Math 313/513, Homework 5 (due Thurs. Feb. 16)

Name:_____ 313 or 513 (circle)

Reading

- Read sections 3.4–3.5

Book problems

- Math 313:
  - Section 3.4: 3, 6, 14, 16, 17, 23
  - Section 3.5: 2, 9, 11, 16, 26, 32
- Math 513: all of the above, plus:
  - Section 3.4: 34
  - Section 3.5: 40

MATLAB assignment

This week we will study integral calculus in a discrete setting.

- Write a function `lastname_simp_int` (in your file `lastname_simp_int.m` where `lastname` is your last name with no spaces) that takes in the following data: a function $f(x)$ to be integrated (see hints below), the starting and ending values a and b of the integration, and the (even!) number n of subdivisions. The output of `lastname_simp_int` is the output of performing Simpson's rule to numerically approximate $\int_a^b f(x)dx$.
- Begin by recalling how Simpson's rule works. First, find Δx. Next, create a column vector $\vec{y}$ consisting of the values of $f(x)$ at the points $a, a+\Delta x, a+2\Delta x, \ldots, b$ Finally construct a row vector S consisting of appropriate values so that $S\vec{y}$ outputs the result.
- You may wish to test out your code on functions you can integrate exactly, like $\sin(x)$ or x^2 to compare your function's output with the true value. The grader will use your function to give a good approximation to $\int_{-10}^{10} e^{-x^2}dx$ with $n = 40$.
- Recall that Simpson's rule works by locally approximating f near x_k by the parabola passing through $(x_{k-1}, y_{k-1}), (x_k, y_k), (x_{k+1}, y_{k+1})$, then adding up the areas under all these parabolas. Within your function `lastname_simp_int`, generate a plot that shows the graph of f overlaid with all these segments of parabolas. (Hint: on the second assignment, you generated code that finds the coefficients of a polynomial passing through specified points.)

Include your comments, and submit your code to Blackboard. Please remember to name your file in the form `lastname_hw05.m`

Some MATLAB hints

1. How do you pass a function like $f(x) = x^2$ to another function in MATLAB?

   ```
   sqr = @(x) x.^2;
   S = simp_int(sqr, 0, 1, 10)
   ```

   This would call the function `simp_int` with $f(x) = x^2$, from $x = 0$ to $x = 1$, with $n = 10$ subdivisions.