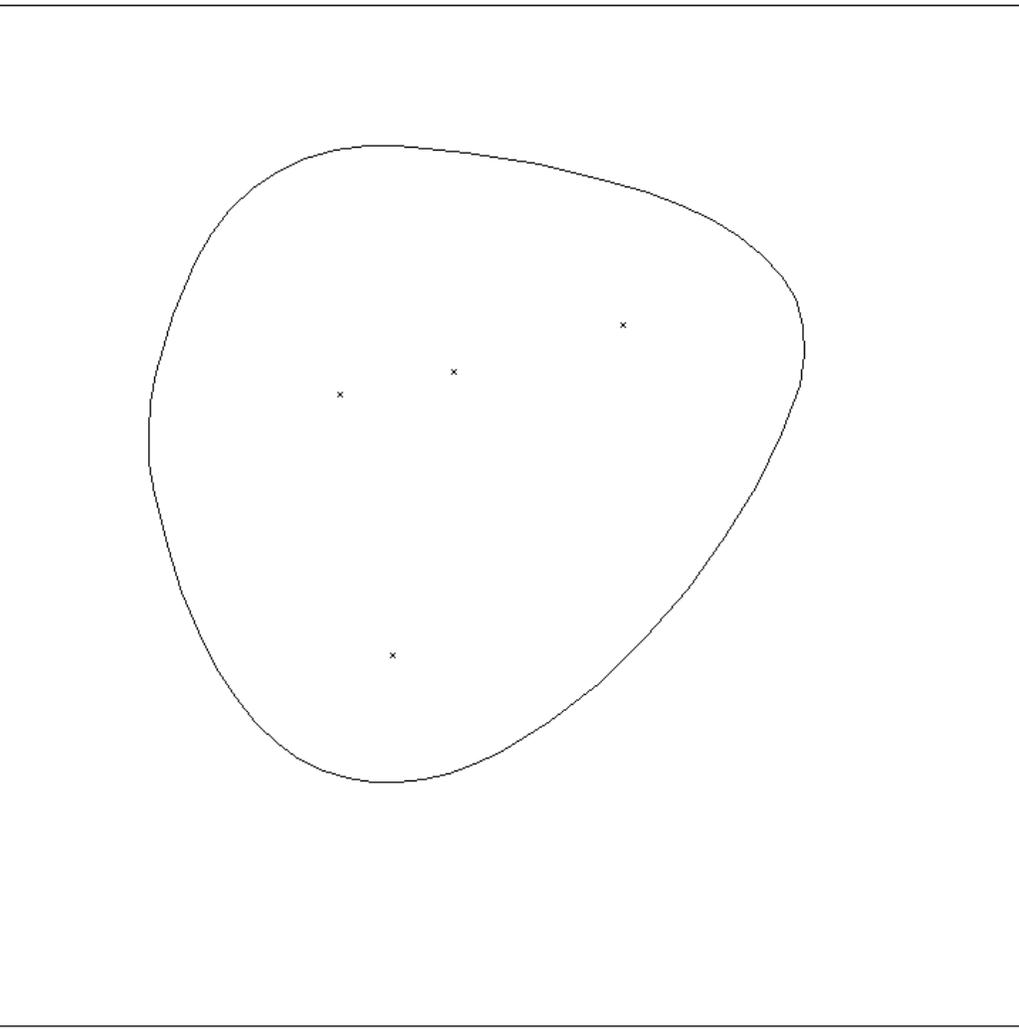


Hanging anchors will sometimes be cut by the laser cutter and can cause errors when you attempt to export to other programs (ie SolidWorks)



Paths

You can manually add or delete anchors by using + or - (plus and minus) respectively, but if you have a lot of anchors, that can be quite tedious.

