```
S = load('mnist_train.mat');
disp(S)
```

```
    digits: [784×60000 double]
    labels: [5 0 4 1 9 2 1 3 1 4 3 5 3 6 1 7 2 8 6 9 4 0 9 1 1 2 4 3 2 7 3 8 6 9 0 5 6 0 7 6 1 8 7 9 3 9 8 5 9 3 3 0
```

```
digits = digits(:,1:10000);

N = 10000;
k = 20;
group = randi(k, 1, N);

max = 50;
error_tol = 1e-5;
z = zeros(784,k);

for i = 1:max
    for j = 1:k
        idx = find(group == j);
        if ~isempty(idx)
            z(:,j) = mean(digits(:,idx),2);
        else
            z(:,j) = digits(:,randi(N));
        end
    end

    dists = zeros(k,N);
    for j = 1:k
        diff = digits - z(:,j);
        dists(j,:) = sum(diff.^2, 1);
    end
    [~, newGroup] = min(dists, [], 1);
    J = mean(min(dists, [], 1));
    if i > 1 && abs(J- Jprev) < error_tol * Jprev
        fprintf('Converged at i: %d\n', i);
        break;
    end
    Jprev = J;
    group = newGroup;
end
```

```
Converged at i: 42
```

```
figure;
for j = 1:k
    subplot(4, 5, j);
    imshow(reshape(z(:,j), 28, 28))
end
```