Lab 4

Task 1:

Define five 5th order equations using symbolic variables. Solve each of the equations separately with respect to one variable.

```
syms x

f1 = 10*(x ^ 5) + 6*(x ^ 4) + 2*x + 9
```

f1 = $10\,x^5+6\,x^4+2\,x+9$

```
f2 = (40 * x ^ 5) + (6 * x ^ 3) + (2 * x ^ 2) + (9*x) + 1
```

f2 = $40\,x^5+6\,x^3+2\,x^2+9\,x+1$

```
Equ_3 = (x ^ 5) + (6 * x) + 64
```

Equ_3 = $x^5+6\,x+64$

```
Equ_4 = (2 * x ^ 5) + (x ^ 4) + (3* x ^3)
```

Equ_4 = $2\,x^5+x^4+3\,x^3$

```
Equ_5 = (-21 * x ^ 5) + x - 23
```

Equ_5 = $-21\,x^5+x-23$

```
Sol_1 = solve(f1,x)
```

Sol_1 =

$$\begin{pmatrix}\mathrm{root}(\sigma_1, z, 1)\\ \mathrm{root}(\sigma_1, z, 2)\\ \mathrm{root}(\sigma_1, z, 3)\\ \mathrm{root}(\sigma_1, z, 4)\\ \mathrm{root}(\sigma_1, z, 5)\end{pmatrix}$$

where

$$\sigma_1 = z^5+\frac{3\,z^4}{5}+\frac{z}{5}+\frac{9}{10}$$

```
Sol_2 = solve(f2,x)
```

Sol_2 =

$$\begin{pmatrix} \mathrm{root}(\sigma_1, z, 1) \\ \mathrm{root}(\sigma_1, z, 2) \\ \mathrm{root}(\sigma_1, z, 3) \\ \mathrm{root}(\sigma_1, z, 4) \\ \mathrm{root}(\sigma_1, z, 5) \end{pmatrix}$$

where

$$\sigma_1 = z^5 + \frac{3\,z^3}{20} + \frac{z^2}{20} + \frac{9\,z}{40} + \frac{1}{40}$$

```
Sol_3 = solve(Equ_3,x)
```

```
Sol_3 =
```

$$\begin{pmatrix} \mathrm{root}(z^5 + 6\,z + 64, z, 1) \\ \mathrm{root}(z^5 + 6\,z + 64, z, 2) \\ \mathrm{root}(z^5 + 6\,z + 64, z, 3) \\ \mathrm{root}(z^5 + 6\,z + 64, z, 4) \\ \mathrm{root}(z^5 + 6\,z + 64, z, 5) \end{pmatrix}$$

```
Sol_4 = solve(Equ_4,x)
```

```
Sol_4 =
```

$$\begin{pmatrix} 0 \\ 0 \\ 0 \\ -\frac{1}{4} - \frac{\sqrt{23}\ \mathrm{i}}{4} \\ -\frac{1}{4} + \frac{\sqrt{23}\ \mathrm{i}}{4} \end{pmatrix}$$

```
Sol_5 = solve(Equ_5,x)
```

```
Sol_5 =
```

$$\begin{pmatrix} \mathrm{root}\left(z^5 - \frac{z}{21} + \frac{23}{21}, z, 1\right) \\ \mathrm{root}\left(z^5 - \frac{z}{21} + \frac{23}{21}, z, 2\right) \\ \mathrm{root}\left(z^5 - \frac{z}{21} + \frac{23}{21}, z, 3\right) \\ \mathrm{root}\left(z^5 - \frac{z}{21} + \frac{23}{21}, z, 4\right) \\ \mathrm{root}\left(z^5 - \frac{z}{21} + \frac{23}{21}, z, 5\right) \end{pmatrix}$$

Task 2:

Declare two 2nd order equations using symbolic variables and solve them simultaneously. Make five sets of equations.

```
syms x y f(x,y) g(x,y)

%Set 1
f(x,y) = (x ^ 2) - (3*x*y) - x + (2 * y ^2)
```

f(x, y) = $x^2 - 3\,x\,y - x + 2\,y^2$

```
g(x,y) = (2 * x ^ 2) - (3 *x*y)+ (y^2) - 20
```

g(x, y) = $2\,x^2 - 3\,x\,y + y^2 - 20$

```
%Set 2
Equ_3 = (2 * x ^ 2) - (5 * x * y) - (3 * y)
```

Equ_3 = $2\,x^2 - 5\,y\,x - 3\,y$

```
Equ_4 = (x ^ 2) + (4 * x) - 5
```

Equ_4 = $x^2 + 4\,x - 5$

```
%Set 3
Equ_5 = (x ^ 2) + (y ^ 2) - 9
```

Equ_5 = $x^2 + y^2 - 9$

```
Equ_6 = (y ^ 2) + ((2 * y - 3) ^ 2) - 9
```

Equ_6 = $(2\,y - 3)^2 + y^2 - 9$

```
%Set 4
Equ_7 = (5 * x ^ 2) - (6 * y) + 5
```

