Table of Contents

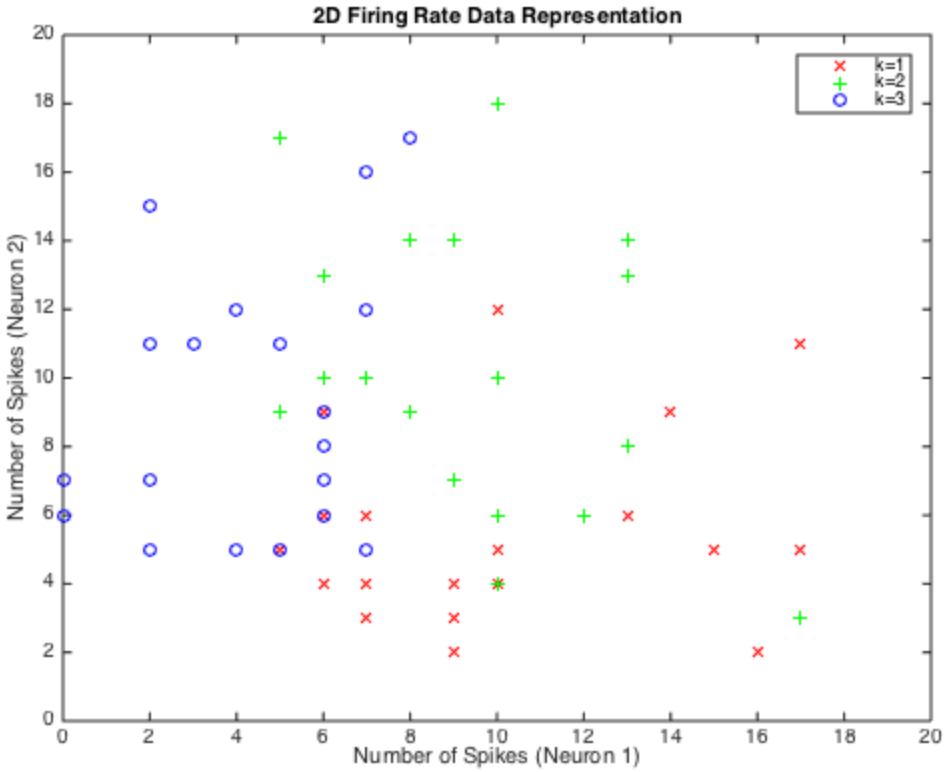

```
% EE239AS Homework 4
```

Problem 3: Simulated Neural Data

```
ps3_data = importdata('ps4_simdata.mat');

% 20x3 struct
% rows = data point
% columns = class
```

Part A: 2D Plot

```
n_class = size(ps3_data,2);
n_trial = size(ps3_data,1);
data = cell(1, n_class);

for i = 1:n_trial
    for j = 1:n_class
        data{1,j} = [data{1,j}, ps3_data(i,j).x];
    end
end

figure(1)
plot(data{1,1}(1,:),data{1,1}(2,:),'xr', data{1,2}(1,:),data{1,2}(2,:), '+g', ...
     data{1,3}(1,:),data{1,3}(2,:), 'ob')

title('2D Firing Rate Data Representation')
xlabel('Number of Spikes (Neuron 1)')
ylabel('Number of Spikes (Neuron 2)')
legend('k=1','k=2','k=3')
axis([0 20 0 20])
```



Part B: ML Parameters

```
% Model (i) Gaussian, Shared Covariance
N_k = n_trial;
N = N_k*n_class;
P_Ck = N_k/(n_class*N_k);

mu_i = zeros(D_trial, n_class);
cov_trial_i = zeros(D_trial, D_trial);
S_k_i = cell(1, n_class);
sigma_i = cov_trial_i;

for i = 1:n_class
    mu_i(:,i) = 1/(N_k)*sum(data{1,i},2);
    for j = 1:n_trial
        cov_trial_i = cov_trial_i + (data{1,i}(:,j)-mu_i(:,i))*(data{1,i}(:,j)-mu_
    end
    S_k_i{i} = 1/N_k * cov_trial_i/n_trial;
    sigma_i = sigma_i + N_k/N * S_k_i{i};
end

fprintf('Model (i) Gaussian, Shared Covariance\n\n')
disp('Probability of Class:')
disp(P_Ck)
disp('Means:')
```

