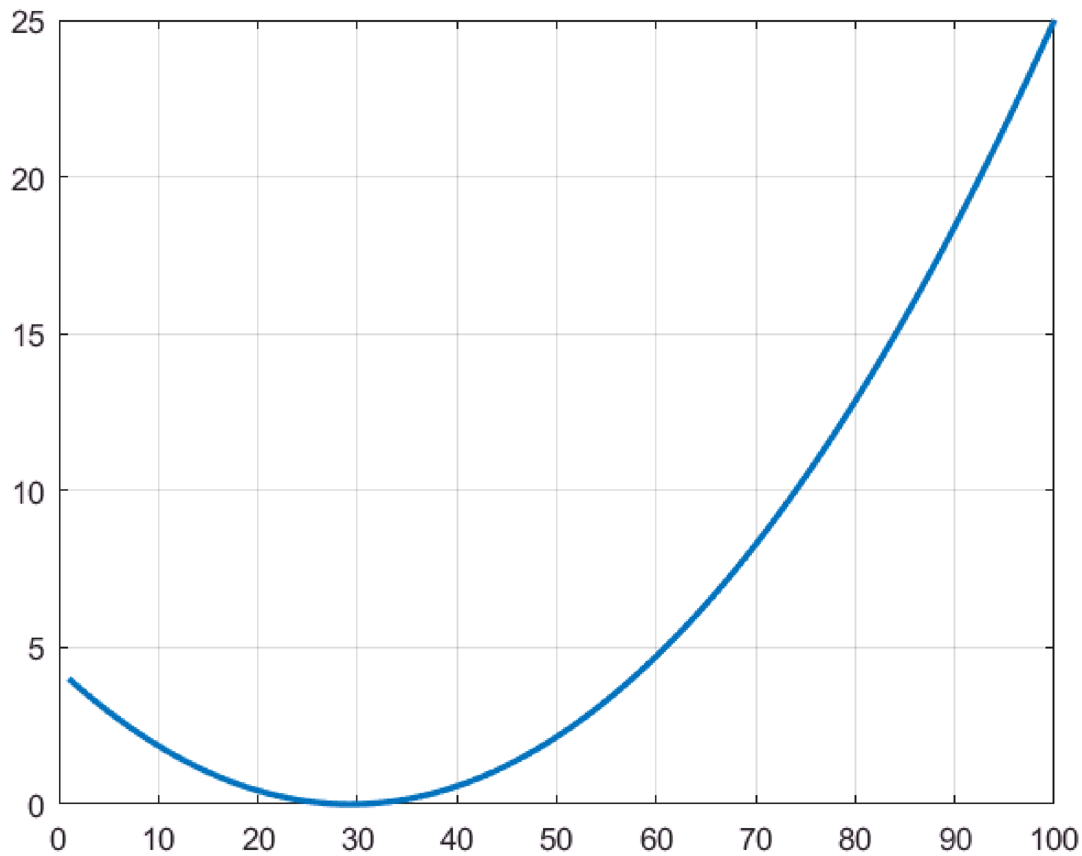
data representation

assume you may want a plot $f(x) = x^2$, over $x \in [-2\ \ 5]$ you may code as

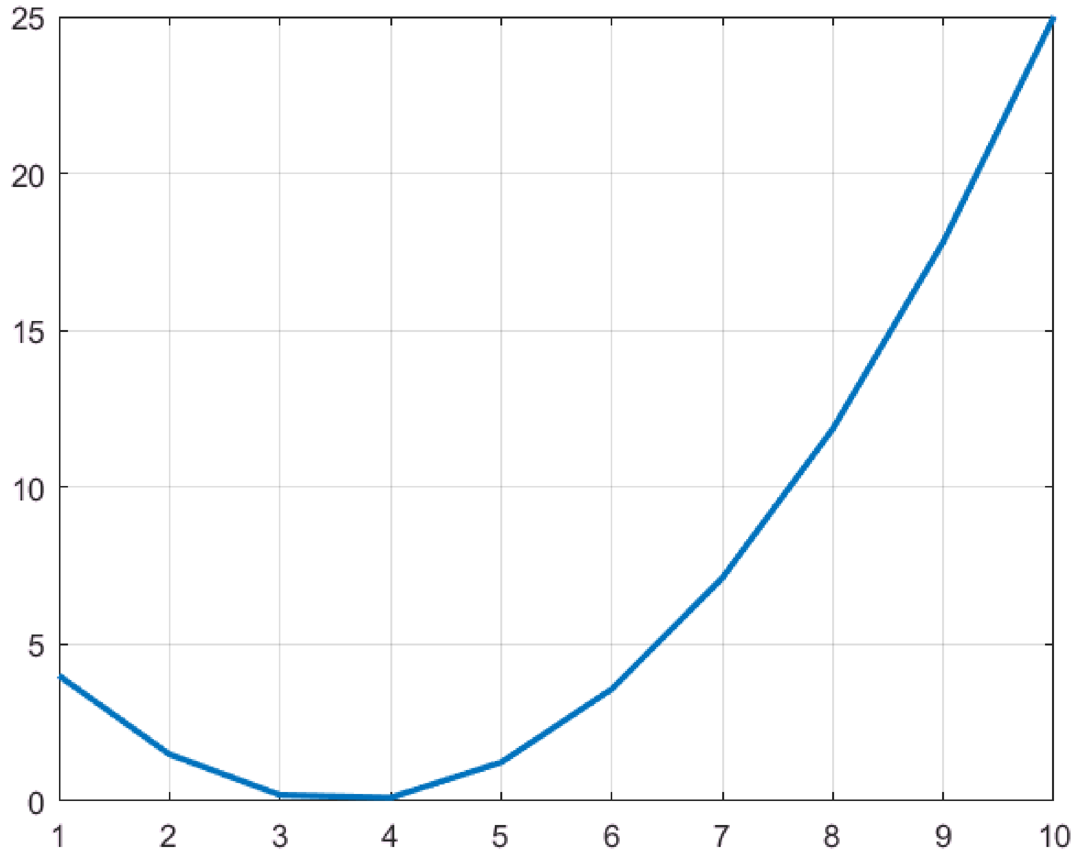
```
clear all;     % delete the memory in your workspace
LW ='LineWidth';
x = linspace(-2, 5,100);      % sampling points
figure(1)
f = x.^2;                      % f is a function of x
plot(f,LW,2); grid on
```



data representation - anonymous function

You may see the smoothness corresponding to the number of the data

```
h = @(x)  x.^2;
x = linspace(-2,5,10);
plot(h(x),LW,2); grid on
```



