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% ECE 236A - Final Project
% Peter Racioppo & David Martinez

MAIN

```
close all;
clear all;
clc;

% Load data:
load pendigits_tes.mat
load pendigits_tra.mat

% Data dimensions:
% s_train: 7494x1
% y_train: 7494x16
% s_test: 3498x1
% y_test: 3498x16

K = 10; % Number of classes
M = size(y_train,2); % Number of features

% lambda = 3;
% p = poissrnd(lambda, [1,M])/100;
% test_data_c = f_Corrupt(y_test,p,M);
```

Classifier 1, Run Once

```
tic
obj1 = MyClassifier1(K,M); % MyClassifier1
obj1 = train(obj1,y_train,s_train); % Train
label1 = classify(obj1,y_test); % Classify
acc1 = sum(label1==s_test)/length(s_test); % Percent Accuracy
disp(['Accuracy = ', num2str(round(100*acc1,2)), '%']); % Print
    accuracy
runtime_C1 = toc;
disp(['Runtime = ', num2str(runtime_C1), ' seconds']); % Print
    accuracy

Accuracy = 95%
Runtime = 124.3447 seconds
```

Classifier 2, Run Once

```
tic
obj2 = MyClassifier2(K,M); % MyClassifier2
obj2 = train(obj2,y_train,s_train); % Train
label2 = classify(obj2,y_test); % Classify
acc2 = sum(label2==s_test)/length(s_test); % Percent Accuracy
disp(['Accuracy = ', num2str(round(100*acc2,2)), '%']); % Print
    accuracy
runtime_C2 = toc;
disp(['Runtime = ', num2str(runtime_C2), ' seconds']); % Print
    accuracy

Accuracy = 85.99%
Runtime = 36.7364 seconds
```

Dropout probability:

```
p = poissrnd(5, [1,M])/100;
k = 0:0.01:1;
k = 0.2;
p = k*ones(1,M);
```

Classifier 3v2, Run Once

```
tic
obj3v2 = MyClassifier3v2(K,M); % MyClassifier3
obj3v2 = train(obj3v2,y_train,s_train); % Train
label3v2 = TestCorrupted1(obj3v2,y_test,p); % Classify
acc3v2 = sum(label3v2==s_test)/length(s_test); % Accuracy
disp(['Accuracy = ', num2str(round(100*acc3v2,2)), '%']); % Print
    accuracy
runtime_C3v2 = toc;
disp(['Runtime = ', num2str(runtime_C3v2), ' seconds']); % Print
    accuracy
```

```
Accuracy = 61.29%
Runtime = 35.1959 seconds
```

Classifier 4, Run Once

```
tic
obj4 = MyClassifier4(K,M,p); % MyClassifier4
obj4 = train(obj4,y_train,s_train); % Train
label4 = TestCorrupted2(obj4,y_test,p); % Classify
acc4 = sum(label4==s_test)/length(s_test); % Accuracy
disp(['Accuracy = ', num2str(round(100*acc4,2)), '%']); % Print
    accuracy
runtime_C4 = toc;
disp(['Runtime = ', num2str(runtime_C4), ' seconds']); % Print
    accuracy

Accuracy = 65.75%
Runtime = 35.0863 seconds
```

Classifier 3, Run Once

```
tic
obj3 = MyClassifier3(K,M); % MyClassifier1
obj3 = train(obj3,y_train,s_train); % Train
label3 = TestCorrupted1(obj3,y_test,p); % Classify
acc3 = sum(label3==s_test)/length(s_test); % Percent Accuracy
disp(['Accuracy = ', num2str(round(100*acc3,2)), '%']); % Print
    accuracy
runtime_C3 = toc;
disp(['Runtime = ', num2str(runtime_C3), ' seconds']); % Print
    accuracy

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% WARNING FOLLOWING SECTIONS ARE TIME INTENSIVE %%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

Accuracy = 94.05%
Runtime = 75.16 seconds
```

