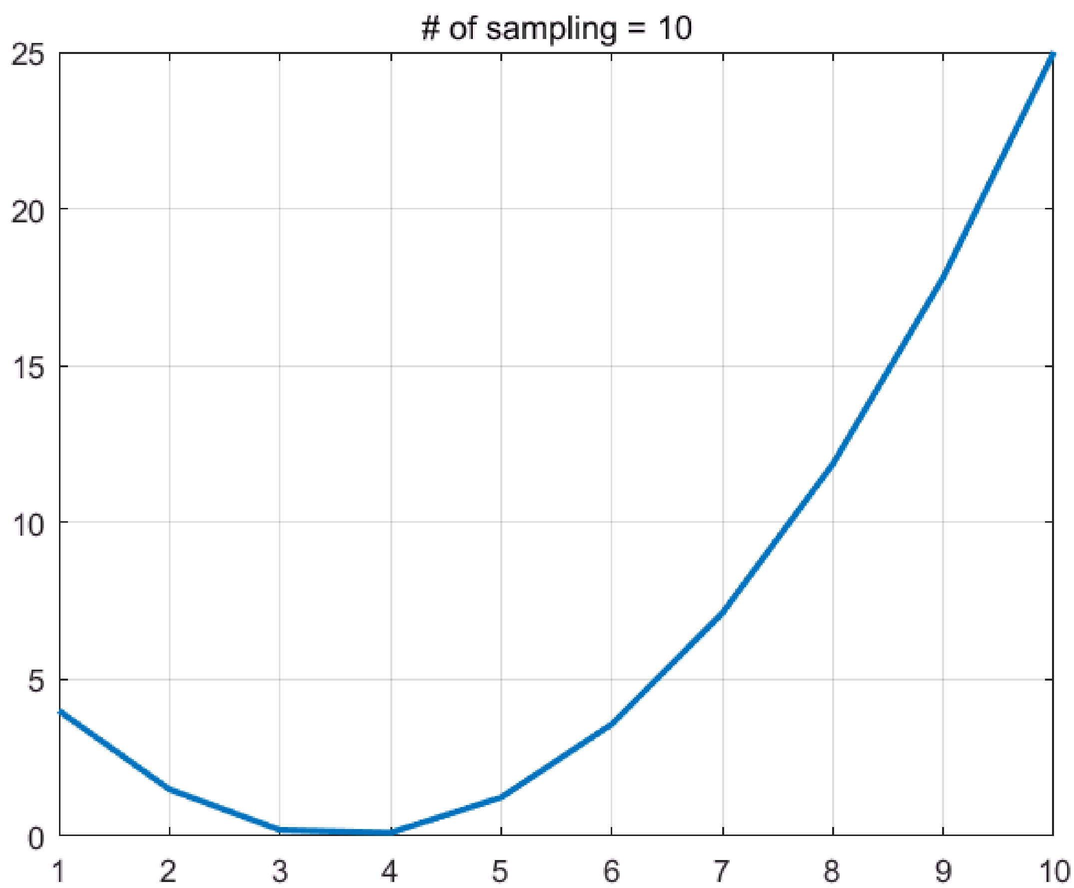
data representation

the number of sampling points

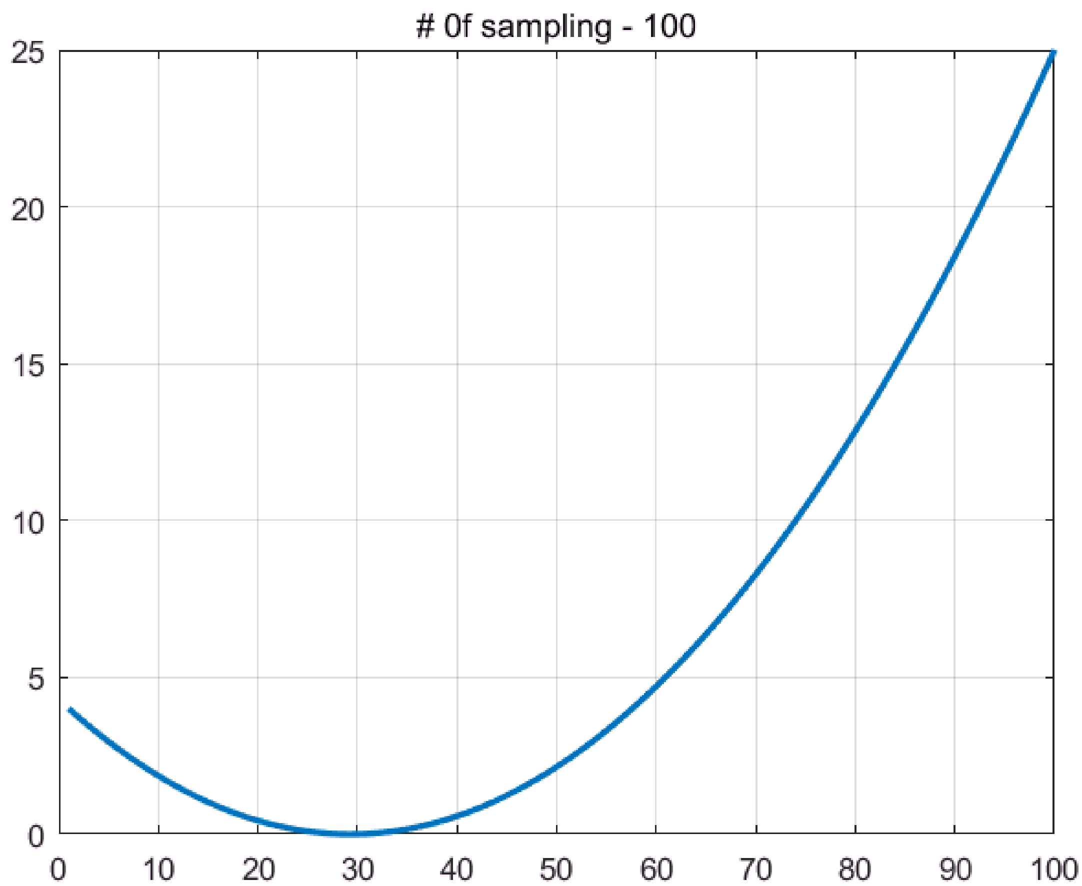
assume you may want a plot $f(x) = x^2$ over x in [-2 5] you may code as

```
clear all;    % delete the memory in your workspace
LW ='LineWidth';
x = linspace(-2, 5,10);     % # ofsampling points= 10
figure(1)
f = x.^2;                   % f is a function of x
plot(f,LW,2); grid on
title('# of sampling = 10')
```



If you increase the number of sampling points,the graph is smoother than before as

