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%%%%%%%%% Math 430 - Homework 2 %%%%%%%%%%%%
%
% MONTES Virginie
% Due sept. 11
%
```

Problem 1:

```
clear all
close all

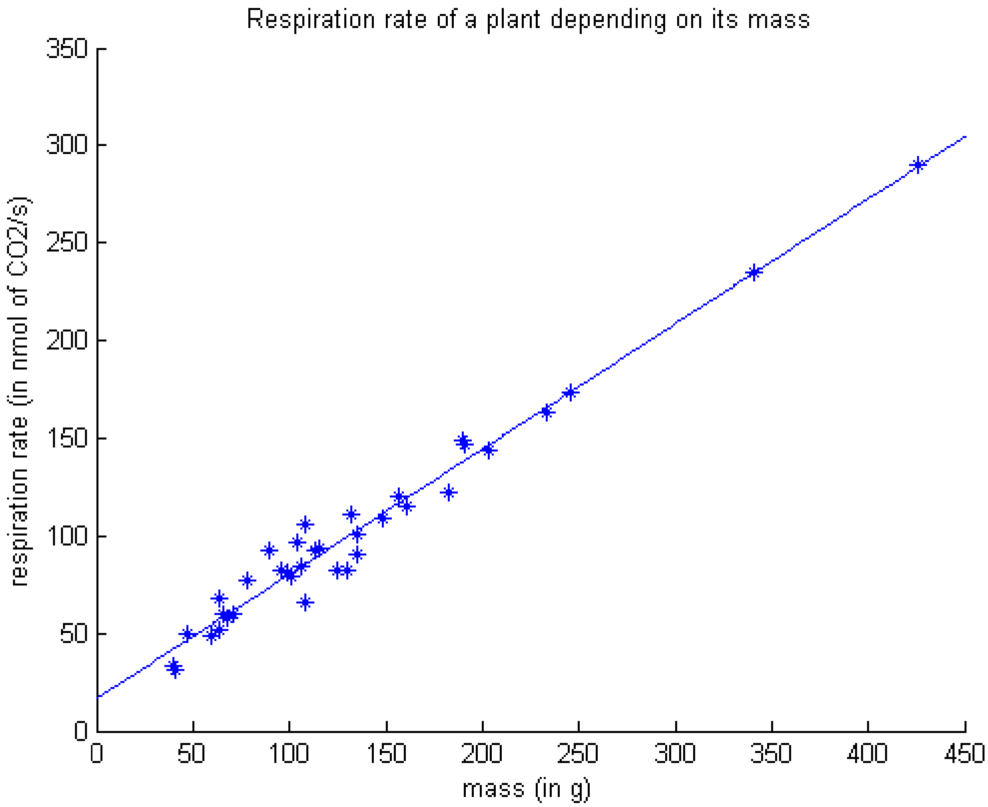
data1 = load ('-ascii','respirrate.txt');
mass = data1(:,1);
rate = data1(:,2);

% I chose the least square regression equation to fit the data. The aim is
% to pick a curve to minimize  sum(y(actual)-y(predicted))^2.

figure (1);
hold on
plot (mass,rate,'*')
xlabel ('mass (in g)');
ylabel ('respiration rate (in nmol of CO2/s)');
title ('Respiration rate of a plant depending on its mass');
n = length(mass);
X = [ones(n,1) mass];
bhat = X\rate;
bhat;

xc = 0:1:450;
yc = bhat(1)+bhat(2)*xc;
plot(xc,yc);
hold off

% As we can see in the figure 1, the data are well described by the least square r
```



Problem 2:

```
% a)

x = (-5:1:5)';
y = zeros(11,1);
y(2) = 0.2;
y(6) = 0.2;
y(8) = 0.2;

n = length(x);
X = [ones(n,1) x];
bhat = X\y;
bhat;

xc = -6:1:6;
yc = bhat(1)+bhat(2)*xc;

