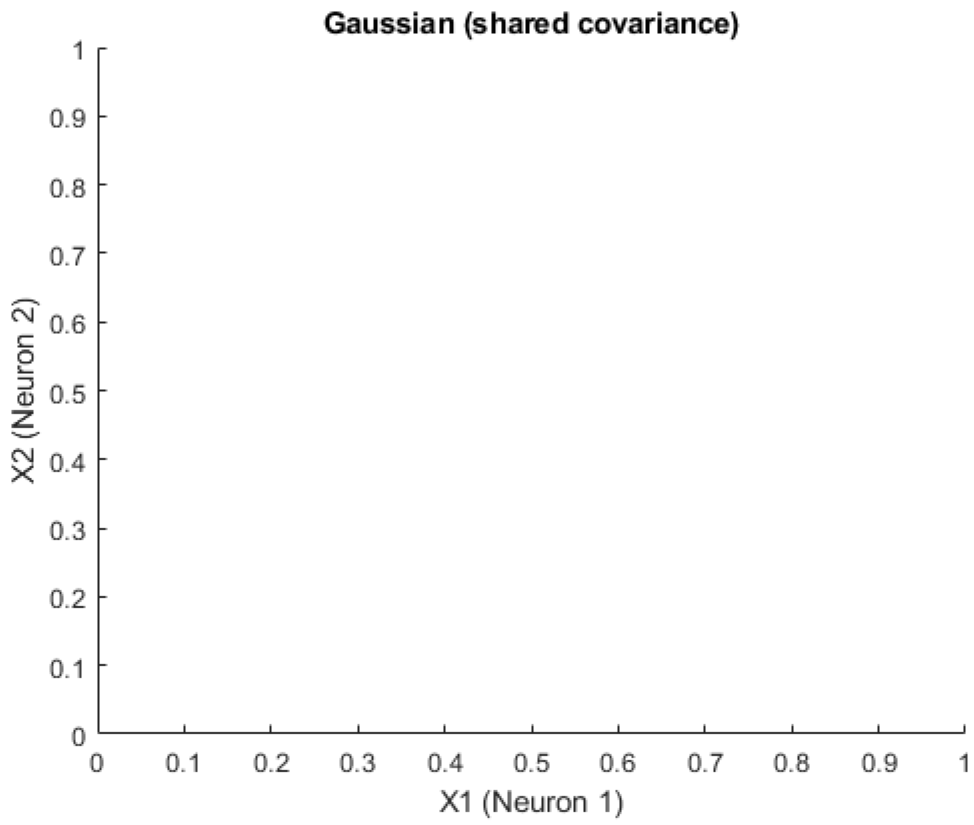
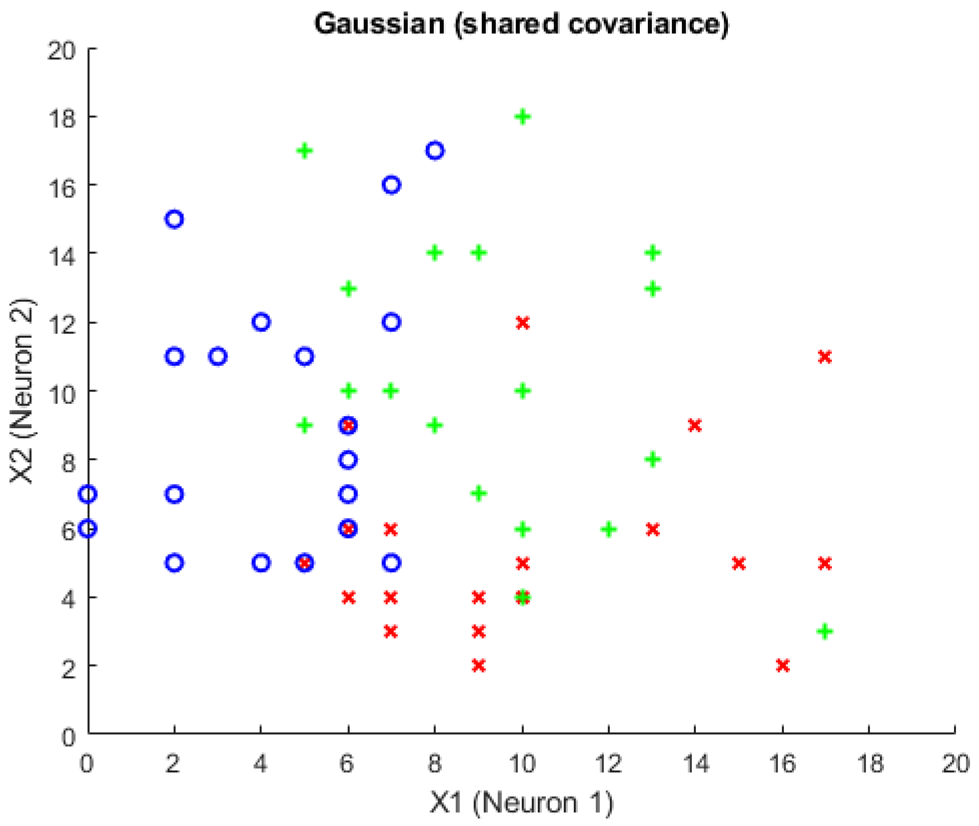
Table of Contents

```
load('ps3_simdata.mat')
figure
xlabel('X1 (Neuron 1)')
ylabel('X2 (Neuron 2)')
title('Gaussian (shared covariance)')