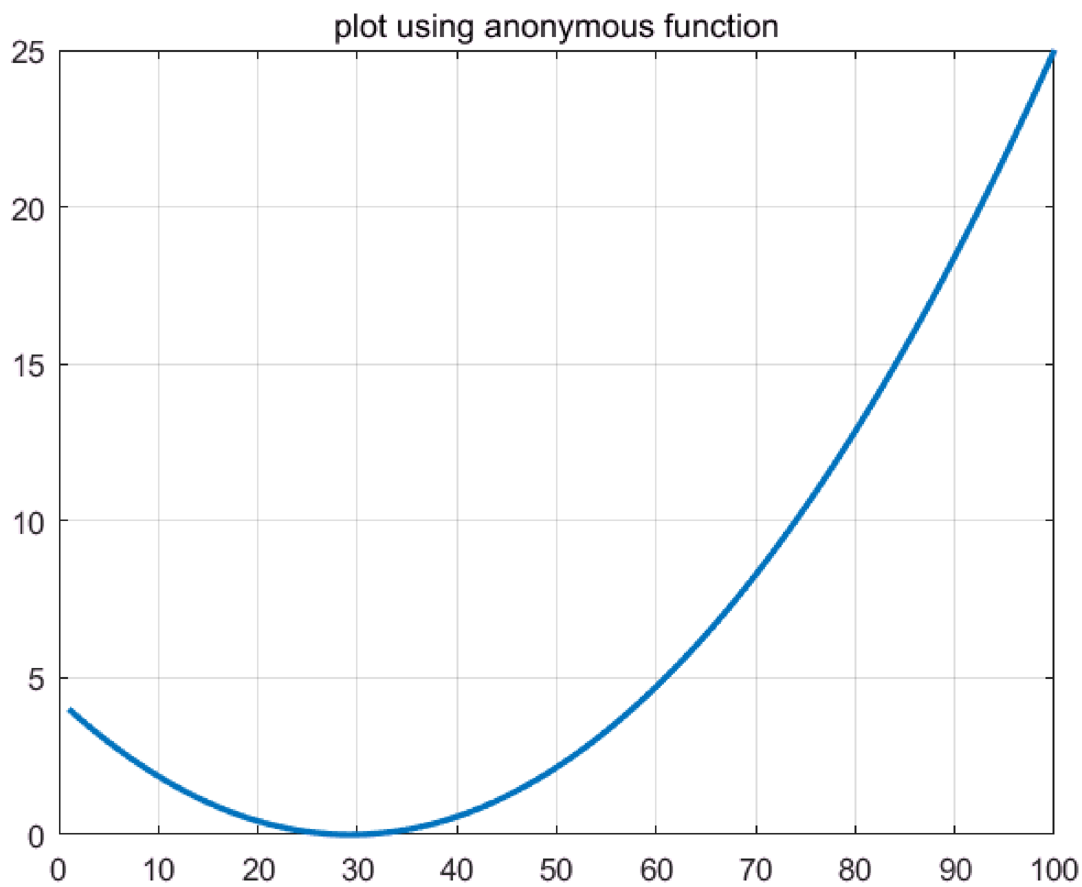
```
x = linspace(-2, 5,100);     % # ofsampling points= 100
figure(2)
f = x.^2;                    % f is a function of x
plot(f,LW,2); grid on
title('# 0f sampling - 100')
```



Anonymous function

If you use an anonymous function as

```
h = @(x)  x.^2;
x = linspace(-2,5,100);       % # ofsampling points= 100
figure(3)
plot(h(x),LW,2); grid on
title('plot using anonymous function')
```

