Geometer's Sketchpad – Part 2

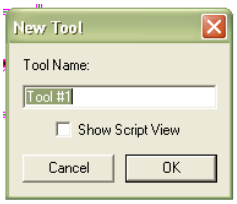
Creating Tools

Suppose that you wanted to make ten different parallelograms for a demonstration. You could painstakingly make each one, but it would be nice to have a simpler way to do this. One way is to make one and then select the entire parallelogram and copy it. Let's try this and see what happens.

- Start a new sketch and make a parallelogram (using the method from the Exercises section of part 1).
- Then click on the Selection Arrow Tool and then create a box around the entire parallelogram. Press Ctrl-C (Copy) and then Ctrl-V (Paste).
- The newly copied parallelogram should be completely highlighted, indicating that it is presently selected. Carefully drag it to a different part of the screen so that the two parallelograms do not overlap. Now, click on any blank part of the screen in order to deselect the parallelogram.
- Experiment with moving each individual part of the new parallelogram (each vertex, each side) and notice that the shape stays a parallelogram. That is, it remembers the work that went into constructing it and keeps sides parallel that were constructed to be parallel. This remembering is very helpful (and is not present in earlier versions of Geometer's Sketchpad).

Suppose that you want a way to permanently make parallelograms quickly whenever you want, without having to have one already on the screen. That is, you want a tool for parallelograms, just like the Compass Tool for making circles. Let's create this tool now.

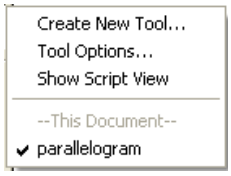
- Select one parallelogram by creating a selection box around it with the Selection Arrow Tool.
- Click on the Custom Tool button:  . Select Create New Tool. You should see the following box appear. Type "parallelogram" for the name of the tool and click OK.



- Now select the Custom Tool again. Notice that this time it does not have a pop-up menu that appears, the tool is merely selected as if it were the Point or Compass tool. That is because this is now the Parallelogram Tool. To use it, click once on the sketch and then move the cursor somewhere else and click again. As you pull the cursor away from the second point you will see your parallelogram appear. Click a third time to finish the parallelogram.

Let's create a second tool to make triangles.

- First, construct a triangle and use the selection arrow tool to create a selection box around it.
- Since you already have a custom tool defined, you must ***press and hold*** the Custom Tool button in order for the pop-up menu to appear. You should notice that parallelogram is currently checked (see below), so that if you click on the Custom Tool button it will create a parallelogram.



- In this pop-up menu, select Create New Tool and name it triangle. Use the steps from before to make a custom tool for a triangle.
- Once you have finished making this tool, click on the Custom Tool button then click anywhere in the sketchpad. Click for a second point and then notice that it will draw the triangle as you move the cursor to place the third point. Practice making several triangles.

The Custom Tool button can only work for one tool at a time. So, if you want to go back to making parallelograms, you must select it for the custom tool.

- Press and hold the Custom Tool button to see the pop-up menu. This time it will list both triangle and parallelogram, with triangle checked. Select parallelogram. Then click (3 points) in the sketchpad to draw the parallelogram.

You can create several tools that are available while you work. If you open a new sketch, the Custom Tool pop-up menu above will show tools created in "This Document" and it will have an option to look at tools in other documents from this session (probably named "untitled", unless you saved your last document with a new filename).

Transformations - Reflections, Rotations, and Dilations

Reflections

- Start a new sketch. Use your triangle tool, to construct a small triangle.

We are going to make a mirror image of this triangle. But first, we need to create a line segment to act as our reflection axis, or "mirror".

- Somewhere near the triangle, construct this line segment.
- Under the Transform menu, select Mark Mirror. Then select the entire triangle.
- Under the Transform menu choose Reflect. You should see a mirror image of your triangle appear.
- Move the line segment and the original triangle to see that the second triangle is always a reflection through this line segment.
- Practice with reflections by reflecting the triangle over each of its sides.

Rotations

- Start a new sketch and construct a small triangle.

We are going to rotate this triangle about a point on the screen.

- Construct a point somewhere near the triangle to acts the center of rotation.
- Under the Transform menu, choose Mark Center. Now select the entire triangle.
- Under the Transform menu choose Rotate. Put in the number of degrees you wish to rotate the figure. Notice that the program provides you with a preview showing where the rotated figure will appear. Now click Rotate.
- Select one of the vertices and mark it as the center. Rotate the triangle 180 degrees about this vertex. Repeat this process for each of the vertices.
- Practice rotations, by changing the points and degrees.

Dilations

- Start a new sketch and again, construct a small triangle.

Now we are going to stretch this triangle by a fixed amount.

- Construct a point near the triangle and choose Mark Center from the Transform menu. Now select the entire triangle and choose Dilate from the Transform menu. This opens the following window.

  The present ratio of 1/2 means that every point in the dilated triangle would be 1/2the distance from the Point D as the corresponding point in the undiluted triangle. Notice that the preview of the dilated triangle is smaller than the original triangle. Since we want to stretch this triangle, we want a ratio larger than 1.

- Change the ratio to 2/1. Then click Dilate.
- Now mark one of the vertices as the center and practice stretching and shrinking.

Creating Regular Polygons

- Start a new sketch and try to draw an equilateral triangle (equal sides and equal angles).

Once you have it close, you should realize this is not so easy to do. Your triangle is probably close to an equilateral triangle and the slightest movement will change the angles and/or lines.

- Go ahead and select this triangle and delete it.
- Now draw a line segment AB and mark A as the center.
- Now select the entire line (***including the endpoints***) and rotate it about 60 degrees using the Transform menu.
- Repeat the process using point C as the center.

This should construct an equilateral triangle (adjust the angles to rotate if needed).

- Highlight the triangle and create a new tool named "equilateral triangle". Use your tool to make several equilateral triangles. Click on them and move the points around to verify that it remains equilateral.

This process of rotating each line segment about the new vertex can be used to make regular polygons with any number of sides (regular polygons have equal angles at each vertex and equal lengths for each side). ***But be sure to include the endpoints to be rotated also, otherwise you will not have a new point to select for the center of the next rotation***.

Exercises

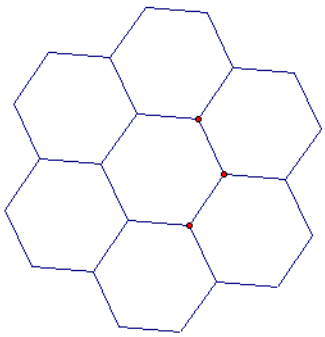
1. [Start a new sketch and type your name.]

    a. Create a square tool. (Make sure your tool makes squares – i.e. The angles remain 90° and sides remain equal when you move a corner point around.)

    b. Use your square tool to create a square circumscribed by a circle (this means that the square is inside the circle with its vertices lying on the circle). Then make a new tool from this figure named circle square. Use this tool to create a picture that shows at least 15 circumscribed squares of different sizes.

    [Make sure your name is on the sketch. Before printing, select Print Preview under the File menu. If your sketch does not fit on one page, select Fit To Page at the top of this window, then select Print]

2. [Start a new sketch and type your name.]
    Create a hexagon tool. Use reflections to create the figure below (you may have labels on yours):



    If you select the original vertex A, you should be able to change the size of your hexagon pattern. [Make sure your name is on the sketch and that it fits the page before printing.]

3. Come up with your own interesting tool or design. If possible try to come up with one that would be useful in a high school geometry class. [Make sure your name is on the sketch and that it fits the page before printing.]