BIL 108E Intr. to Sci. & Eng.Computing

Res.Asst.Çiğdem Toparlı

EXERCISES -5

Example-1

Suppose a and b are defined as follows: a = [2 -1 5 0]; b = [3 2 -1 4]; Evaluate by hand the vector c in the following statements. Check your answers with MATLAB.

a) c = a - b;

b) c = b + a - 3;

c) c = 2 * a + a .^ b

d) c = b ./ a;

e) c = b .\ a;

f) c = a .^ b

g) c = 2.^ b+a;

h) c = 2*b/3.*a;

i) c = b*2.*a;

Example-2

If z = [0 -1 2 4 -2 1 5 3], and J = [5 2 1 6 3 8 4 7], determine what is produced by the following sets of Matlab statements:

>> x = z', A = x*x', s = x'*x, w = x*J,

>> length(x), length(z)

>> size(A), size(x), size(z), size(s)

Example-3

Determine what is produced by the Matlab statements:

```
>> i = 1:10
>> j = 1:2:11
>> x = 5:-2:-3
```

Example-4

If z = [0 -1 2 4 -2 1 5 3], and J = [5 2 1 6 3 8 4 7], determine what is produced by the following Matlab statements:

```
>> z(2:5)
>> z(J)
```

Example-5

Determine what is produced by the following Matlab statements:

```
>> x = linspace(1, 1000, 4)
>> y = logspace(0, 3, 4)
```

Example-6

Calculate the following summation with user input n, and plot S versus k graph.

$$S = \sum_{k=0}^{n} \frac{1}{k^2 + 1}$$

Solution-6

```
clc     % ekrani sil

% kullanicidan n degiskeninin girilmesi isteniyor
n = input('n degerini gir: ');

% aratoplam adinda n+1 elemanli ve sifirlardan olusan bir dizi olusturuluyor
aratoplam = zeros(1, n + 1);

for k = 0:n % k'ya sifirdan baslayip bir arttirarak n'ye kadar degerler ver
    aratoplam(k + 1) = 1 / (k ^ 2 + 1);
    % aratoplam dizisinde toplam sembolundeki k. elemanlar tutuluyor. yani
    % k=0 için aratoplam dizisinin birinci elemani terimde k=0 yazilmasiyla
    % bulunan deger (1.0), aratoplam dizisinin ikinci elemani terimde k=1
    % yazilmasiyla bulunan deger (0.5) vs.
end
```

Solution-6

```
toplam = sum(aratoplam);    % terimler tek tek hesaplandiktan
sonra sum
                    % fonksiyonuyla aratoplam dizisinin tüm
elemanlari
                    % toplami toplam adinda bir degiskene ataniyor
x = 0:n;

% son olarak aratoplam dizisinin tüm elemanlari yani sirasiyla
toplam
% sembolüne giren degerler tek tek hangi k'lara karsilik
geliyorlarsa
% bunu gösteren grafik ekrana çizdiriliyor.
plot(x, aratoplam)
```

Example-7

A function that classifies a flow according to the values of its Reynolds (Re) and Mach (Ma) numbers, such that if Re < 2000, the flow is laminar; if 2000 < Re < 5000, the flow is transitional; if Re > 5000, the flow is turbulent; if Ma < 1, the flow is sub-sonic, if Ma = 1, the flow is sonic; and, if Ma >1, the flow is super-sonic. Write an m-file classifying the flow according to its Reynolds and Mach numbers.

Solution-7

```
clc     % ekrani sil
clear   % ve tüm kullanilan degiskenleri sil (clear all ile ayni)

% Re ve Ma degiskenlerini kullanicidan al
r = input('Reynolds (Re) sayisi: ');
m = input('Mach  (Ma)  sayisi  : ');

if (r < 2000)
   % eger r 2000den küçükse sadece burasi çalisacak ve type1
   % degiskenine laminar yazisi atanacak
   type1 = 'Laminar';
elseif (r < 5000)
   % eger r 2000den büyükse yukaridaki (r<5000) karsilastirma çalisacak ve r
   % 5000'den küçükse type1 degiskenine transitional yazisi atanacak
   type1 = 'Transitional';
else
   % eger her ikisi de dogru degilse o zaman type1 degiskeninin degeri
   % turbulent yazisi olacak
   type1 = 'Turbulent';
end

i
```

