1)

Problem 3.11 Plot the solution as a function of "del", the error tolerance.

Apply the secant method developed in Section 3.3 to solve $f(x) = e^{x^2}\ln(x^2) - x = 0$. Discuss the procedure for dealing with more than one root in a given region.

2)

Problem 3.12 Plot the solution as a function of "del", the error tolerance. Note, you can focus on just the 2-dimensional case. No need for the code to work in higher dimensions.

Develop a subprogram that implements the Newton method to solve $\mathbf{f}(\mathbf{x}) = \mathbf{0}$, where both $\mathbf{f}$ and $\mathbf{x}$ are l-dimensional vectors. Test the subprogram with

$$f_1(x_1, x_2) = e^{x_1^2}\ln(x_2) - x_1^2$$

and

$$f_2(x_1, x_2) = e^{x_2}\ln(x_1) - x_2^2$$

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3)

Simpson Rule with non-Uniform Data points:

Part a)

Construct a program to approximate the integral of a Gaussian on the whole line:

$$S = \int_{-\infty}^{\infty} e^{x^2}\,dx$$

using the Simpson rule with a non-uniform mesh for x. For the mesh, choose: $x_j = he^{\alpha j^2}$ where α and h are small constants. To estimate error, plot the exact answer and your results for different numbers of discrete points in the mesh.

Part b)

Use the adaptive Simpson code (See text, Chapter 3) to compute S. Plot the tolerance (the error) against the number of divisions needed along the x-axis. Compare with your results from part a. Which method requires the fewest number of partitions along the x axis to meet the same tolerance?