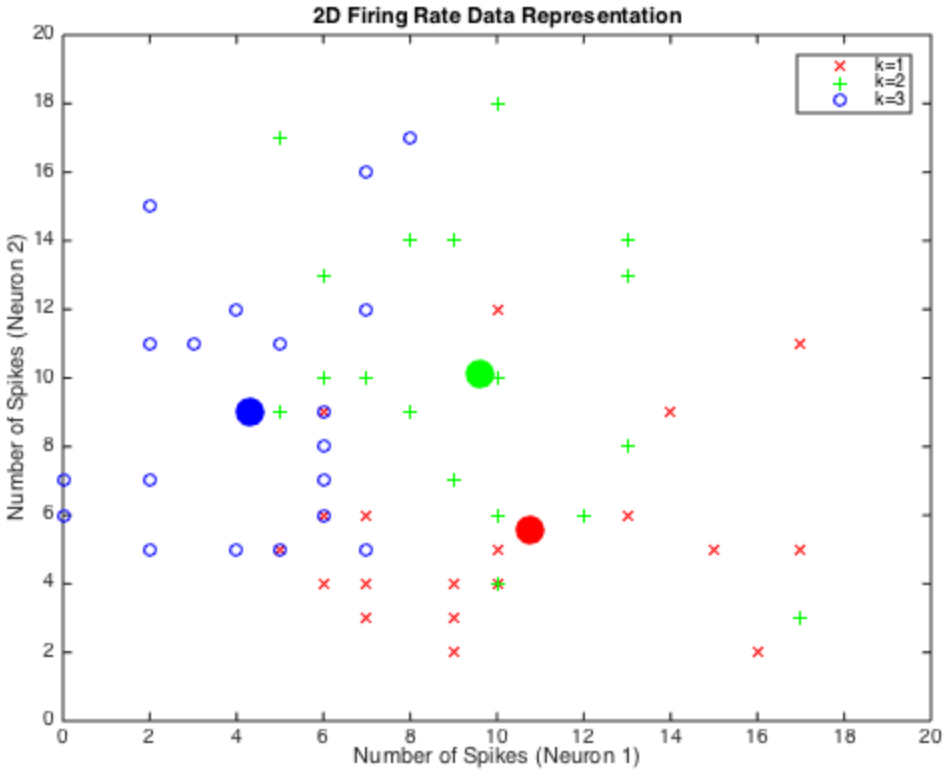
```
disp(mu_i)
disp('Covariance Matrix:')
disp(sigma_i)


% *Model (ii) Gaussian, Class Specific Covariance*

fprintf('Model (ii) Gaussian, Class Specific Covariance\n\n')
disp('Probability of Class:')
disp(P_Ck)
disp('Means:')
disp(mu_i)
disp('Covariance Matrix (Class 1):')
disp(S_k_i{1})
disp('Covariance Matrix (Class 2):')
disp(S_k_i{2})
disp('Covariance Matrix (Class 3):')
disp(S_k_i{3})
```

```
Model (i) Gaussian, Shared Covariance

Probability of Class:
    0.3333

Means:
   10.7500    9.6000    4.3000
    5.5500   10.1000    9.0000

Covariance Matrix:
    1.4575   -0.0085
   -0.0085    1.1304

Model (ii) Gaussian, Class Specific Covariance

Probability of Class:
    0.3333

Means:
   10.7500    9.6000    4.3000
    5.5500   10.1000    9.0000

Covariance Matrix (Class 1):
    1.0494    0.1069
    0.1069    0.3624

Covariance Matrix (Class 2):
    1.5264   -0.1286
   -0.1286    1.1519

Covariance Matrix (Class 3):
    1.7969   -0.0036
   -0.0036    1.8769
```

Part C

```
figure(2)
plot(data{1,1}(1,:),data{1,1}(2,:),'xr', data{1,2}(1,:),data{1,2}(2,:), '+g', ...
     data{1,3}(1,:),data{1,3}(2,:), 'ob')

title('2D Firing Rate Data Representation')
xlabel('Number of Spikes (Neuron 1)')
ylabel('Number of Spikes (Neuron 2)')
legend('k=1','k=2','k=3')
axis([0 20 0 20])

hold on
plot(mu_i(1,1), mu_i(2,1),'.r','markersize',50)
plot(mu_i(1,2), mu_i(2,2),'.g','markersize', 50)
plot(mu_i(1,3), mu_i(2,3),'.b','markersize', 50)
hold off
display(mu_i)

% Model (ii) Gaussian, Class Specific Covariance
% Model (iii) Poisson
```

```
mu_i =

   10.7500    9.6000    4.3000
    5.5500   10.1000    9.0000
```



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