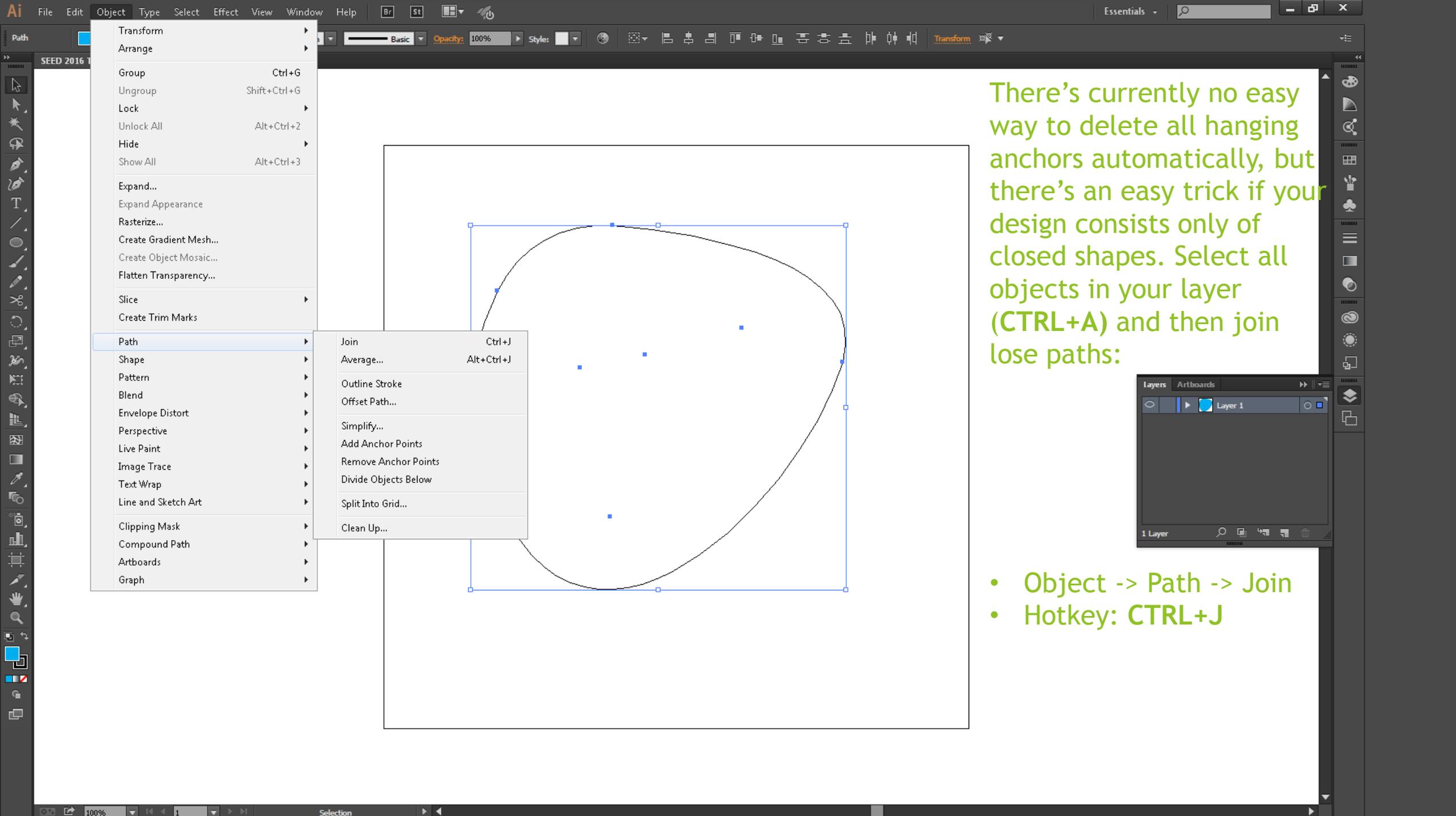


Layers Artboards

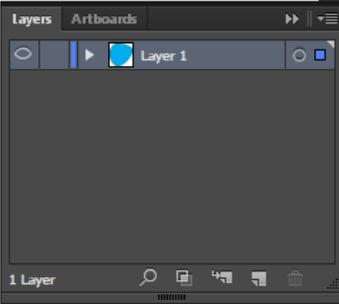
Layer 1

1 Layer

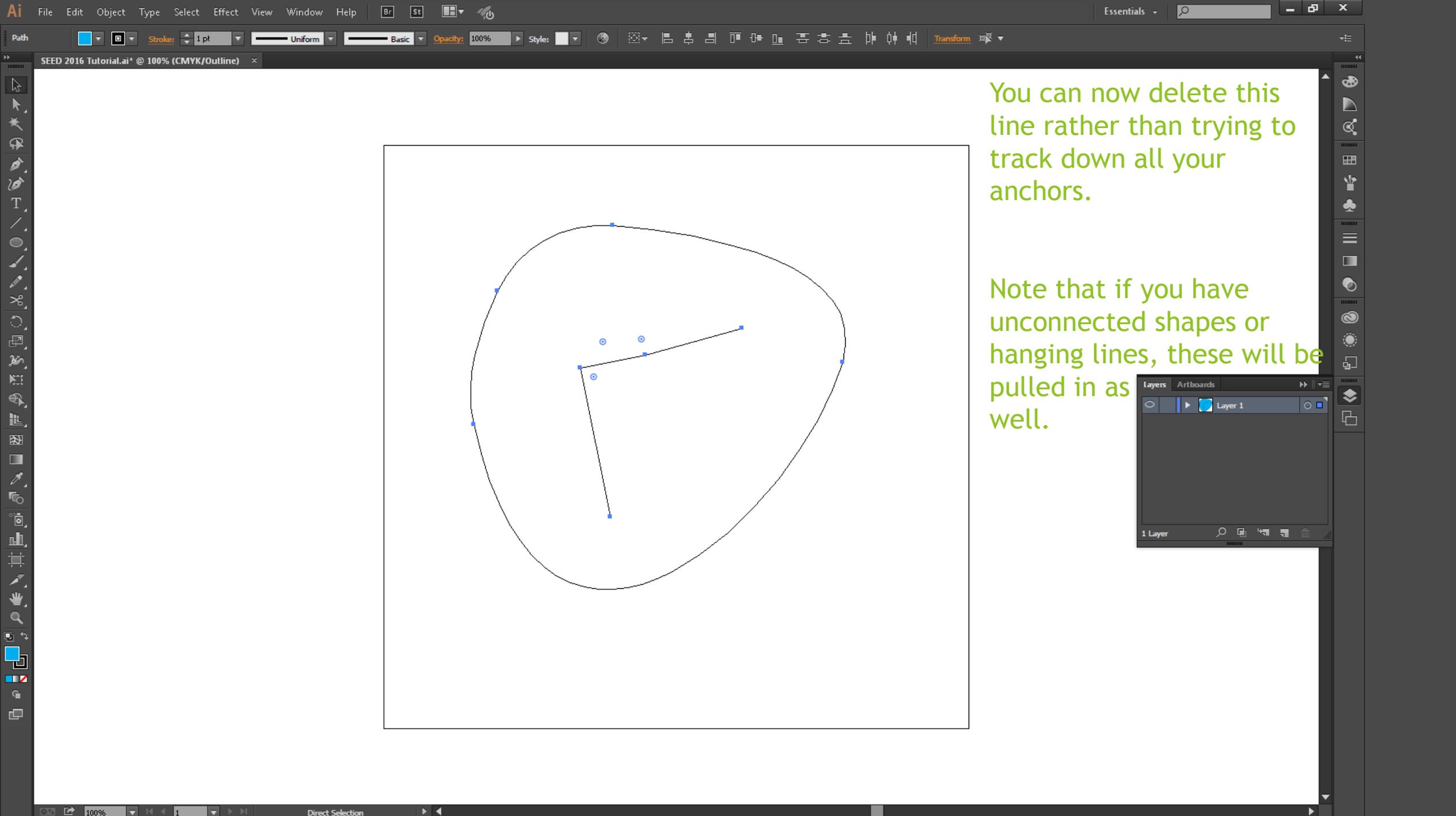
The screenshot shows the Adobe Illustrator Layers panel. It has two tabs: 'Layers' and 'Artboards'. The 'Layers' tab is active, showing a single layer named 'Layer 1' with a blue square icon. Below the layer name, there are icons for visibility, lock, and other layer actions. At the bottom of the panel, it says '1 Layer'.



There's currently no easy way to delete all hanging anchors automatically, but there's an easy trick if your design consists only of closed shapes. Select all objects in your layer (**CTRL+A**) and then join loose paths:



- Object -> Path -> Join
- Hotkey: **CTRL+J**



You can now delete this line rather than trying to track down all your anchors.

Note that if you have unconnected shapes or hanging lines, these will be pulled in as well.

Image Trace

As you remember, Illustrator works in *vector* images. Most file formats stored online are rasters (.png, .jpeg, .gif), which means that Illustrator cannot read them initially.

There is, however, a workaround for this.

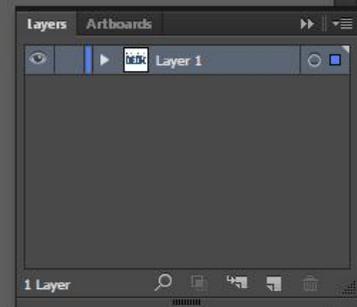


Layers Artboards Layer 1 1 Layer

Image Trace

If you try to click on the image, you'll notice two things:

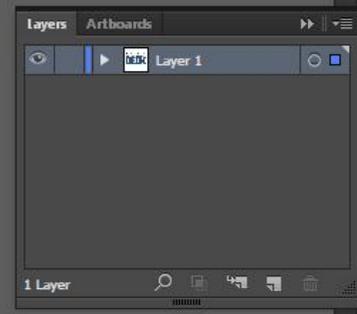
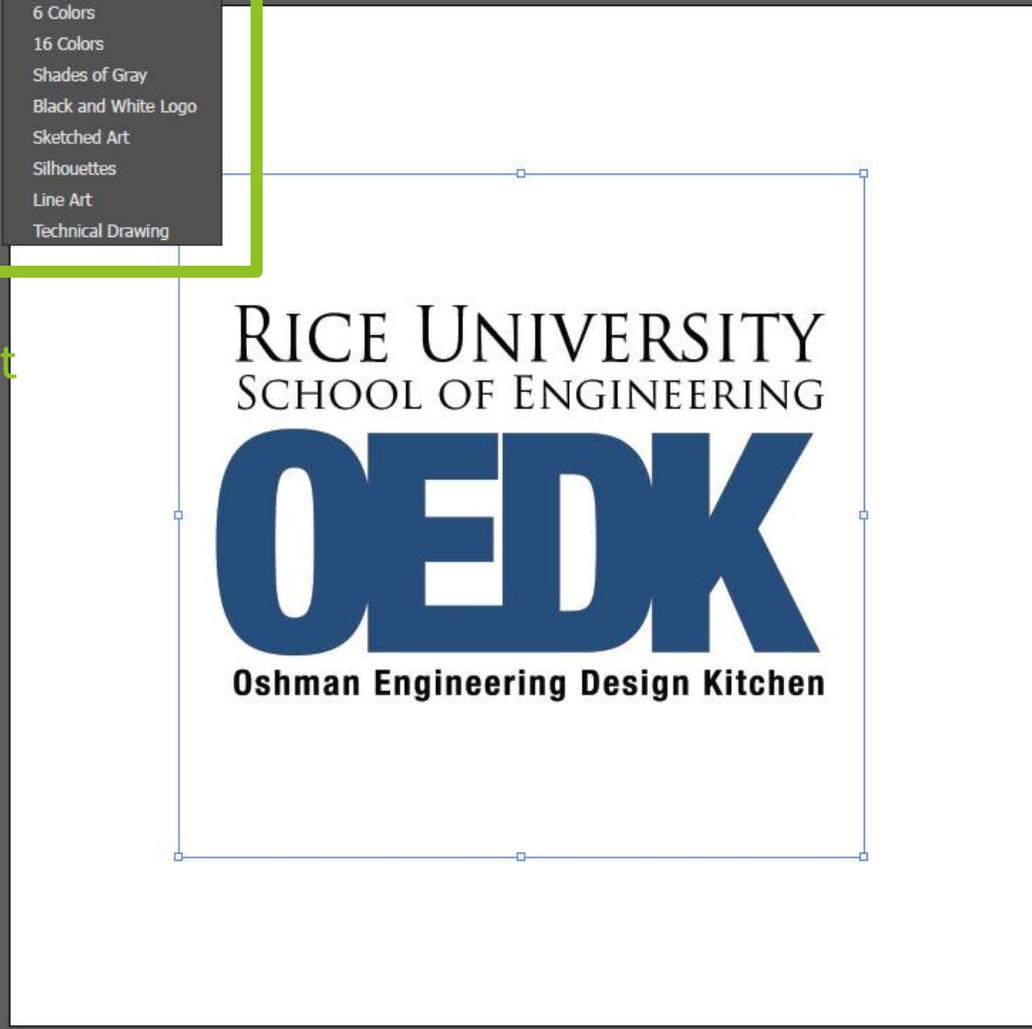
- First, that you can't edit the individual components as you'd like
- Second, that the toolbar has changed to an Image Trace toolbar. Let's look into that.





