البرمجة الإجرائية

Lecture No. 12

Syms - Solve equations - dsolve

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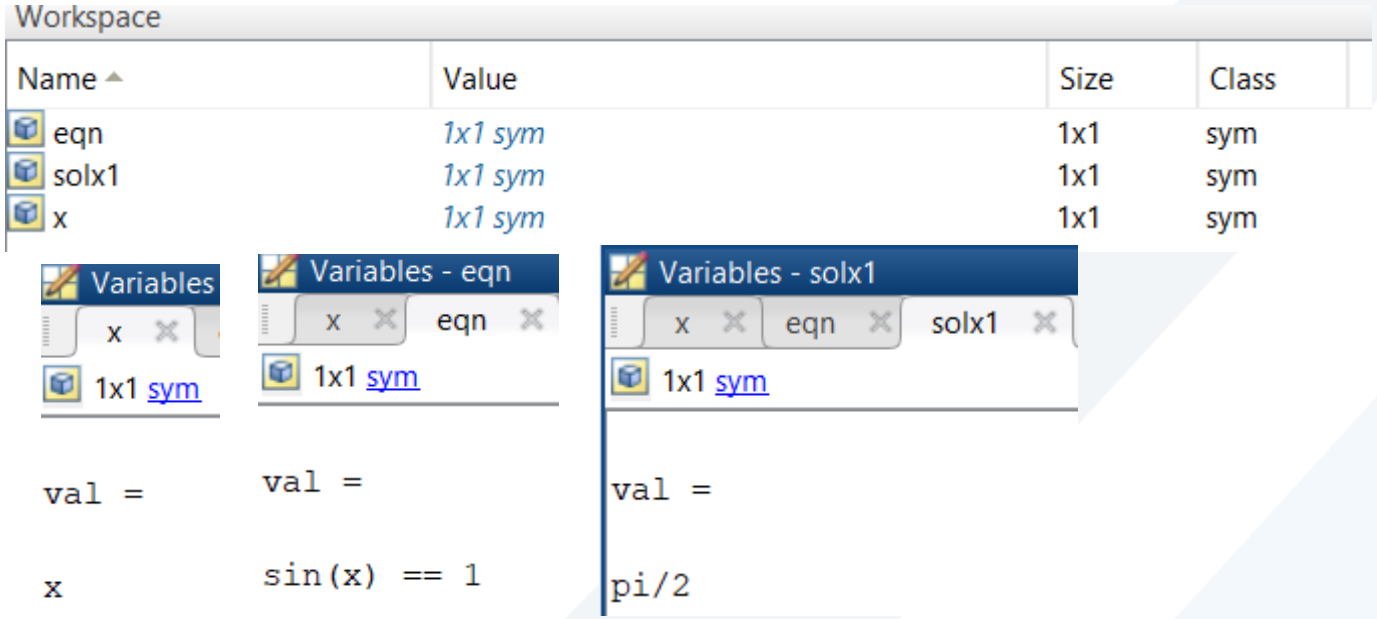
syms-solve

```
syms x
eqn = sin(x) == 1;
solx1 = solve(eqn,x)
```

solx1 =

pi/2




```
syms p x r
solx2 = solve(p*sin(x) == r,x)
solx3 = solve(p*sin(x) == r)
%chooses 'x' as the unknown and returns
```

solx2 =

asin(r/p)

pi - asin(r/p)

solx3 =

asin(r/p)

pi - asin(r/p)

