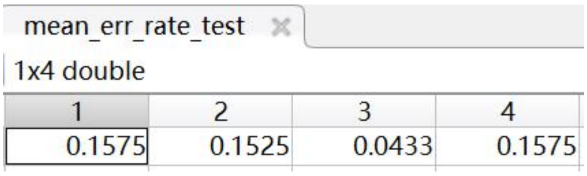
Image Analysis, Assignment 3

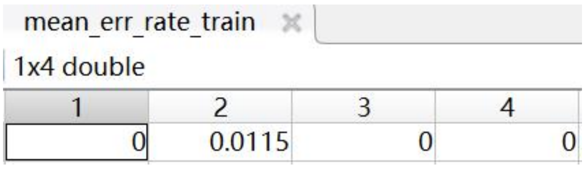
1&2 Your own classifier & pre-coded machine learning techniques

```
function classification_data = class_train(X, Y)
classification_data = [X;Y];
end

function Y = classify(X,CD)
train_set = CD(1:size(CD,1)-1,:);
diff = zeros(1,size(train_set,2));
for i = 1:size(train_set,2)
    diff(i) = norm(X - train_set(:,i));
end
[value,position] = min(diff);
Y = CD(end,position);
end
```



1x4 double

1	2	3	4
0.1575	0.1525	0.0433	0.1575



1x4 double

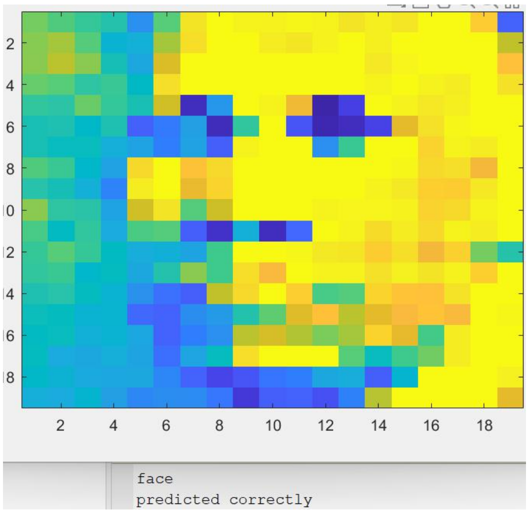
1	2	3	4
0	0.0115	0	0

1:my own method. 2:regression tree. 3:SVM 4:Nearest neighbor

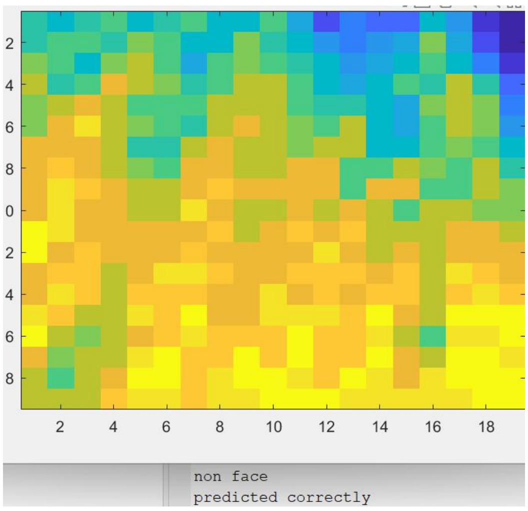
The error rates of training data is 0, because I use nearest neighbor method, the classify result is just choosing the nearest data in the training data which can find exactly the same picture when we test it on the training data, so the label can not be wrong.

The error rates of test data is higher than training data. And among them, the SVM classifier(3rd) has the lowest error rate, and the Regression tree Classifier and Nearest Neighbor Classifier have almost the same error rates.

My own NN classifier has the same error rate with the NN method by built in function.

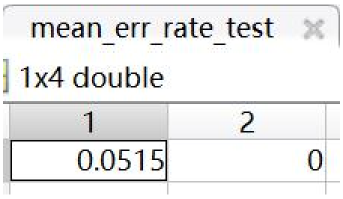


```
face
predicted correctly
```



```
non face
predicted correctly
```

