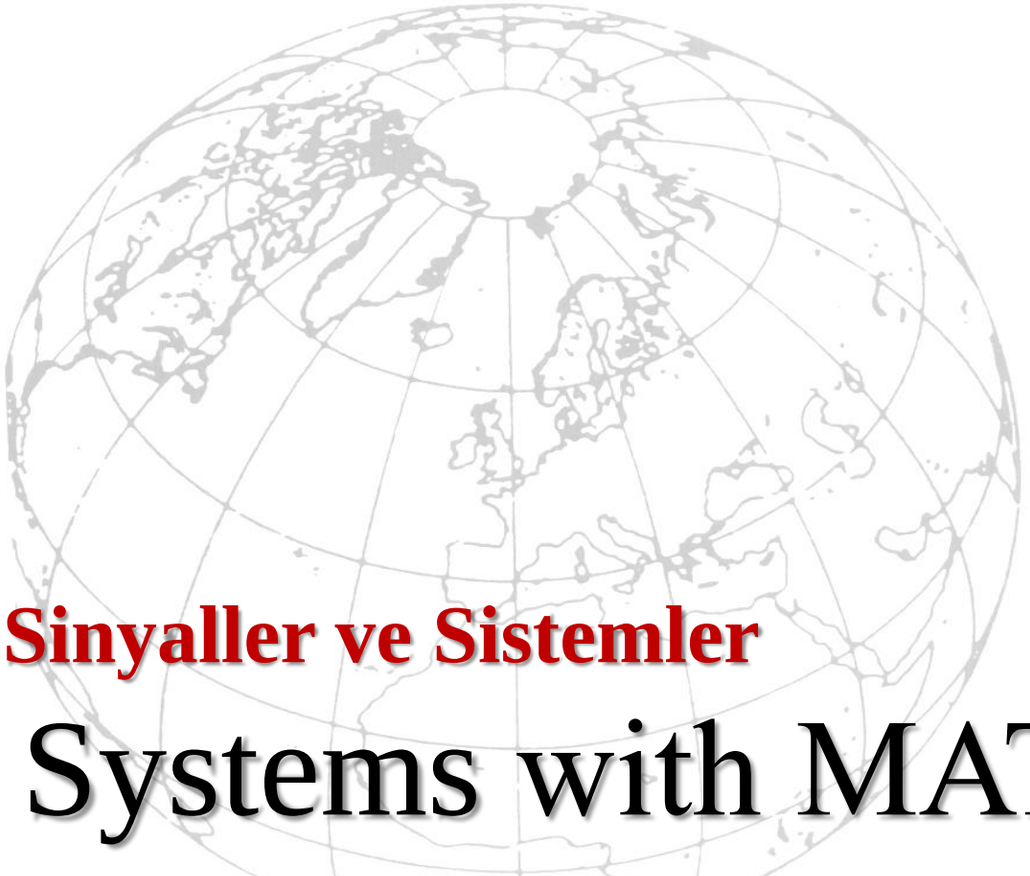


Sinyaller ve Sistemler

“Signal and Systems with MATLAB”

Dr. Cahit Karakuş, 2020

Latex

^{ }	Superscript	'text^{superscript}'
_{ }	Subscript	'text_{subscript}'
\bf	Bold font	'\bf text'
\it	Italic font	'\it text'
\sl	Oblique font (usually the same as italic font)	'\sl text'
\rm	Normal font	'\rm text'

Character Sequence	Symbol	Character Sequence	Symbol	Character Sequence	Symbol
\alpha	α	\upsilon	υ	\sim	~
\angle	∠	\phi	ϕ	\leq	≤
\ast	*	\chi	χ	\infty	∞
\beta	β	\psi	ψ	\clubsuit	♣
\gamma	γ	\omega	ω	\diamondsuit	♦
\delta	δ	\Gamma	Γ	\heartsuit	♥
\epsilon	ϵ	\Delta	Δ	\spadesuit	♠
\zeta	ζ	\Theta	Θ	\leftrightarrow	↔
\eta	η	\Lambda	Λ	\leftarrow	←
\theta	θ	\Xi	Ξ	\Leftarrow	⇐
\vartheta	ϑ	\Pi	Π	\uparrow	↑
\iota	ι	\Sigma	Σ	\rightarrow	→
\kappa	κ	\Upsilon	Υ	\Rightarrow	⇒
\lambda	λ	\Phi	Φ	\downarrow	↓
\mu	μ	\Psi	Ψ	\circ	°
\nu	ν	\Omega	Ω	\pm	±
\xi	ξ	\forall	∀	\geq	≥
\pi	π	\exists	∃	\propto	∝
\rho	ρ	\ni	∋	\partial	∂
\sigma	σ	\cong	≅	\bullet	•
\varsigma	ς	\approx	≈	\div	÷
\tau	τ	\Re	ℜ	\neq	≠
\equiv	≡	\oplus	⊕	\aleph	ℵ
\Im	ℑ	\cup	∪	\wp	℘

\otimes	⊗	\subseteq	⊆	\oslash	∅
\cap	∩	\in	∈	\supseteq	⊇
\supset	⊃	\lceil	⌈	\subset	⊂
\int	∫	\cdot	·	\o	o
\rfloor	⌋	\neg	¬	\nabla	∇
\lfloor	⌊	\times	x	\ldots	...
\perp	⊥	\surd	√	\prime	′
\wedge	∧	\varpi	ϖ	\0	∅
\rceil	⌉	\rangle	⟩	\mid	∣
\vee	∨	\langle	⟨	\copyright	©

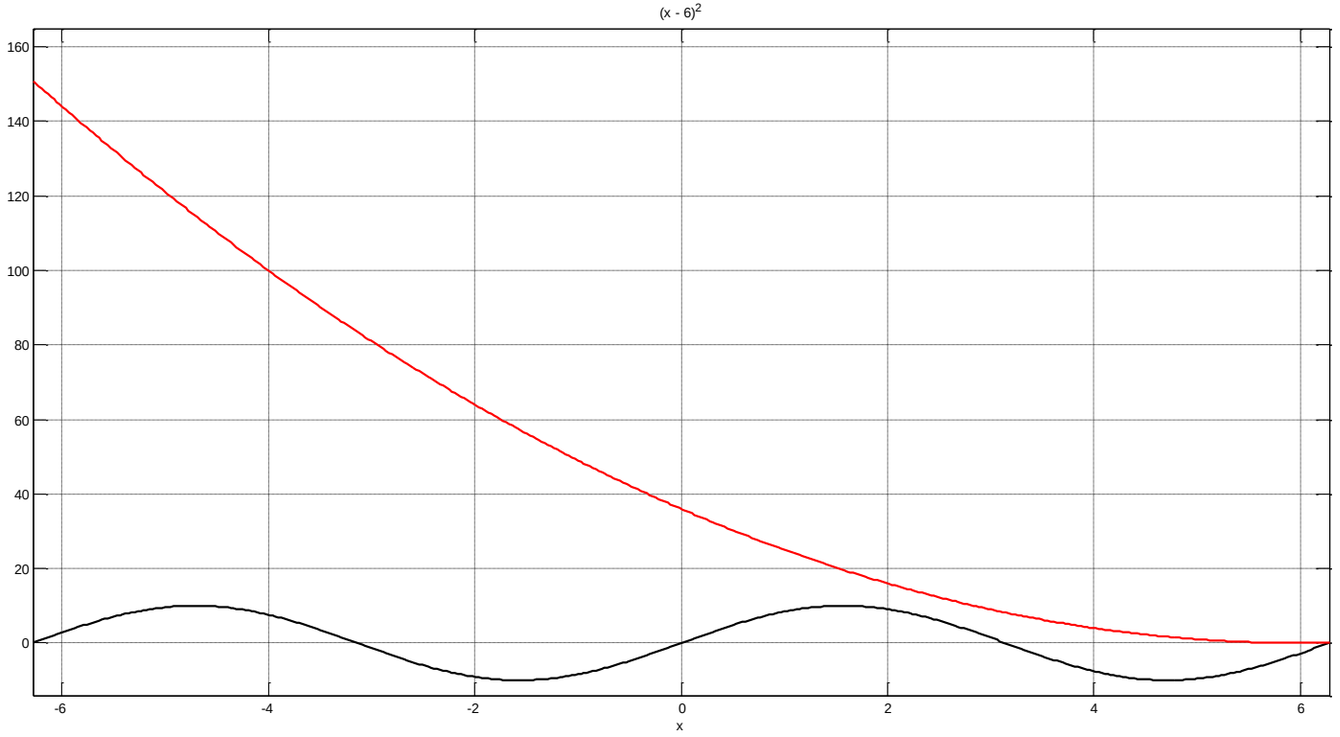
Symbolic Expressions

Manipulating symbolic expressions

- numden()
- expand()
- factor()
- collect()
- simplify()
- simple()
- poly2sym()

syms ezplot

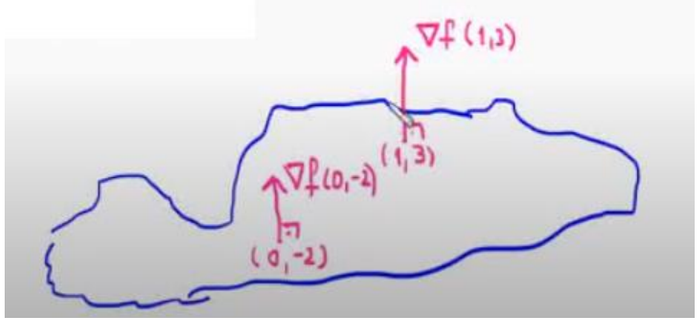
```
clear
clc
syms x
%functia obiectiv
f=ezplot(10*sin(x));
set(f,'Color','black', 'LineWidth', 2)
hold on
%conditia la limita
j=ezplot((x-6)^2)
set(j,'Color','red', 'LineWidth', 2)
grid on
```



Gradient of Function

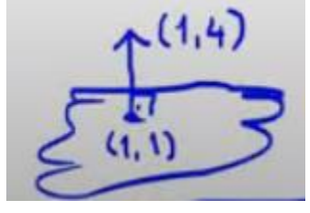
Gradyan

- Bir skaler alanın yön türevi artımın en çok olduğu yere doğru yönelmiş bir vektör alanını verir ve büyüklüğü değişimin en büyük değerine eşittir. Örneklemek gerekirse bir odadaki zamandan bağımsız sıcaklık dağılımı düşünülebilir.
- Gradyan vektörü, f(x,y) veya f(x, y, z) gibi çok değişkenli fonksiyonlardan elde edilir. ∇f ile gösterilir, f fonksiyonun gradyan vektörü denir.
- $\nabla f(x,y)=(fx, fy)$ dir. Bir vektördür, türev yardımı ile elde edilir.
- $\nabla f(x,y,z)=(fx, fy, fz)$ dir. Bir vektördür, türev yardımı ile elde edilir.
- Gradyan vektörü fonksiyonun kısmi türevinden elde edilen bir vektördür.
- f(x,y), bir yüzeysel fonksiyondur. Yeri gelir bir maksiumum, yeri gelir bir minumumdur. Bu fonksiyondan elde edilen gradyan vektörü, bu fonksiyonun herhangi bir noktasında çizilen dik vektörü verir.



