ENR 261 Spring 2023 Symbolic Homework

General Instructions:

Save all of your MATLAB files for this chapter in a folder named **Week 12** located inside your GitHub repository.

Use **compact** format to reduce blank spaces in output.

Required File: Program_12_1.m

Use symbolic expressions to complete the problem pictured below. Use the pretty() function to display your final answers for parts a, b, and c.

Please ensure your output matches the example output.

11.10 PROBLEMS

1. Define x as a symbolic variable and create the two symbolic expressions:

$$S_1 = (x-4)^2 - (x+3)^2 + 16x - 4 \text{ and } S_2 = x^3 - 6x^2 - x + 30$$

Use symbolic operations to determine the simplest form of following expressions:

a) $S_1 \cdot S_2$.

b) $\frac{S_1}{S_2}$.

c) $S_1 + S_2$.

d) Use the `subs` command to evaluate the numerical value of the result from part *c* for $x = 2$.

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Example Output

```
Output for Program_12_1 written by Geoff Berl.

Original Symbolic Equations:
S1 = 16*x - (x + 3)^2 + (x - 4)^2 - 4
S2 = x^3 - 6*x^2 - x + 30

------------ Part a: S1*S2 ---------------

S1*S2 = -(16*x - (x + 3)^2 + (x - 4)^2 - 4)*(x + 6*x^2 - x^3 - 30)

collect(S1xS2) = 2*x^4 - 9*x^3 - 20*x^2 + 57*x + 90

pretty(S1xS2)
   4      3       2
2 x  - 9 x  - 20 x  + 57 x + 90


------------ Part b: S1/S2 ---------------

S1divS2 =
-(16*x - (x + 3)^2 + (x - 4)^2 - 4)/(- x^3 + 6*x^2 + x - 30)

simple(S1/S2)
S1divS2 =
-(2*x + 3)/(- x^3 + 6*x^2 + x - 30)

pretty(S1/S2)
         2 x + 3
- --------------------
     3      2
  - x  + 6 x  + x - 30


------------ Part c: S1+S2 ---------------

S1plusS2 =
15*x - (x + 3)^2 + (x - 4)^2 - 6*x^2 + x^3 + 26

expand(S1+S2)
S1plusS2 =
x^3 - 6*x^2 + x + 33

pretty(S1+S2)
 3      2
x  - 6 x  + x + 33


------ Part d: subs(S1plusS2,x,2) ---------

S1plusS2_x_eq_2 =
19
```

Required File: Program_Sym_2.m

Use symbolic expressions to complete the problem pictured below. After factoring in part a, solve the equation to confirm that the roots are as given. In part b, show the polynomial in standard form using the pretty function. Solve the equation in part b to confirm the roots are as given.

Please ensure your output matches the example output.

4. Define x as a symbolic variable.
   a) Show that the roots of the polynomial:
   $$f(x) = x^5 - x^4 - 27x^3 + 13x^2 + 134x - 120$$
   are 1, 2, 5, –3, and –4 by using the `factor` command.
   b) Derive the equation of the polynomial that has the roots: $x = 5$, $x = -3$, $x = -2$, and $x = 4$.

Example Output:

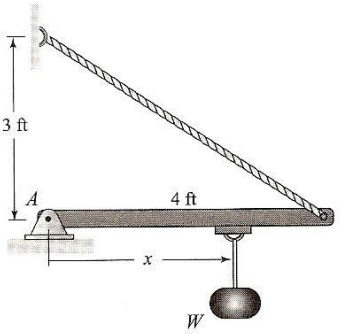
```
Output for Program_12_2 written by Geoff Berl.

Part a: Original Function f Defined
f =
x^5 - x^4 - 27*x^3 + 13*x^2 + 134*x - 120

f = factor(f)
f =
[x - 1, x - 2, x + 4, x + 3, x - 5]

X = solve(f)
X =
Empty sym: 0-by-1

Part b: Original Function g Defined
g =
(x + 2)*(x + 3)*(x - 4)*(x - 5)

g = expand(g)
g =
x^4 - 4*x^3 - 19*x^2 + 46*x + 120

pretty(g)
 4      3       2
x  - 4 x  - 19 x  + 46 x + 120


X = solve(g)
X =
-3
-2
 4
 5
```

Required File: Program_12_3.m

Use symbolic expressions to complete the problem pictured below. Create the plot as shown below (use fplot).

Please ensure your output matches the example output.

10. A 4 ft long boom supports a weight W positioned a distance x from support A as shown. The tension T in the cable and the x and y components of the force at A (F_{Ax} and F_{Ay}) can be calculated from the equations:



$$\frac{12}{5}T - Wx = 0$$

$$F_{Ax} - \frac{4}{5}T = 0$$

$$F_{Ay} + \frac{3}{5}T - W = 0$$

a) Use MATLAB to derive expressions for the forces T, F_{Ax}, and F_{Ay} in terms of x, and W.

b) Use the `subs` command to substitute $W = 200$ lb into the expressions that were derived in part *a*. This will give the forces as a function of the distance x.

c) Use the `ezplot` command to plot the forces (all three in the same plot) as a function of x, for x starting at 0 and ending at 4 ft.

Example Output

```
Output for Program_12_3 written by Geoff Berl.

The Original Equations to Solve
a =
(12*T)/5 - W*x
b =
Fax - (4*T)/5
c =
Fay + (3*T)/5 - W

PartA: Solutions for T, Fay, and Fay in terms of x and W
solution_Fax =
(5*W*x)/12
solution_Fay =
(W*x)/3
solution_T =
W - (W*x)/4

PartB: Solutions for T, Fay, and Fay with W = 200lbs
solution_T =
200 - 50*x
solution_Fax =
(250*x)/3
solution_Fay =
(200*x)/3
```