HW Solutions from Mar 29
(Bisection and Newton)

p. 105, 1-3. Turn in 1, 2.

1. Root of $e^x - 5x$ using Bisection and Newton by hand:

   (a) Estimate the first root of $e^x - 5x$ by computing three iterations of the bisection method on the interval $[0, 1]$.

   SOLUTION: Let $f(x) = e^x - 5x$. Then f is continuous and $f(0) = 1$ and $f(1) < 0$.

   Let $c = 1/2$, and $f(0.5) \approx -0.85$, so the new interval is $[0, 0.5]$.

   Let $c = 1/4$, and $f(0.25) \approx 0.034$. The new interval is $[0.25, 0.5]$

   Let $c = 0.375$, and $f(0.375) \approx -0.42$. The new interval is then $[0.25, 0.375]$. Currently, we could output our estimate as 0.3125 (the midpoint of the last interval).

   (b) Using Newton's Method:

$$x_{i+1} = x_i - \frac{e^{x_i} - 5x_i}{e^{x_i}} = x_i - \left(1 - 5x_i e^{-x_i}\right)$$

$$x_0 = 2, \quad x_1 \approx 2.353 \quad x_2 \approx 2.472 \quad x_3 \approx 2.515$$

   If we were to continue, we would find the root to be approximately 2.5426.

1. Computer problem. Just change the scripts to run on $f(x) = 3x^3 + x^2 - x - 5$.

   The only tricky part in Matlab/Octave:

   At one time, Matlab would not allow subroutines (or functions) to appear with commands in a script file, only in function files. That has recently changed within the past couple of years, so that Matlab does allow that now (and the script file given in class reflects that). However, it looks like Octave does not.

   In that case, you should just change the first line in the script file from class to be

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function main()
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   and that changes our script into a function. This was done for you, so now just change the function and the derivative in the file main.m, then type: main