Solution-7

```
f (m < 1)
   % bu karsilastirmada m degiskeni 1'den küçükse type2'ye sub-sonic
   % yazisi atanacak
   type2 = 'Sub-sonic';
elseif (m == 1)
   % eger m < 1 ifadesi yanlissa bir de m == 1 ifadesi çalistirilacak
   % ve eger karsilastirmanin sonucu dogruysa yani m birse type2 degiskenine
   % sonic yazisi atanacak
   type2 = 'Sonic';
else
   % eger hicbiri dogru degilse yani m ne birden küçük ne de bire esit
   % degilse o zaman m yalnizca birden büyük olabilir ve bu durumda type2
   % degiskenine super-sonic yazisi atanir.
   type2 = 'Super-Sonic';
end


disp(['Reynolds türü: ' type1 '   Mach türü: ' type2])
% yukaridaki köseli parantezlere dikkat ediniz. disp fonksiyonu deger olarak
% bir vektör alir. vektörler olusturulurken degerlerin arasina bosluk yada
% virgül koyuldugunu hatirlayiniz. örn. [ 8 6 1 ] yada [ 8, 6, 1 ] gibi.
% bu yüzden yukarida yazilan yazilar ve type1 yada type2 gibi degiskenlerin
% arasinda en az bir bosluk olmasi gerekmektedir. buna dikkat edin.
```

Example-8

In one of your calculus classes you probably learned that sin(x) can be expanded in a power series, $\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + - \ldots$. Compare sin x to the first two and first three terms of this expansion for x = 0.01, 0.1 and 1.

Solution-8

```
x = 0.01;       % x'e soruda istenildigi gibi 0.1 ve 1 de degerleri verip
                % program oyle calistirilmalidir.

toplam = 0;     % toplam degiskeni kumulatif degisken olarak kullanilacak
                % bu yuzden degeri kullanmadan önce sifirlaniyor
gercek_deger = sin(x);  % bu da sin(x)'in yani bu örnekte sin(0.01)in
                        % gerçek degeri

for n = 1:3
   us = 2 * n - 1;     % serideki sayilarin usleri: 1, 3, 5
   toplam = toplam + (-1) ^ (n + 1) * x ^ us / factorial(us);
   % serideki toplam ifadesi. (-1) ^ (n + 1) kismi seride bir eksi bir
   % arti olmasini sagliyor. factorial fonksiyonu da sayinin faktöryelini
   % döndürüyor.
   hata = abs(toplam - gercek_deger)
   % her seriye tek tek terim eklendiginde toplam degiskeninde olusturulan
   % serinin, gerçek degerden ne kadar farkli oldugunu belirlemek için
   % sayilarin farklarinin mutlak degerini al. ekrana yazdir (noktali virgül
   % koyulmamis dikkat!)
end
```

Example-9

Find the solution to the following set of linear equations:

$2x-3y+4z = 5$

$y+4z+x = 10$

$-2z+3x+4y = 0$

Solution-9

```
>> clear, clc, syms x y z;
>> eq1 = '2*x-3*y+4*z = 5'
>> eq2 = 'y+4*z+x = 10'
>> eq3 = '-2*z+3*x+4*y = 0'
>> [x,y,z] = solve(eq1,eq2,eq3,x,y,z)
```

Example-10

Take the derivative of the function by using symbolic math;

$$f(x) = x^3 - \cos(x)$$

Solution-10

```
>> syms x
>> f=x^3-cos(x);
>> g=diff(f)

g =

3*x^2+sin(x)
```

Example-11

Take the derivative of the function by using symbolic math;

$$f(x,y) = x^2 + (y+5)^3$$

Solution-11

Matlab command entries:

```
>> syms x y
>> f=x^2+(y+5)^3;
>> diff(f,y)
```

Matlab returns:

```
ans =

3*(y+5)^2
```

Note that in this case, the command **diff(f,y)** is equivalent to

$$\frac{\partial f(x,y)}{\partial y}$$

Example-12

Integrate the function by using symbolic math;

$$f(x,y) = x^2 + (y+5)^3$$

Solution-12

>> int(f,x)

Matlab returns:

ans =

1/3*x^3+(y+5)^3*x

The syntax of the integral command can be viewed by typing **>> help int** in Matlab command window.

If we wish to perform the following definite integral:

$$\int_0^{10} f(x,y)dy$$

Matlab command entry:

>> int(f,y,0,10)

Matlab returns:

ans =

12500+10*x^2

Example-13

Consider the following polynomial:

$$f(x) = 2x^2 + 4x - 8$$

Suppose we wish to find the roots of this polynomial.

Solution-13

```
>> syms x
>> f=2*x^2 + 4*x -8;
>> solve(f,x)
```

Matlab returns:

```
ans =

5^(1/2)-1
-1-5^(1/2)
```

Alternately, you may use the following lines in Matlab to perform the same calculation:

```
>> f=[2 4 -8];
>> roots(f)
```

Matlab returns:

```
ans =

-3.2361
1.2361
```

Note that the results from both approaches are the same.