Generating Figures for Part I

```
num__i=31; runtime_C1_his=zeros(1,num__i); runtime_C2_his=zeros(1,num__i); acc_C1_his=ze-
ros(1,num__i); acc_C2_his=zeros(1,num__i); obj1 = MyClassifier1(K,M); % MyClassifier1 obj1.gam-
ma=10.7784878220700; %[10,1,-0.2,30]; %10.7784878220700 obj1 = train(obj1,y_train,s_train); %
Train gamma=obj1.gamma;
```

```

for i=1:num__i tic obj1 = MyClassifier1(K,M); % MyClassifier1 obj1.gamma=gamma; obj1 =
train(obj1,y_train,s_train); % Train obj1 = classify(obj1,y_test); % Classify acc_C1_his(i) = sum(obj1==s_test)/length(s_test); % Percent Accuracy runtime_C1_his(i)=toc; tic obj2 = MyClassifier2(K,M);
% MyClassifier2 obj2.gamma=gamma; obj2 = train(obj2,y_train,s_train); % Train obj2 = classify(obj2,y_test); % Classify acc_C2_his(i) = sum(obj2==s_test)/length(s_test); % Percent Accuracy runtime_C2_his(i)=toc;

end

save Part_1.mat

```

Averages Part 1

```

%
avg_runtime=sum([runtime_C1_his(1:num__i);runtime_C2_his(1:num__i)],2)/
num__i
% avg_acc=sum([acc_C1_his(1:num__i);acc_C2_his(1:31)],2)/num__i

```

Plotting Part I

```

figure; subplot(2,1,1) plot(1:31, acc_C1_his(1:31),'k') title('Prediction Accuracy Over 31 Iterations') xlabel('Testing Iterations') ylabel('C1 Accuracy (%)') hold on yyaxis right plot(1:31,acc_C2_his(1:31)) ylabel('C2 Accuracy (%)') legend('Classifier 1','Classifier 2','location','south') axis tight

```

```

subplot(2,1,2) plot(1:31, runtime_C1_his(1:31),'k') title('Runtime Over 31 Iterations') xlabel('Testing Iterations') ylabel('C1 Runtime (sec)') yyaxis right plot(1:31,runtime_C2_his(1:31)) ylabel('C2 Runtime (sec)') % legend('Classifier 1','Classifier 2') axis tight

```

Generating Figures for Part II C3

```

% num__i=10;
% prob3=linspace(0,1,num__i);
% acc_C3_his=zeros(1,num__i);
% runtime_C3_his=zeros(1,num__i);
% for i=1:num__i
%     tic
%     obj3 = MyClassifier3(K,M); % MyClassifier1
%     obj3 = train(obj3,y_train,s_train); % Train
%     obj3.p=prob3(i)*ones(1,M);
%     label_pred = TestCorrupted1(obj3,y_test,obj3.p); % Classify
%     acc_C3_his(i) = sum(label_pred==s_test)/length(s_test) % Percent Accuracy
%     runtime_C3_his(i) = toc;
% end
%
% % save('Classifier3_data.mat','prob3','acc_C3_his','runtime_C3_his')

```

Plot Figure C3 for Part II

```

figure; subplot(2,1,1) plot(prob3(1:10), acc_C3_his(1:10)) title('Classifier 3 Prediction Accuracy') ylabel('Accuracy (%)') xlabel('Erasure Probability (%)') axis tight

```

```
subplot(2,1,2) plot(1:length(acc_C3_his(1:10)), runtime_C3_his(1:10)) title('Classifier 3 Runtime') xlabel('Testing Iterations') ylabel('Runtime (sec)') axis tight
```

Generating Figures for Part II C3v2

```
% num__i=10;
% prob3v2=linspace(0,1,num__i);
% acc_C3v2_his=zeros(1,num__i);
% runtime_C3v2_his=zeros(1,num__i);
% for i=1:num__i
%     tic
%     obj3v2 = MyClassifier3v2(K,M); % MyClassifier1
%     obj3v2 = train(obj3v2,y_train,s_train); % Train
%     obj3v2.p=prob3v2(i)*ones(1,M);
%     label_pred = TestCorrupted1(obj3v2,y_test,obj3v2.p); % Classify
%     acc_C3v2_his(i) = sum(label_pred==s_test)/length(s_test) %
Percent Accuracy
%     runtime_C3v2_his(i) = toc;
% end

%
save('Classifier3v2_data.mat','prob3v2','acc_C3v2_his','runtime_C3v2_his')
```