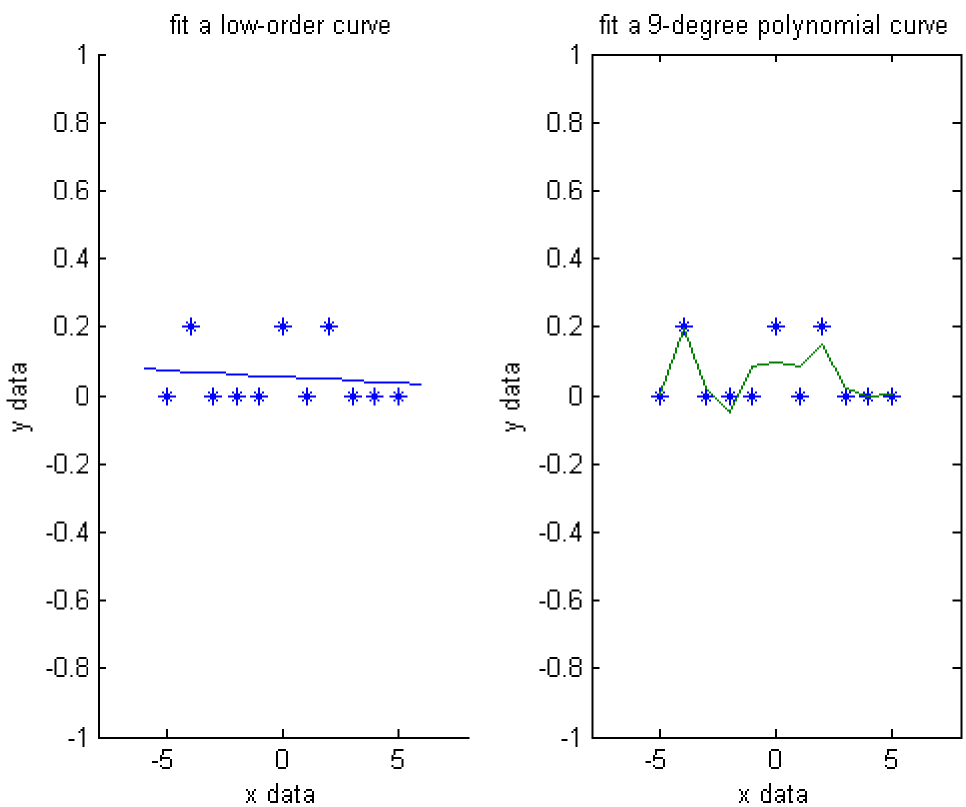

figure (2)
subplot(1,2,1)
hold on
plot (x,y,'*')
axis ([-8 8 -1 1]);
xlabel ('x data');
ylabel ('y data');
title ('fit a low-order curve');
plot(xc,yc);
hold off

% As we can see in the figure 2 on the left, the low order curve (1-degree
```

```
% polynome) is not fitting very bad for so few points.

% b)
p = polyfit(x,y,9);
f = polyval(p,x);
subplot(1,2,2)
plot(x,y,'*',x,f,'-')
xlabel ('x data');
ylabel ('y data');
title ('fit a 9-degree polynomial curve');
axis ([-8 8 -1 1]);

% The 9-degree polynomial fit almost exactly the data, which is not good
% because if the data change a little, the fit will change a lot.
```



Problem 2:

```
%c)

x = (-5:1:5)';
y = zeros(11,1);
y(2) = -0.2;
y(6) = 0.2;
y(8) = 0.2;

n = length(x);
X = [ones(n,1) x];
bhat = X\y;
bhat;