If you want what data in code are as

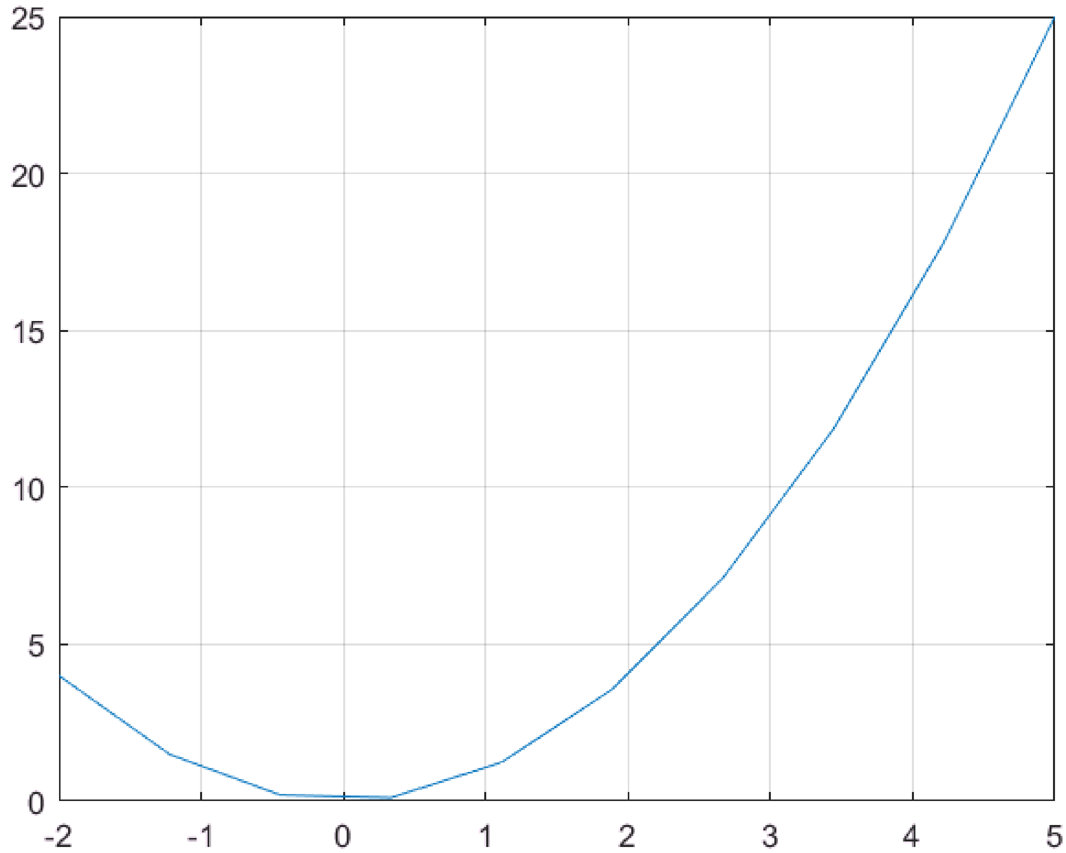
```
whos
```

```
  Name      Size             Bytes  Class              Attributes

  LW        1x9                 18  char
  f         1x100              800  double
  h         1x1                 32  function_handle
  x         1x10                80  double
```

```
x
```

```
x = 1x10 double

   -2.0000   -1.2222   -0.4444    0.3333    1.1111    1.8889    2.6667    3.4444 ⋯
```