Örnek

- f(x,y)=x^2y+y^3-x+1 ise grdyan vektörü nedir?
- ∇f(x,y)=(2xy-1, x^2+3y^2)
- ∇f(1,1)=(1, 4)




```
clear all
close all

syms x y z
f = x^2*y+y^3-x+1;
gradient(f, [x, y])

ans =
   2*x*y - 1
 x^2 + 3*y^2
```

Gradient vector of scalar function

The *gradient* of a function of two variables, $F(x, y)$, is defined as

$$\nabla F = \frac{\partial F}{\partial x}\hat{i} + \frac{\partial F}{\partial y}\hat{j}$$

```
clear all
close all

syms x y z
f = 2*y*z*sin(x) + 3*x*sin(z)*cos(y);
gradient(f, [x, y, z])
```

Answer:

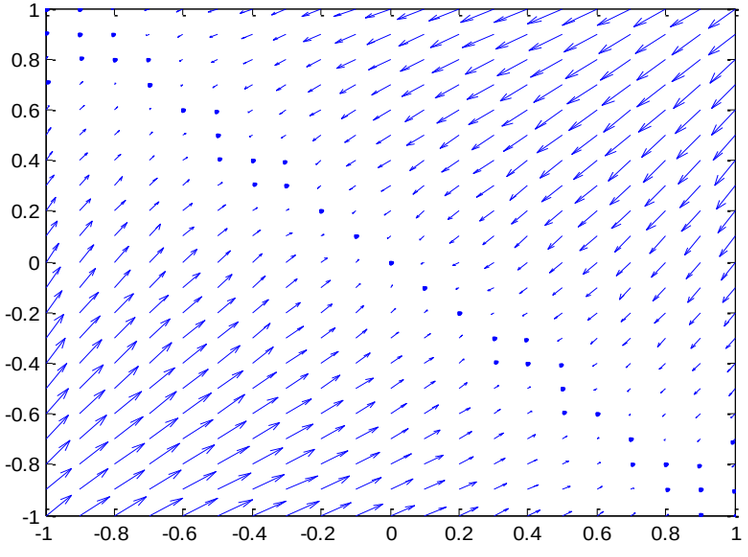
```
fx=2*y*z*cos(x) + 3*cos(y)*sin(z)
fy=2*z*sin(x) - 3*x*sin(y)*sin(z)
fz=2*y*sin(x) + 3*x*cos(y)*cos(z)
```

```
clear all
close all

syms x y
f = -(sin(x) + sin(y))^2;
g = gradient(f,[x,y])
```

Answaer

```
g =
 -2*cos(x)*(sin(x) + sin(y))
 -2*cos(y)*(sin(x) + sin(y))
```

```
[X, Y] = meshgrid(-1:.1:1,-1:.1:1);
G1 = subs(g(1),[x y],{X,Y});
G2 = subs(g(2),[x y],{X,Y});
quiver(X,Y,G1,G2)
```



Not: subs(s,old,new) returns a copy of s, replacing all occurrences of old with new, and then evaluates s.

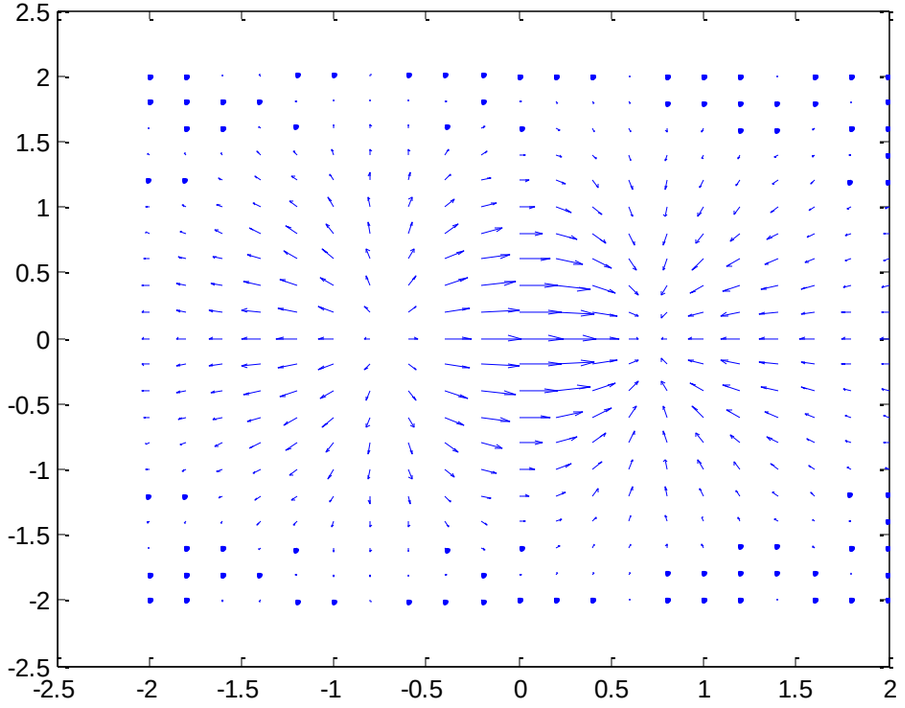
```
syms a b
subs(a + b, a, 4)
ans = b + 4
```

Quiver or vector plot

- quiver(X,Y,U,V), X ve Y tarafından belirtilen Kartezyen koordinatlarda yön bileşenleri U ve V olan okları çizer. Örneğin, ilk ok X(1) ve Y(1) noktalarından kaynaklanır, yatay olarak uzanır U(1)'e göre ve V(1)'e göre dikey olarak uzanır. Varsayılan olarak, titreme işlevi ok uzunluklarını örtüşmeyecek şekilde ölçeklendirir.

Gradient and Quiver

```
clear all
close all

spacing = 0.2;
[X,Y] = meshgrid(-2:spacing:2);
Z = X.*exp(-X.^2 - Y.^2);
[DX,DY] = gradient(Z,spacing);

quiver(X,Y,DX,DY)
```

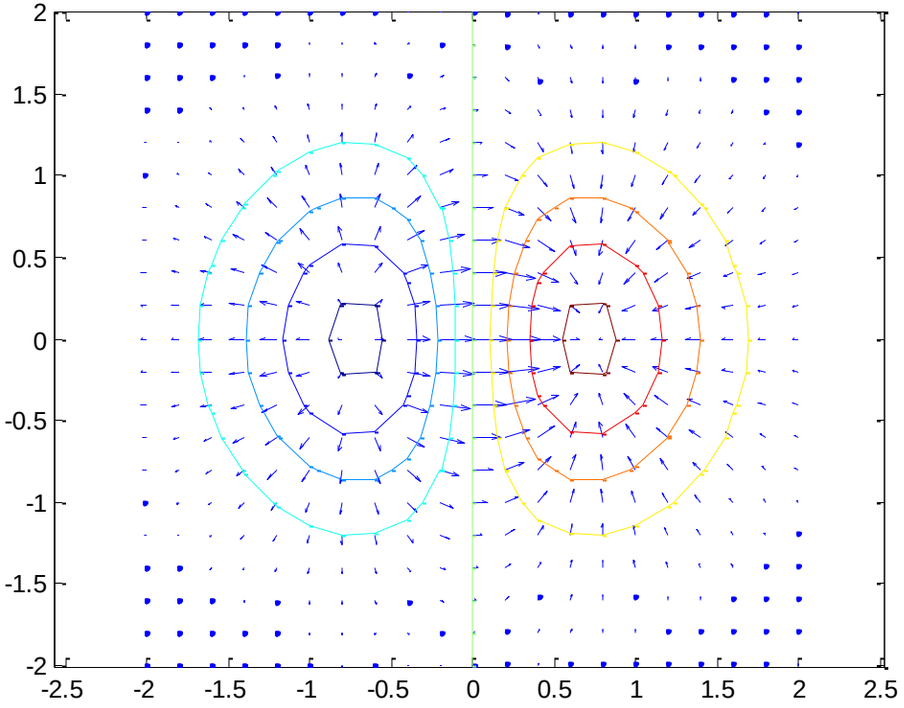


Contour

- Contour(Z), Z matrisinin izolinlerini içeren bir kontur grafiği oluşturur; burada Z, x-y düzlemindeki yükseklik değerlerini içerir.
- Contour(X,Y,Z), Z'deki değerler için x ve y koordinatlarını belirtir.

