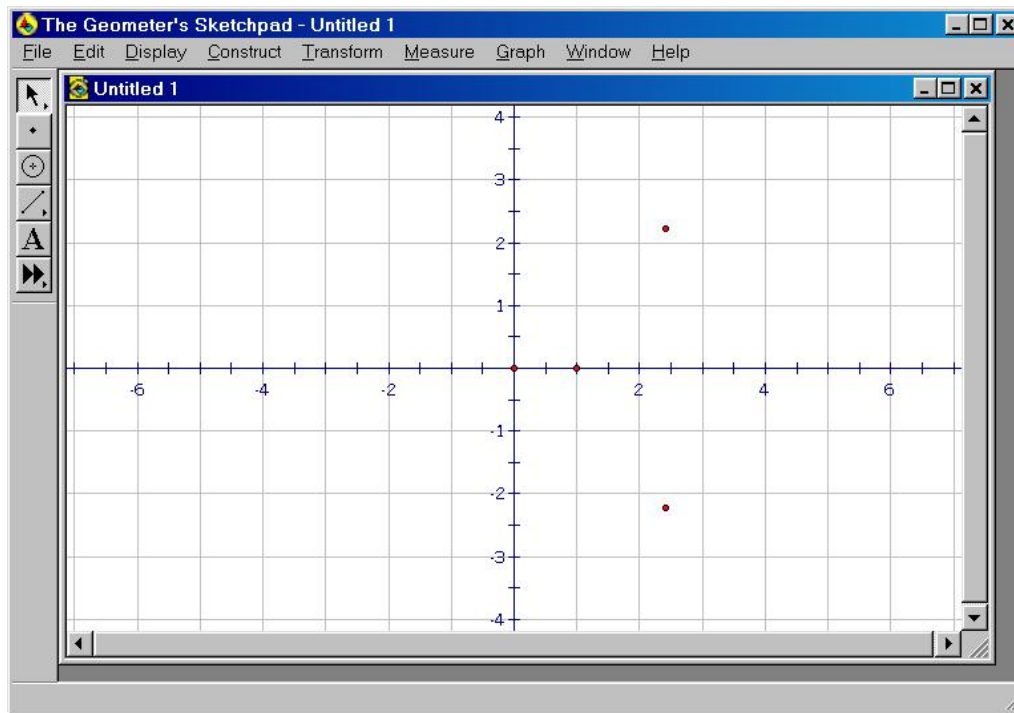


Symmetry Investigation — The Easy Way

When I was writing up the constructions to investigate symmetry I forgot to show you the easy way to do it in GSP and WinGeom. There are built-in functions in both GSP and WinGeom to do reflections, rotations and translations, plus a few other things along those lines. This handout will guide you through the steps to do the same constructions using these facilities.