xc = -6:1:6;
```

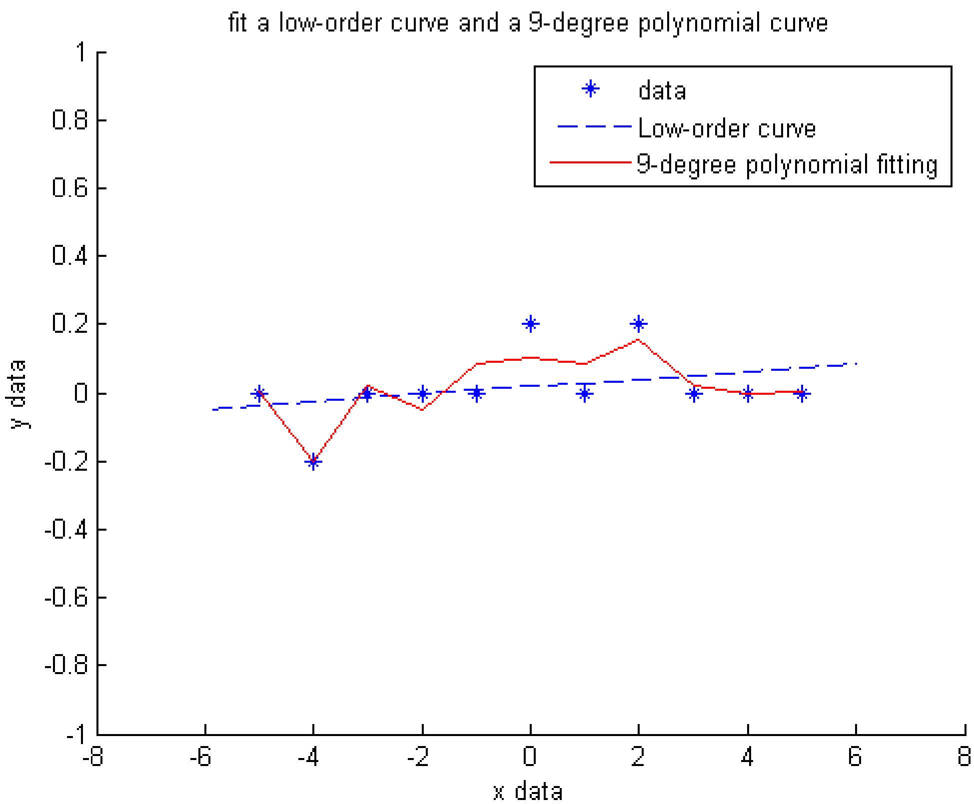
```
yc = bhat(1)+bhat(2)*xc;


figure (3)
hold on
plot (x,y,'*')
axis ([-8 8 -1 1]);
xlabel ('x data');
ylabel ('y data');
title ('fit a low-order curve and a 9-degree polynomial curve');
plot(xc,yc,'--b');

p = polyfit(x,y,9);
f = polyval(p,x);

plot(x,f,'-r')
legend ('data','Low-order curve', '9-degree polynomial fitting')
hold off


%There is not much data, so every time there is a fluctuation in the data, the 9-d
%If we assume that there is maybe outliers in the data, this curve will be not a
%good approximation of the data for so few points.
```



Problem 3:

```
% a)

data2 = load ('-ascii','TempAnom.txt');
year = data2(:,1);
temp = data2(:,2);
```

```
%  I fitted a 1-degree polynomila curve:
figure (4);
hold on
plot (year,temp,'*')
xlabel ('Year');
ylabel ('Temperature anomalies (in degrees Celsius)');
title ('Global temperature anomalies');
n = length(year);
X = [ones(n,1) year];
bhat = X\temp;
bhat;

xc = 1880:1:2008;
yc = bhat(1)+bhat(2)*xc;
plot(xc,yc);
hold off

% b)

% I fitted the residual versus the prediction:
figure (5)
pred = X*bhat;
resid = temp-pred;
plot(pred,resid,'<')
xlabel ('prectited data');
ylabel ('residual');
title ('residual versus prediction');


% In the plot of the figure 5, it seems to be a periodic function in the
% curve.

