Equation of a Line

Prepared by: Teton Multimedia (www.TetonMultimedia.com)

It's likely that you studied basic algebra in the past, and if so, it's also likely that you learned about the "equation of a line." During this study, you may have wondered "why, oh why am I learning this?" What good is all of this? And after a year or two of study, you knew a bunch of algebra, and you knew all about equations of lines, but you had no idea what good any of it was. So a year or two after your studies, you forgot all of it, and rightly so. After all, if something has no use or aesthetic appeal, it generally gets tossed in the trash.

However, it turns out that the "equation of a line" is very useful in animation and physics, so we are introducing it here in preparation for good things to come. It really isn't a difficult concept… it's simply a formalized method of discussing a straight line passing through a rectangular grid. Like algebra in general, it can be viewed as a rule system that lets us communicate about straight lines. It is similar to streets on a map. Sometimes the streets run north-south, sometimes east-west, and sometimes they run at a diagonal. The equation of a line gives us a method to communicate about these lines.

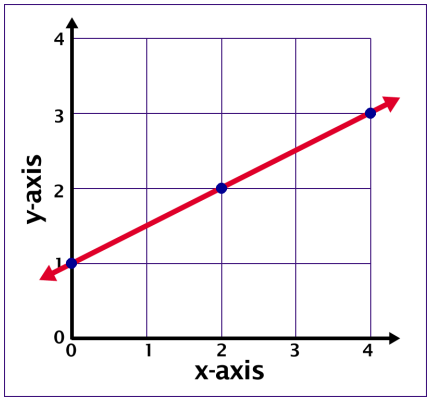
In textbooks, the "equation of a line" is generally written as

1.1 $$y = mx + b$$

where ***m*** is the slope and ***b*** is the y-axis intercept.

Naturally, a picture helps explain this mumbo-jumbo. In the picture shown here, the line's equation is

1.2 $$y = 0.5*x + 1$$



In other words, if we choose random values for x and plug them into the right-hand side of the equation, we will get a resulting y value. If we plot these x,y pairs on the graph and run a line through them, the line will be as shown here.

The red line crosses the y-axis at 1. So, in equation 1.1, b = 1.

The slope, m, can be calculated using any two points on the line. It is given by:

1.3 $$m = (y_2 - y_1) / (x_1 - x_2)$$

In this example, we can use the left-most and right-most blue points. Then m is calculated as m = (3 – 1) / (4 – 0). Completing the math gives us m = 0.5.

Note that in this case the slope is greater than zero. This is always true when the line slopes upward to the right. When the line slopes downward to the right, the slope is negative. However, the truth of this statement is only assured when the x-axis and y-axis "point" in the direction shown. In Director, the y-axis (or Locv-axis) points downward, and the (0,0) point is in the upper left rather than the lower left. This is simply a matter of convenience, and it is neither more nor less correct than the orientation shown above. However, the implication is that, in Director, lines sloping upward to the right have a negative slope. Lines sloping downward to the right have a positive slope.

Note that this distinction really isn't terribly important since the orientation is all relative. Left Vs. Right, Up Vs. Down, it really doesn't matter which means what, provided that everyone knows what is meant. And in Director, higher values of Locv are lower on the monitor. You simply need to be aware of this fact, and of the implication it has on slope.

Finally, and very importantly, you'll notice that the slope, ***m*** , is very closely related to the tangent mentioned in our lesson, "Trig and ArcTangents." In fact, within the context of our lessons, the slope and tangent are the same. This implies that if you know the slope, then you know the tangent *and* you can calculate the angular orientation of the line.[2]

----- ---------- ----------

Notes:

1. In this discussion we're calling the axes the "x-axis" and "y-axis". This is the standard naming convention used in algebra textbooks. However, any naming convention can be used. For example, in Director we might call them the "h-axis" and the "v-axis", corresponding to Loch and Locv.

2. Mathematical purists may blanch at our comparison of slope and tangent; however, it is a very useful comparison. If you feel compelled to compose a dissertation expounding our lack of rigor, then by all means please do so (yawn).