hold on
```



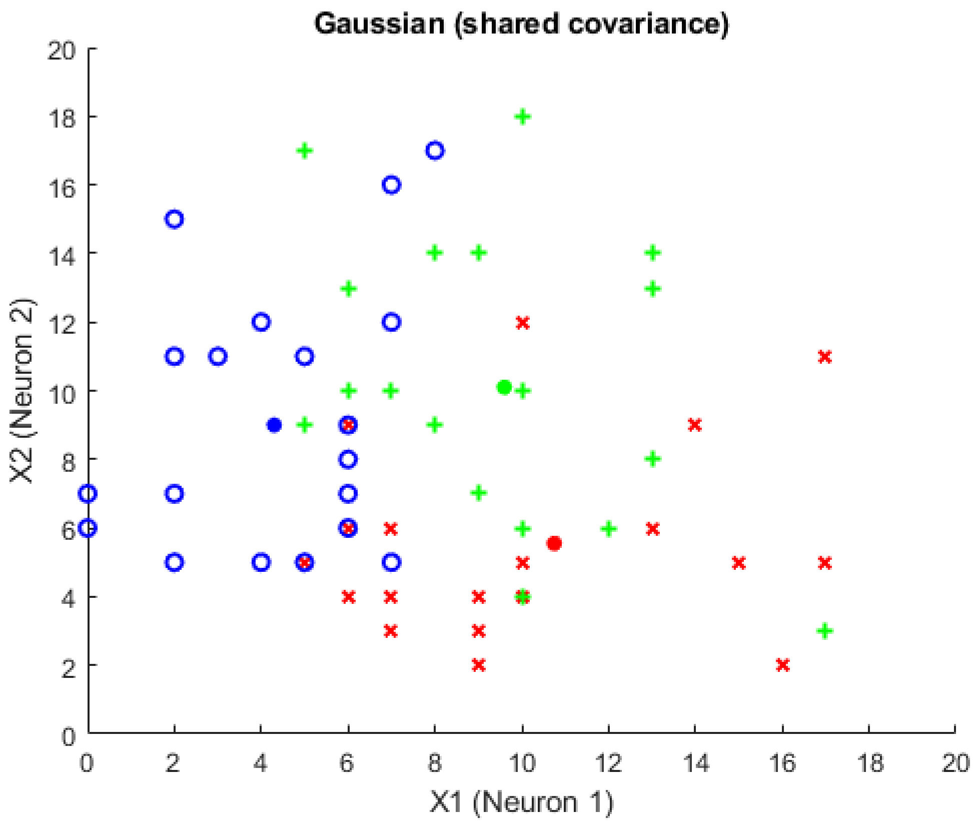
Plot the data points in a two-dimensional space. For classes k = 1, 2, 3, uses a red ×, green +, and blue o for each data point, respectively.

