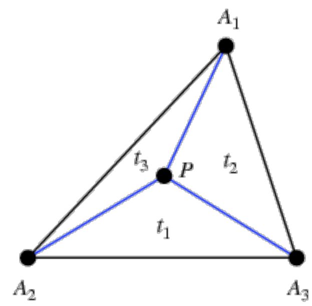
Next week we're learn about *barycentric coordinates*. Given any triangle $\triangle ABC$, it turns out you can write any point $X \in \mathbb{R}^2$ as a unique linear combination of the vertices:

$$X = rA + sB + tC.$$

where r, s and t satisfy the condition $r + s + t + 1$. These numbers are the *barycentric coordinates of X based on* $\triangle ABC$, and we'll sometimes write $X = (r, s, t)^{\triangle ABC}$.

In class we'll talk about *why* we might care about this, but for now this lab will let you experiment with another interpretation of barycentric coordinates. As illustrated in this diagram from Mathworld, if $P = t_1 A_1 + t_2 A_2 + t_3 A_3$, where P is inside the triangle and $t_1 + t_2 + t_3 = 1$, then t_1 represents the area of triangle PA_2A_3 as a percentage of the area of the whole triangle. Similarly, t_2 represents the area of the triangle PA_1A_3 as a percentage of the whole triangle, and t_3 represents the percentage of PA_1A_2.



GeoGebra Construction

(1) Open a new GeoGebra window. Define a triangle with verticies $A = (-1, 1)$, $B = (2, -1)$ and $C = (3, 3)$. If this is the first thing you've done, GeoGebra will also show a dependent object called `poly1` which represents the area of this triangle. Right click on the name (or the interior of the triangle) and rename it `totalArea`.

(2) Define a point P somewhere inside the triangle (e.g. $(1, 1)$).

(3) Define the triangle `ta = Polygon[P, B, C]`; you can either enter this command in the Input Field below, or choose the Polygon tool and click on those points. (You can then rename the Polygon to `ta` in that case.) Define triangles `tb` and `tc` as appropriate. You should now see the triangle ABC split into three smaller triangles which meet at P, similar to the picture above.

(4) You are now ready to define the barycentric coordinates of your point P. In the input field below, enter

```
r = ta / totalArea
```

followed by appropriate definitions for `s` and `t`.

(5) To check your coordinates, defined a point Q by typing `Q = r*A + s*B + t*C` in the input field. The new point Q should be superimposed on the point P if you've done everything correctly.

(6) Test your construction by moving the points A, B, C, and P. What happens when you move P outside of the triangle? On Monday we'll learn about the "quadrants" of the barycentric plane, after which you might be able to see why Q is in the wrong place.

To receive credit for this assignment, save your file as `lastname-5335-lab3.ggb` and email it to me as an attachment by the beginning of class on Wednesday, 10/28/15. Before you send it to me, you should spend a bit of time right-clicking on unnecessary labels and hiding them, etc., to make everything look nice!