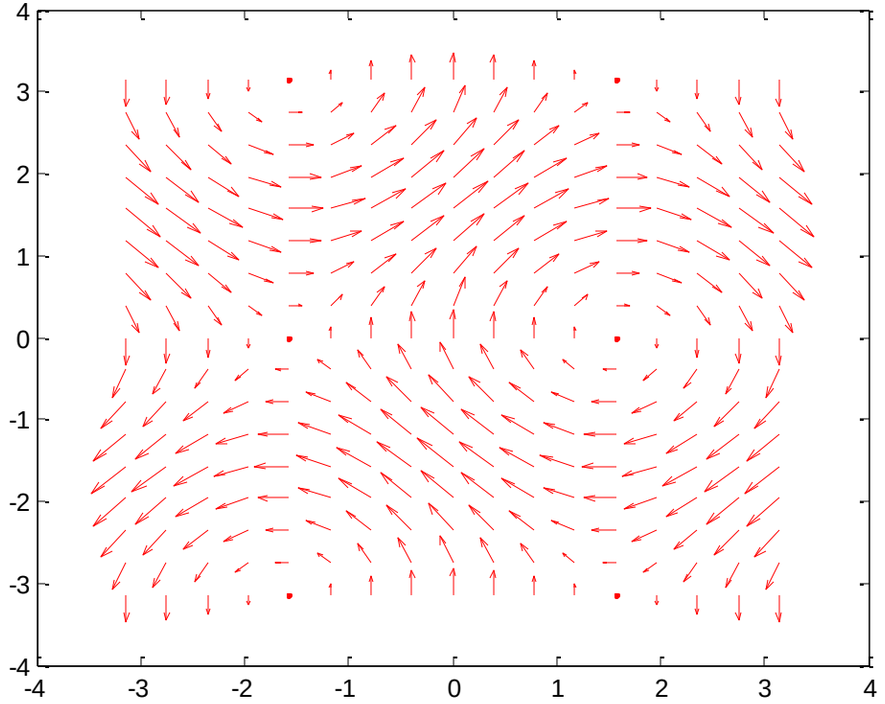
Gradient – Quiver - Contour

```
clear all
close all

spacing = 0.2;
[X,Y] = meshgrid(-2:spacing:2);
Z = X.*exp(-X.^2 - Y.^2)
[DX,DY] = gradient(Z,spacing);
quiver(X,Y,DX,DY)
hold on
contour(X,Y,Z)
axis equal
hold off
```



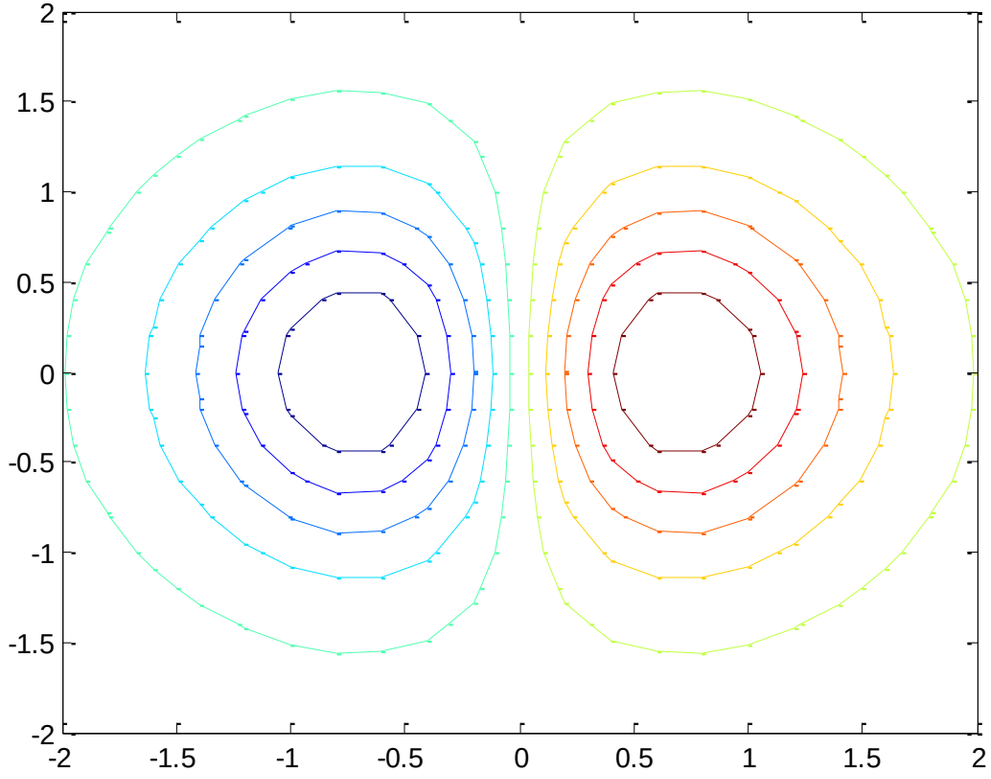
Gradient and Quiver

```
clear all
close all

[X,Y] = meshgrid(-pi:pi/8:pi,-pi:pi/8:pi);
U = sin(Y);
V = cos(X);
quiver(X,Y,U,V,'r')
```



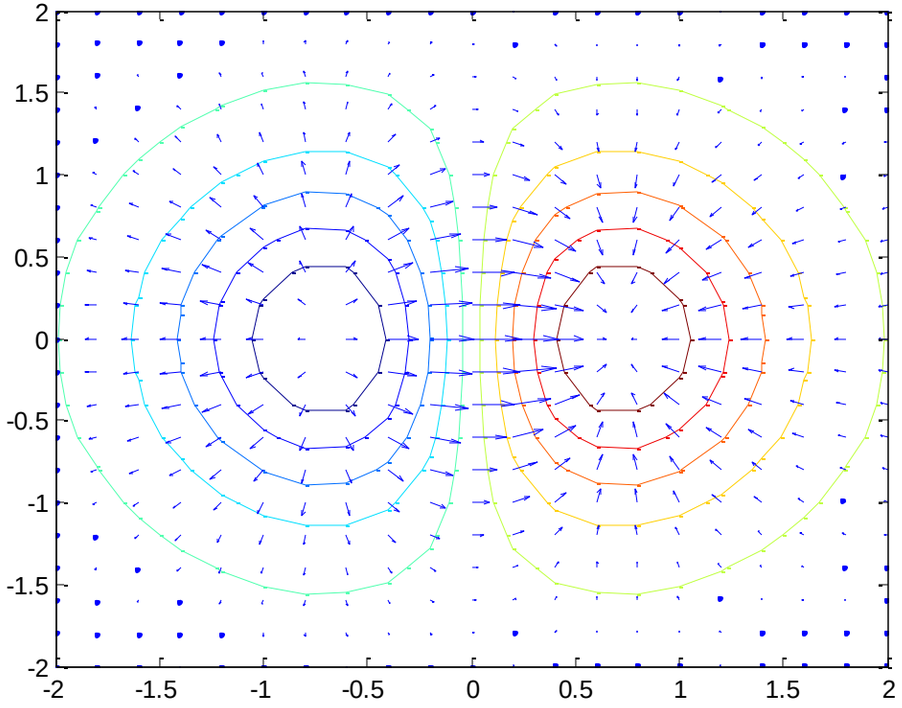
Örnek: Plot contours of $xe^{-x^2-y^2}$ over a grid from -2 to 2 in the *x* and *y* directions.

```
clear all
close all

[X,Y] = meshgrid(-2:0.2:2);
Z = X .* exp(-X.^2 - Y.^2);
contour(X,Y,Z,10)
```

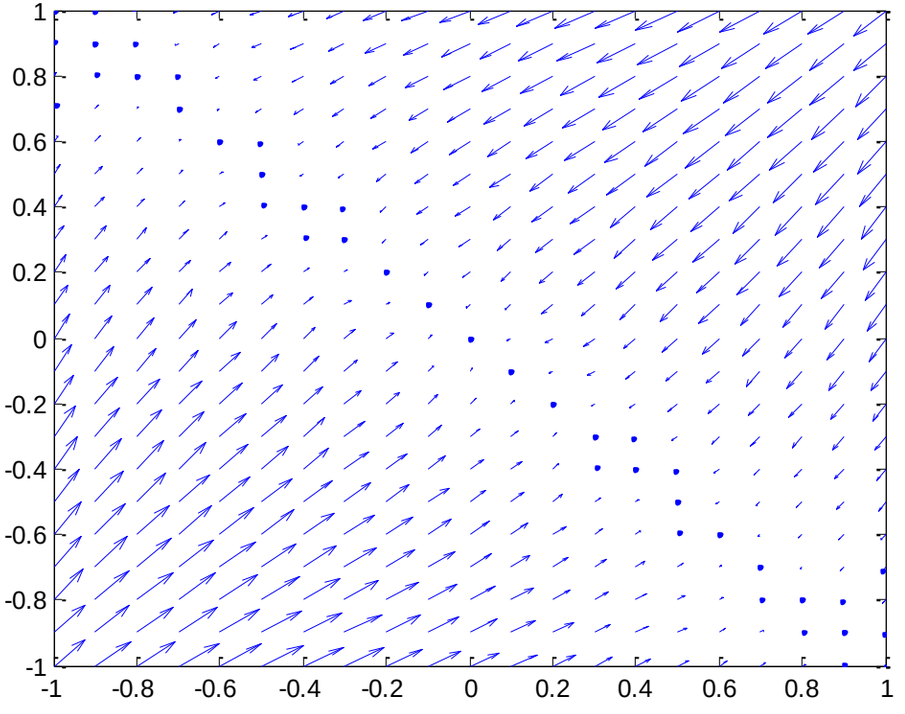


Örnek: Plot contours of $xe^{-x\text{^}2-y\text{^}2}$ over a grid from -2 to 2 in the *x* and *y* directions.

```
clear all
close all

[X,Y] = meshgrid(-2:0.2:2);
Z = X .* exp(-X.^2 - Y.^2);
contour(X,Y,Z,10)
[U,V] = gradient(Z,0.2,0.2);
hold on
quiver(X,Y,U,V)
hold off
```