These are color presets that determine how Illustrator will adapt your image into vector form. You should probably play around with them all to see how they work, but the most useful ones are:

- High Fidelity Photo
- 3 Colors
- 16 Colors
- Shades of Grey



- New Window
- Arrange
- Browse Add-ons...
- Workspace
- Control
- Tools
- Actions
- Align Shift+F7
- Appearance Shift+F6
- Artboards
- Attributes Ctrl+F11
- Brushes F5
- Color F6
- Color Guide Shift+F3
- Color Themes
- CSS Properties
- Document Info
- Flattener Preview
- Gradient Ctrl+F9
- Image Trace
- Layers F7
- Libraries
- Links
- Magic Wand
- Navigator
- Pathfinder Shift+Ctrl+F9
- Pattern Options
- Separations Preview
- Stroke Ctrl+F10
- SVG Interactivity
- Swatches
- Symbols Shift+Ctrl+F11
- Transform Shift+F8
- Transparency Shift+Ctrl+F10
- Type
- Variables
- Brush Libraries
- Graphic Style Libraries
- Swatch Libraries
- Symbol Libraries
- SEED 2016 Tutorial.ai* @ 100% (CMYK/Prev...

Image Trace

Preset: High Fidelity Photo

View: Tracing Result

Mode: Color

Palette: Full Tone

Colors: 85

Advanced

Paths: 50%

Corners: 50%

Noise: 5 px

Method: Fills Strokes

Strokes: 10 px

Options: Snap Curves To Lines Ignore White

Paths: 450 Colors: 310 Anchors: 3715

Preview Trace

Opening the Image Trace Window allows you to fiddle even more with the presets to get the exact settings that you want.

A general rule of thumb: the higher the numbers you have here, the longer the render time.

Layers Artboards

Layer 1

1 Layer

Let's try out "High Fidelity Photo" for this one.

Image Trace

Press "Expand" to create your Image Trace. This approximates the photo in vector form.



Layers Artboards

Layer 1

1 Layer

Image Trace

Ungroup the resulting Group.

You may need some fine-tuning in your settings before you get the color presets right.



Layers Artboards

Layer 1

1 Layer

Image Trace

You may need some fine-tuning in your settings before you get the color presets right.

In this case, the precision of High Fidelity Photo actually worked against us: we only have two colors in this logo, so the 3 Colors preset does a much better job.



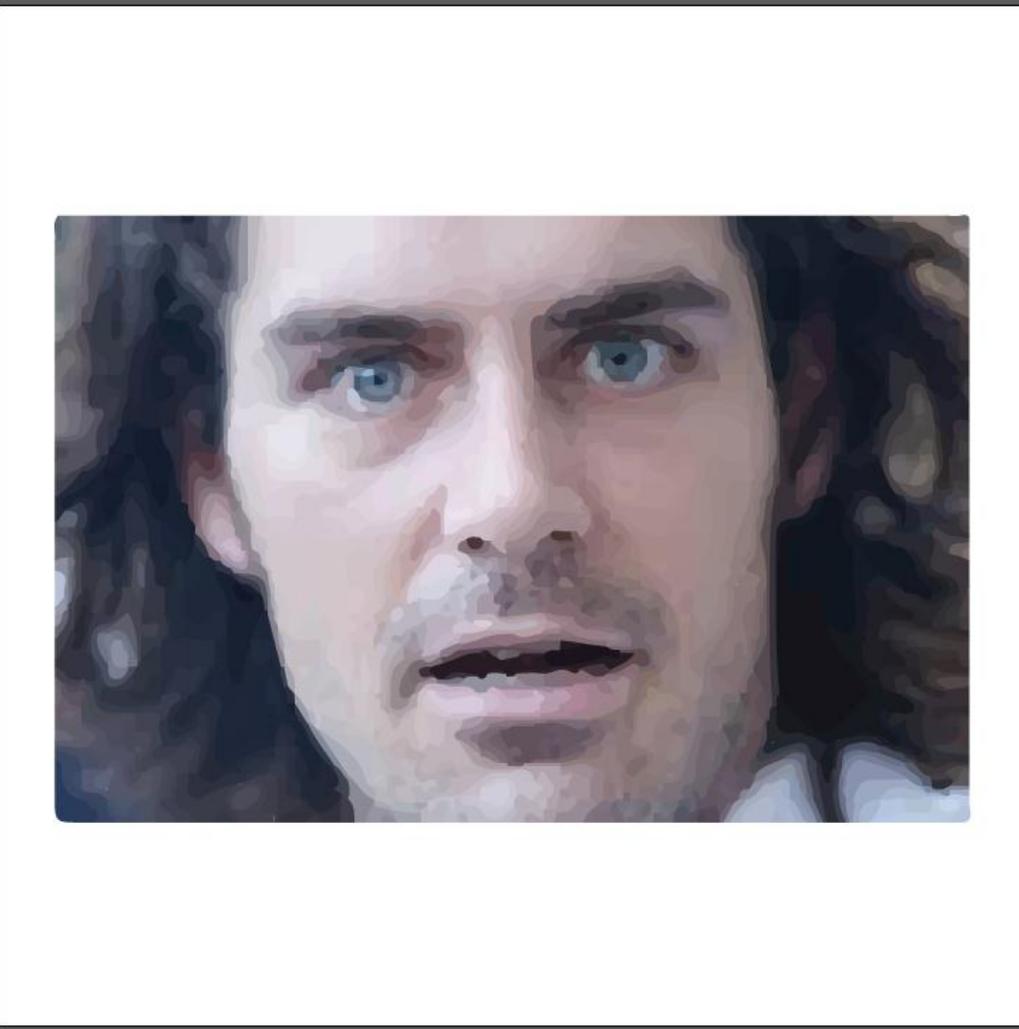
Layers Artboards

Layer 1

1 Layer

Image Trace

Note that, even with the highest settings, Illustrator struggles to render photos properly.



Layers Artboards

- Layer 1

1 Layer

Image Trace

Note that, even with the highest settings, Illustrator struggles to render photos properly.