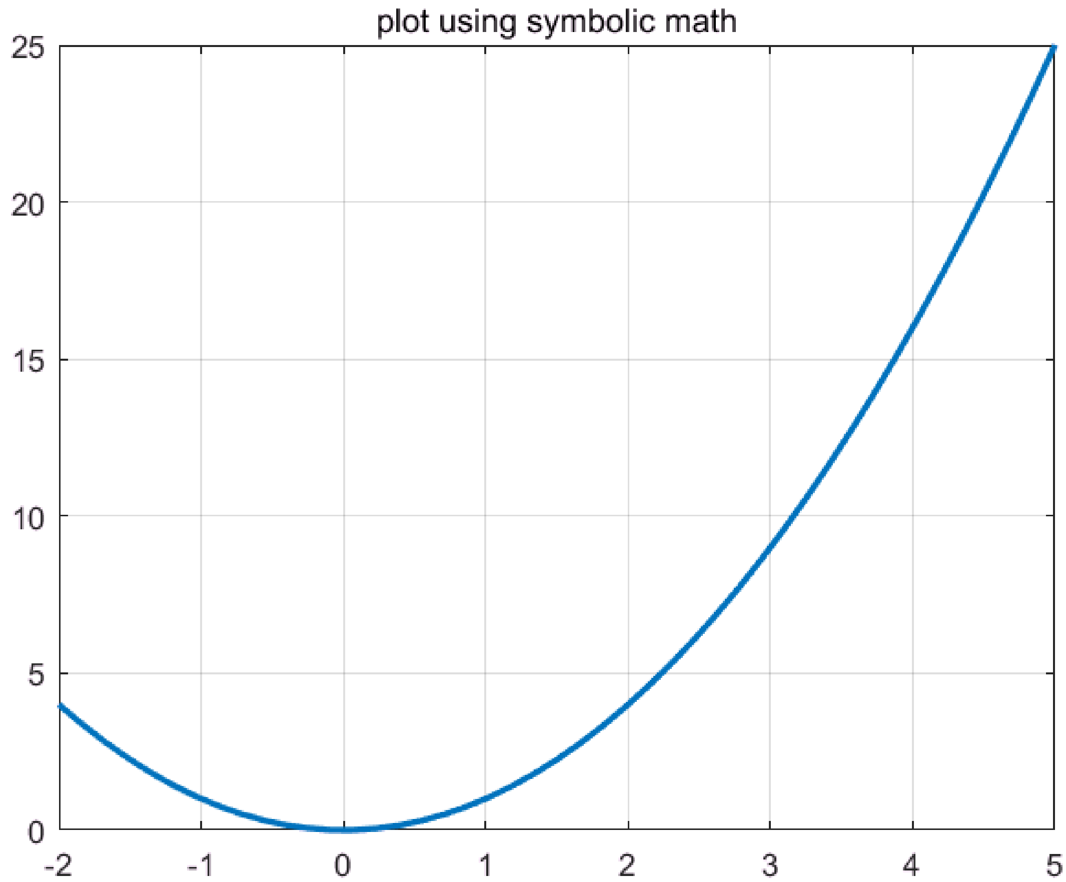
```
plot(x,h(x)); grid on
```



symbolic variables

In data representation, there are the "value" of the variable at the specific points, (it may be called as the sampling points in "digital signal process"). Without the specific points(the sampling points) sometime is useful to analyze the mathmetiacal expressions. See the following

```
clear all; clc;clf;
LW = 'LineWidth';
% define  a symbolic variable
syms x
g = x^2;
fplot(g,[-2 5],LW,2); grid on
title('plot using symbolic math')
```



The plot looks like the previous one, however, there is no sampling points. If the sampling point is given , x=2, substitue cmd subs gives

```
subs(g,x,2)
```

ans $=4$

```
% or the sampling point are multiple as previous,
subs(g,x,linspace(-2,5,10))
```

