ELEMENTARY MATLAB® COURSE – SESSION 4

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POLYNOMIALS

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- How to define a polynomial in MATLAB?

$f(x) = ax^n + bx^{n-1} + cx^{n-2} + \cdots + d$ => f = [a, b, c, …, d]

- polyval(f,m) assign "m" instead of "x"
- roots(f) Solve f(x) = 0
- polyfit(x,y,n) Fit a "n^{th}" order polynomial
- conv(u,v) Multiply u and v polynomials

EXAMPLE

The following table shows measurements of reaction temperature versus time. Determine the 1st – order, 2nd – order, 4th – order, and 8th-order polynomials to represent this data and reaction temperature when t = 4.26 hr.

t (hour)	1	2	3	4	5	6	7	8
T (°C)	50.8	54.4	55.1	57.6	61.2	59.5	54.6	53.5

EXAMPLE

The van der Waals equation can be rearranged as:

$$Pv^3 - (bP + RT)v^2 + av - ab = 0$$

In this equation, v is represented as specific volume, R = 0.082054 lit.atm/(mol.K) , a = 3.592 & b = 0.04267 (for CO_2).

- Find the specific volume of CO_2 when P = 12 atm ,T = 315.6 K

POLYNOMIALS DERIVATION AND INTEGRATION

- $k(x) = \frac{d}{dx} p(x)$ — k = polyder(p)
- $k(x) = \frac{d}{dx} [a(x)b(x)]$ — k = polyder(a,b)
- $\frac{q(x)}{d(x)} = \frac{d}{dx} \left[\frac{a(x)}{b(x)}\right]$ — [q, d] = polyder(a,b)
- $q(x) = \int p(x)\, dx$ — q = polyint(p,k)