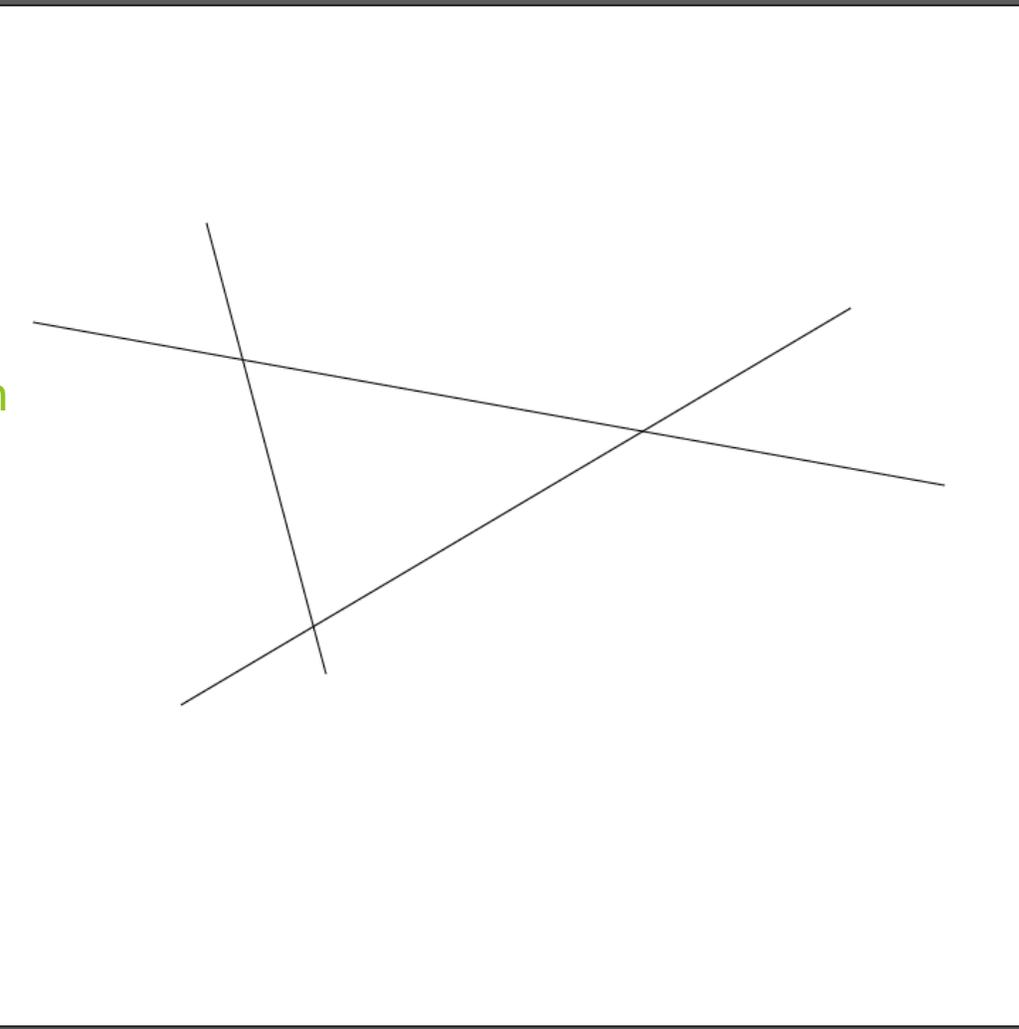
Layers Artboards

Layer 1

1 Layer

Outlines

Some tools such as the plasma cutter may work better if you try to cut the outline of a line rather than a line. This can be quite tedious; luckily, there's an easy workaround.



Layers Artboards

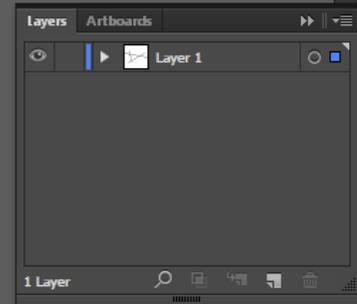
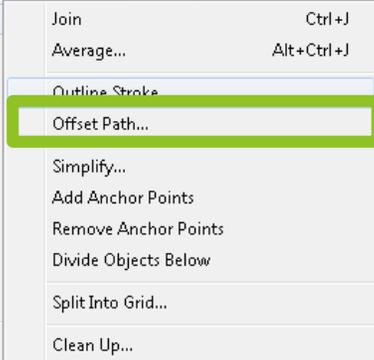
- Layer 1

1 Layer

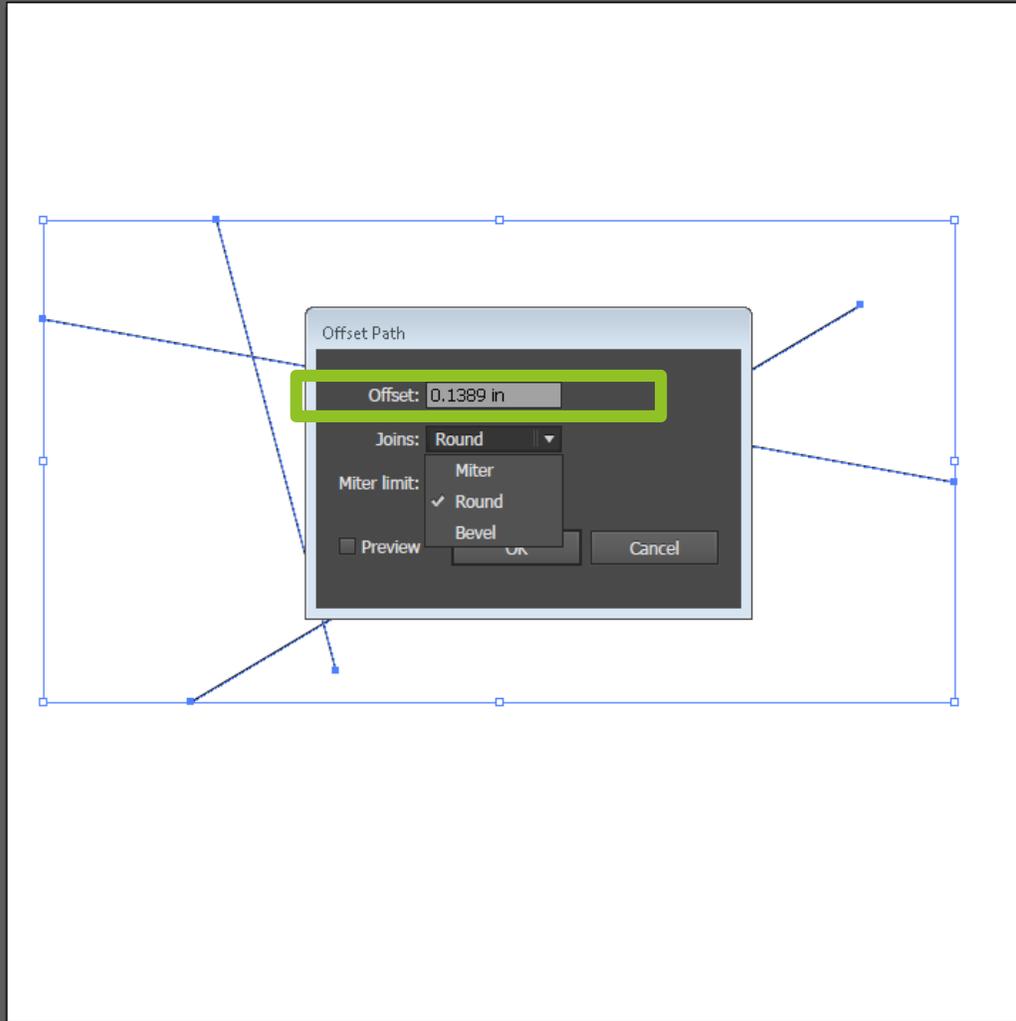
Outlines

Select the collection of lines you want to outline:

