MAE 4301 May 2008

HW #2 Solutions

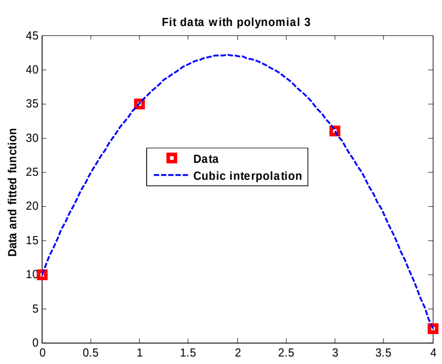
Problem 1

Solve Problem 17, page 55.

Also plot the data points with a red square and also plot the polynomial by a blue dashed line. Put labels, title and legend for the figure.

Solution:

```
%Problem 1: Problem 17, page 55
XY=[0 10;1 35;3 31;4 2]
Xdata=XY(:,1);Ydata=XY(:,2);
%% solution of the coefficients for the polynomial
% f=a(1) + a(2)*x + a(3)*x^2 + a(4)*x^3

A=[Xdata.^0 Xdata Xdata.^2 Xdata.^3]
a=A\Ydata

%% Evaluate the function at xx
xx=linspace(0,4,100)';  % a column vector
Axx=[xx.^0 xx xx.^2 xx.^3];
Yxx=Axx*a;
%% Plot data
figure,plot(Xdata,Ydata,'rs','linewidth',3)
hold on
% Plot function
plot(xx,Yxx,'b--','linewidth',2)
legend('\bfData','\bfCubic interpolation')
title('\bfFit data with polynomial 3')
xlabel('\bfx')
ylabel('\bfData and fitted function')
grid on
```



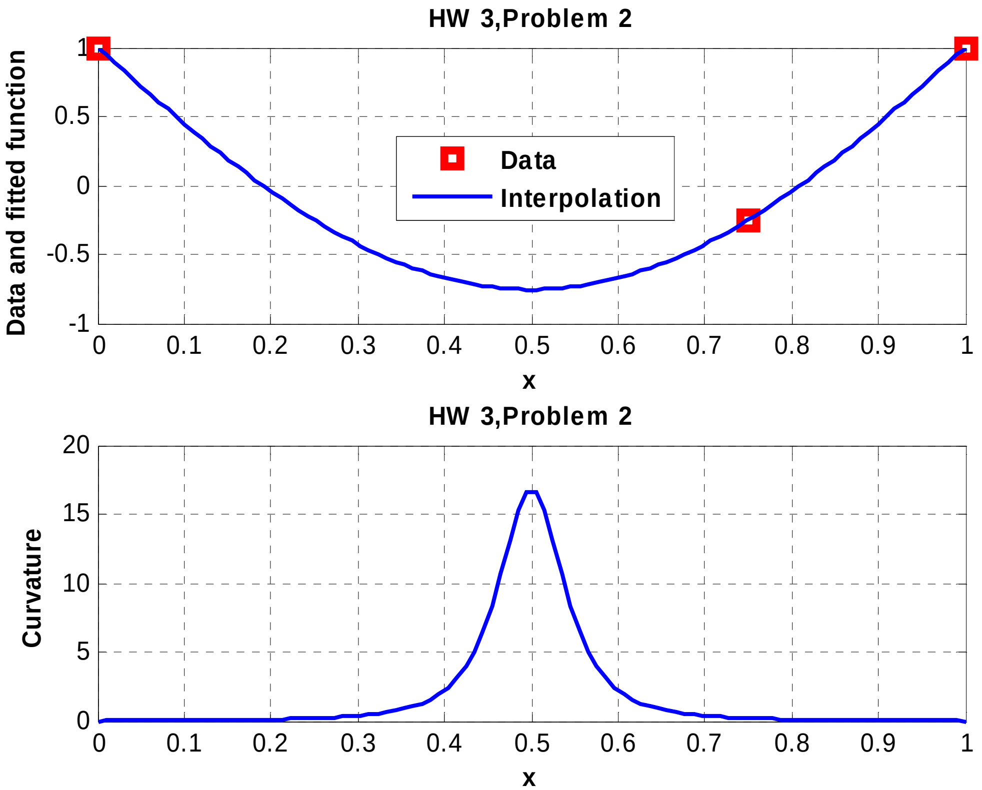
Problem 2
Problem 19, page 55.
Additionally, use subplots to (1) Plot the data points with a red square and also plot the polynomial by a blue dashed line. Put labels, title and legend for the figure(subplot(2,1,1)) (2) Plot the curvature for the function. (subplot(2,1,2)).