syms-solve

```
syms x y
solx4 = solve(x^2 -4*x + 4 == 0,x)
```

solx4 =

2

2

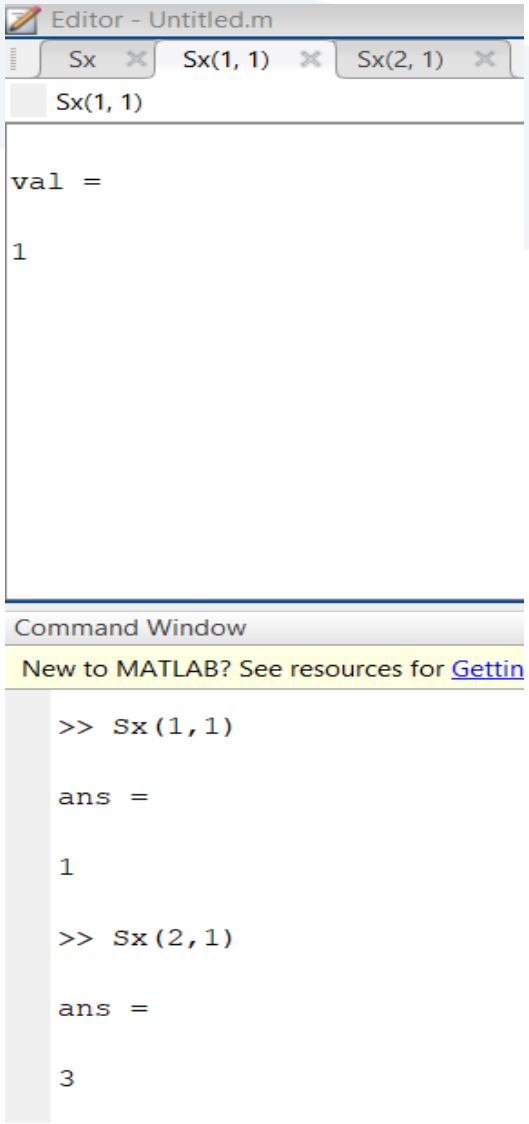
```
syms x y
solx5 = solve(x^2 + x*y + y == 3,x)
```

solx5 =

- y/2 - (y^2 - 4*y + 12)^(1/2)/2

(y^2 - 4*y + 12)^(1/2)/2 - y/2

Syms-solve




```
syms x y
eq1 = x^2 + x*y + y == 3;
eq2= x^2 - 4*x + 3 == 0;
[Sx,Sy] = solve(eq1,eq2)
```