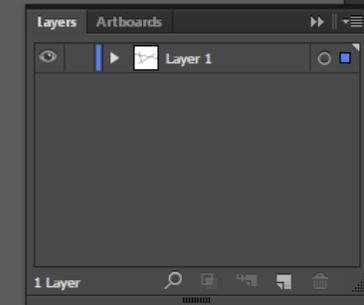
- Object -> Path -> Offset Stroke



Outlines

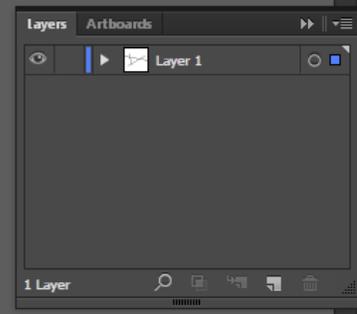
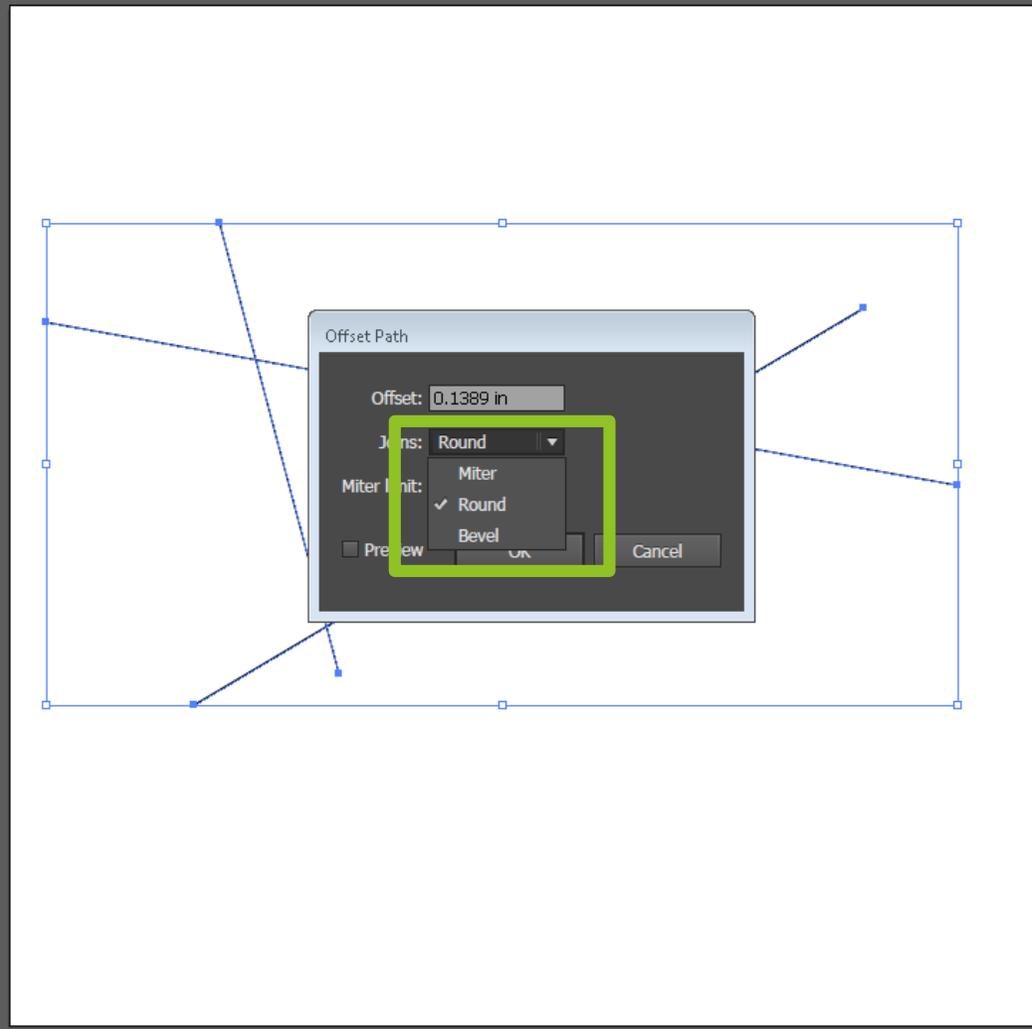


The Offset window determines the distance between the original path and the outline.

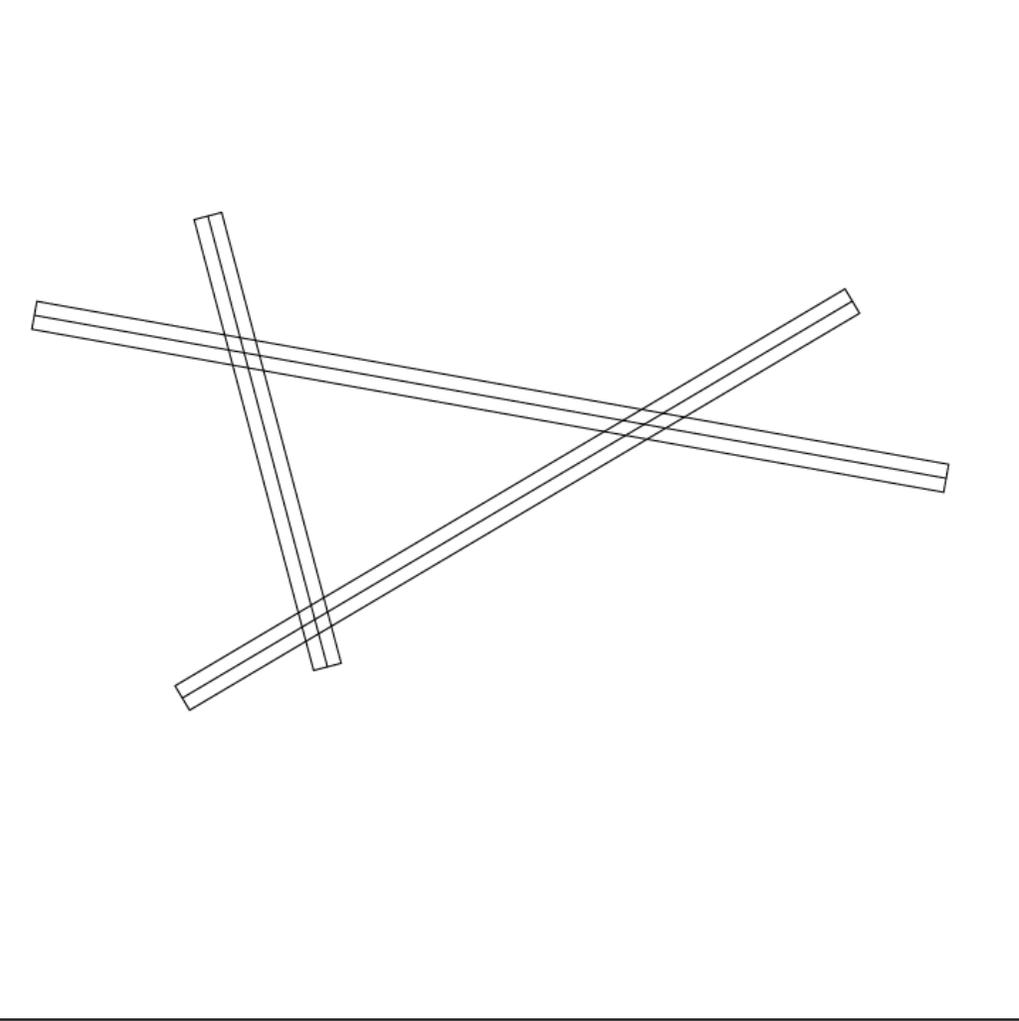


Outlines

You can choose between types of offsets.



Outlines



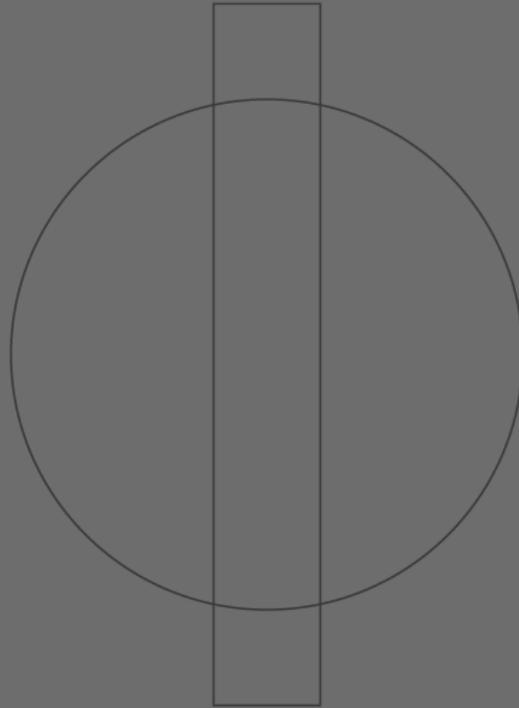
Layers Artboards

- Layer 1

1 Layer

Offset Rotation

Let's pretend that, for whatever reason, you want to manually create gears rather than using a gear generator. You can do this quite easily using the Rotation tool, which allows you to rotate from custom points rather than strictly about the center.