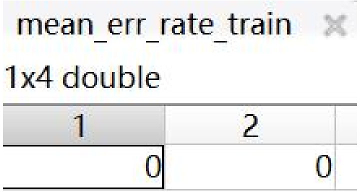
3 Testing a simple CNN model



mean_err_rate_test

1x4 double

1	2
0.0515	0



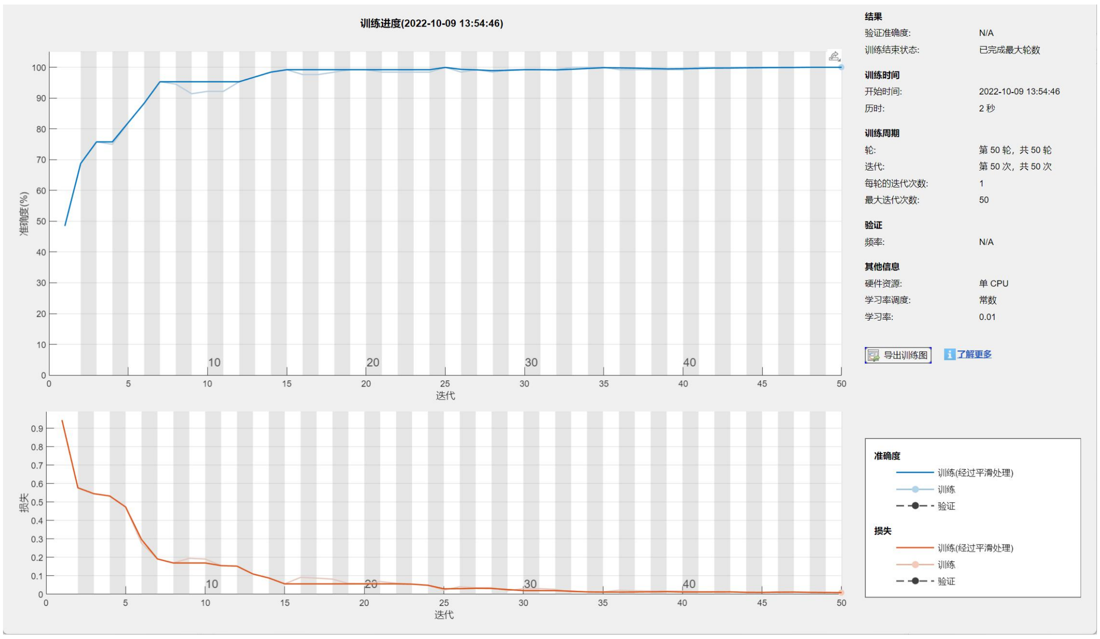
mean_err_rate_train

1x4 double

1	2
0	0

This model is much more complex than the previous models, this is a CNN model contains 3 convolutional layers, 2 max pooling layers and a fully connected layer. And it takes over 5 minutes to run this model, it's a long time compared to the previous methods.

The error rate in test data is lower than regression tree and NN and my own classifier, and a bit higher than the SVM classifier.



训练进度(2022-10-09 13:54:46)

结果

验证准确度: N/A

训练结束状态: 已完成最大轮数

训练时间

开始时间: 2022-10-09 13:54:46

历时: 2 秒

训练周期

轮: 第 50 轮，共 50 轮

迭代: 第 50 次，共 50 次

每轮的迭代次数: 1

最大迭代次数: 50

验证

频率: N/A

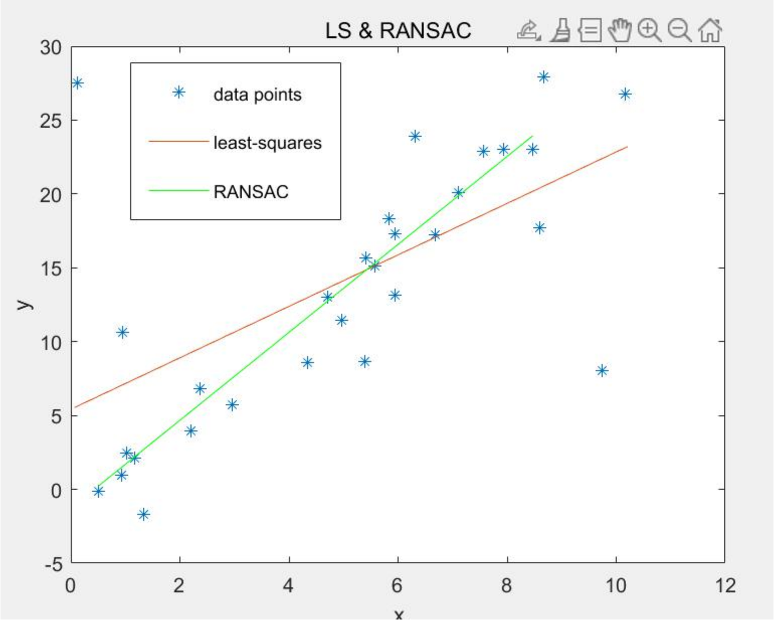
其他信息

硬件资源: 单 CPU

学习率调度: 常数

学习率: 0.01

4 Line fit



```
% Fit a line to these data points with least squares
train_xm = [xm,ones(N,1)];
train_ym = ym;
p_ls = train_xm\train_ym;
plot(x_fine, p_ls(1) * x_fine + p_ls(2))
% Fit a line to these data points using RANSAC.
bestins = 0;
theshold = 1;
for i=1:100
    idx = randperm(N,2);
    k = (ym(idx(1),1)-ym(idx(2),1))/(xm(idx(1),1)-xm(idx(2),1));
    m = ym(idx(1),1)- k*xm(idx(1),1);
    line = [k -1 m];
    distance = abs(line*[xm';ym';ones(1,N)]);
    ins = sum(distance<theshold);
    if ins > bestins
        bestins = ins;
        trueline = line;
    end
end
pa(1) = trueline(1);
pa(2) = trueline(3);
plot(x_fine,pa(1)*x_fine+pa(2),'k--')
```

Need 2 points to sample to estimate the line model in RANSAC.
Least squares method can be affected by noisy points (outliers), and can not fit the line well, and RANSAC approach can refit a line to the inliers, and this line is robust to the outliers that RANSAC identified and ignored.