EXAMPLE

1. Calculate the derivation of these polynomials:

$$f(x) = 3x^3 - 5x^2 + 2x - 7$$

$$g(x) = (2x^4 - 7x^3 + 5x^2 - x + 4)(2x + 1)$$

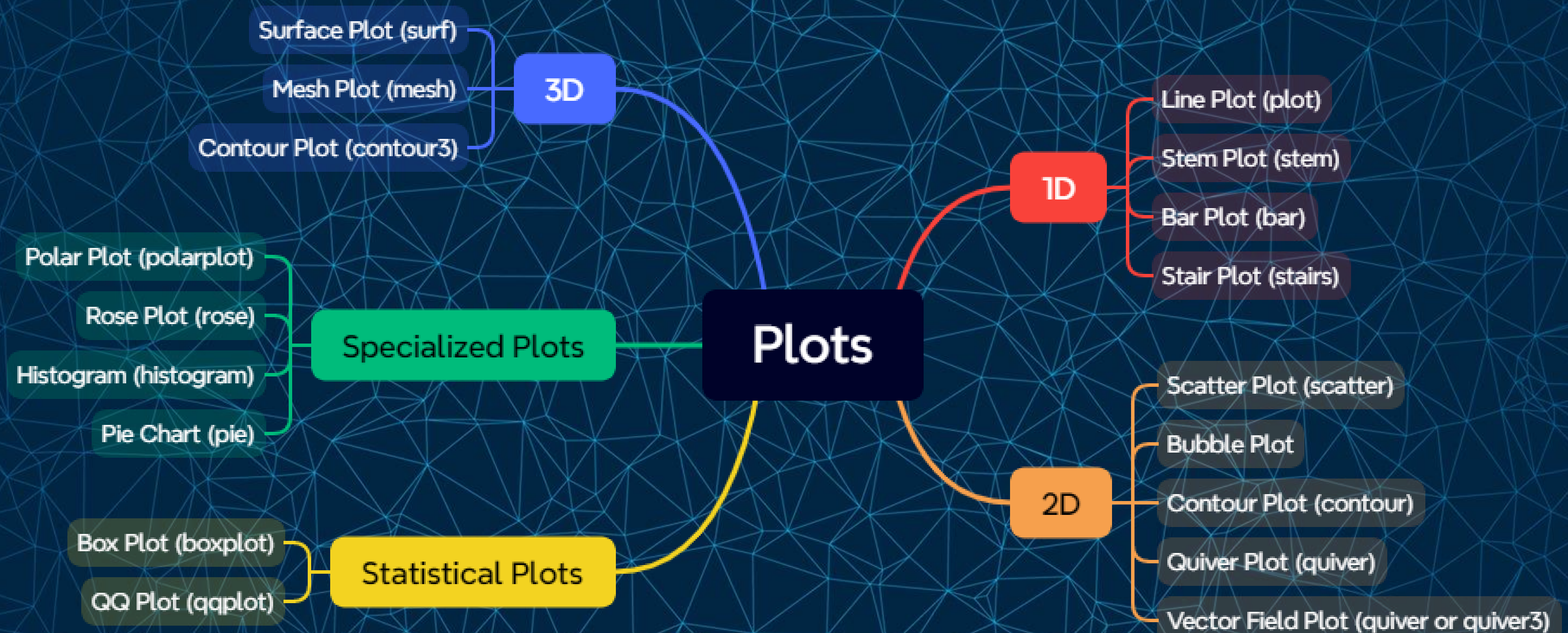
$$h(x) = \frac{x^4 - 3x^2 - 1}{x + 4}$$

2. Calculate these integrations:

$$I(x) = \int x^5 - 2x^4 + 3x^3 - 4x^2 + 5x - 6 \; dx$$

$$I(x) = \int_0^2 (x^5 - x^3 + 1)(x^2 + 1)\, dx$$

VISUALIZATION


Plots
3D
Surface Plot (surf)
Mesh Plot (mesh)
Contour Plot (contour3)
Specialized Plots
Polar Plot (polarplot)
Rose Plot (rose)
Histogram (histogram)
Pie Chart (pie)
Statistical Plots
Box Plot (boxplot)
QQ Plot (qqplot)
1D
Line Plot (plot)
Stem Plot (stem)
Bar Plot (bar)
Stair Plot (stairs)
2D
Scatter Plot (scatter)
Bubble Plot
Contour Plot (contour)
Quiver Plot (quiver)
Vector Field Plot (quiver or quiver3)

PLOTTING COMMON SYNTAX

- figure % new figure window
- grid on % Turn on gridlines
- xlabel(‘’) % add label to axis x
- ylabel(‘’) % add label to axis y
- xlim([a,b]) % set limits to axis x
- ylim([c,d]) % set limits to axis y
- title(‘name’,’Fontsize’,22) % title of figure
- hold on % retains current figure when adding new stuff
- hold off % restores to default (no hold on)
- loglog(x,y) % plot y & x on log scale
- text(x,y,’text’) % place text at position x,y

EXAMPLE

Here are some experimental wind tunnel data for Force *(F)* versus velocity *(v)* :

v [m/s]	10	20	30	40	50	60	70	80
F [N]	25	70	380	550	610	1220	830	1450

These data can also be described by the following function:

$$F = 0.2741\, v^{1.9842}$$

First, generate experimental measured force versus velocity. Then, plot the function *F* for v from 0 to 100 m/s.

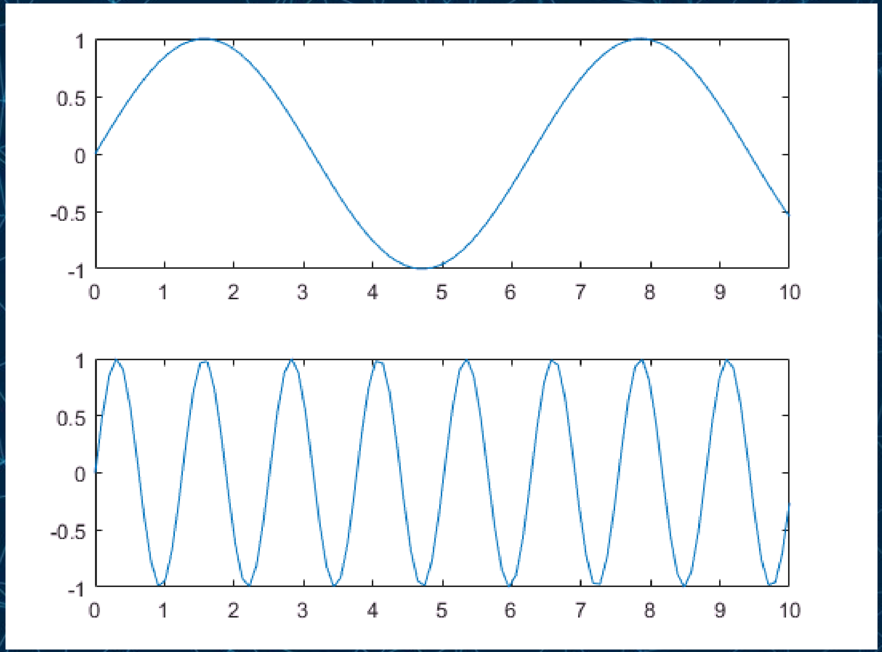
EXAMPLE

Table below shows the global CO2 emissions in Giga metric ton (Gt) over the years 2010–2020. Illustrate the provided data as bar plot.

Year	CO_2 Emission	Year	CO_2 Emission
2010	30.5824	2016	32.3747
2011	31.4595	2017	32.8374
2012	31.806	2018	33.5133
2013	32.3707	2019	36.4568
2014	32.3886	2020	34.0752
2015	32.3655		

MERGE MULTIPLE PLOTS INTO ONE FIGURE

```
subplot(2,1,1);
 x = linspace(0,10);
 y1 = sin(x);
plot(x,y1)
subplot(2,1,2);
 y2 = sin(5*x);
 plot(x,y2)
```



EXTRA COMMANDS

Character Color	Character Symbol	Character Line Style
b blue	. point	- Solid
g green	o circle	: dotted
r red	x x-mark	-. dash dot
c cyan	+ plus	-- dashed
m magenta	* Star	
y yellow	s square	
	d diamond	
	v triangle(down)	
	^ triangle(up)	
	< triangle(left)	
	> triangle(right)	
	p pentagram	
	h hexagram	

END OF PRESENTATION AND COURSE!

Thanks for your attention. 🥹