Sx =

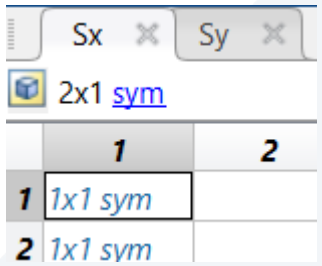
1

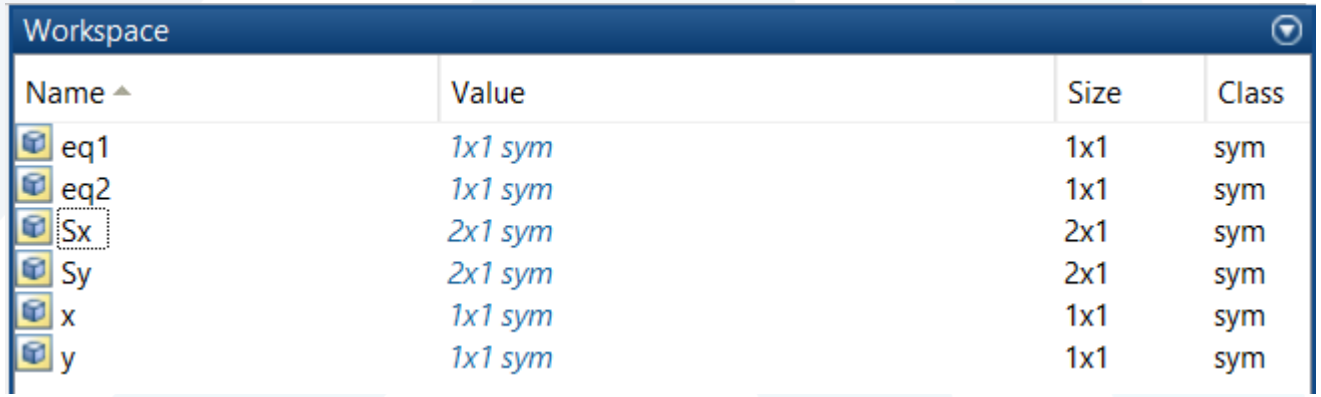
3

Sy =

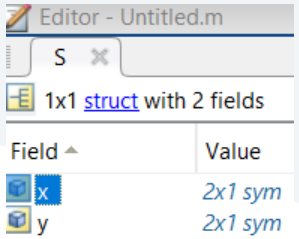
1

-3/2





Syms-solve

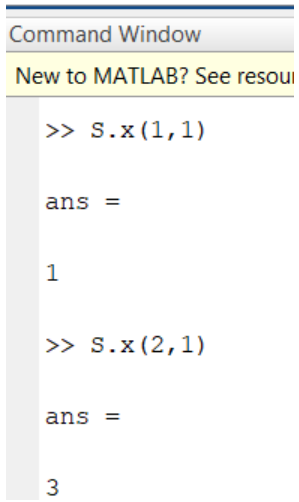


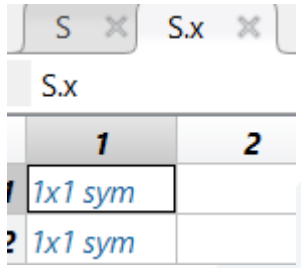

```
syms x y
eq1 = x^2 + x*y + y == 3;
eq2= x^2 - 4*x + 3 == 0;
S=solve(eq1,eq2)
```

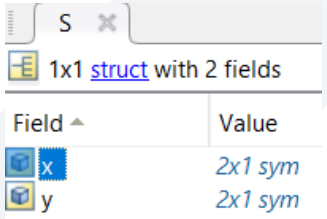
S =

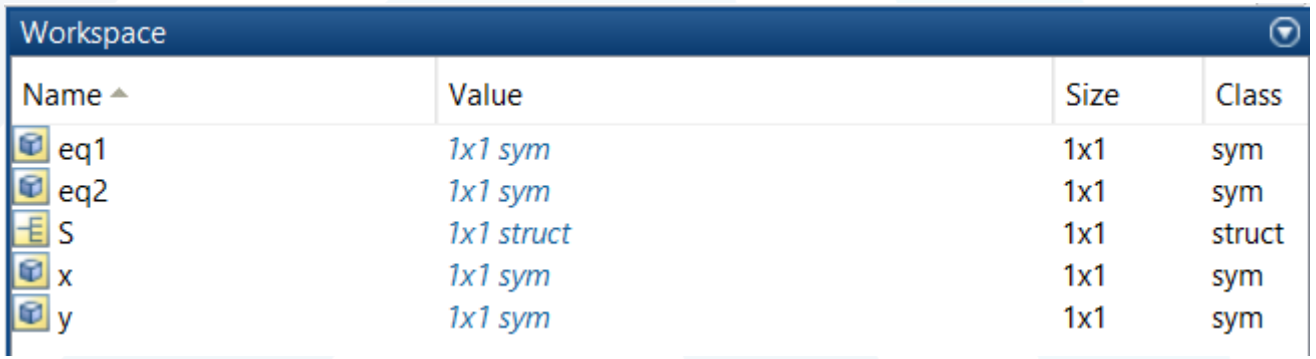
struct with fields:

x: [2×1 sym]
y: [2×1 sym]