% c)
% In the figure 5, we can see a periodic trend, which we can measure the
% periode directly in the graph. We have only to read the
% number of years for which there are two consecutive depressions or humps

% d)

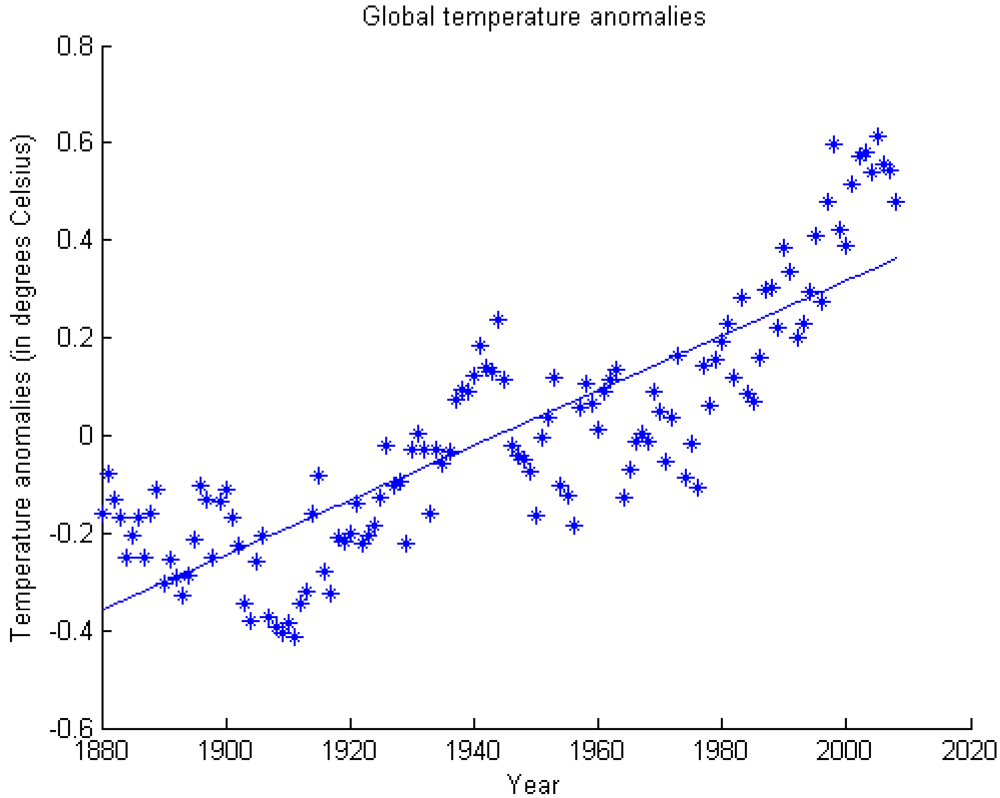
% I tried to fit a sum of cos and sin function on the data but it is not
% fitting very well. So I decided to fit a polynomial curve on the data.
figure(6)
Xp = [ones(n,1) sin(2*pi*year/64) cos(2*pi*year/64)];
beta = Xp\temp;
yhat = Xp*beta;
hold on
plot (year,temp,'*')
plot (xc,yhat,'--r')
xlabel ('Year');
ylabel ('temperature in degrees Celsius');
title ('fit a periodic curve');