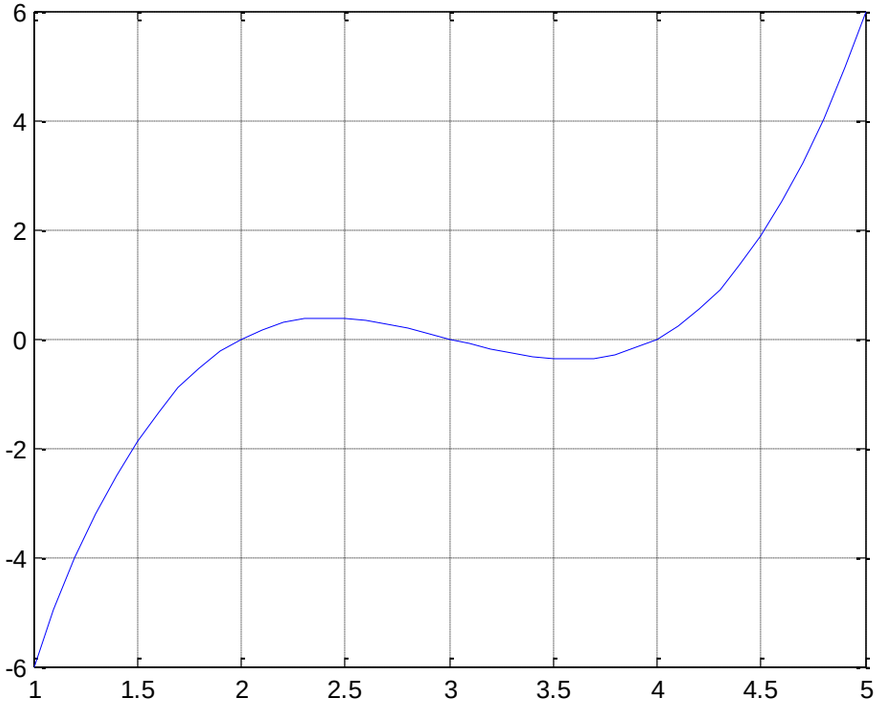


```
clear all
close all

syms  x y
f = -(sin(x) + sin(y))^2;
g = gradient(f,[x,y])


[X, Y] = meshgrid(-1:.1:1,-1:.1:1);
G1 = subs(g(1),[x y],{X,Y});
G2 = subs(g(2),[x y],{X,Y});
quiver(X,Y,G1,G2)
```



Polynomials and Roots

```
clear all
close all


c = [ 1 -9 26 -24 ]
 x = 1:0.1:5;  % define range for plotting
 y = polyval(c,x); % compute samples
plot(x,y) % make the plot
grid on
r = roots(c)
```

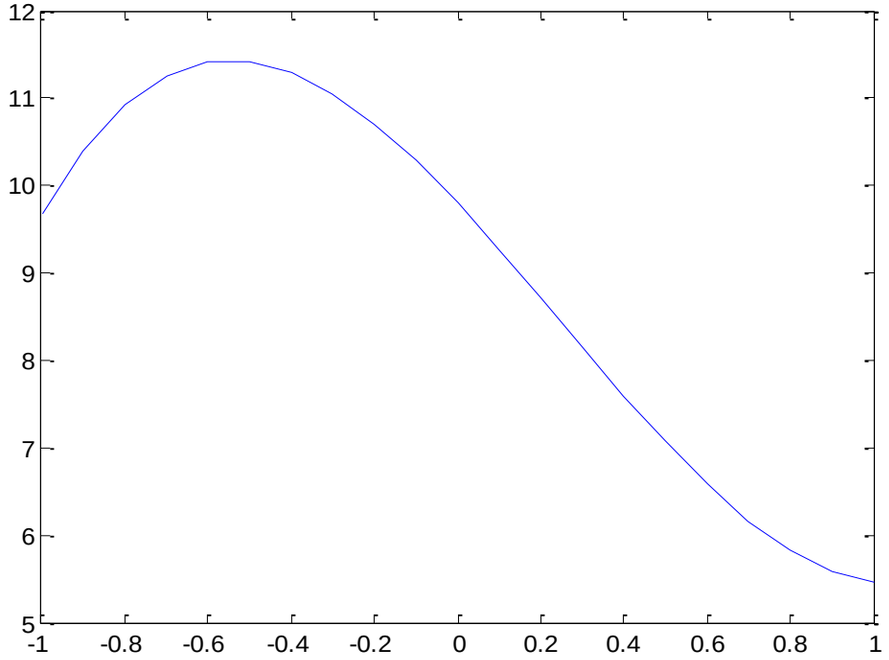


Polynomials and Roots

clear all; close all

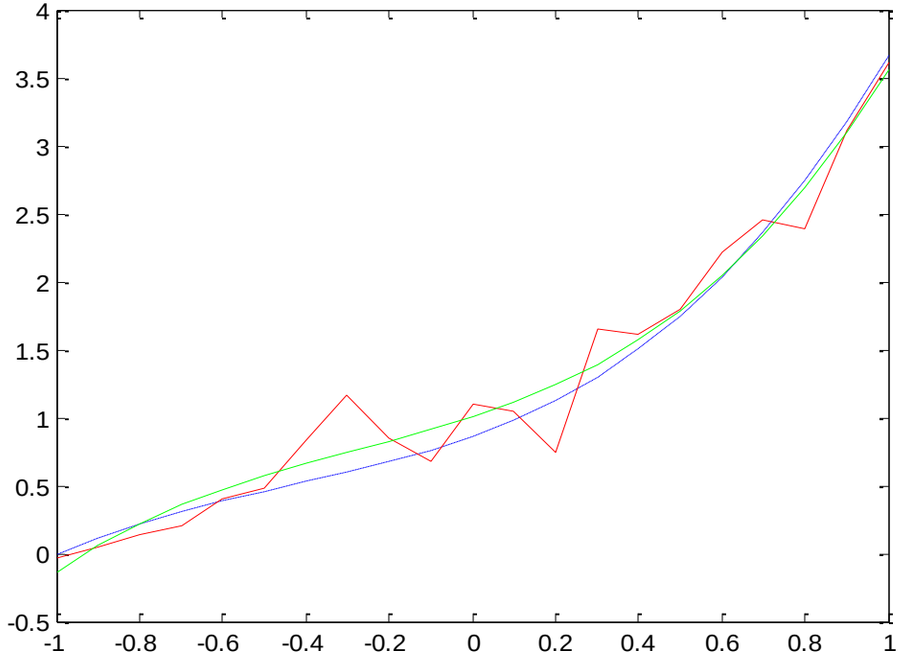
$$3x^3 - 2.23x^2 - 5.1x + 9.8.$$

```
c = [ 3 -2.23 -5.1 9.8 ]
 x = -1:0.1:1; % define range for plotting
 y = polyval(c,x); % compute samples
plot(x,y) % make the plot
r = roots(c)

cr = poly(r) % defines (x-r(1))*(x-r(2))*...
norm(c(1)*cr-c) % how far from original polynomial?

r =
   -1.5985 + 0.0000i
   1.1709 + 0.8200i
   1.1709 - 0.8200i

cr =    1.0000   -0.7433   -1.7000    3.2667
ans =   1.1374e-14
```



Polynomials and Roots

```
clear all
close all

 c3 = [0.74 0.97 1.1 0.86]; % data source
 x = -1:0.1:1; % sample range for x
 y = polyval(c3,x); % sample cubic at x
 noise = randn(1,size(y,2)); % random noise of same size as y
 noise = noise/norm(noise); % normalize the noise
ey = y + noise; % make noisy data
ec = polyfit(x,ey,3); % fit noisy data with cubic

 plot(x,y,'b--') % exact polynomial
 hold on
 plot(x,ey,'r') % noisy data
 hold on
 fy = polyval(ec,x) % sample fitted polynomial
 plot(x,fy,'g') % reconstructed data source
```



Integral – Derivative

Finding the integral of a function

Mathematical Operation	MATLAB Command
$\int x^n \, dx = \frac{x^{n+1}}{n+1}$	`int(x^n)` or `int(x^n,x)`
$\int_0^{\pi/2} \sin(2x) \, dx = 1$	`int(sin(2*x),0,pi/2)` or `int(sin(2*x),x,0,pi/2)`

$g = \cos(at + b)$
$\int g(t)dt = \frac{\sin(at+b)}{a}$
	`g = cos(a*t + b)`
	`int(g)` or
	`int(g,t)`

$\int J_1(z) \, dz = -J_0(z)$	`int(besselj(1,z))` or `int(besselj(1,z),z)`

q = integral(fun,xmin,xmax), $f(x)=e-x^2(lnx)^2$

```
clear all
close all

fun = @(x) exp(-x.^2).*log(x).^2;

q = integral(fun,0,Inf)
```