Syms-solve

$$ {}^{4}_{0}T = {}^{1}_{0}T.{}^{2}_{1}T.{}^{3}_{2}T.{}^{4}_{3}T = \begin{bmatrix} c_{\theta_1} & -s_{\theta_1} & 0 & k_1 c_{\theta_1} \\ s_{\theta_1} & c_{\theta_1} & 0 & k_1 s_{\theta_1} \\ 0 & 0 & 1 & h \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} c_{\theta_2} & s_{\theta_2} & 0 & k_2.c_{\theta_2} \\ s_{\theta_2} & -c_{\theta_2} & 0 & k_2.s_{\theta_2} \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & k_3 + d_3 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} c_{\theta_4} & -s_{\theta_4} & 0 & 0 \\ s_{\theta_4} & c_{\theta_4} & 0 & 0 \\ 0 & 0 & 1 & e \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

code

```
clc;clear;format bank
syms t01(theta1,k1,h)
syms t12(theta2,k2)
syms t23(k3,d3)
syms t34(theta4,e)

t01(theta1,k1,h) =[cos(theta1),-sin(theta1),0,k1*cos(theta1); sin(theta1),cos(theta1),0,k1*sin(theta1); 0,0,1,h;0,0,0,1];

t12(theta2,k2) =[cos(theta2) sin(theta2) 0 k2*cos(theta2);sin(theta2) -cos(theta2) 0 k2*sin(theta2);0 0 -1 0;0 0 0 1];

t23(k3,d3) =[1 0 0 0;0 1 0 0; 0 0 1 k3+d3;0 0 0 1];

t34(theta4,e) =[cos(theta4) -sin(theta4) 0 0;sin(theta4) cos(theta4) 0 0; 0 0 1 e;0 0 0 1];
```

```
t04=simplify(t01(theta1,k1,h)*t12(theta2,k2)*t23(k3,d3)*t34(theta4,e));
```

الاختصار

النتيجة النهائية بعد الاختصار

```
t04 =

[ cos(theta1 + theta2 - theta4),  sin(theta1 + theta2 - theta4),  0, k2*cos(theta1 + theta2) + k1*cos(theta1)]
[ sin(theta1 + theta2 - theta4), -cos(theta1 + theta2 - theta4),  0, k2*sin(theta1 + theta2) + k1*sin(theta1)]
[                             0,                              0, -1,                          h - e - d3 - k3]
[                             0,                              0,  0,                                       1]
```

```
th1=0.00;th2=0.00;di3=0.00;th4=0.00;
h=47; k1=50; k2=50; k3=50; e=10;
t040=double(t01(th1,k1,h)*t12(th2,k2)*t23(k3,di3)*t34(th4,e))
```

```
t040 =

    1.00       0       0     100.00
       0   -1.00       0          0
       0       0   -1.00     -13.00
       0       0       0       1.00
```

diff - dsolve

Solve the equation: dy/dt=ay

Solve the equation: dx/dt=-ax

```
syms a y(t)
eqn = diff(y,t) == a*y
dsolve(eqn)
```

```
eqn(t) =
 diff(y(t), t) == a*y(t)

 ans =
 C5*exp(a*t)
```

```
syms x(t) a
eq= diff(x) == -a*x
dsolve(eq)
```

```
eq(t) =
 diff(x(t), t) == -a*x(t)

 ans =
 C4*exp(-a*t)
```

Workspace

Name	Value	Size	Class
a	*1x1 sym*	1x1	sym
ans	*1x1 sym*	1x1	sym
eq	*1x1 symfun*	1x1	symfun
eqn	*1x1 symfun*	1x1	symfun
t	*1x1 sym*	1x1	sym
x	*1x1 symfun*	1x1	symfun
y	*1x1 symfun*	1x1	symfun

diff - dsolve

Solve the equation d2y/dt2=ay.

```
syms y(t) a
eqn = diff(y,t,2) == a*y;
ySol(t) = dsolve(eqn)
```

ySol(t) =

C6*exp(-a^(1/2)*t) + C7*exp(a^(1/2)*t)

Specify the second-order derivative of a function y by using diff(y,t,2) or diff(y,t,t). Similarly, specify the n-th order derivative by using diff(y,t,n).

