GeoGebra – Lesson 4

Disappearing objects and inputs

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Key Concepts from GeoGebra

- Already discussed: 
- Inputs
- Making objects appear and disappear

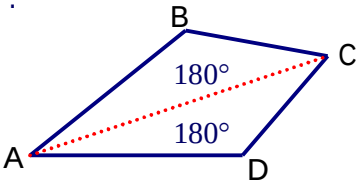
Key Concepts from Mathematics

- The sign function is a cool function that jumps between its values. This makes it a good function for something that we want to suddenly appear.

about Polygons

- General: A (convex) polygon with n vertices can be divided into n-2 triangles and so the inside angles add up to $(n-2)\times 180°$.
- Specific: A quadrilateral can be split into 2 triangles and so the inside angles add up to $2\times 180° = 360°$.

Quadrilateral



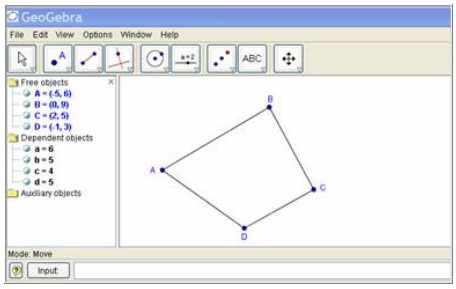
Script-o-matic

1. Understanding the activity
   a. Make an arbitrary quadrilateral – that is, a quadrilateral where all four vertices are movable (free objects - blue points in GeoGebra)
   b. Make a slider that – as the student moves it from left to right a line is drawn from vertex A to the opposite vertex C.
   c. When the line gets to C (slider reaches right limit), the corresponding two triangles ACB and ACD appear.

d. The student "knows" that a triangle has inside angles that add to 180°.
e. He "sees" that that the angles of the triangles add up to the angles of the quadrilateral and so
f. He "understands" that the inside angles of a quadrilateral always add to 360°.

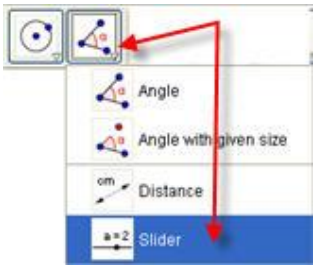
2. Get going with GeoGebra
   a. Open GeoGebra
   b. We don't want to see alot of decimals
      i. Click Options -> Decimal places -> 0
      ii. Doing this just hides the decimals. They are still there – that is, this is different than "snap to grid" where only points with whole number coordinates are allowed (see Lesson 6).
   c. Open the Algebra Window
      i. Click View -> Algebra Window
      ii. The Algebra window will appear at left.
   d. Open the Input Field
      i. Click View -> Input Field
      ii. The Input field will appear at bottom.

3. Draw arbitrary quadrilateral
   a. Draw 4 points - click on  and then click in the drawing space 4 times – the points A, B, C and D will be drawn.
   b. Draw 4 line segments – click on  and then click on A and then B, then (again) on B and then C, again on C and then D, again on D and then C.
   c. Move the labels of the points – not shown on screencast
      i. Select the move tool: 
      ii. Click and drag the point labels A, B, C and D as desired.
   d. Remove labels from segments – not shown on screencast
      i. Right-click on each segment and then de-select "Show Label"
      ii. You have:



4. Understand that the moving point G is on the line AC that will divide the quadrilateral into two triangles.

5. Draw a slider from 0 to 1
   a. Select the slider tool:



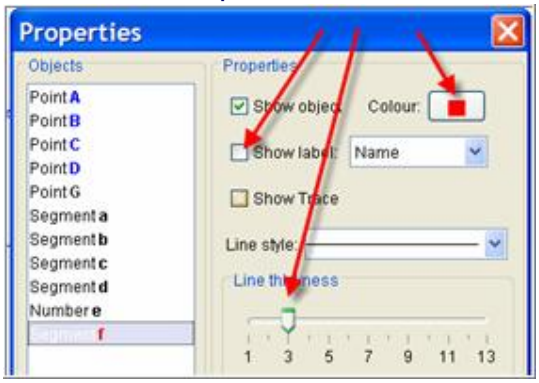
      i. Click on the drawing pad where you want the slider to go.
      ii. Change the min: 0.001, the max: 1 and the increment: 0.001

      iii. Click on Apply.
      iv. If you want to move the slider, first select the move tool and then click and drag it to another position.
      v. Click and drag the slider to a middle position.

