Final

2020/6/20

- Write a report to answer the questions
- You can use any material related to this course except commercial problem-solving services
- Discussions are now allowed
- MS Word / PDF files are accepted
- Include entire MATLAB code in your report

Problem 1. Answer the following questions.

(1) Use the following code to generate a data set. Plot the data.

```
x = [0:0.1:5]';
y = sin(2*pi*0.05*x) + 0.05*randn(size(x));
```

(2) Do the linear regression and plot the model with the original data
(3) Do the nonlinear regression using polynomials up to the 2nd order and plot the model with the original data
(4) Use the following code to generate a data set. Plot the data.

```
x = [-5:0.1:5]';
y = zeros(size(x));
y(1:50) = -1;
y(52:end) = 1;
y = y + 0.05*randn(size(y));
```

(5) Do the nonlinear regression using the following three functions and plot the model with the original data

$$\sin\left(\frac{2\pi x}{10}\right), \quad \sin\left(\frac{4\pi x}{10}\right), \quad \sin\left(\frac{6\pi x}{10}\right)$$

Problem 2. Use the following MATLAB code to answer the questions.

```matlab
% generate data
n = 200;
data1 = mvnrnd([1,1], eye(2), n);
data2 = mvnrnd([3,4], eye(2), n);
data3 = mvnrnd([6,9], eye(2), n);

data_all = [data1; data2; data3];

plot(data_all(:,1), data_all(:,2), '.')
axis equal
hold on
xlabel('x1')
ylabel('x2')
```

(1) Do the k-means clustering to separate the data into three groups. Plot the result.
(2) Starting from the following mean values, the MATLAB code we used in the class does not work. Explain (a) why, (b) discuss how it can be resolved, and (c) write MATLAB code to implement it.

Problem 3.

(1) Use the following code to generate a data set and find two principal components (PC). Plot the PCs with the original data.

```
n = 500;
mu = [0 0]; % mean values
sigma = [3 1.5; % standard deviation
         1.5 1];
X = mvnrnd(mu,sigma,n);

plot(X(:,1),X(:,2),'.')
hold on
grid on
xlabel('x1')
ylabel('x2')
```

(2) Use the following code to generate a data set and find the first two principal components (PC). Plot the PCs with the original data.

```
n = 500;
mu = [0 0 0]; % mean values
sigma = [3 1.5 0 ;   % standard deviation
         1.5 1 0
         0 0 0.01];
X = mvnrnd(mu,sigma,n);

plot3(X(:,1),X(:,2),X(:,3),'.')
hold on
grid on
axis equal
xlabel('x1')
ylabel('x2')
zlabel('x3')
```

Problem 4. Use the following number data to answer the questions.

```
numbers = zeros(5,5,5);
numbers(:,:,1) = [0 1 1 0 0
                  0 0 1 0 0
                  0 0 1 0 0
                  0 0 1 0 0
                  0 1 1 1 0]; % number 1
numbers(:,:,2) = [1 1 1 1 0
                  0 0 0 0 1
                  0 1 1 1 0
                  1 0 0 0 0
                  1 1 1 1 1]; % number 2
numbers(:,:,3) = [1 1 1 1 0
                  0 0 0 0 1
                  0 1 1 1 0
                  0 0 0 0 1
                  1 1 1 1 0]; % number 3
numbers(:,:,4) = [0 0 0 1 0
                  0 0 1 1 0
                  0 1 0 1 0
                  1 1 1 1 1
                  0 0 0 1 0]; % number 4
numbers(:,:,5) = [1 1 1 1 1
                  1 0 0 0 0
                  1 1 1 1 0
                  0 0 0 0 1
                  1 1 1 1 0]; % number 5
```

(1) Write an artificial neural network (ANN) code to classify the number data.
(2) Add number 6 to your data. Train your ANN and show the test result.