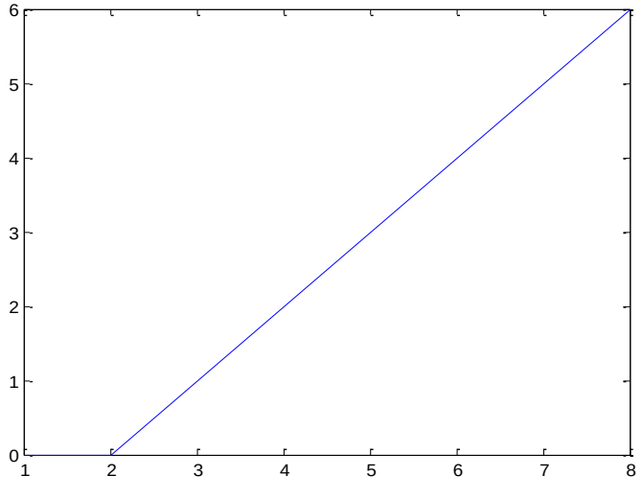
```
q = 1.9475
```

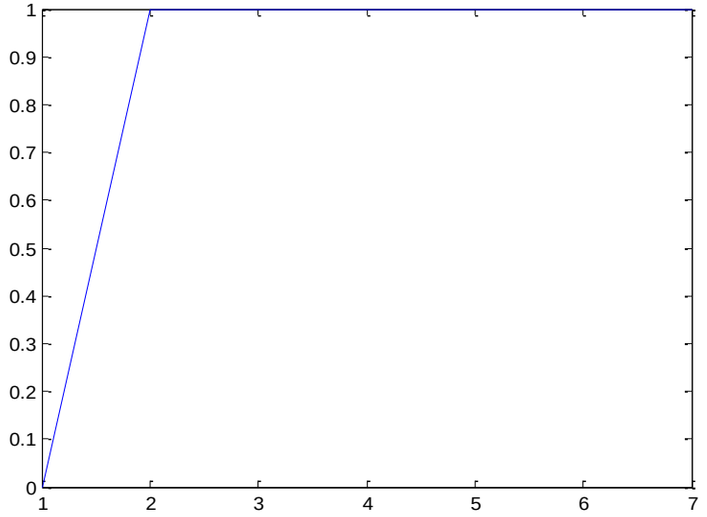
İntegral, derivative

```
clear all
close all

syms x
y1=int(4*x^2+3)
y2=int(4*x^2+3, x, -1, 3)

y1 = (4*x^3)/3 + 3*x
y2 = 26/3
```

```
clear all
close all
syms x real
f = 1/x
y= diff(f)

y=-1/x^2
```

```
clear all
close all

X = [0 0 1 2 3 4 5 6];
figure, plot(X)
Y = diff(X)
figure, plot(Y)
```





```
clear all
close all

syms x
f = cos(8*x)
g = sin(5*x)*exp(x)
h =(2*x^2+1)/(3*x)
a1=diff(f)
a2=diff(g)
a3=diff(h)
```

```
f =cos(8*x)
g = sin(5*x)*exp(x)
h =(2*x^2 + 1)/(3*x)

a1 = -8*sin(8*x)
a2 = 5*cos(5*x)*exp(x) + sin(5*x)*exp(x)
a3 = 4/3 - (2*x^2 + 1)/(3*x^2)
```

$$\frac{\partial f}{\partial x} = ?$$

```
clear all
close all

syms x y
f = sin(x*y)
diff(f,x)
```

```
Ans=y*cos(x*y)
```

```
clear all
close all

syms x a b c
S = simplify(sin(x)^2 + cos(x)^2)
S = simplify(exp(c*log(sqrt(a+b))))

S = 1
S =(a + b)^(c/2)
```

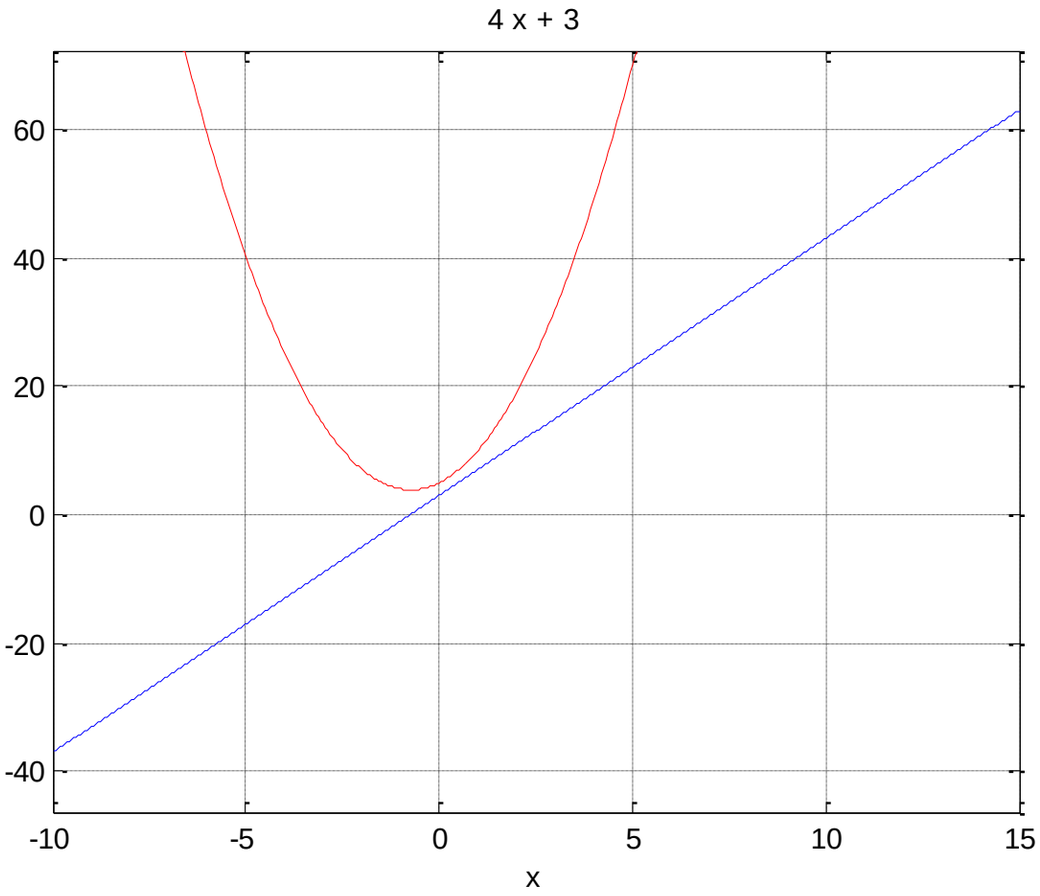
Limit

Finding the Limits of a function- f(x)

Mathematical Operation	MATLAB Command
$\lim_{x\to 0} f(x)$	`limit(f)`
$\lim_{x\to a} f(x)$	`limit(f,x,a)` or `limit(f,a)`
$\lim_{x\to a+} f(x)$	`limit(f,x,a,'right')`
$\lim_{x\to a-} f(x)$	`limit(f,x,a,'left')`

Evaluate: (a) $\lim_{x\to 0}\left(\frac{1}{x}\right)$ (b) $\lim_{x\to 0+}\left(\frac{1}{x}\right)$ (c) $\lim_{x\to 0-}\left(\frac{1}{x}\right)$

```
clear all
close all

syms x
f = 2*x^2+3*x+5

ez1=ezplot(f, [-10 15])
hold on
set(ez1,'color',[1 0 0])
grid on

g=diff(f)
 ezplot(g, [-10 15])

hold off
```



Limit of symbolic expression

- limit(f,var,a) returns the Bidirectional Limit of the symbolic expression f when var approaches a.
- limit(f,a) uses the default variable found by symvar.
- limit(f) returns the limit at 0.
- limit(f,var,a,'left') returns the Left Side Limit of f as var approaches a.
- limit(f,var,a,'right') returns the Right Side Limit of f as var approaches a.

Örnek: Limit of symbolic expression

```
syms x
f = 1/x;
limit(f,x,0,'right')
ans = ∞

limit(f,x,0,'left')
ans = −∞
```

Since the limit from the left does not equal the limit from the right, the two-sided limit does not exist. In this case, limit returns NaN (not a number).

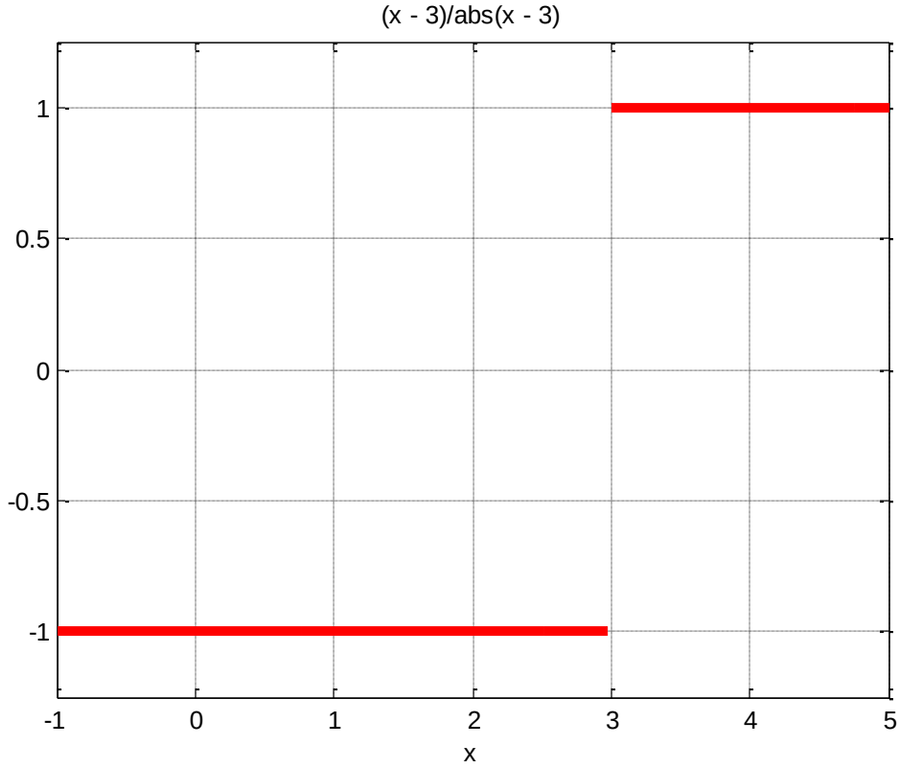
```
limit(f,x,0)
ans = NaN
```

Örnek: Limit of symbolic expression

```
syms x
f =(x^3 + 5)/(x^4 + 7)
limit(f)
ans =    5/7

syms x
 f = (x-3)/(x-1)
limit(f,1)
ans =   NaN
```

