In both mathematics and programming we use variables. Early on math students settle into using the variables x, y, and even z. But as problems become more complex we often need more variables. Sure we can use other letters, and we often do. For example, we might use a, b, and c as the lengths of the sides of a triangle. Then, we might use the letter “s” to represent half the sum of the lengths of the sides, as in s=(a+b+c)/2. Finally, we might use Huron’s formula to find that the area of the triangle is equal to the square root of s*(s-a)*(s-b)*(s-c). But if we want to assign a variable to that <u>area</u> we have the small inconvenience that we already used the natural choice for a value to represent <u>area</u>, namely a, for the length of one of the sides. We would have to choose a different variable to represent the area of the triangle, perhaps we might choose “x” for that purpose and we could write x=square root of s*(s-a)*(s-b)*(s-c).

With more complex problems we often need many variables. One solution to this seeming shortage of variables is the use subscripts. Thus, instead of using a, b, and c for the lengths of the sides of the triangle, we might use L_1, L_2, and L_3, where the different subscripts indicate different variables, all called "L" but differentiated by their subscripts. With that change we can rewrite the value for s as $s=(L_1+L_2+L_3)/2$ and then we could say that the area, which we can now call "a", is equal to the square root of $s*(s-L_1)*(s-L_2)*(s-L_3)$.

Or to look at another example, consider how we might represent the problem of finding the average of five values. We want to have a variable for each value and then be able to write the sum of the values divided by the number of values. Rather than use a different letter for each variable, we can just use the subscripted variable x. Thus our five values are x_1, x_2, x_3, x_4, and x_5. Our average then becomes $a=(x_1+x_2+x_3+x_4+x_5)/5$. Note how easily this scheme extends to a problem of 10 values or fifty values or more.

A problem that involves multiple variables each having multiple instances, also lends itself to using subscripted variables. For example, if we were on a long, cross country trip and we wanted to keep a record for each leg of the trip (a leg being the travel between stops), we could use "t_1" as the time we were driving on leg 1, "d_1" as the distance that we drove on leg 1, and "g_1" as the gas used on leg 1. Then we could extend this scheme so that for leg 5 we would have t_5 for the time, d_5 for the distance, and g_5 for the gas used. If we have 8 legs then the total driving time is $t_1+t_2+t_3+t_4+t_5+t_6+t_7+t_8$. Furthermore, the miles per gallon for leg 3, which we could call m_3, would be given as $m_3=d_3/g_3$. In fact, we could express the miles per gallon for a leg "i" as $m_i=d_i/g_i$.

We see even more flexibility if it turns out that we had two drivers, you and me, and that we took turns driving. Then, if I drove the first leg, the distance that I drove was $d_1+d_3+d_5+d_7$ and the gallons of gas you used was $g_2+g_4+g_6+g_8$.

Subscripting variables allows us to have a huge number of variables, well beyond our 26 letter alphabet, and to organize those variables in a meaningful way.