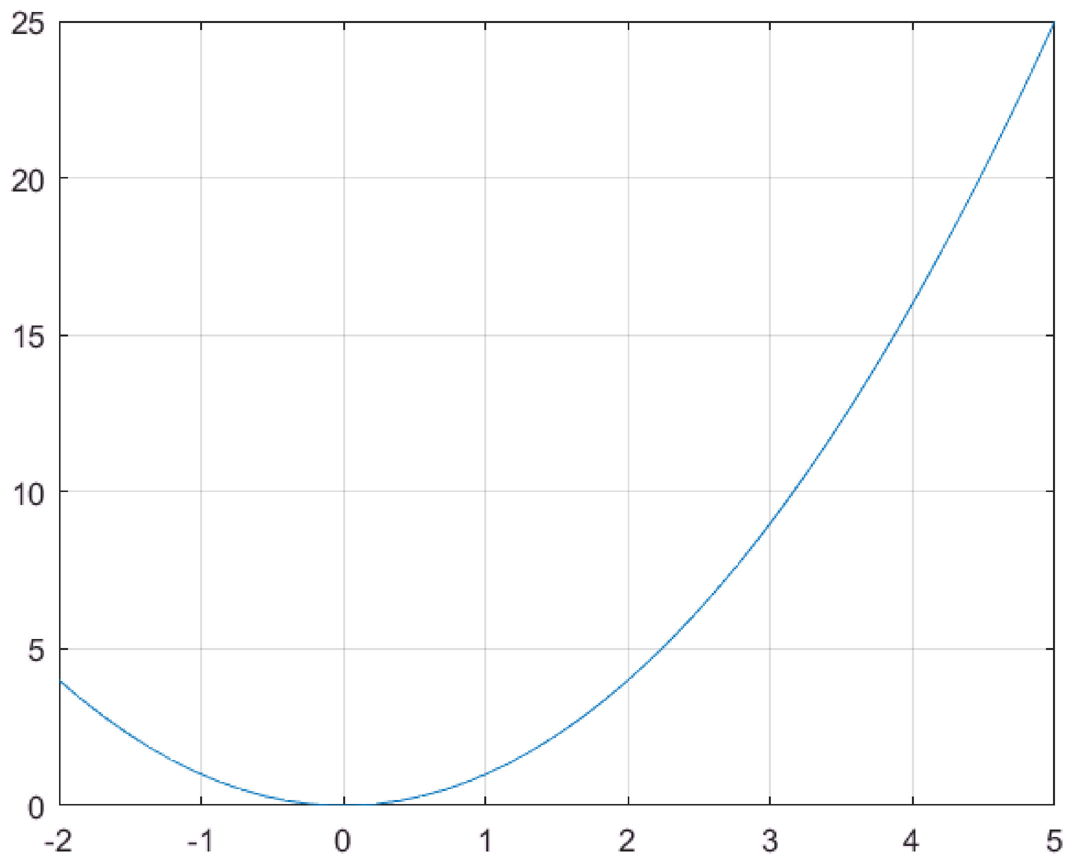
ans $=\begin{pmatrix} 4 & \frac{121}{81} & \frac{16}{81} & \frac{1}{9} & \frac{100}{81} & \frac{289}{81} & \frac{64}{9} & \frac{961}{81} & \frac{1444}{81} & 25 \end{pmatrix}$

```
% whose the same results in the case of vector .
