Matlab Homework 11*a*

In the online book:

- Do the "Challenge Activities" of: 11.1,3; 12.1,3; 18.1
- Do the "Participation Activities" of: 10.8,9

Matlab Homework 11*b*

The same general requirements as for homework 4b apply. And you must study the posted lesson(s) and have done the online book part above before you can ask a TA or the instructor for help.

1. Repeat the last question of the previous homework, where you keep summing the Taylor series of $\mathrm{Si}(x)$ until the accuracy no longer improves. However, this time use a `while` loop instead of a `for` loop.

   The `while` loop was not covered in class, so you will have to look up how it is done at the end of lesson6 yourself.

   The question is already set up to use a `for` loop. Just make the appropriate changes to turn that into a `while` loop.

2. Answer using symbolic math:

   (a) Given the equation for the area of a cylindrical container:

   $$A = 2\pi r^2 + 2\pi r\ell$$

   - Use the `solve` function to solve symbolically for the length ℓ in the equation in terms of A and r.
   - Test out the symbolic solution by verifying that if you take $A = \pi$ and $r = 2/3$, you get $1/12$ exactly. Be sure to use `sym('...')` wherever Matlab would provide a 16 digit number otherwise.
   - Convert the symbolic solution into a handle to a standard Matlab anonymous function.
   - Check that that function too returns $1/12$ for the example data, but only to about 16 significant digits. Do so by using `fprintf` to print the result out to 32 digits behind the point, as

     ```
     Test length numeric:  1.12345678901234567890123456789012
     Test length from vpa: 1.12345678901234567890123456789012
     ```

     Here the second line should be the test length to 32 correct digits, as obtained from the symbolic solution using `vpa`. Make sure this number is printed aligned with the above approximate one, so that you can easily compare digits. To do so, convert the `vpa` output to a string using the `char` function, then print that with `fprintf` using the %s string formatting operator. (This does not work well in Octave. Octave users should instead show the `vpa` output using `disp`, preceded by an `fprintf` that prints the "Test length from vpa:" header without a `\n` newline.)

(b) Consider the cubic

$$(x-3)(x-1)(x+2)$$

- Let Matlab find the expanded cubic.
- Let Matlab re-factor the expanded cubic. The output should look just like the one shown above.
- Let Matlab find the exact roots of the expanded cubic.

3. Answer using symbolic math:

(a) Let Matlab symbolically integrate

$$\int \ln(x)\,\mathrm{d}x$$

and then differentiate the result again, twice.

(b) Let Matlab symbolically integrate

$$\int_0^1 \ln(x)\,\mathrm{d}x \qquad \text{and} \qquad \int_{-3}^0 \frac{x}{x-b}\,\mathrm{d}x$$

The exact answers are

$$\int_0^1 \ln(x)\,\mathrm{d}x = -1 \qquad \int_{-3}^0 \frac{x}{x-b}\,\mathrm{d}x = 3 + b\ln\left(\frac{b}{b+3}\right)$$

(The second solution given by Matlab and Octave is not quite ideal; the two logarithms should have been combined as above for at least real b. As is, the expression becomes complex for positive real b. Matlab, but not Octave, will also blather about the singular case that the pole $x = b$ is in the domain of integration.)

(c) For the ratio

$$\frac{s^3 - 5s^2 + 2s - 5}{s^4 - 4s^3 + 5s^2 - 4s + 4}$$

let Matlab factor it and find its partial fraction expansion.