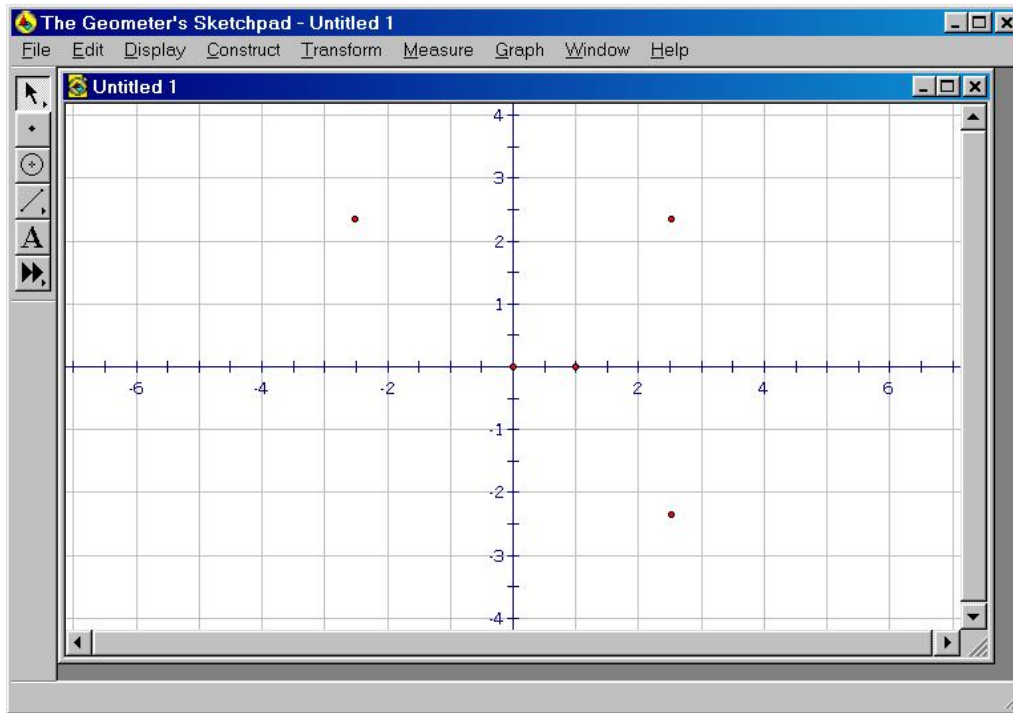
Geometer's Sketchpad

1. Start-up GSP and select Graph \succ Show Grid.
2. Place a point on the grid.
3. With the arrow selected from the toolbar double-click on the x -axis. When you do this the x -axis will highlight, there will then be a couple of animated squares around the axis then the squares will disappear and the axis will unhighlight. What you have done is mark the x -axis as the current transformation object.
4. Now select the point and select Transform \succ Reflect from the menu. At this point your picture should look like the one below.



Move the initial point around to see that the transformed point remains its reflection across the x -axis.

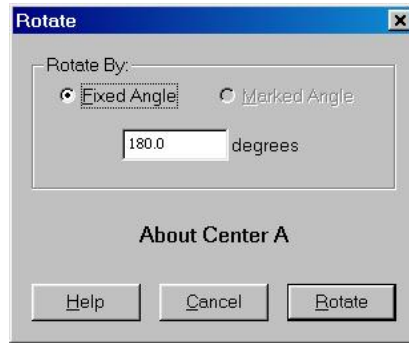
5. Now double-click the y -axis, the same animation will occur. Select the initial point and then select Transform \succ Reflect from the menu. At this point your picture should look like the one below.



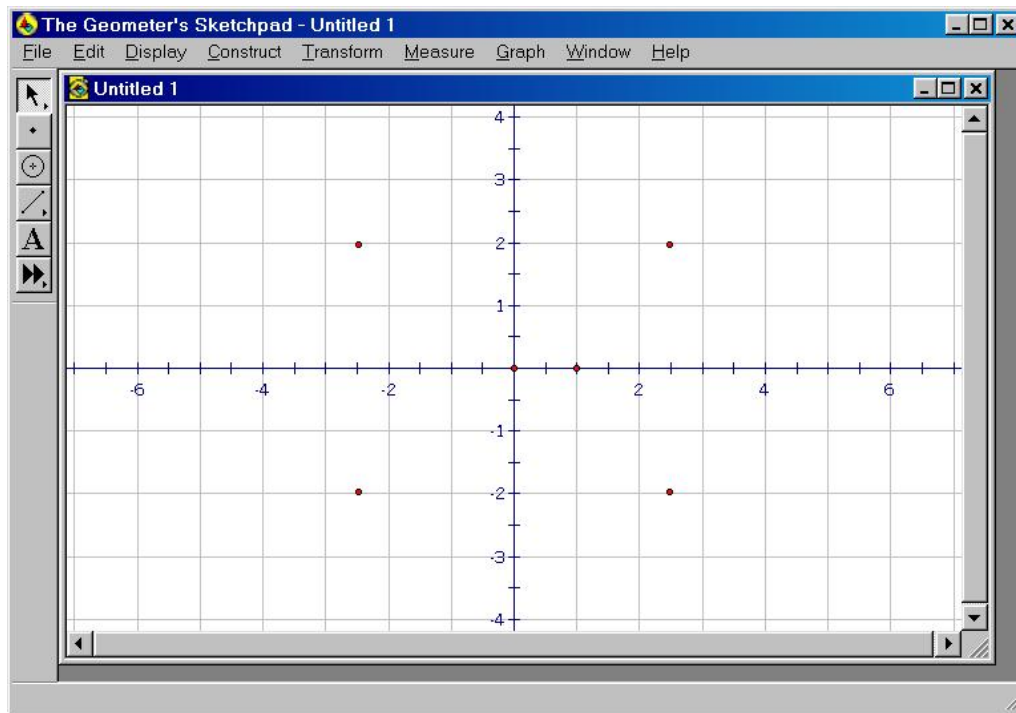
Again, move the initial point around to see that the transformed points remain its reflections across the x and y axes.