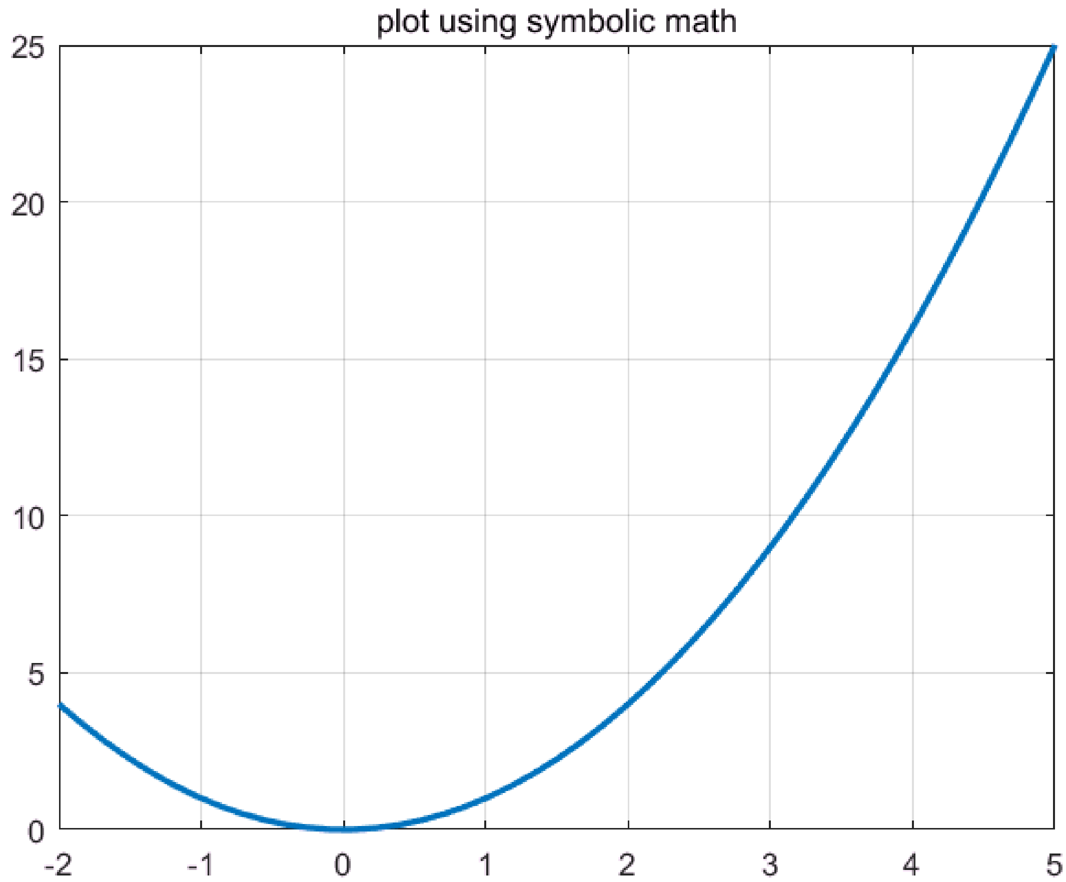


Symbolic Math

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))

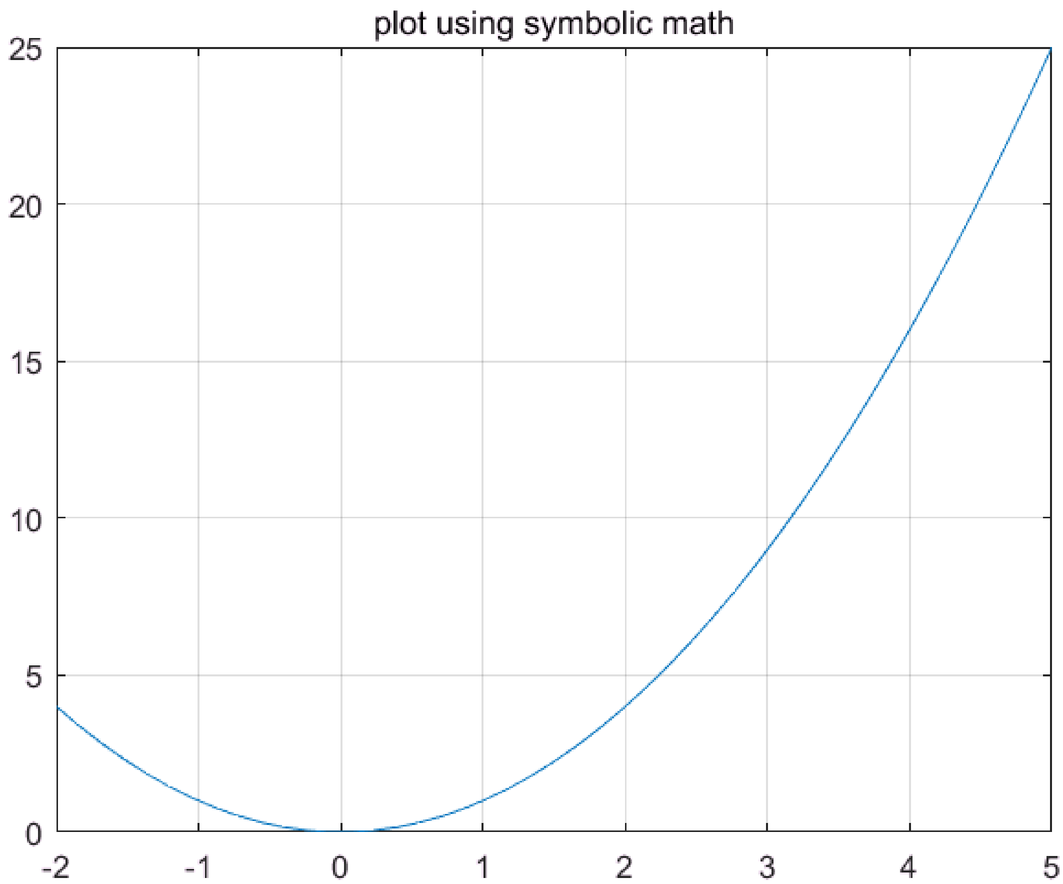
whose the same results in the case of vector . In this case we do not need to define the sampling points, since the symbolic mathe gives the result in the machine precision.