Solve Differential Equation with Condition

Solve the equation $dy/dt=ay$ with the condition y(0)=5.

```
syms y(t) a
eqn = diff(y,t) == a*y;
cond = y(0) == 5;
ySol(t) = dsolve(eqn,cond)
```

ySol(t) =

5*exp(a*t)

Solve the equation
d2y/dt2= (a^2)y. with two conditions, y(0)=b and y'(0)=1.

```
syms y(t) a b
eqn = diff(y,t,2) == a^2*y;
Dy = diff(y,t);
cond = [y(0)==b, Dy(0)==1];
ySol(t) = dsolve(eqn,cond)
```

ySol(t) =
(exp(a*t)*(a*b + 1))/(2*a) + (exp(-a*t)*(a*b - 1))/(2*a)

Solve the equation
d2y/dt2= (a^2) y. with two conditions, y(0)=b and y'(0)=1.
b=0, a=2

```
syms y(t)
eqn = diff(y,t,2) == 2^2*y;
Dy = diff(y,t);
cond = [y(0)==0, Dy(0)==1];
ySol(t) = dsolve(eqn,cond)
```

ySol(t) =
exp(2*t)/4 - exp(-2*t)/4

ySol(t) =
(exp(a*t)*(a*b + 1))/(2*a) + (exp(-a*t)*(a*b - 1))/(2*a)

Solve System of Differential Equations

$$\frac{dy}{dt} = z$$

$$\frac{dz}{dt} = -y.$$

```
syms y(t) z(t)
eqns = [diff(y,t) == z, diff(z,t) == -y];
sol = dsolve(eqns)
soly(t) = sol.y
solz(t) = sol.z
```

Workspace

Name	Value	Size	Class
eqns	*1x1 symfun*	1x1	symfun
sol	*1x1 struct*	1x1	struct
soly	*1x1 symfun*	1x1	symfun
solz	*1x1 symfun*	1x1	symfun
t	*1x1 sym*	1x1	sym
y	*1x1 symfun*	1x1	symfun
z	*1x1 symfun*	1x1	symfun

```
sol =
  struct with fields:
    z: [1×1 sym]
    y: [1×1 sym]
```

```
soly(t) =
 C14*cos(t) + C13*sin(t)

 solz(t) =
 C13*cos(t) - C14*sin(t)
```

```
soly(0)
 ans =
 C14

>> solz(0)
 ans =
 C13
```

Solve the initial value problem

$$y'(x) = xy; \quad y(1) = 1.$$

```
eqn1 = 'Dy = y*x'
inits = 'y(1)=1';
y = dsolve(eqn1,'y(1)=1','x')
%or
y = dsolve(eqn1,inits,'x')
```

```
eqn1 =
   'Dy = y*x'


y =
 exp(-1/2)*exp(x^2/2)


y =
 exp(-1/2)*exp(x^2/2)
```

Solve the second order differential equation

$$y''(x) + 8y'(x) + 2y(x) = \cos(x);$$

$$y(0) = 0,\ y'(0) = 1$$

```
clear
clc
eqn2 = 'D2y + 8*Dy + 2*y = cos(x)'
inits2 = 'y(0)=0, Dy(0)=1'
y=dsolve(eqn2,inits2,'x')
```

eqn2 =
'D2y + 8*Dy + 2*y = cos(x)'

inits2 =
'y(0)=0, Dy(0)=1'

y =
(14^(1/2)*exp(x*(14^(1/2) - 4))*(7*14^(1/2) - 27))/(28*(8*14^(1/2) - 31)) - (14^(1/2)*exp(4*x + 14^(1/2)*x)*exp(-x*(14^(1/2) + 4))*(sin(x) + cos(x)*(14^(1/2) + 4)))/(28*((14^(1/2) + 4)^2 + 1)) + (14^(1/2)*exp(4*x - 14^(1/2)*x)*exp(x*(14^(1/2) - 4))*(sin(x) - cos(x)*(14^(1/2) - 4)))/(28*((14^(1/2) - 4)^2 + 1)) + (14^(1/2)*exp(-x*(14^(1/2) + 4))*(393*14^(1/2) - 1531))/(28*(8*14^(1/2) - 31)^2*(8*14^(1/2) + 31))

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Thanks .