6. Now to get the symmetry with respect to the origin we have a few options. There is not a direct reflection way to do it but we can either reflect one of the already reflected points or we can rotate the initial point about the origin by 180° . We will look at both of these methods.
- (a) We will start with the reflection of a reflection.
 - i. Double-click the x -axis and select the point that is the y -axis reflection.
 - ii. Select Transform \succ Reflect from the menu. This will place the final point in and finish the worksheet. The image should look like the one below.
 - (b) The rotation process.
 - i. Double-click the origin and select the initial point. When you double click the origin there will be an animated circle about the origin letting you know that you have marked it as the current transformation object.
 - ii. Select Transform \succ Rotate from the menu. When you do a small dialog box

will appear like the one below.



Make sure that Fixed Angle is selected and that the angle is set to 180, then click Rotate. The image should look like the one below.



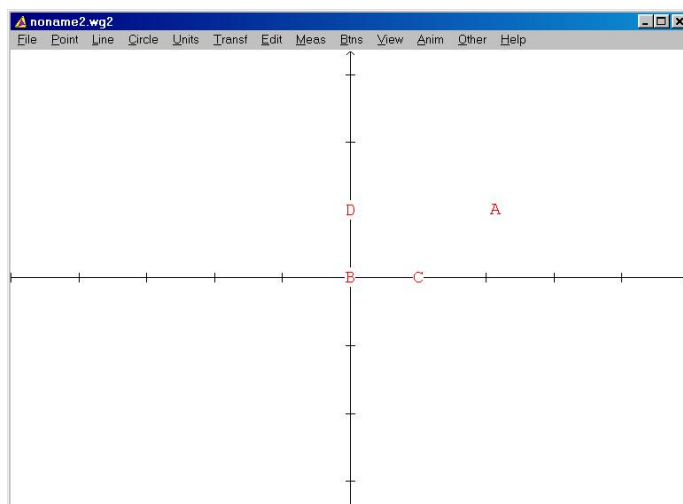
WinGeom

1. Start-up WinGeom and select a 2-dimensional worksheet.
2. Select View \succ Axes.
3. Place a point on the grid by selecting either Segment, Ray, Line or Circle on the toolbar and right-clicking on the worksheet.
4. Now we need to place three points on the axes in order to do the transformations. These points need to be on the x and y axes and a reasonable choice would be the

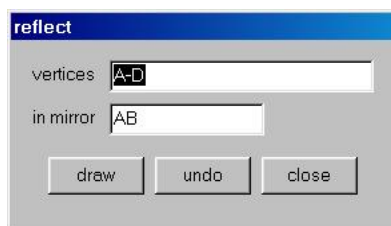
points $(0, 0)$, $(1, 0)$ and $(0, 1)$. Select Point \succ Coordinates from the menu and you will see the following dialog box.



One-by-one put in the coordinates for the three points and click Mark after each one. At this point your image should look like the following.

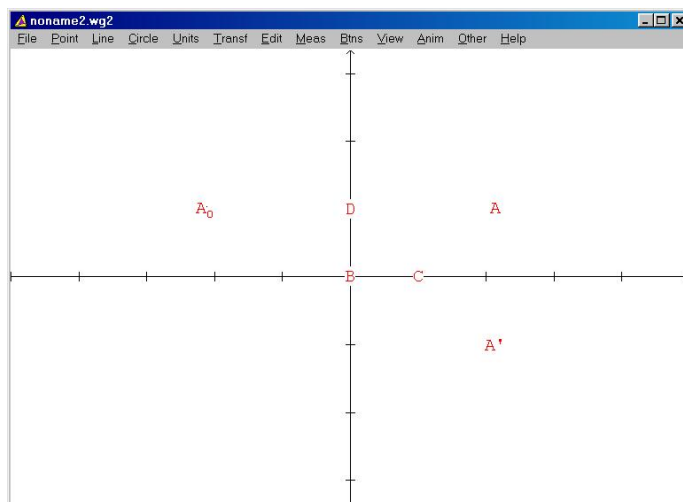


5. We will start with the symmetric point about the x -axis. Select Transf \succ Mirror... from the menu. At this point a small dialog box will appear like the following.