Layers Artboards

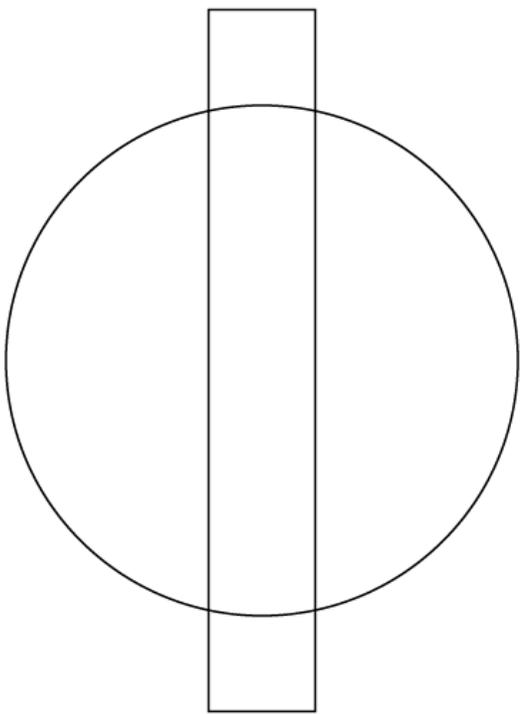
Layer 1

1 Layer

A screenshot of the Adobe Illustrator Layers panel. The panel is titled 'Layers Artboards' and shows a single layer named 'Layer 1'. The layer is currently selected, as indicated by a blue bar to its left. The panel also shows standard layer controls like visibility, lock, and delete icons.

Offset Rotation

We begin with a circle, and then a centered rectangle to serve as a guide for symmetry.



Layers Artboards

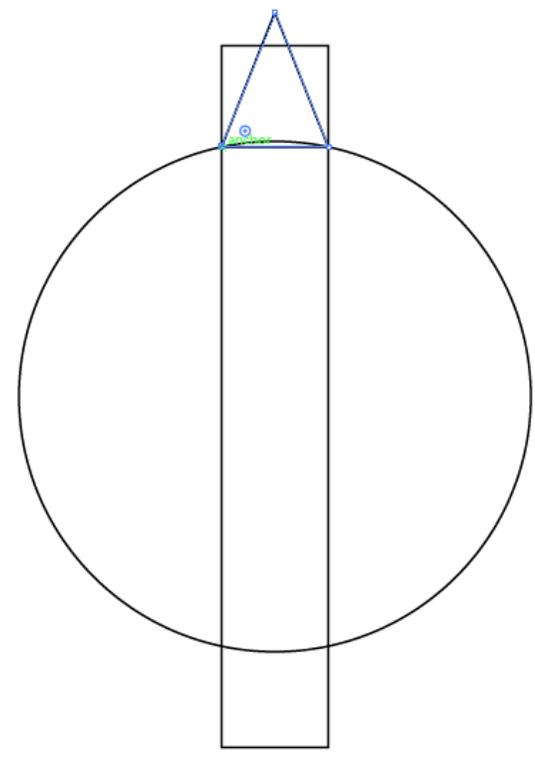
- Layer 1

1 Layer



Offset Rotation

Using the pen tool, we can create a shape for a geartooth whose center we know aligns with the center of the gear hub.



Layers Artboards

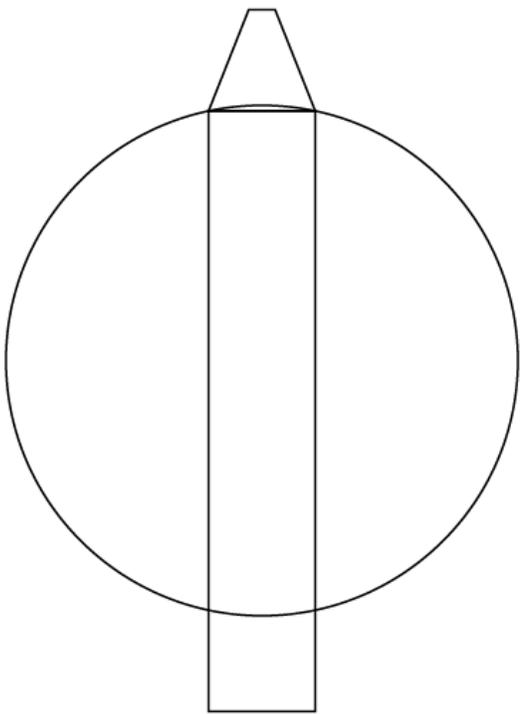
- Layer 1

1 Layer



Offset Rotation

A bit of Shapebuilder gives us the shape we want.



Layers Artboards

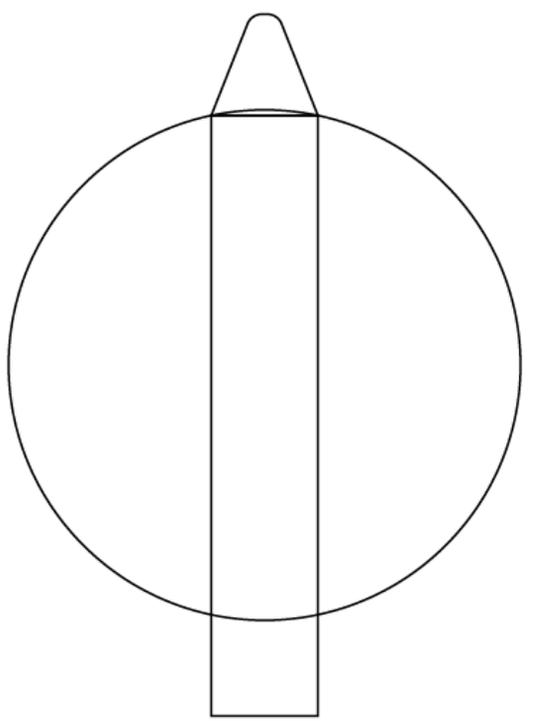
- Layer 1

1 Layer



Offset Rotation

And we can round off the corners using our techniques from before.