Equ_7 = $5\,x^2 - 6\,y + 5$

```
Equ_8 = (5 * y ^ 2) - (6 * x) + 5
```

Equ_8 = $5\,y^2 - 6\,x + 5$

```
%Set 5
Equ_9 = (x ^ 2) - (3 * y) - 6
```

Equ_9 = $x^2 - 3\,y - 6$

```
Equ_10 = (5 * x ^ 2) - (6 * y) - 1
```

Equ_10 = $5\,x^2 - 6\,y - 1$

```
%Sol 1
[Sol1_x, Sol1_y] = solve(f(x,y),g(x,y))
```

Sol1_x =

$$\begin{pmatrix} -8 \\ -\frac{5\sqrt{145}}{6} - \frac{35}{6} \\ \frac{5\sqrt{145}}{6} - \frac{35}{6} \end{pmatrix}$$

Sol1_y =

$$\begin{pmatrix} -6 \\ -\frac{2\sqrt{145}}{3} - \frac{20}{3} \\ \frac{2\sqrt{145}}{3} - \frac{20}{3} \end{pmatrix}$$

```
%Sol 2
[Sol2_x, Sol2_y] = solve(Equ_3,Equ_4,x,y)
```

Sol2_x =

$$\begin{pmatrix} 1 \\ -5 \end{pmatrix}$$

Sol2_y =

$$\begin{pmatrix} \frac{1}{4} \\ -\frac{25}{11} \end{pmatrix}$$

```
%Sol 3
[Sol3_x, Sol3_y] = solve(Equ_5,Equ_6,x,y)
```

Sol3_x =

$$\begin{pmatrix} -3 \\ 3 \\ -\frac{9}{5} \\ \frac{9}{5} \end{pmatrix}$$

Sol3_y =

$$\begin{pmatrix} 0 \\ 0 \\ \frac{12}{5} \\ \frac{12}{5} \end{pmatrix}$$

```
%Sol 4
```

```
[Sol4_x, Sol4_y] = solve(Equ_7,Equ_8,x,y)
```

Sol4_x =

$$\begin{pmatrix} \frac{3}{5}-\frac{4}{5}\,\mathrm{i} \\ \frac{3}{5}+\frac{4}{5}\,\mathrm{i} \\ -\frac{3}{5}+\frac{2\,\sqrt{13}\,\mathrm{i}}{5} \\ -\frac{3}{5}-\frac{2\,\sqrt{13}\,\mathrm{i}}{5} \end{pmatrix}$$

Sol4_y =

$$\begin{pmatrix} \frac{3}{5}-\frac{4}{5}\,\mathrm{i} \\ \frac{3}{5}+\frac{4}{5}\,\mathrm{i} \\ -\frac{3}{5}-\frac{2\,\sqrt{13}\,\mathrm{i}}{5} \\ -\frac{3}{5}+\frac{2\,\sqrt{13}\,\mathrm{i}}{5} \end{pmatrix}$$

```
%Sol 5
[Sol5_x, Sol5_y] = solve(Equ_9,Equ_10,x,y)
```

Sol5_x =

$$\begin{pmatrix} -\frac{\sqrt{33}\,\mathrm{i}}{3} \\ \frac{\sqrt{33}\,\mathrm{i}}{3} \end{pmatrix}$$

Sol5_y =

$$\begin{pmatrix} -\frac{29}{9} \\ -\frac{29}{9} \end{pmatrix}$$

Task 3:

Declare five 5th order symbolic equations and differentiate them. Find first, second, third, fourth and fifth order derivatives.

```
%First Equation
Equ_1 = (4 * x ^ 5) - (2 * x ^ 4) + (5 * x ^ 3) - (4 * x ^ 2) + (3 * x) + 7
```

Equ_1 = $4\,x^5-2\,x^4+5\,x^3-4\,x^2+3\,x+7$

```
differential1_Equ1 = diff(Equ_1,x,1)
```

differential1_Equ1 = $20x^4 - 8x^3 + 15x^2 - 8x + 3$

```
differential2_Equ1 = diff(Equ_1,x,2)
```

differential2_Equ1 = $80x^3 - 24x^2 + 30x - 8$

```
differential3_Equ1 = diff(Equ_1,x,3)
```

differential3_Equ1 = $240x^2 - 48x + 30$

```
differential4_Equ1 = diff(Equ_1,x,4)
```

differential4_Equ1 = $480x - 48$

```
differential5_Equ1 = diff(Equ_1,x,5)
```

differential5_Equ1 = 480

```
%Second Equation
Equ_2 = (4 * x ^ 5) + (2 * x ^ 4) - (3 * x ^ 3) + 1
```

