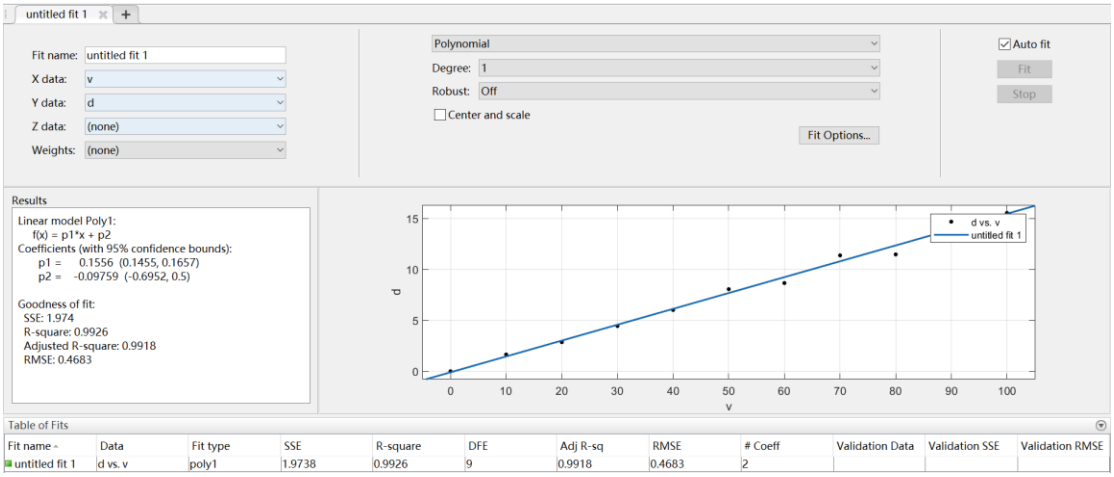
Assignment 3

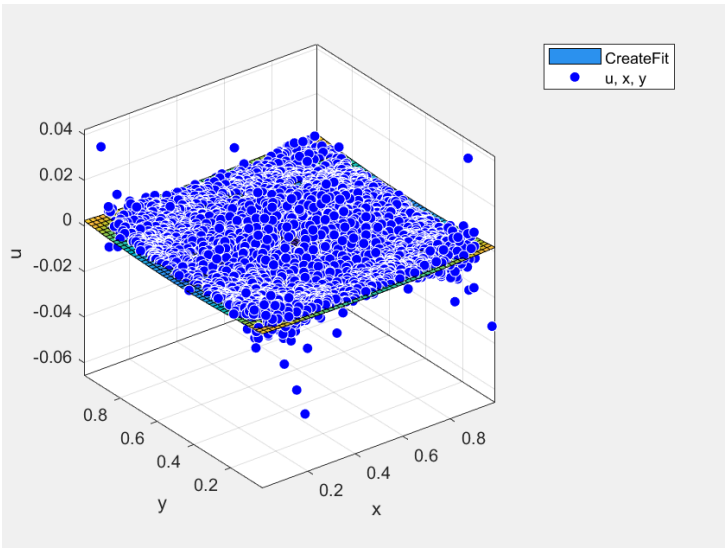
1.



G is estimated as $G = 0.1566$.
The displacement of the actuator is $d = 11.5724$ for the internal voltage of 75 volts.

2.

a) The results of surface fitting to the given data (x,y,u) is shown as follow




```
function [fitresult, gof] = createFit(x, y, u)

[xData, yData, zData] = prepareSurfaceData( x, y, u );

ft = fittype( 'poly22' );

[fitresult, gof] = fit( [xData, yData], zData, ft );

figure( 'Name', 'createFit' );
h = plot( fitresult, [xData, yData], zData );
```

```
legend( h, 'CreateFit', 'u, x, y');
xlabel x
ylabel y
zlabel u
```

b)

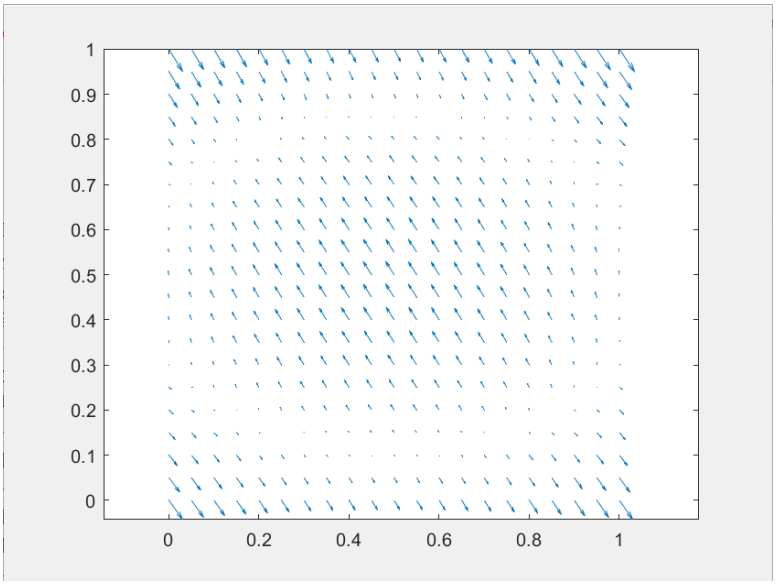
```
load('data2.mat');

[gridx,gridy] = meshgrid(0:0.05:1,0:0.05:1);

[ufit, gofu] = createFit(x, y, u);
[vfit, gofv] = createFit(x, y, v);

quiver(gridx, gridy, ufit(gridx, gridy), vfit(gridx, gridy));
axis equal
```