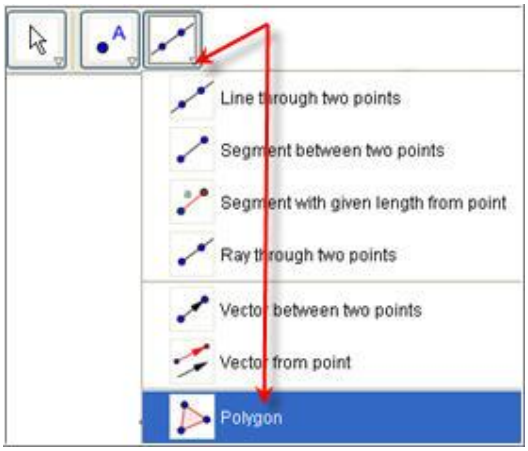
6. Input the value of the point G
   a. In the input field type: G=A+e*(C-A)
      i. You can use a blank or a star for multiplication!
      ii. Notice that A, C and G are all points (with an x- and y- coordinate) and e is a number (between 0 and 1) that multiplies both coordinates of the point (C-A).
      iii. When e=0, we have G=A and when e=1, we have G=C.
   b. Hit Enter.

      GeoGebra will complain if you give it mixed up things such as a point and a number: G=A+e

7. Make a line segment from A to G
   a. Select the segment tool:  and then click on A and then on G.
   b. Right-click on the segment and select Properties.
      i. De-select Show Label.
      ii. Click and drag the thickness to 3.
      iii. Click on the color patch and choose red and click OK.



8. Make the first triangle
   a. Click on the polygon tool



   b. Click on B, then on A and G and again on B.
      i. The polygon makes 4 objects (number of vertices +1) – the polygon P and the three line segments: a_1, b_1 and g.
      ii. Don't bother to hide the labels now!!

9. Define the appearing/dissappearing variable: ee
   a. Understand the sign function: sgn(x)
      i. $\operatorname{sgn}(x) = \begin{cases} 1 & x > 0 \\ 0 & x = 0 \\ -1 & x < 0 \end{cases}$
      ii. The idea is that this function jumps between its values!

10. In the input field type: ee=1-sgn(1-e)
    a. When 0<e<1, (1-e)>0 and so sgn(1-e)=1 and ee=0.
    b. The moment e=1 - and this is when the point G is C – (1-e)=0 and so sgn(1-e)=0 and ee=1.

11. Fix the polygon to only appear when G is C.
    a. Right-click on P in the Algebra Window and select Redefine.
    b. In the input field, in front of B, A and G, type in ee*

    c. Click on Apply.
        i. Notice that the three line sides have been renamed: g, h and i.

12. Input the other polygon
    a. Copy the formula from P
        i. Right-click on P in the Algebra Window and select Redefine.
        ii. The text is marked so just press Ctrl+C (to copy formula).
        iii. Click on Cancel.
        iv. Click down in the Input field and press Ctrl+V (to paste formula).
        v. Replace P with Q and B with D
        vi. Hit Enter (or click on Apply).
    b. We now have two dissappearing and appearing triangles. Click on the move tool and test this by moving the slider back and forth.

13. Fix the properties on the polygons
    a. Now, hide the labels on all 6 objects: g, h, i and j, k, l.
        i. Right-click on the objects in the Algebra window (this avoids having to choose between two overlapping objects!) and de-select Show Label.
    b. Change the colors of the polygons
        i. Right-click in each of the polygons, select properties and click on the color patch, choose a new color patch and click OK and then Apply.

14. Final fixes and Save!
    a. Hide the point G.
    b. Change the properties on the slider e: hide the label, make the color red and the line style dashed.
    c. You are done – save your file!