Equ_2 = $4x^5 + 2x^4 - 3x^3 + 1$

```
differential1_Equ2 = diff(Equ_2,x,1)
```

differential1_Equ2 = $20x^4 + 8x^3 - 9x^2$

```
differential2_Equ2 = diff(Equ_2,x,2)
```

differential2_Equ2 = $80x^3 + 24x^2 - 18x$

```
differential3_Equ2 = diff(Equ_2,x,3)
```

differential3_Equ2 = $240x^2 + 48x - 18$

```
differential4_Equ2 = diff(Equ_2,x,4)
```

differential4_Equ2 = $480x + 48$

```
differential5_Equ2 = diff(Equ_2,x,5)
```

differential5_Equ2 = 480

```
%Third Equation
Equ_3 = (x ^ 5) + (6 * x) + 64
```

Equ_3 = $x^5 + 6x + 64$

```
differential1_Equ3 = diff(Equ_3,x,1)
```

differential1_Equ3 = $5x^4 + 6$

```
differential2_Equ3 = diff(Equ_3,x,2)
```

differential2_Equ3 = $20\,x^3$

```
differential3_Equ3 = diff(Equ_3,x,3)
```

differential3_Equ3 = $60\,x^2$

```
differential4_Equ3 = diff(Equ_3,x,4)
```

differential4_Equ3 = $120\,x$

```
differential5_Equ3 = diff(Equ_3,x,5)
```

differential5_Equ3 = 120

```
%Fourth Equation
Equ_4 = (2 * x ^ 5) + (x ^ 4) + (3* x ^3)
```

Equ_4 = $2\,x^5 + x^4 + 3\,x^3$

```
differential1_Equ4 = diff(Equ_4,x,1)
```

differential1_Equ4 = $10\,x^4 + 4\,x^3 + 9\,x^2$

```
differential2_Equ4 = diff(Equ_4,x,2)
```

differential2_Equ4 = $40\,x^3 + 12\,x^2 + 18\,x$

```
differential3_Equ4 = diff(Equ_4,x,3)
```

differential3_Equ4 = $120\,x^2 + 24\,x + 18$

```
differential4_Equ4 = diff(Equ_4,x,4)
```

differential4_Equ4 = $240\,x + 24$

```
differential5_Equ4 = diff(Equ_4,x,5)
```

differential5_Equ4 = 240

```
%Fifth Equation
Equ_5 = (-21 * x ^ 5) + x - 23
```

Equ_5 = $-21\,x^5 + x - 23$

```
differential1_Equ5 = diff(Equ_5,x,1)
```

differential1_Equ5 = $1 - 105\,x^4$

```
differential2_Equ5 = diff(Equ_5,x,2)
```

differential2_Equ5 = $-420\,x^3$

```
differential3_Equ5 = diff(Equ_5,x,3)
```

differential3_Equ5 = $-1260\,x^2$

```
differential4_Equ5 = diff(Equ_5,x,4)
```

differential4_Equ5 = $-2520\,x$

```
differential5_Equ5 = diff(Equ_5,x,5)
```

differential5_Equ5 = -2520

Task 4:

Find the definite integral of five symbolic expressions with lower and upper limits 0 and 1 respectively.

```
%First Equation
Equ_1 = (4 * x ^ 5) - (2 * x ^ 4) + (5 * x ^ 3) - (4 * x ^ 2) + (3 * x) + 7
```

Equ_1 = $4\,x^5 - 2\,x^4 + 5\,x^3 - 4\,x^2 + 3\,x + 7$

```
Integral_Equ1 = int(Equ_1,x,0,1)
```

Integral_Equ1 =

$$\frac{521}{60}$$

```
%Second Equation
Equ_2 = (4 * x ^ 5) + (2 * x ^ 4) - (3 * x ^ 3) + 1
```

Equ_2 = $4\,x^5 + 2\,x^4 - 3\,x^3 + 1$

```
Integral_Equ2 = int(Equ_2,x,0,1)
```

Integral_Equ2 =

$$\frac{79}{60}$$

```
%Third Equation
Equ_3 = (x ^ 5) + (6 * x) + 64
```

Equ_3 = $x^5 + 6\,x + 64$

```
Integral_Equ3 = int(Equ_3,x,0,1)
```

Integral_Equ3 =

$$\frac{403}{6}$$

```
%Fourth Equation
```

```
Equ_4 = (2 * x ^ 5) + (x ^ 4) + (3* x ^3)
```

Equ_4 = $2x^5 + x^4 + 3x^3$

```
Integral_Equ4 = int(Equ_4,x,0,1)
```

Integral_Equ4 =

$$\frac{77}{60}$$

```
%Fifth Equation
Equ_5 = (-21 * x ^ 5) + x - 23
```

Equ_5 = $-21x^5 + x - 23$

```
Integral_Equ5 = int(Equ_5,x,0,1)
```

Integral_Equ5 = -26

Conclusion:

This report has explored one of MATLAB’s key capabilities; that is Symbolic Lab. This capability allows us to find solutions for complicated equations quickly. The main objectives of this lab are to solve one-variable linear equations, quadratic equations, derivatives, and integrals.