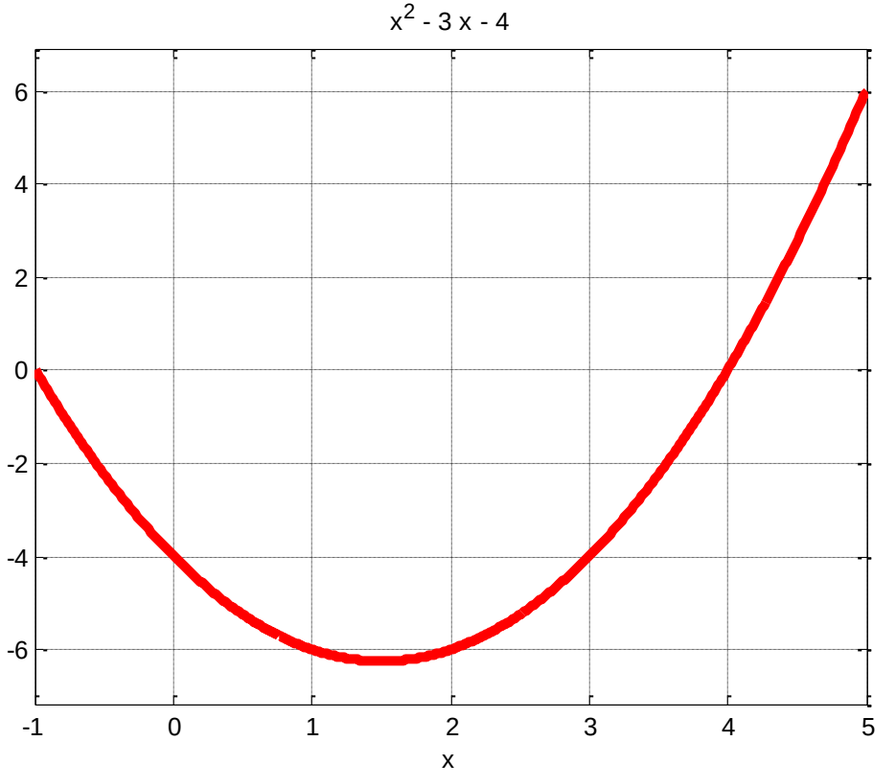
Örnek: Limit of symbolic expression

```
clear all
close all

syms x
f = (x - 3)/abs(x-3);
h= ezplot(f,[-1,5])
set(h,'Color','red', 'LineWidth', 4)
grid on

l = limit(f,x,3,'left')
r = limit(f,x,3,'right')

l = -1
r = 1
```



Örnek: Limit of symbolic expression

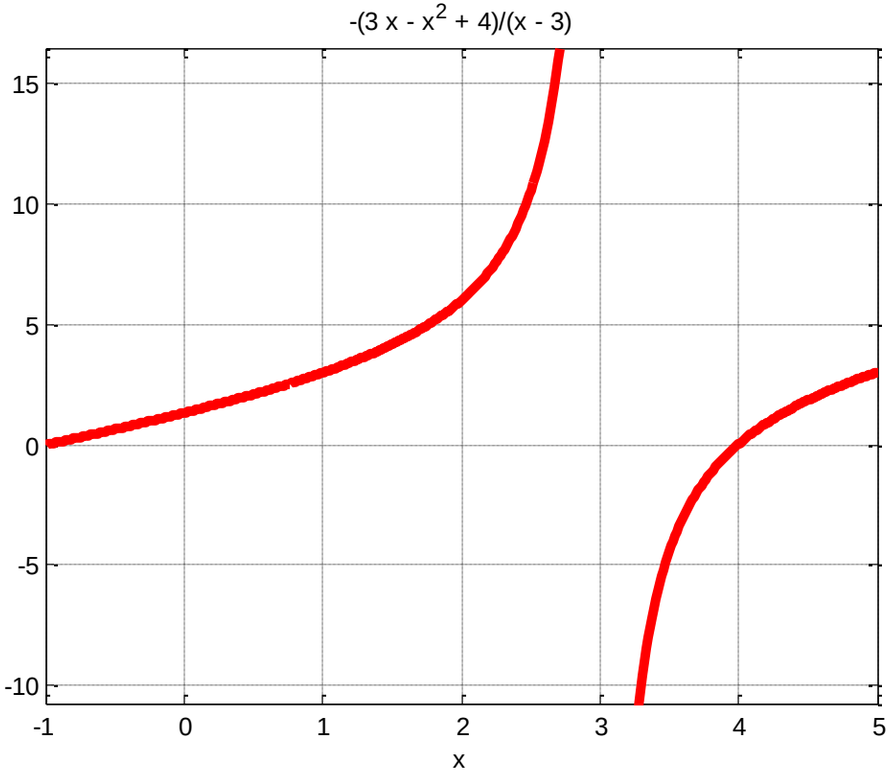
```
clear all
close all

syms x
f = x^2-3*x-4;
h= ezplot(f,[-1,5])
set(h,'Color','red', 'LineWidth', 4)
grid on

l = limit(f,x,1,'left')
r = limit(f,x,1,'right')
l = -6
r = -6
```



Örnek: Limit of symbolic expression

```
clear all
close all

syms x
f = (x^2-3*x-4)/(x-3);
h= ezplot(f,[-1,5])
set(h,'Color','red', 'LineWidth', 4)
grid on

l = limit(f,x,3,'left')
r = limit(f,x,3,'right')
```

```
l =Inf
r =-Inf
```



Solution of Differential Equations with MATLAB

$$d^2y/dx^2=\cos(2x)-y,\ y(0)=1, y'(0)=0.$$

```
clear all
close all

syms y(x)
Dy = diff(y);

ode = diff(y,x,2) == cos(2*x)-y;
cond1 = y(0) == 1;
cond2 = Dy(0) == 0;

conds = [cond1 cond2];
ySol(x) = dsolve(ode,conds);
ySol = simplify(ySol)
```

```
ySol(x) = 1 - (8*sin(x/2)^4)/3
```

Differential Equation	MATLAB® Commands

$\frac{dy}{dt} + 4y(t) = e^{-t},$
$y(0) = 1.$
	`syms y(t)`
	`ode = diff(y)+4*y == exp(-t);`
	`cond = y(0) == 1;`
	`ySol(t) = dsolve(ode,cond)`
	
	`ySol(t) =`
	`exp(-t)/3 + (2*exp(-4*t))/3`

$2x^2\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - y = 0.$	`syms y(x)`
	`ode = 2*x^2*diff(y,x,2)+3*x*diff(y,x)-y == 0;`
	`ySol(x) = dsolve(ode)`
	
	`ySol(x) =`
	`C2/(3*x) + C3*x^(1/2)`

The Airy equation.
$\frac{d^2y}{dx^2} = xy(x).$
	`syms y(x)`
	`ode = diff(y,x,2) == x*y;`
	`ySol(x) = dsolve(ode)`
	
	`ySol(x) =`
	`C1*airy(0,x) + C2*airy(2,x)`

Solve Differential Equations in Matrix Form

Solve differential equations in matrix form by using `dsolve`.

Consider this system of differential equations.

$$\frac{dx}{dt} = x + 2y + 1,$$

$$\frac{dy}{dt} = -x + y + t.$$

The matrix form of the system is

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 1 \\ t \end{bmatrix}.$$

Let

$$Y = \begin{bmatrix} x \\ y \end{bmatrix}, A = \begin{bmatrix} 1 & 2 \\ -1 & 1 \end{bmatrix}, B = \begin{bmatrix} 1 \\ t \end{bmatrix}.$$

The system is now $Y' = AY + B$.

```
syms x(t) y(t)
A = [1 2; -1 1];
B = [1; t];
Y = [x; y];
odes = diff(Y) == A*Y + B
```

```
odes(t) =
  diff(x(t), t) == x(t) + 2*y(t) + 1
   diff(y(t), t) == t - x(t) + y(t)
```

Solve the matrix equation using `dsolve`. Simplify the solution by using the `simplify` function.

```
[xSol(t), ySol(t)] = dsolve(odes);
xSol(t) = simplify(xSol(t))
ySol(t) = simplify(ySol(t))
```

Suppose we want to solve and plot the solution to the second order equation

$$y''(x) + 8y'(x) + 2y(x) = \cos(x); \qquad y(0) = 0,\ y'(0) = 1.$$

```
clear all
close all

eqn2 = 'D2y + 8*Dy + 2*y = cos(x)';
inits2 = 'y(0)=0, Dy(0)=12';
y=dsolve(eqn2,inits2,'x')
y1 = simplify(y)
```

```
y1 = cos(x)/65 + (8*sin(x))/65 - exp(x*(14^(1/2) - 4))/130 - exp(-
x*(14^(1/2) + 4))/130 +
(192*14^(1/2)*exp(x*(14^(1/2) - 4)))/455 - (192*14^(1/2)*exp(-
x*(14^(1/2) + 4)))/455
```

```
clear all
close all

eqn2 = 'D2y + 8*Dy + 2*y = cos(t)';
inits2 = 'y(0)=0, Dy(0)=12';
y=dsolve(eqn2,inits2,'t')
y1 = simplify(y)
```

```
ezplot(y, [-4.5 -3])
```

Suppose we want to solve and plot solutions to the system of three ordinary differential equations

$$
\begin{aligned}
x'(t) &= x(t) + 2y(t) - z(t) \\
y'(t) &= x(t) + z(t) \\
z'(t) &= 4x(t) - 4y(t) + 5z(t).
\end{aligned}
$$

```
clear all
close all

[x,y,z]=dsolve('Dx=x+2*y-z','Dy=x+z','Dz=4*x-4*y+5*z')
```

```
x = - (C3*exp(t))/2 - (C1*exp(2*t))/2 - (C2*exp(3*t))/4
y = (C3*exp(t))/2 + (C1*exp(2*t))/4 + (C2*exp(3*t))/4
 z = C3*exp(t) + C1*exp(2*t) + C2*exp(3*
```

Suppose we want to solve and plot solutions to the system of three ordinary differential equations

$$\begin{aligned} x'(t) &= x(t) + 2y(t) - z(t) \\ y'(t) &= x(t) + z(t) \\ z'(t) &= 4x(t) - 4y(t) + 5z(t). \end{aligned}$$

```
clear all
close all
inits='x(0)=1,y(0)=2,z(0)=3';
[x,y,z]=dsolve('Dx=x+2*y-z','Dy=x+z','Dz=4*x-4*y+5*z',inits)

t=linspace(0,.5,25);
xx=eval(vectorize(x));
yy=eval(vectorize(y));
zz=eval(vectorize(z));
plot(t, xx, t, yy, t, zz)
```