symbolic function - one variable

define symbolic functions

```
syms f(x)
```

```
f(x)= x^2;
figure(2)
fplot(f,[-2 5]); grid on
title('plot using symbolic math')
```



to get the values of the function at the sampling points

```
f(linspace(-2,5,10))
```

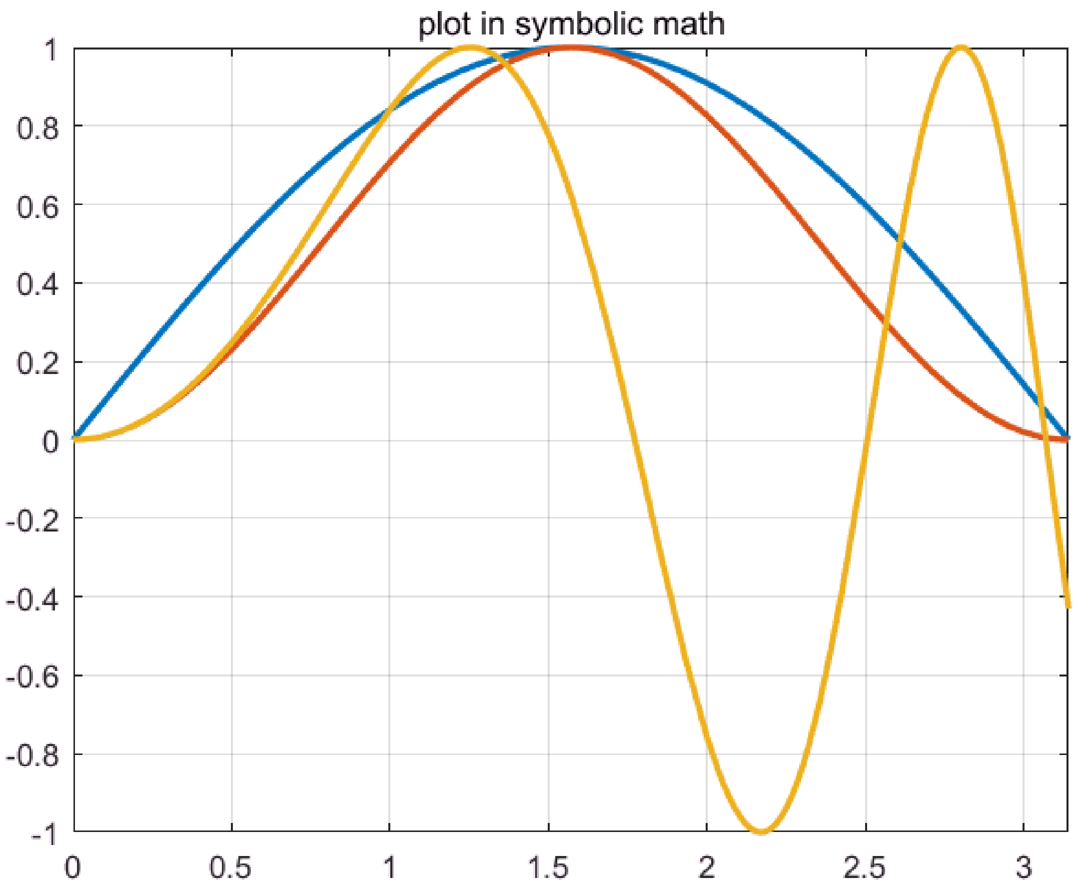
ans $= \left(4 \quad \frac{121}{81} \quad \frac{16}{81} \quad \frac{1}{9} \quad \frac{100}{81} \quad \frac{289}{81} \quad \frac{64}{9} \quad \frac{961}{81} \quad \frac{1444}{81} \quad 25\right)$