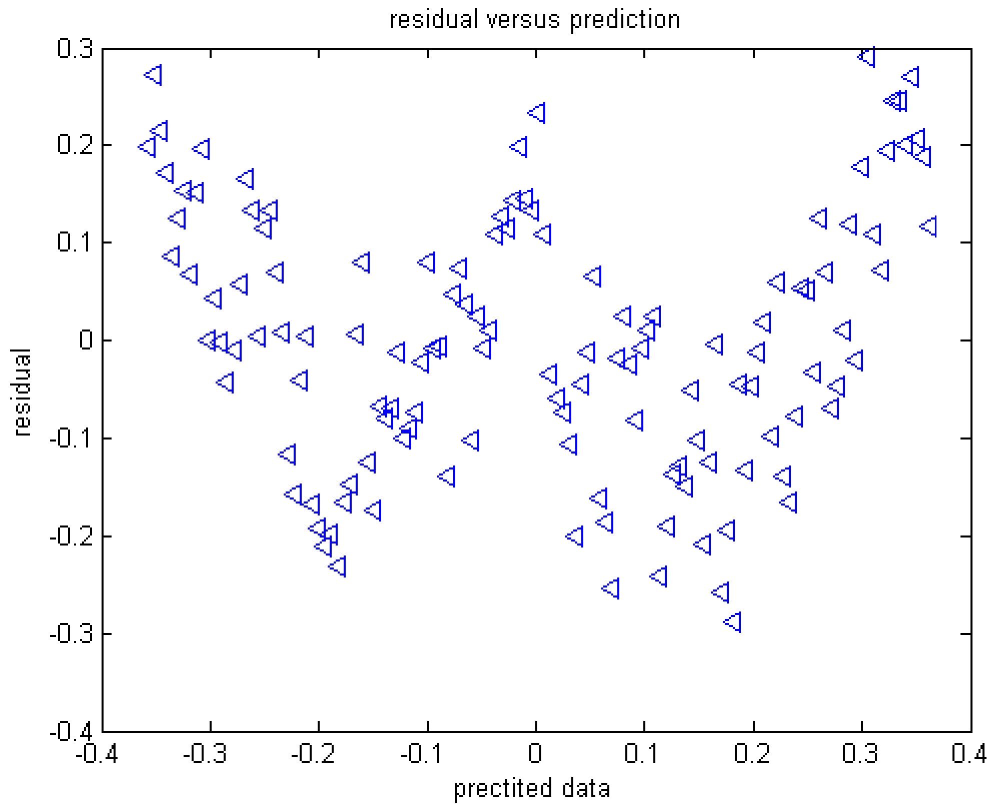
hold off

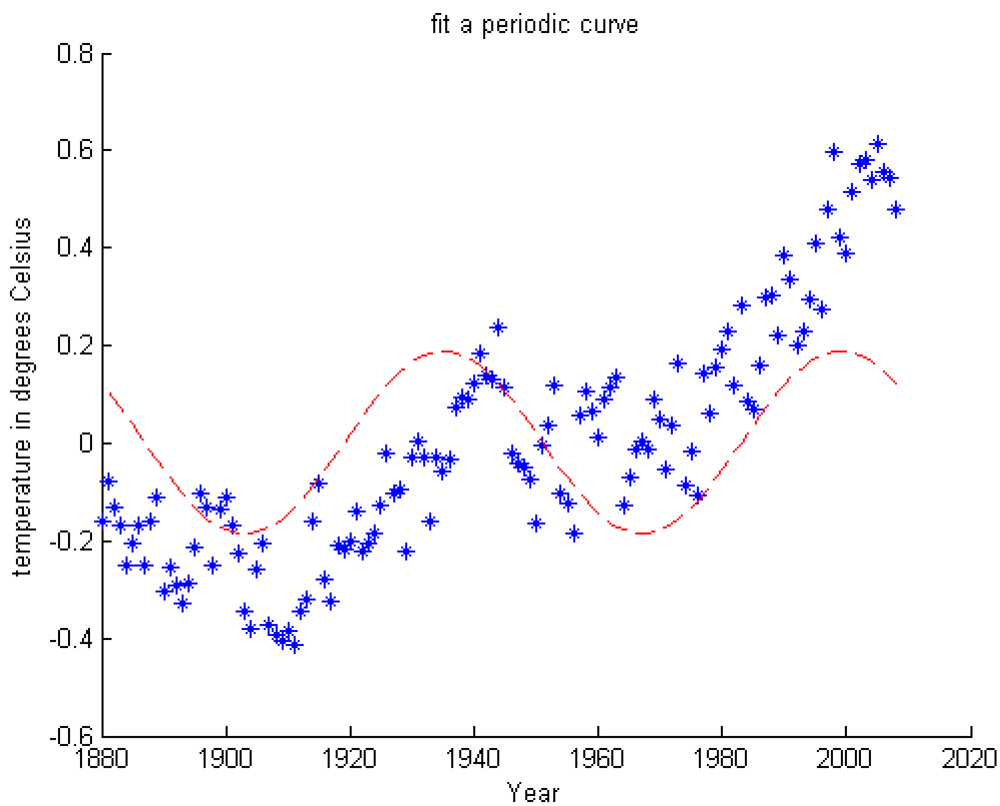
% I fitted the polynomial curve:
figure(7)
p = polyfit(year,temp,8);
f = polyval(p,year);
plot(year,temp,'*',year,f,'-')
xlabel ('Year');
ylabel ('temperature in degrees Celsius');
title ('fit a 8-degree polynomila curve');
```

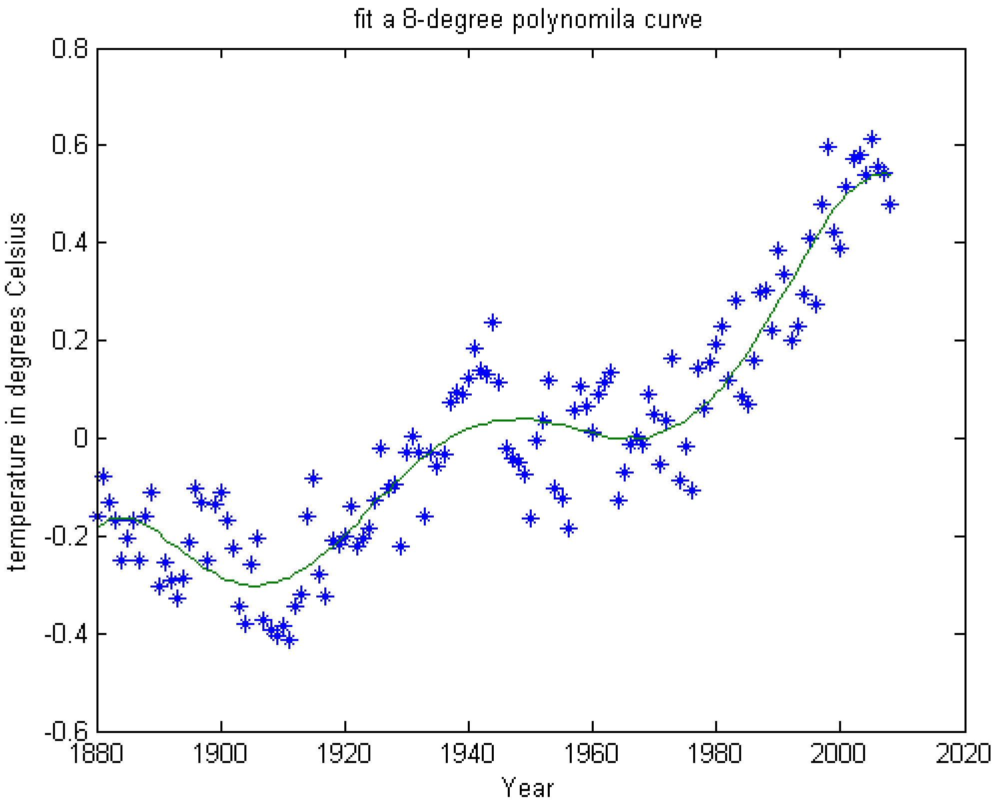
```
% I chose a 8-degree polynomial curve because it is the most similar to the
% data, not folowing to much the variation of the points and not to
% straight.
```

Warning: Polynomial is badly conditioned. Add points with distinct X values, reduce the degree of the polynomial, or try centering and scaling as described in HELP POLYFIT.




residual versus prediction
residual
prectited data
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4


fit a periodic curve
temperature in degrees Celsius
Year
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
1880
1900
1920
1940
1960
1980
2000
2020



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