Symbolic Differential Equation Terms

y

- y

$\frac{dy}{dt}$

- Dy

$\frac{d^2y}{dt^2}$

- D2y

$\frac{d^ny}{dt^n}$

- Dny

$$b_2 \frac{d^2y}{dt^2} + b_1 \frac{dy}{dt} + b_0 y = A \sin at$$

$$y(0) = C_1 \qquad \text{and } y'(0) = C_2$$

y = dsolve('b2*D2y+b1*D1y+b0*y=A*sin(a*t)',
'y(0)=C1', 'Dy(0)=C2')

ezplot(y, [t1 t2])

$$\frac{dy}{dt} + 2y = 12 \qquad y(0) = 10$$

```
y = dsolve('Dy + 2*y = 12', 'y(0)=10')
```

```
>> y =6+4*exp(-2*t)
>> ezplot(y, [0 3])
>> axis([0 3 0 10])
```

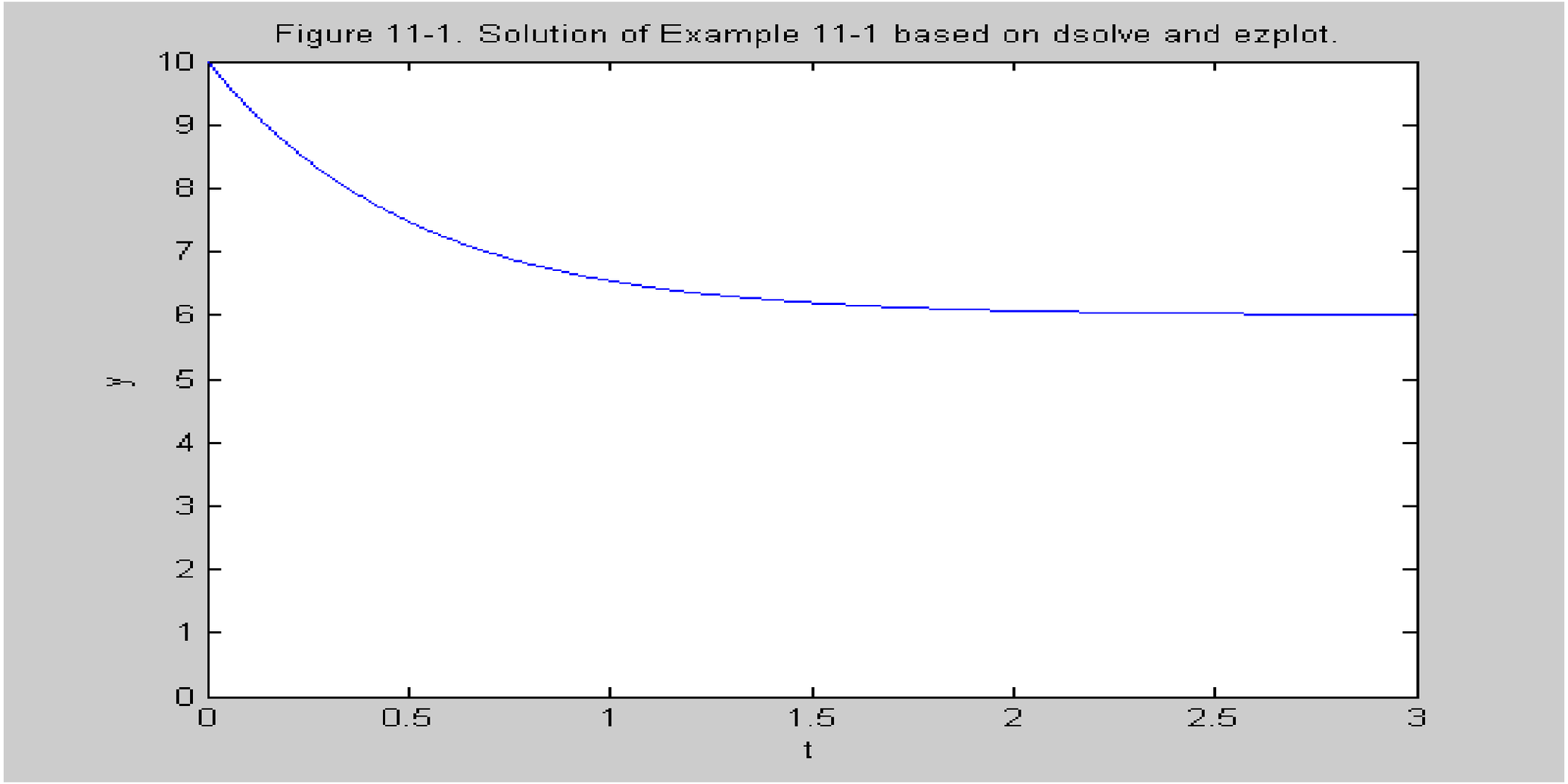


Figure 11-1. Solution of Example 11-1 based on dsolve and ezplot.
y
t
10
9
8
7
6
5
4
3
2
1
0
0
0.5
1
1.5
2
2.5
3

$$\frac{d^2y}{dt^2} + 3\frac{dy}{dt} + 2y = 24$$

$$y(0) = 10 \quad y'(0) = 0$$

- >> y = dsolve('D2y + 3*Dy + 2*y = 24', 'y(0)=10', 'Dy(0)=0')

- y =
- 12+2*exp(-2*t)-4*exp(-t)

- >> ezplot(y, [0 6])

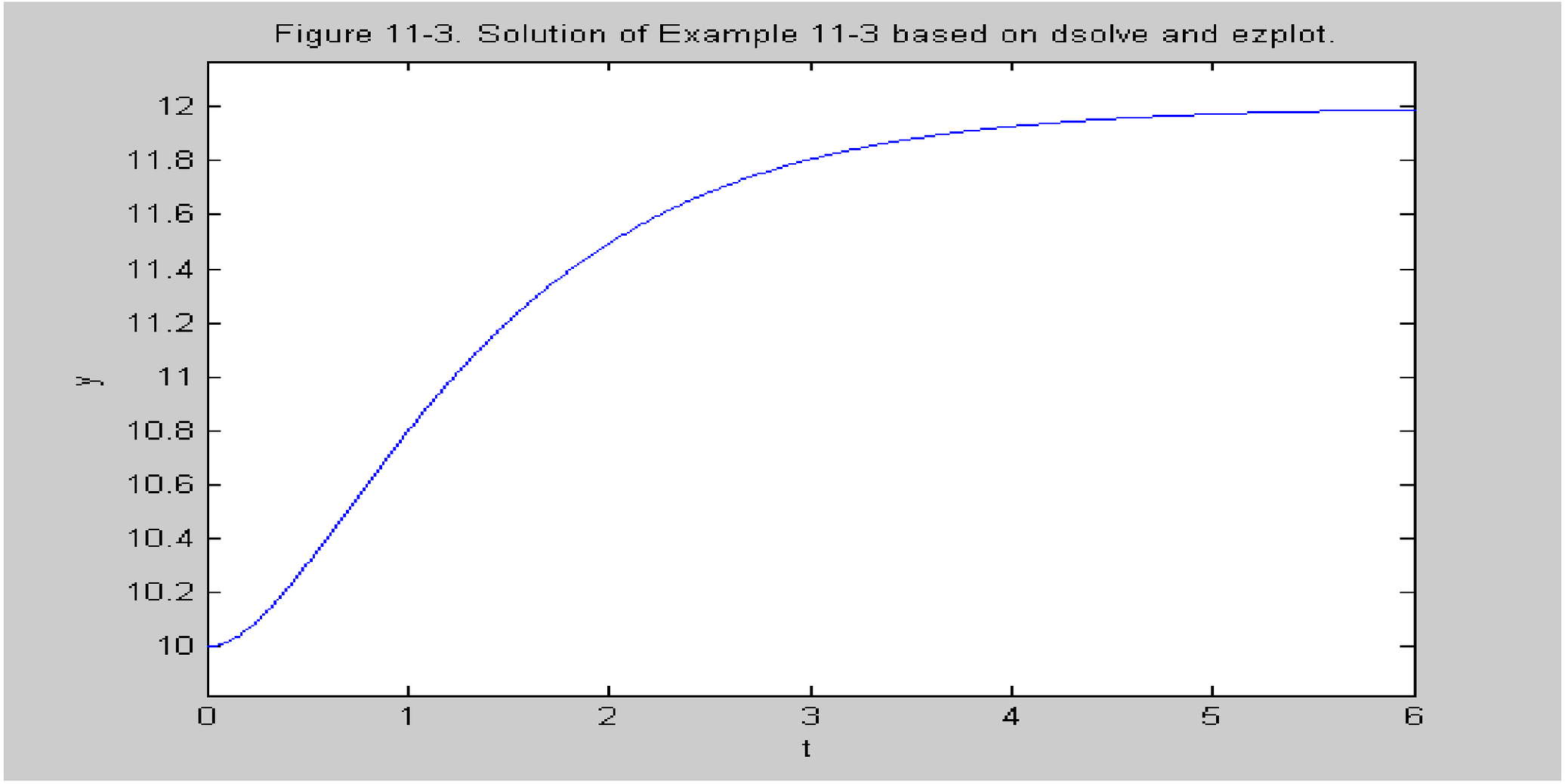
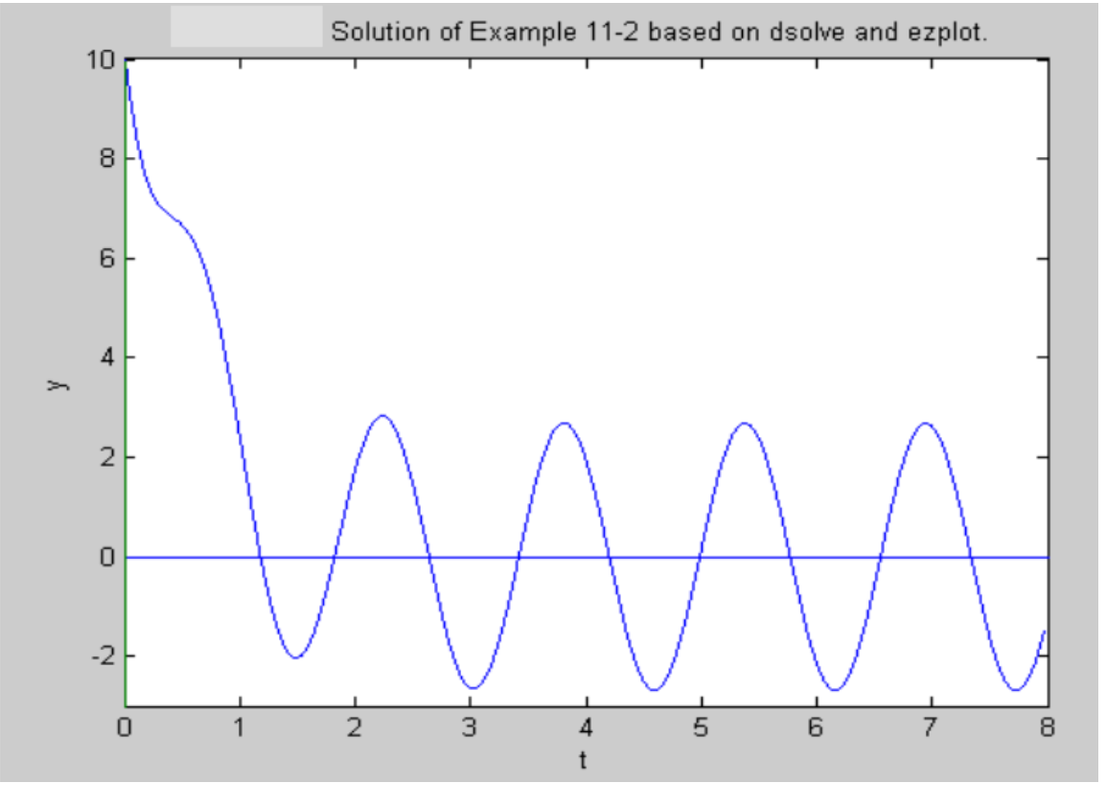