Example-14

Write an m file to determine the sum of the infinite series $\sum_{n=1}^{\infty}\frac{1}{n^2}$ converges to $\pi^2/6$. Do this by computing the sum for a) n=100, b) n=1000 and c) n=10000. Do this by assigning n values using logspace command.

Solution-14

```
for limit = logspace(2, 4, 3)
   % limit sirayla [100, 1000, 10000] degerlerini alir
   toplam = 0;
   for n = 1:limit
      toplam = toplam + 1 / n ^ 2;
      % sigma'nin asil hesaplandigi yer burasi
   end
   hata = abs((pi ^ 2 / 6) - toplam);
   disp( [limit, toplam, hata] );
end
```

Example-15

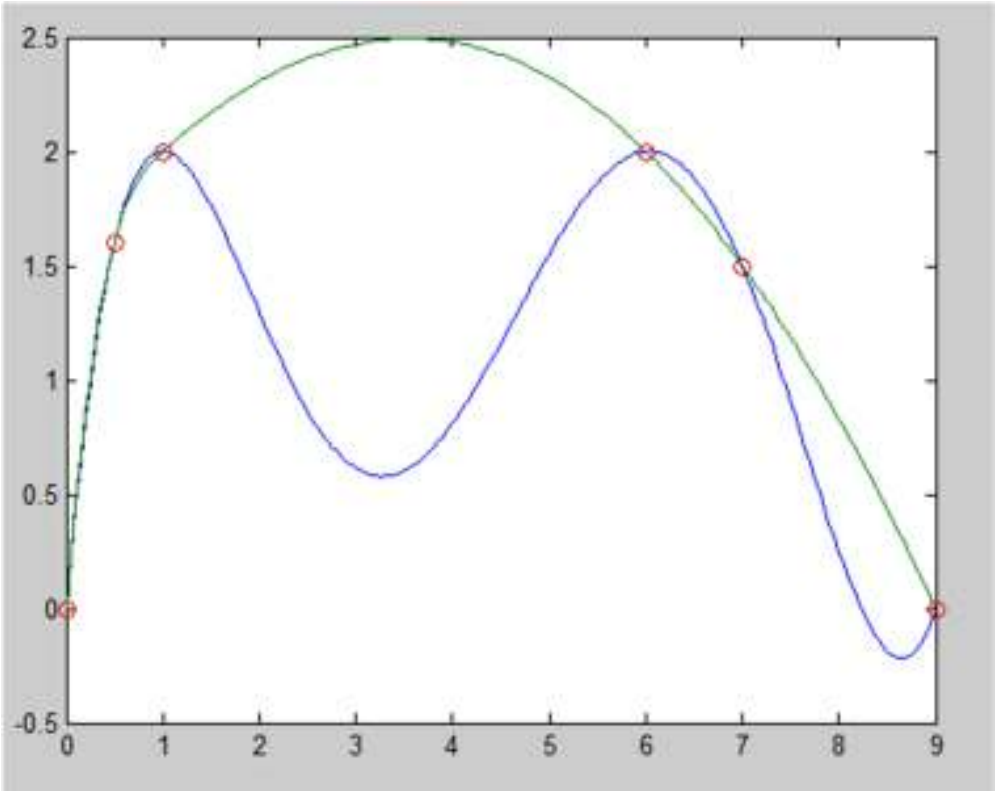
An experiment has produced the following data:

t	0	0.5	1.0	6.0	7.0	9.0
y	0	1.6	2.0	2.0	1.5	0

We wish to interpolate the data with a smooth curve in the hope of obtaining reasonable values of y for values of t between the points at which measurements were taken. Plot experimental data overlay with the interpolated values. What is y at $t = 4$.

Solution-16

```
clc
clear all

t = [0 0.5 1 6 7 9];
y = [0 1.6 2.0 2.0 1.5 0];

tler = 0:0.05:9;

p = polyfit(t, y, 5);
yp = polyval(p, tler);

y3 = interp1(t, y, tler, 'spline');

plot(t, y, 'o', tler, yp, tler, y3);

interp1(t, y, 4, 'spline')
polyval(p, 4)
```