```

symbolic function - one variable

define symbolic functions

```
syms f(x)
f(x)= x^2;
figure(2)
fplot(f,[-2 5]); grid on
```

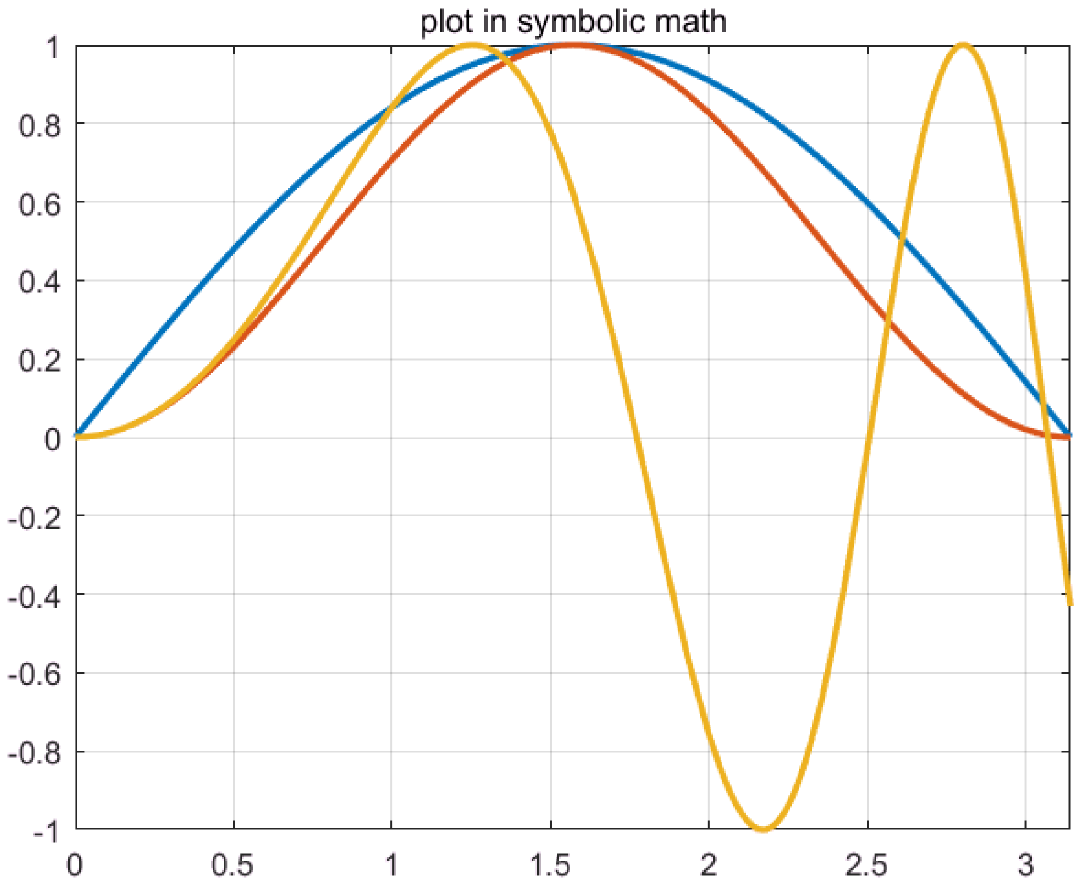



```
% to get the values of the function at the sampling points
f(linspace(-2,5,10))
```