Plot Figure C3 for Part II

```
figure; subplot(2,1,1) plot(prob3v2(1:10), acc_C3v2_his(1:10)) title('Classifier 3v2 Prediction Accuracy') ylabel('Accuracy (%)') xlabel('Erasure Probability (%)') axis tight
```

```
subplot(2,1,2) plot(1:length(acc_C3v2_his(1:10)), runtime_C3v2_his(1:10)) title('Classifier 3v2 Runtime') xlabel('Testing Iterations') ylabel('Runtime (sec)') axis tight
```

Generating Figures for Part II C4

```
% num__i=10;
% prob4=linspace(0,1,num__i);
% acc_C4_his=zeros(1,num__i);
% runtime_C4_his=zeros(1,num__i);
% for i=1:num__i
%     tic
%     obj4 = MyClassifier4(K,M,prob4(i)*ones(1,M)); % MyClassifier1
%     obj4 = train(obj4,y_train,s_train); % Train
%     obj4.p=prob4(i)*ones(1,M);
%     label_pred = TestCorrupted2(obj4,y_test,obj4.p); % Classify
%     acc_C4_his(i) = sum(label_pred==s_test)/length(s_test) % Percent
Accuracy
%     runtime_C4_his(i) = toc;
% end
```

Plot Figure C4 for Part II

```
figure; subplot(2,1,1) plot(prob4(1:10), acc_C4_his(1:10)) title('Classifier 4 Prediction Accuracy') ylabel('Accuracy (%)') xlabel('Erasure Probability (%)') axis tight
```

```
subplot(2,1,2) plot(1:length(acc_C4_his(1:10)), runtime_C4_his(1:10)) title('Classifier 4 Runtime') xlabel('Testing Iterations') ylabel('Runtime (sec)') axis tight
```

```
% save('Classifier4_data.mat','prob4','acc_C4_his','runtime_C4_his')
```

Plot all Accuracies and Runtimes Together

```
figure; subplot(2,1,1) plot(prob3(1:10), acc_C3_his(1:10)) hold on plot(prob3v2(1:10), acc_C3v2_his(1:10)) plot(prob4(1:10), acc_C4_his(1:10)) title('Classifier Prediction Accuracy') ylabel('Accuracy (%)') xlabel('Erasure Probability (%)') legend('C_3', 'C_{3v2}', 'C_4') axis tight ylim([0 1]) yticks([0 .25 .5 .75 .9 1]) grid on
```

```
subplot(2,1,2) plot(1:length(acc_C3_his(1:10)), runtime_C3_his(1:10)) hold on plot(1:length(acc_C3v2_his(1:10)), runtime_C3v2_his(1:10)) plot(1:length(acc_C4_his(1:10)), runtime_C4_his(1:10)) title('Classifier Runtime') xlabel('Testing Iterations') ylabel('Runtime (sec)') grid on
```

Generate and Plot Erasure Histogram

```
Ones = ones(100,16); obj3 = MyClassifier3(K,M); obj3.p = Ones*0.25; out = f_Corrupt(obj3,Ones); sum(sum(isnan(out))) x = [0.01, 0.1, 0.25, 0.5, 0.75]; y = [0.17, 1.58, 3.98, 8.2, 11.86]; bar(x,y); xlabel('Erasure Probability'); ylabel('Number of Erased Features'); grid on; title('Feature Erasure with 0.01, 0.1, 0.25, 0.5, 0.75 Probability')
```

Save Figures to PNG Files

```
% figures = [];
% for f = 1:length(findobj('type','figure'))
%     fig = figure(f);
%     print(fig, strcat(pwd, '\html\','Figure ', string(f), '_ ', ...
% datestr(now, 'dd_mm_yy-HH_MM'), '.png'), '-dpng')
% end
% close all
```

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