Example-17

The data points in the table lie on the plot of $f(x) = 4.8 \cos(\pi x/20)$

Interpolate this data at $x = 0, 0.5, 1.0, \ldots, 8.0$

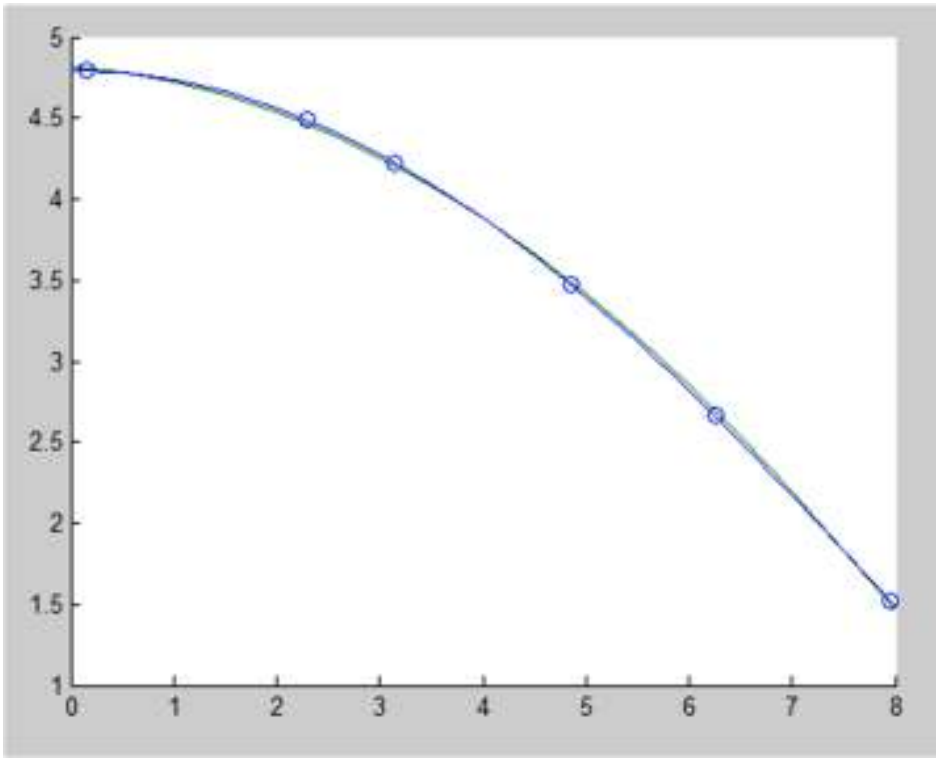
by the lowest degree polynomial and compare the results with the

"exact" values given by $y = f(x)$

x	0.15	2.30	3.15	4.85	6.25	7.95
y	4.79867	4.49013	4.2243	3.47313	2.66674	1.51909

Example-17

```
x = [0.15 2.30 3.15 4.85 6.25 7.95];
y = [4.79867 4.49013 4.2243 3.47313 2.66674 1.51909];

% === regresyon kismi ===
p = polyfit(x, y, 2);
yeni_x = 0:0.5:8;
yeni_y = polyval(p, yeni_x);

hold on
plot(x, y, 'o', yeni_x, yeni_y);

% === enterpolasyon kismi ===
yeni_yi = interp1(x, y, yeni_x, 'spline');
plot(yeni_x, yeni_yi);

% === hatanin hesaplanmasi ===
py = polyval(p, x);
y - py
```



Example-17

The deflection y, as a function of x is given by the following equations;

$$y = -\frac{wx}{384} EI\left(16x^3 - 24Lx^2 + 9L^3\right) for\ 0 \le x \le L/2$$

$$y = -\frac{wx}{384} EI\left(8x^3 - 24Lx^2 + 17L^2x - L^3\right) for\ L/2 \le x \le L$$

where E is the elastic modulus, I is the moment of inertia, and L is the length of the beam. Make a plot of the deflection of the beam, y, as a function of x.

$$E = 200\times10^9\, Pa \quad I = 348\times10^{-6}\,\mathrm{m}^4 \quad w = 5\times10^3\, N/m \quad \text{and } L = 20m$$

Example-17

```
clc
clear all

E = 2e11;
I = 3.48e-4;
w = 5e3;
L = 20;

x1 = linspace(0, L / 2, 100);
x2 = linspace(L / 2, L, 100);

y1 = -(w .* x1 ./ 384) .* E .* I .* (16 .* x1 .^ 3 - 24 .* L .* x1 .^ 2 +  9 .* L .^ 3);
y2 = -(w .* x2 ./ 384) .* E .* I .* (8  .* x2 .^ 3 - 24 .* L .* x2 .^ 2 + 17 .* L .^ 2 .* x2 + 9 .* L .^ 3);

plot(x1, y1, x2, y2)
```