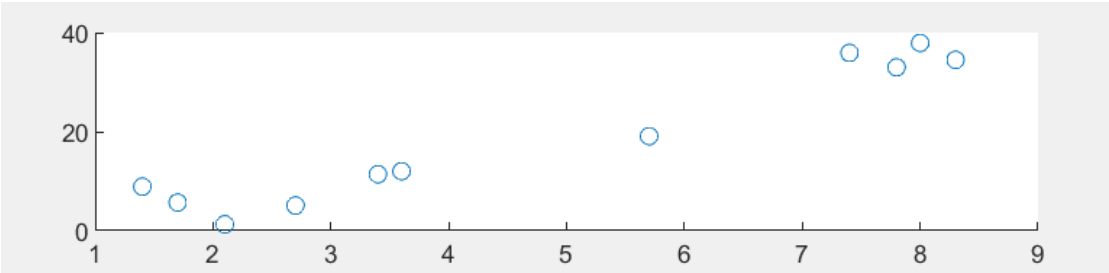
The Plot



3.a)Matlab Code:

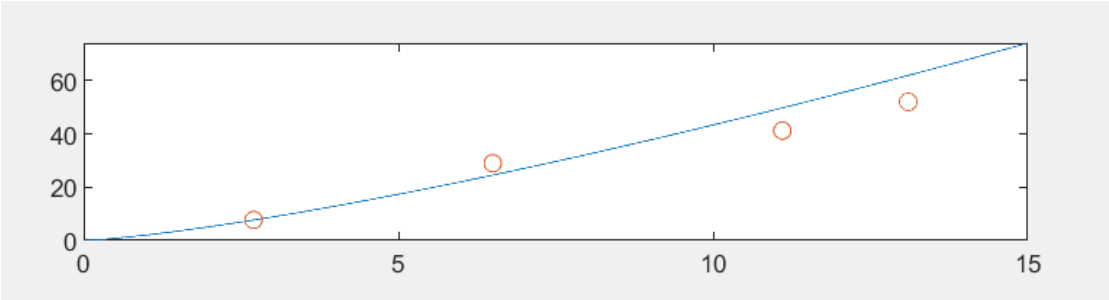
```
clear all; close all;
load data3.mat;
h=figure;
figure(h);
subplot(3,1,1);
scatter(x,y);
n=length(x);
x=log(x);
y=log(y);
xmean=mean(x);
ymean=mean(y);
```

```
sxy=sum(x.*y);
sxx=sum(x.^2);
theta2=(sxy-n*xmean*ymean)/(sxx-n*xmean^2);
disp(['beta1=',num2str(theta2)]);
theta1=ymean-theta2*xmean;
disp(['beta0=',num2str(theta1)]);
yhat=theta1+theta2*x;
figure(h);
subplot(3,1,2);
hold on,
plot(x,yhat);
k1=exp(theta1);
disp(['k1=',num2str(k1)]);
k2=theta2;
disp(['k2=',num2str(k2)]);
```



k1=2.0668
k2=1.3215

b)



SSE_Training=144.2769
SSE_Validation=191.3184
R^2=0.9388

c) Matlab Code:

```
SSE_valid = [];
P1 = polyfit(x,y,1);
yestv1 = polyval(P1,xv);
SSE_valid(1) = sum((yv-yestv1).^2);
```

```
P2 = polyfit(x,y,2);
yestv2 = polyval(P2,xv);
SSE_valid(2) = sum((yv-yestv2).^2);
P3 = polyfit(x,y,3);
yestv3 = polyval(P3,xv);
SSE_valid(3) = sum((yv-yestv3).^2);
P4 = polyfit(x,y,4);
yestv4 = polyval(P4,xv);
SSE_valid(4) = sum((yv-yestv4).^2);
P5 = polyfit(x,y,5);
yestv5 = polyval(P5,xv);
SSE_valid(5) = sum((yv-yestv5).^2);
P6 = polyfit(x,y,6);
yestv6 = polyval(P6,xv);
SSE_valid(6) = sum((yv-yestv6).^2);
P7 = polyfit(x,y,7);
yestv7 = polyval(P7,xv);
SSE_valid(7) = sum((yv-yestv7).^2);
```

The Chart

SSE_valid

1x7 double

	1	2	3	4	5	6	7
1	145.4259	1.8801e+...	4.7373e+...	436.9034	6.6825e+...	8.4281e+...	2.6936e+...

I will choose the first order. Since the number of #1 is the smallest

4.a)

```
function SSE = computeCost(k)
global x y
k1 = k(1);
k2 = k(2);
SSE = sum((y - (k1*(1-exp(-k2*x)))).^2);
end
```

b)

```
load data4.mat
global x y
k1 = 1;
k2 = 1;
k = [k1 k2]; % Initial guess
k = fminsearch('computeCost', k);
```

Results:

k1=1.4927

k2=0.2021

c)
```
k1_surf = linspace(1.4, 1.7, 100);
k2_surf = linspace(0.1, 0.3, 100);

J_surf = zeros(length(k1_surf), length(k2_surf));

for i = 1:length(k1_surf)
    for j = 1:length(k2_surf)
    t = [k1_surf(i); k2_surf(j)];
    J_surf(i,j) = computeCost(t);
    end
end

J_surf = J_surf';

figure;
surf(k1_surf, k2_surf, J_surf);
xlabel('k_1'); ylabel('k_2');
```