Numerical Methods – Spring '18

PA #3

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Programming Assignment #3

Problem 1:

The *Michaelis-Menten* model describes the kinetics of enzyme mediated reactions:

$$\frac{dS}{dt} = -\frac{v_m S}{k_s + S}$$

Here S is the substrate concentration, v_m is the maximum uptake rate, and k_s is the half-saturation constant. If the initial substrate level at t=0 is S_0 then the solution to this differential equation is

$$S = S_0 - v_m t + k_s \ln\left(\frac{S_0}{S}\right)$$

Notice that this is an implicit equation in S. You can't solve directly for S! Set $S_0 = 8, v_m = 0.7,$ and $k_s = 2.5$. Write a MATLAB script that uses a root finding method a plot of S versus t over the interval $0 \leq t \leq 10$.

My Solution:

See cleurodriguez1.m

Problem 2:

Implement the modified secant method for root solving. Write a function that accepts as inputs (function, initial guess, error tolerance, max iterations) and returns the root. Your function should have a failsafe (i.e, don't loop through more than max iterations) in case the routine diverges. The root returned should be within a relative error tolerance specified by the user. Use the δ version of the routine with $\delta = 10^{-6}$. Make sure you address the issue of an initial guess of 0. Write a test script that tests your routine on three separate equations (you choose). Include at least one with an initial guess of 0.

My Solution:

See cleurodriguez2.m

See cleurodriguez2_test.m