ans = $\left(4 \quad \frac{121}{81} \quad \frac{16}{81} \quad \frac{1}{9} \quad \frac{100}{81} \quad \frac{289}{81} \quad \frac{64}{9} \quad \frac{961}{81} \quad \frac{1444}{81} \quad 25\right)$

symboloc - trigonometric function

```
clear all; clc
syms x
LW ='LineWidth';

f = sin(x);
g =sin(x)^2 ;
h = sin(x^2);
domain = [0 pi];
fplot(f, domain,LW,2); hold on; grid on
fplot(g,domain,LW,2);
fplot(h,domain,LW,2);
title('plot in symbolic math')
hold off
```



One of the diffrences between data type and symbolic type

To plot an anonymous function, define your function of variables and simultaneously define the value of the varibles.However to plot a symbolic function, define your function and plot without the values of the variables. If you need function values, you may substitute the values to your function !!

symbolic : Differentiation i one variable (page 1-23, symbolic.ug),

You know $d(sin(x))/dx = cos(x)$ In this case you do not need to define the sampling points. This is same in the symbolic math.

```
clear all;
syms x
f = sin(x)^2;
diff(f)          % the first derivative   df/dx
```

ans $= 2\cos(x)\sin(x)$

```
% diff(f,2)          % the second derivative  d^2f /dx^2
```

symbolic : Partial derivatives

```
clear all;
syms x y
f = x^2  + y^2 ;
diff(f,x)
```

ans $=2\,x$

```
diff(f,y)
```

ans $=2\,y$

symbolic : Second partial and Mixed Derivatives(1-24)

```
clear all
syms x y
f = sin(x)*cos(y);
diff(f,y,2)
```

ans $=-\cos\left(y\right)\sin\left(x\right)$

```
diff(diff(f,y),x)
```

ans $=-\cos\left(x\right)\sin\left(y\right)$

```
diff(diff(f,x),y)
```

ans $=-\cos\left(x\right)\sin\left(y\right)$

symbolic: Integral

I think the power of the symboloc math is integral. See and learn to how to code it . First indefinite integral of one variable

```
clear all; clc
LW = 'LineWidth';
syms x
f = sin(x);
g = sin(x)^2;
h = sin(x^2);
int(f)
```

ans $=-\cos\left(x\right)$

```
fplot(int(f),LW,2); hold on; grid on
int(g)
```

ans $=\frac{x}{2}-\frac{\sin\left(2\,x\right)}{4}$

```
fplot(int(g),LW,2);
int(h)
```

ans =

$$\frac{\sqrt{2}\,\sqrt{\pi}\,S\left(\frac{\sqrt{2}\,x}{\sqrt{\pi}}\right)}{2}$$

```
fplot(int(h),LW,2);
hold off
```