```
for k = 1:3
[X1, X2] = getValues(trial, k);
if k == 1; marker = 'rx';
elseif k == 2; marker = 'g+';
else; marker = 'bo';
end
plot(X1, X2, marker, 'LineWidth', 1.5)
end
axis([0 20 0 20])
```



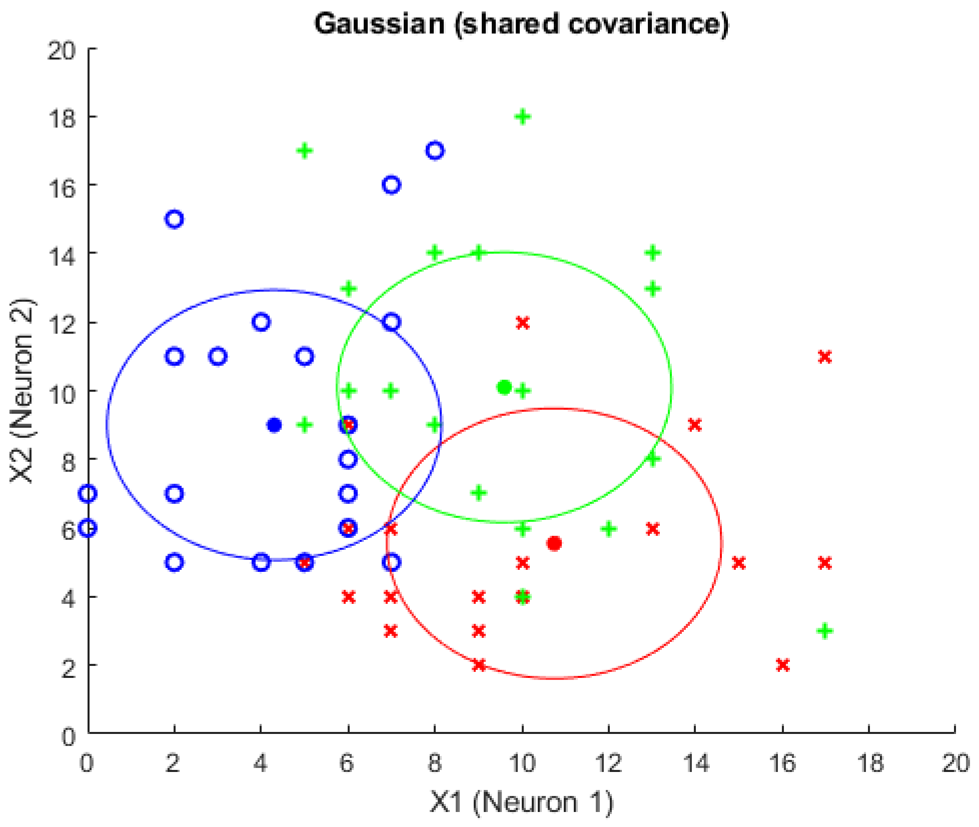
Find the maximum likelihood (ML) parameters for a Gaussian generative model with shared covariance, and plots the ML mean as a solid dot.

```
pi = 20/60; %Nk/N

[mu1] = getMu(trial, 1);
plot(mu1(1), mu1(2), 'r.', 'MarkerSize', 20)
[mu2] = getMu(trial, 2);
plot(mu2(1), mu2(2), 'g.', 'MarkerSize', 20)
[mu3] = getMu(trial, 3);
plot(mu3(1), mu3(2), 'b.', 'MarkerSize', 20)

sigma = zeros(2, 2);
for k = 1:3
    [mu] = getMu(trial, k);
    S = zeros(2, 2);
    for n = 1:20
        x = trial(n, k).x;
        s_x = ((x - mu) * (x - mu)');
        S = S + s_x;
    end
    S = S / 20;
    sigma = sigma + (pi * S);
end

sigma = zeros(2, 2);
for k = 1:3
    S = getSigma(trial, k);
    sigma = (S*pi) + sigma;
end
```



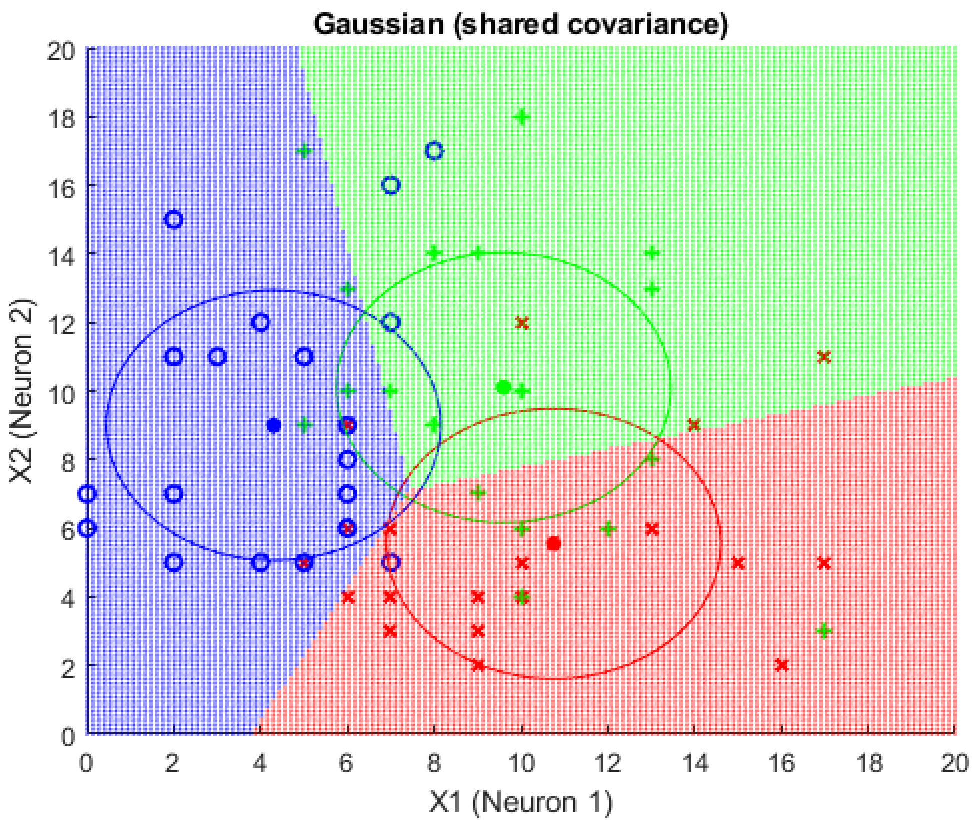
For each class, plots the ML covariance using an ellipse of the appropriate color.

```
x1 = linspace(0,20);
x2 = linspace(0,20);
[X1,X2] = meshgrid(x1(:),x2(:));
X = [X1(:) X2(:)];
Z = mvnpdf(X, mu1', sigma);
Z = reshape(Z,[100 100]);
contour(X1, X2, Z, [0.007, 0.007], 'r');
Z = mvnpdf(X, mu2', sigma);
Z = reshape(Z,[100 100]);
contour(X1, X2, Z, [0.007, 0.007], 'g');
Z = mvnpdf(X, mu3', sigma);
Z = reshape(Z,[100 100]);
