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function [mu, sigma, p] = EM_GMM(X, max_iter, tol)
    % X: Data
    % max_iter: Maximum number of iterations
    % tol: Tolerance for convergence

    [n, d] = size(X); % Number of data points and dimensions

    % Randomly initialize the parameters
    mu = randn(2, d); % Random means
    sigma = repmat(eye(d), [1, 1, 2]); % Identity covariances
    p = [0.5, 0.5]; % Equal mixing probabilities

    likelihood_old = -Inf;

    for iter = 1:max_iter
        % E-step
        likelihood = zeros(n, 2);
        for i = 1:2
            likelihood(:, i) = mvnpdf(X, mu(i, :), sigma(:, :, i)) * p(i);
        end
        weight = likelihood ./ sum(likelihood, 2);

        % M-step
        for i = 1:2
            mu(i, :) = sum(weight(:, i) .* X) / sum(weight(:, i));
            sigma(:, :, i) = ((X - mu(i, :))' * (weight(:, i) .* (X - mu(i, :)))) /
sum(weight(:, i));
            p(i) = mean(weight(:, i));
        end

        % Check for convergence
        likelihood_new = sum(log(sum(likelihood, 2)));
        if abs(likelihood_new - likelihood_old) < tol
            break;
        end
        likelihood_old = likelihood_new;
    end
end

```