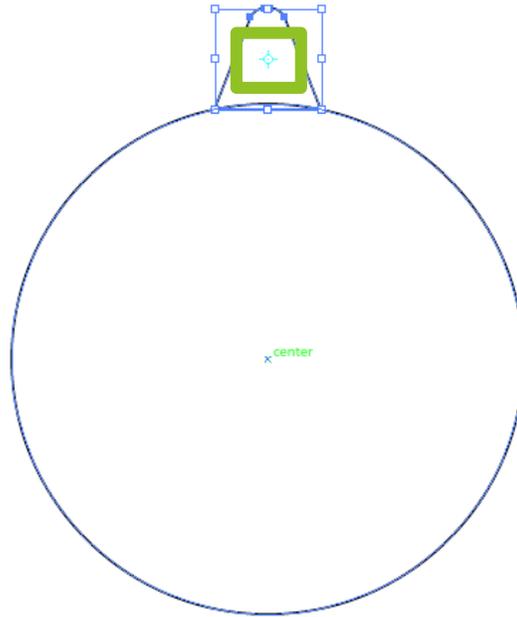
Layers Artboards

- Layer 1

1 Layer

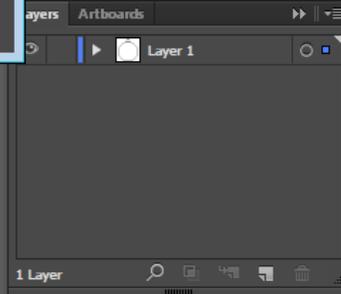
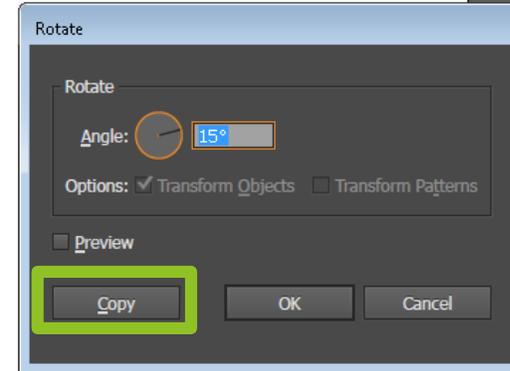
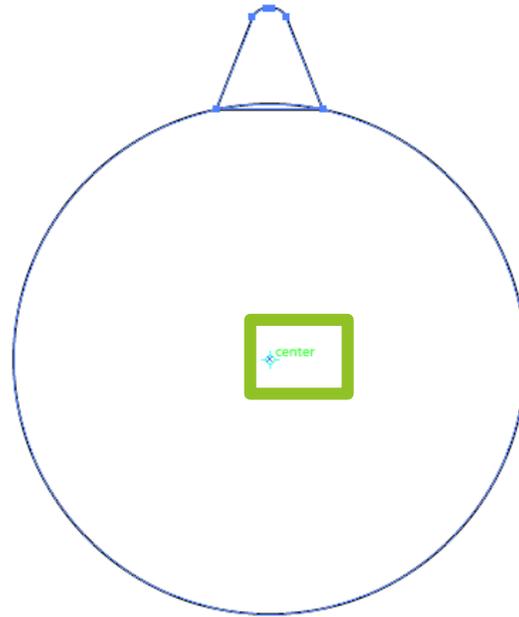
Offset Rotation

Select the Rotate tool from the side (Hotkey: R). Notice that a blue crosshairs now appears on the screen. This represents the point about which your shape will be rotated. The default center of rotation is the center of the shape, but we can move that point with **ALT+CLICK**.



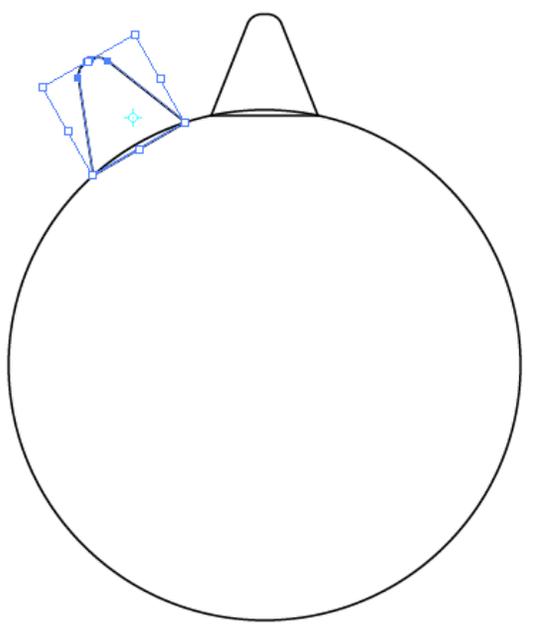
Offset Rotation

Use the SmartGuides to find the center. ALT+CLICK will cause a rotation window to pop up. We'll make sure to use the Copy button.



Offset Rotation

Note that this will only work with angles that fit evenly into 360°.



Layers Artboards

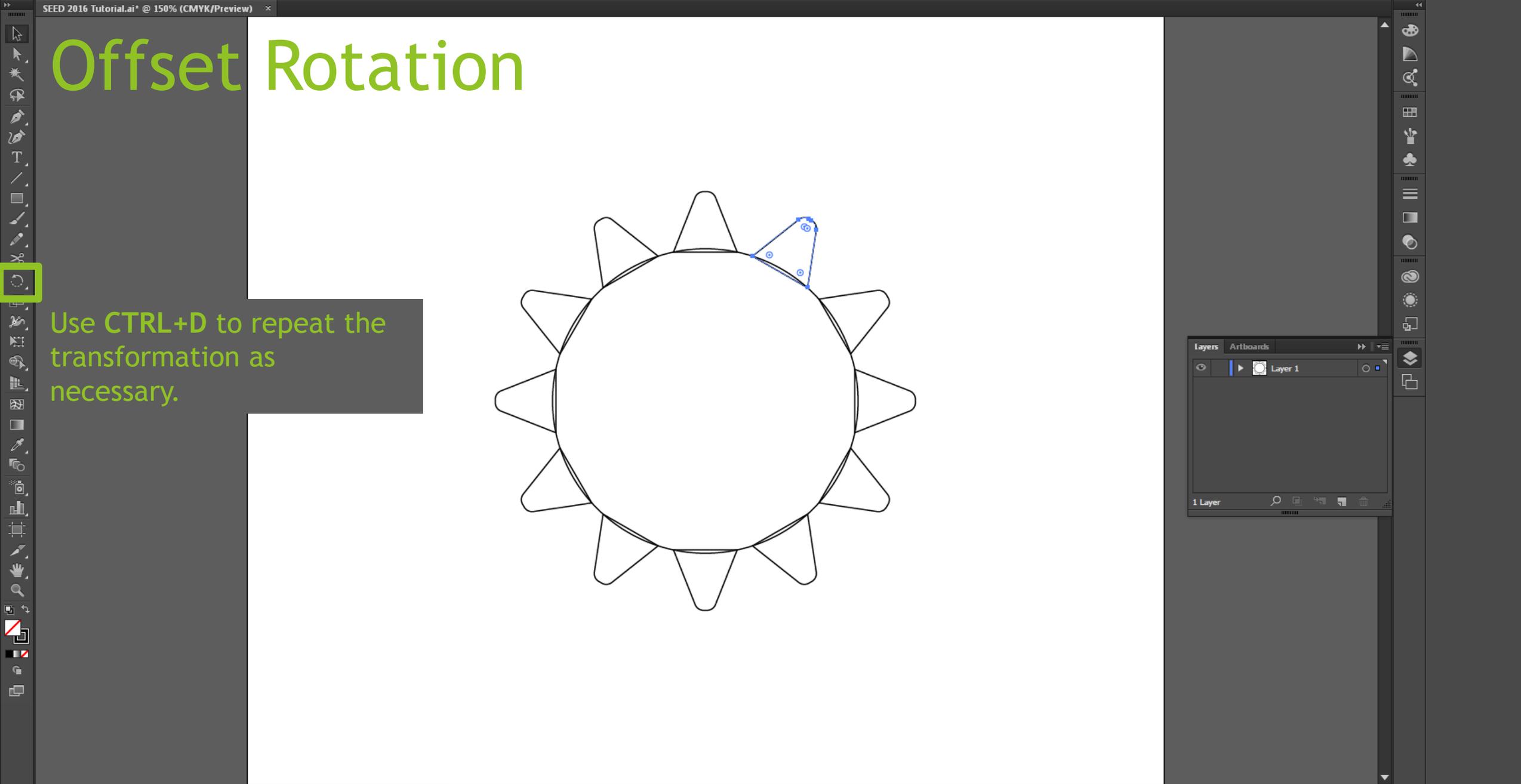
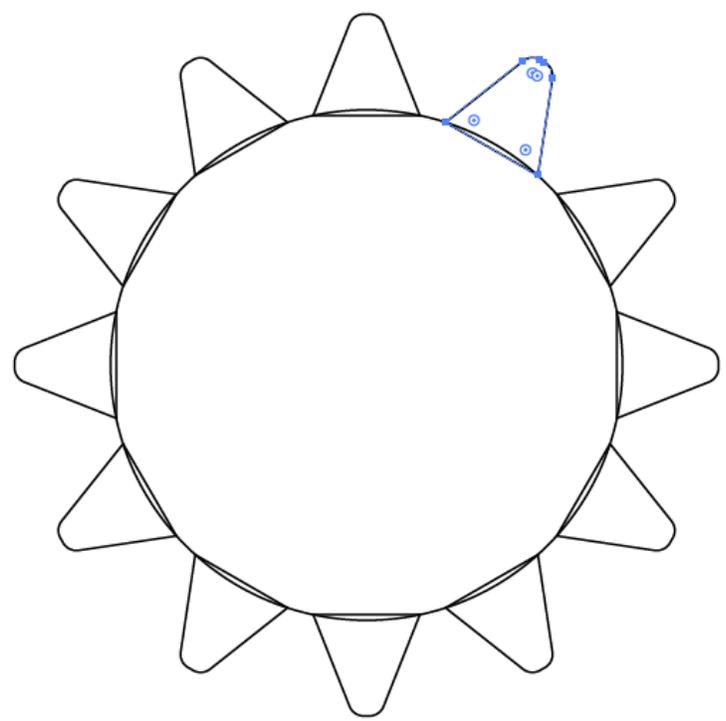
Layer 1