Recall calculus results: For the function $y = f(x)$ the curvature is

$$\kappa = \frac{|y''|}{(1 + y'^2)^{3/2}}.$$

```
XY=[0 1;.75 -.25; 1 1]
Xdata=XY(:,1);Ydata=XY(:,2);
% Coefficient matrix from data
A1=[Xdata.^0 Xdata Xdata.^2 Xdata.^3 Xdata.^4]
% Coefficient matrix from curvature data
Xc=Xdata([1 3],:)
A2=[0*Xc 0*Xc 2*Xc.^0 6*Xc 12*Xc.^2]
A=[A1;A2];
b1=Ydata;
b2=[0;0];
b=[b1;b2]

%% solution of the coefficients for the polynomial
% f=a(1) + a(2)*x + a(3)*x^2 + a(4)*x^3 + a(5)*x^4

a=A\b

%% Evaluate the function at xx
xx=linspace(0,1,100)';  % a column vector

Axx=[xx.^0 xx xx.^2 xx.^3 xx.^4];
Axx1=[0*xx xx.^0 2*xx 3*xx.^2 4*xx.^3];
Axx2=[0*xx 0*xx 2*xx.^0 6*xx 12*xx.^2];
Yxx=Axx*a;
%% Plot data
figure
subplot(2,1,1)
plot(Xdata,Ydata,'rs','linewidth',3)
hold on
plot(xx,Yxx,'b','linewidth',2)
grid on
legend('\bfData','\bfInterpolation')
title('\bfHW 3,Problem 2')
```

```
xlabel('\bfx')
ylabel('\bfData and fitted function')
grid on
%% Calculate curvature
dy1=Axx1*a;  % First order derivative
dy2=Axx2*a;  % 2nd derivative
k=abs(dy2)./((1+dy1.^2).^1.5);
subplot(2,1,2)
plot(xx,k,'b','linewidth',2)
grid on
title('\bfHW 3,Problem 2')
xlabel('\bfx')
ylabel('\bfCurvature')
grid on
```



Problem 3
Problem 16, page 80.
Formulate the equilibrium equation use method of joints and then solve the system of linear equations.

```
theta =    53 % degrees

 A=[1 cosd(theta) 0 0 0;0 sind(theta) 0 0 1;0 0 2*sind(theta) 0 0; ...
0 -cosd(theta) cosd(theta) 1 0;0 sind(theta) sind(theta) 0 0];
F=[0;0;1;0;0];
P=inv(A)*F;
for i=1:5
    disp(['P',num2str(i),' = ',num2str(P(i)),' kN'])
end
disp('------------------------------------------------------- ')
disp('To Check, The result of A*P-F should be a zero matrix')
Check=A*P-F

P1 = 0.37678 kN
P2 = -0.62607 kN
P3 = 0.62607 kN
P4 = -0.75355 kN
P5 = 0.5 kN
-------------------------------------------------------
To Check, The result of A*P-F should be a zero matrix

Check =

     0
     0
     0
     0
     0
```

Problem 4

Problem 19, page 99.

Formulate the temperature equation given in page 100 use the ***spdiags*** function of Matlab and then solve for the temperatures.

```
c=ones(9,1);
A=spdiags([c c -4*c c c],[-3 -1 0 1 3],9,9);
A(4,3)=0;A(3,4)=0;A(6,7)=0;A(7,6)=0;
F=-[0;0;100;0;0;100;200;200;300];
T=inv(A)*F;
for i=1:9
    disp(['T',num2str(i),' = ',num2str(T(i)),' C'])
end
```

T1 = 21.4286 C
T2 = 38.3929 C
T3 = 57.1429 C
T4 = 47.3214 C
T5 = 75 C
T6 = 90.1786 C
T7 = 92.8571 C
T8 = 124.1071 C
T9 = 128.5714 C