contour(X1, X2, Z, [0.007, 0.007], 'b');
```



Plot multi-class decision boundaries corresponding to the decision rule: ˆk = argmax_k P(Ck | x)

```
plotDecisionSharedSigma(mu1, mu2, mu3, sigma);
```



FUNCTIONS

```
function [X1, X2] = getValues(trial, k)
%Returns spike counts from neuron 1 and neuron 2 as an array given
%trial number and class k
X1 = zeros(20, 1);
X2 = zeros(20, 1);
for n = 1:20
    X1(n) = trial(n, k).x(1);
    X2(n) = trial(n, k).x(2);
end
end

function [mu] = getMu(trial, k)
%Returns means spike count for a given class for neuron 1 and neuron 2
 as an array
[X1, X2] = getValues(trial, k);
mu = [sum(X1)/20; sum(X2)/20];
end

function [] = plotDecisionSharedSigma(mu1, mu2, mu3, sigma)
%Plots a decision boundary for a Gaussian model with shared covariance
X1 = linspace(0,20,150);
X2 = linspace(0,20,150);
for i = 1:length(X2)
```

```
    for j = 1:length(X1)
        vx = [X1(i); X2(j)];
        c1 = (mu1' * inv(sigma) * vx) - ((1/2) * mu1' * inv(sigma) *
 mu1) + log(1/3);
        c2 = (mu2' * inv(sigma) * vx) - ((1/2) * mu2' * inv(sigma) *
 mu2) + log(1/3);
        c3 = (mu3' * inv(sigma) * vx) - ((1/2) * mu3' * inv(sigma) *
 mu3) + log(1/3);
        k = max([c1, c2, c3]);

        if k == c1; marker = '.r';
        elseif k == c2; marker = '.g';
        elseif k == c3; marker = '.b';
        end
        plot(X1(i),X2(j),marker, 'MarkerSize', 1);
    end
end
end
```

Published with MATLAB® R2019b