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**Calculator Lesson 7**

**Bisection Method**

Recall that the Bisection Method is a procedure for approximating the zeros of a continuous function $y = f(x)$. The first step is to find two values, $a$ and $b$, such that $f(a)$ and $f(b)$ have opposite signs, thus insuring that there is a zero between $a$ and $b$. We now find $c = (a + b)/2$ and computer $f(c)$. There are now three possibilities: $f(c) = 0$, in which case we are done; the sign of $f(c)$ is the same as the sign of $f(a)$, in which case we replace the value of $a$ with the value of $c$; or the sign of $f(c)$ is the same as the sign of $f(b)$, in which case we replace the value of $b$ with the value of $c$. We repeat this procedure until we find a solution or we find an approximation that is close enough for our purpose.

To start, create a new directory called BISEC as we learned in Lesson 1 and get into it. Now suppose we would like to find $\sqrt[3]{5}$ by solving the equation $x^3 - 5 = 0$. Since $1^3 < 5 < 2^3$, we know the cube root of 5 is between 1 and 2. We first define the function $F(X) = X^3 - 5$ as we did in Lesson 2. Now save 2 in a variable called B and 1 in a variable called A. Now press F1-A and F3-F, then F2-B and F3-F to verify that F(A) is negative and F(B) is positive. Now press F1-A F2-B + 2 ÷ to find the midpoint between A and B, our new approximation, C. Press ENTER twice to put two more copies of this approximation on the stack. Now press F3-F to evaluate the function at the new approximation, then press RA to SWAP the values of the new approximation and its function value. In this case, F(C) < 0, so we press LS F1-A to make this approximation the new A and press the back arrow to drop the function value. Repeat the sequence F1-A F2-B + 2 ÷ ENTER ENTER F3-F RA. This time F(C) > 0, so we press LS F2-B to make it the new B and press the back arrow to drop the function value. Notice that we are also keeping a list of all of the approximations on the stack. Continue repeating this sequence and storing the new approximation in A if its function value is negative and in B if the function value is positive. We quit when we have an approximation that is close enough for your purposes. For example, if we think that two decimal places is good enough, we stop when the second decimal place stops changing. In this case we would stop after 8 iterations. At that point A = 1.7070 and B = 1.7109. Since both of these round to 1.71, that is your two decimal place approximation.

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