Change the vertices to just A and the in mirror to BC (that is, the two points on the x -axis) and then click Draw. With the dialog box still on the screen change the in mirror to BD (that is, the two points on the y -axis) and then click Draw. At this point

your image should look like the following. Click on the close to close the dialog box.

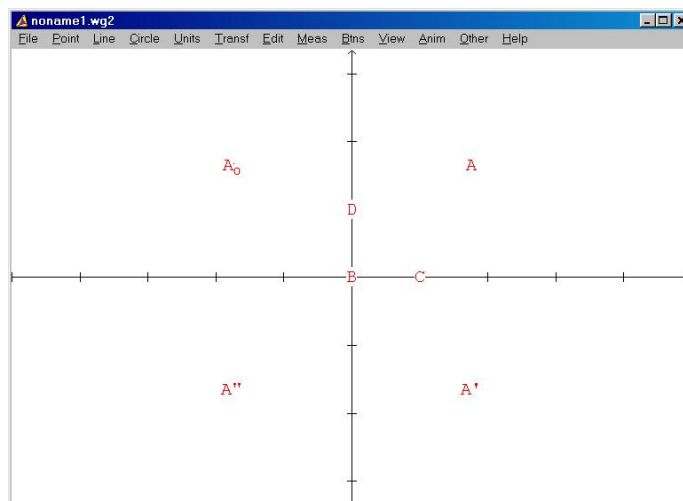


Notice the notation for the new points, the reflection about the x -axis is primed and the reflection about the y -axis is subscripted with a 0. To reference a point that is subscripted in WinGeom we use the underscore character. So A_0 would be written as A_0 .

6. Now for the symmetric point with respect to the origin. As with GSP there are two ways to do this, either reflect a reflection or do a rotation of 180° .

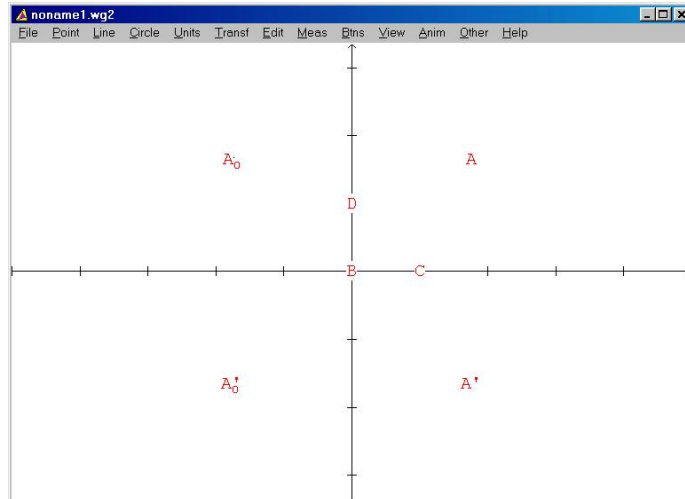
(a) We will start with the reflection of a reflection.

- i. Select $\text{Transf} \succ \text{Mirror}$ from the menu. Change the vertices to just A' and the in mirror to BD . Select Mark to mark the point. It should come in as A'' and your image should look like the one below.



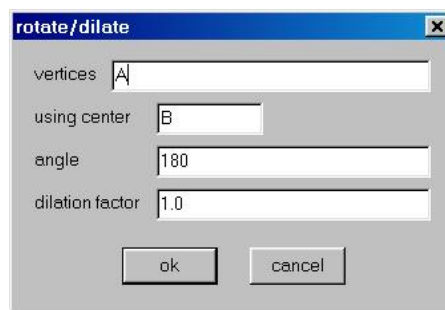
Note that if you reflected the A_0 point in the line BC then the new point

would be A'_0 and your image would look like



(b) The rotation process.

- i. Select **Transf** > **Rotate** from the menu. When you do a small dialog box will appear like the one below.



Make sure that vertices are set to just A, the using center is B (the origin), the angle is set to 180, and the dilation factor is set to 1. Click the OK button and the new point will be marked as E. The image should look like the one below.