Figure 11-3. Solution of Example 11-3 based on dsolve and ezplot.
12
11.8
11.6
11.4
11.2
11
10.8
10.6
10.4
10.2
10
y
0
1
2
3
4
5
6
t

$$\frac{dy}{dt} + 2y = 12\sin 4t \qquad y(0) = 10$$

```
y = dsolve('Dy + 2*y = 12*sin(4*t)', 'y(0)=10')
ezplot(y, [0 8])
axis([0 8 -3 10])

y =  -12/5*cos(4*t)+6/5*sin(4*t)+62/5*exp(-2*t)
```

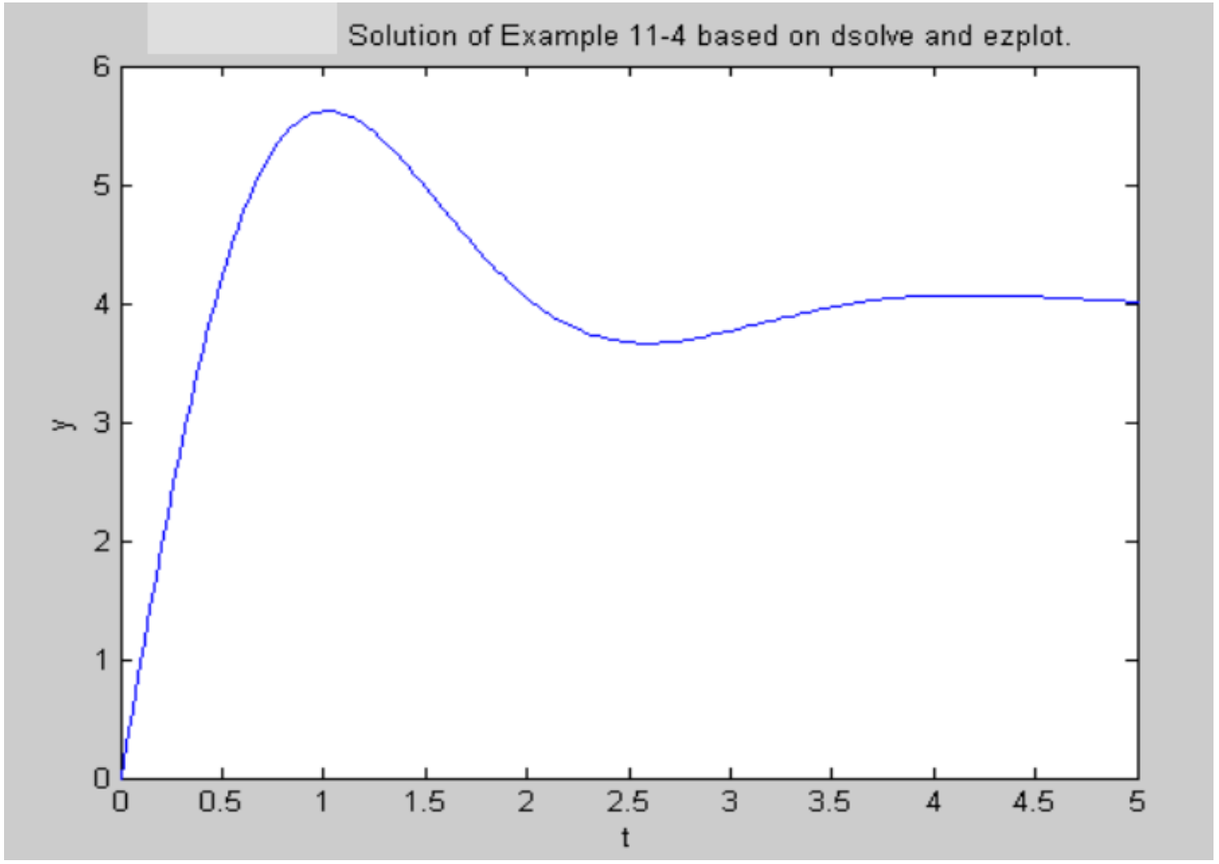


$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 5y = 20$$

$$y(0) = 0 \quad y'(0) = 10$$

```
y = dsolve('D2y + 2*Dy + 5*y = 20',
    'y(0) = 0',  'Dy(0) = 10')
ezplot(y, [0 5])
```

```
y =   4+3*exp(-t)*sin(2*t)-4*exp(-t)*cos(2*t)
```



Nonlinear Differential Equation with Initial Condition

Solve this nonlinear differential equation with an initial condition. The equation has multiple solutions.

$$\left(\frac{dy}{dt} + y\right)^2 = 1,$$

$$y(0) = 0.$$

```
syms y(t)
ode = (diff(y,t)+y)^2 == 1;
cond = y(0) == 0;
ySol(t) = dsolve(ode,cond)
```

```
ezplot(ySol, [0 6])
```

Second-Order ODE with Initial Conditions

Solve this second-order differential equation with two initial conditions.

$$\frac{d^2y}{dx^2} = \cos(2x) - y,$$

$$y(0) = 1,$$

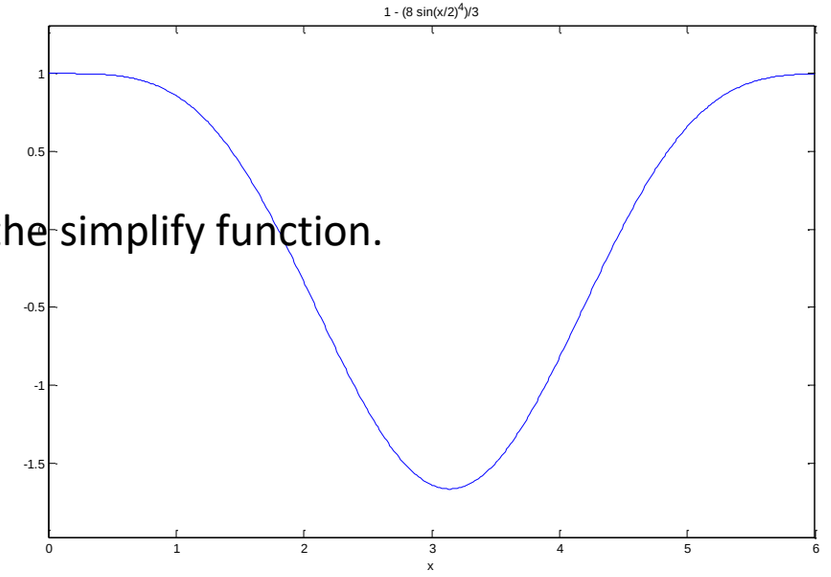
$$y'(0) = 0.$$

Define the equation and conditions. The second initial condition involves the first derivative of y. Represent the derivative by creating the symbolic function Dy = diff(y) and then define the condition using Dy(0)==0.

```
syms y(x)
Dy = diff(y);

ode = diff(y,x,2) == cos(2*x)-y;
cond1 = y(0) == 1;
cond2 = Dy(0) == 0;
```

Solve ode for y. Simplify the solution using the simplify function.

```
conds = [cond1 cond2];
ySol(x) = dsolve(ode,conds);
ySol = simplify(ySol)
ezplot(ySol, [0 6])
ySol(x) =
1 - (8*sin(x/2)^4)/3
```



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- Also, these slides are made publicly available on the web for anyone to use
- If you choose to use them, I ask that you alert me of any mistakes which were made and allow me the option of incorporating such changes (with an acknowledgment) in my set of slides.

Sincerely,

Dr. Cahit Karakuş

cahitkarakus@esenyurt.edu.tr