1 Layer



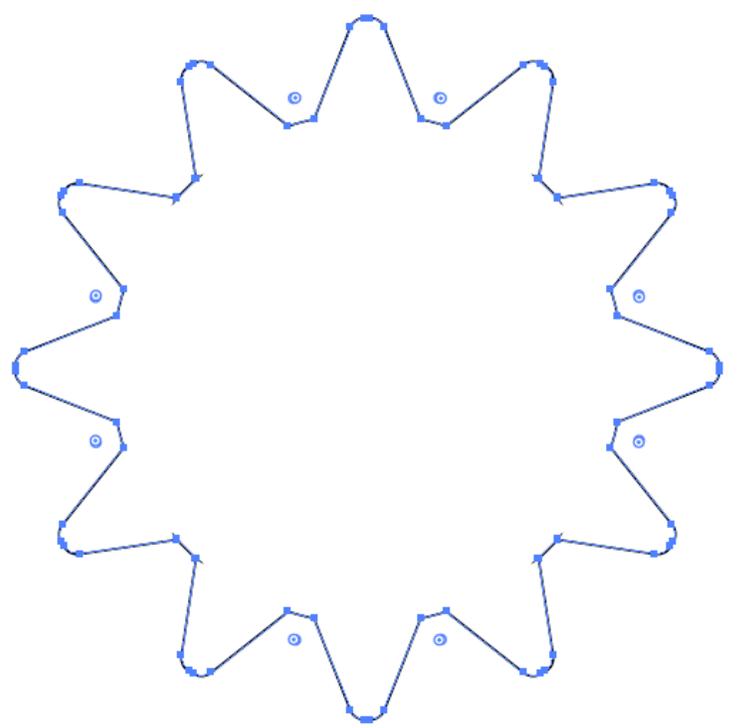
Offset Rotation

Use CTRL+D to repeat the transformation as necessary.



Offset Rotation

And Shapebuilder to complete the shape!



Layers Artboards

Layer 1

1 Layer

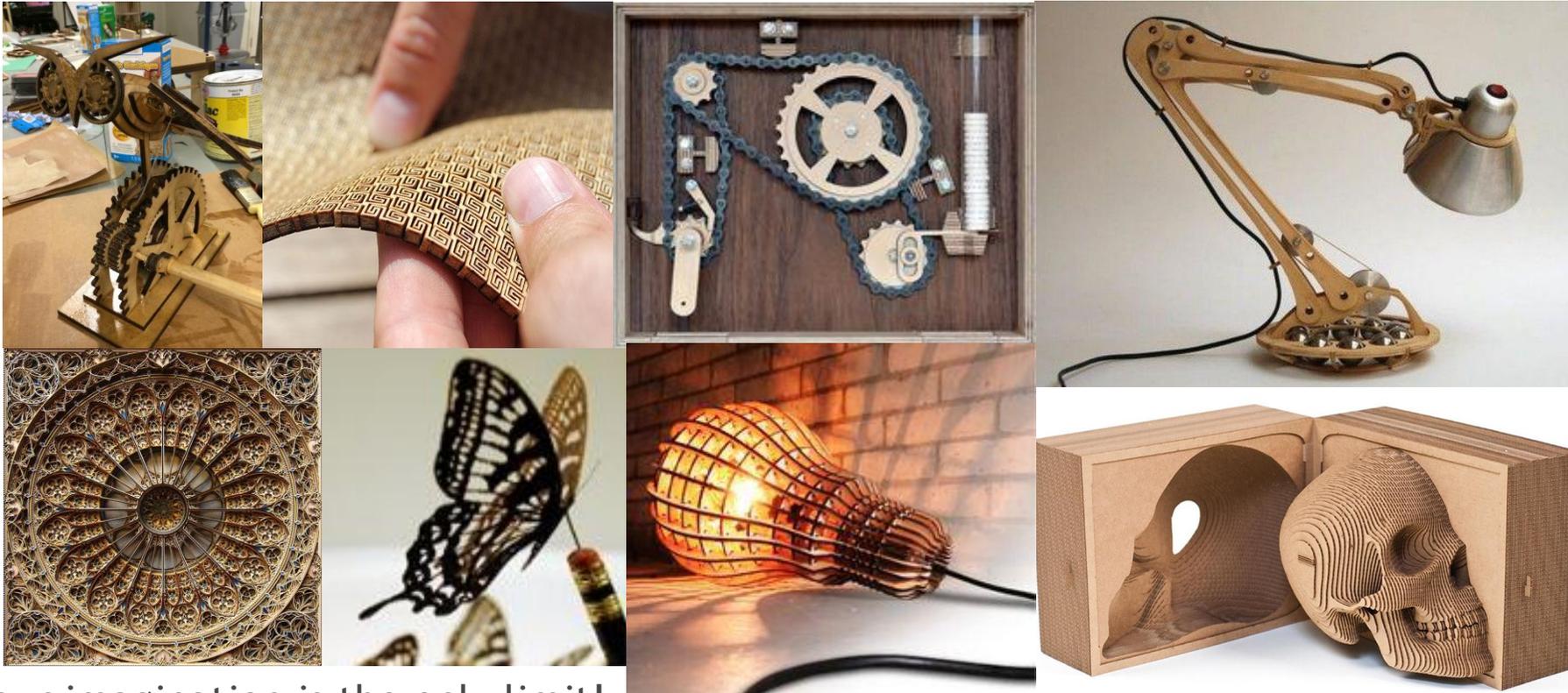
Now What?

- ▶ The laser cutter works on flat materials; the most common ones in the OEDK are:
 - ▶ Wood
 - ▶ Acrylic
 - ▶ Cardboard
 - ▶ Cardstock/Paper
 - ▶ Polyvinyl

- ▶ PSA: you should **NEVER** cut a material if you don't know if its safe to cut. For example, PVC produces chlorine gas when laser cut. Chlorine gas is a major component of mustard gas, and it essentially mixes with the water in your airways and lungs to become hydrochloric acid, which then eats away at you from the inside.

Now What?

- ▶ On a brighter note, the laser cutter's effective limitation (that it only cuts 2D objects) can actually be overcome with some creative workarounds, and laser cutting has a wide variety of applications, both engineering and otherwise:



- ▶ Your imagination is the only limit!

Now What?

- ▶ This is basically everything you'll need to make basic laser cut and plasma cut CAD Files.
- ▶ Some useful websites:
 - ▶ Box Designer (<http://boxdesigner.connectionlab.org/>): creates 2D files to assemble a rectangular prism of given dimensions
 - ▶ Gear Generator (<http://geargenerator.com>): creates 2D files of gears with given specifications
 - ▶ Thingiverse (<https://www.thingiverse.com/>): repository for open-source lasercut CAD files