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 of one variable (1-23)

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
```

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

symbolic : Partial derivatives

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

ans $= 2x$

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

ans $= 2y$

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

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

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

```

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

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

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

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

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 $= -\cos(x)$

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

```
int(g)
```

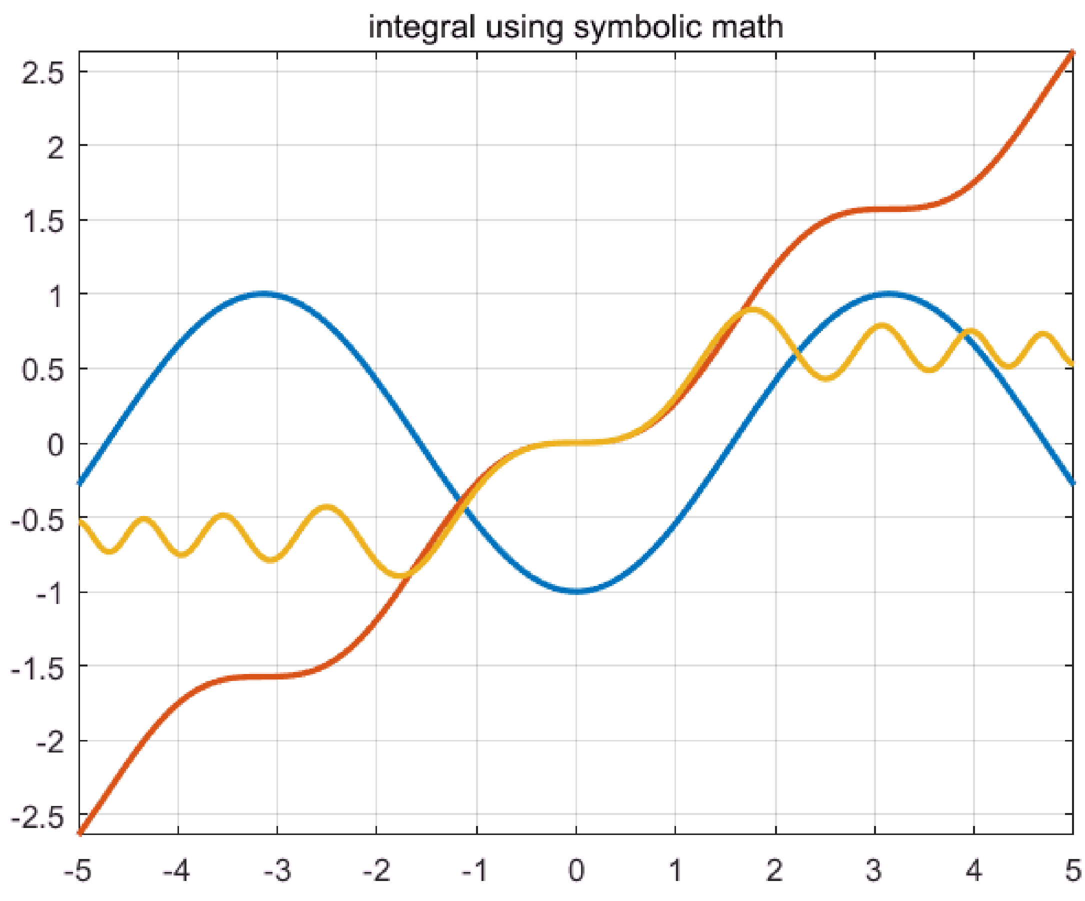
ans $= \frac{x}{2} - \frac{\sin(2\,x)}{4}$

```
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
title('integral using symbolic math')
```



The last third one, a part of the result is $S(\frac{\sqrt{(2)}x}{\sqrt{(\pi)}})$ is a special function which is called a Fresnel integral