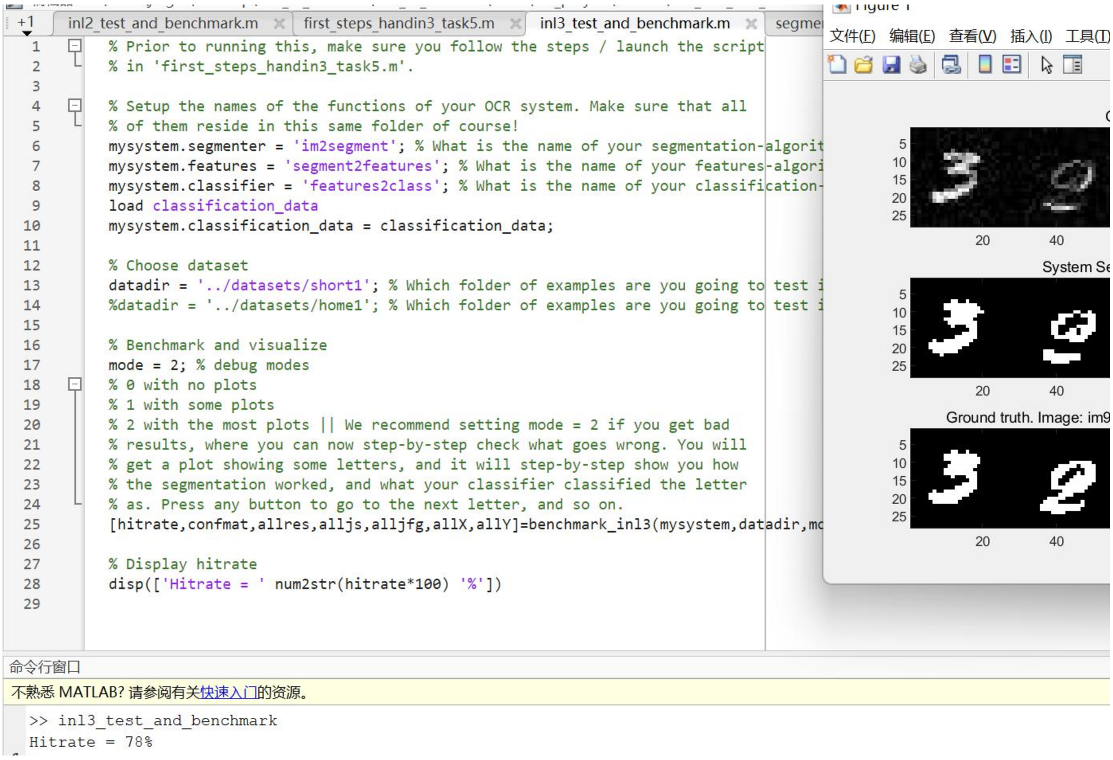
```
% WRITE CODE BELOW TO COMPUTE THE 4 ERRORS
LS_squared_vertical_errors = 0;
LS_squared_orthogonal_errors = 0;
RANSAC_squared_vertical_errors = 0;
RANSAC_squared_orthogonal_errors = 0;
for i =1:N

    LS_squared_vertical_errors = (p_ls(1) * xm(i) + p_ls(2) - ym(i))^2 +
LS_squared_vertical_errors;
    LS_squared_orthogonal_errors =
(abs(p_ls(1)*xm(i)+p_ls(2)-ym(i))/sqrt(p_ls(1)^2+1))^2 +
LS_squared_orthogonal_errors;
    RANSAC_squared_vertical_errors = (modelInliers(1) * xm(i) + modelInliers(2)
- ym(i))^2 + RANSAC_squared_vertical_errors;
    RANSAC_squared_orthogonal_errors = (abs(modelInliers(1)*xm(i) +
modelInliers(2)-ym(i))/sqrt(modelInliers(1)^2+1))^2 +
RANSAC_squared_orthogonal_errors;
end
LS_squared_vertical_errors
LS_squared_orthogonal_errors
RANSAC_squared_vertical_errors
RANSAC_squared_orthogonal_errors
```

```
LS_squared_vertical_errors =
   1.4839e+03
LS_squared_orthogonal_errors =
   367.7324
RANSAC_squared_vertical_errors =
   1.9028e+03
RANSAC_squared_orthogonal_errors =
   192.2856
```

Among the four error, squared_orthogonal_error (TLS) for RANSAC is the lowest.
The two LS error are much higher than the two TLS error.
So RANSAC is the better approach than LS, because its TLS is lower.

5 OCR system construction and system testing

For the short1, Hit rate = 78%


inl2_test_and_benchmark.m
first_steps_handin3_task5.m
inl3_test_and_benchmark.m
segme
文件(F) 编辑(E) 查看(V) 插入(I) 工具(T)
System Se
Ground truth. Image: im9
5
10
15
20
25
20
40

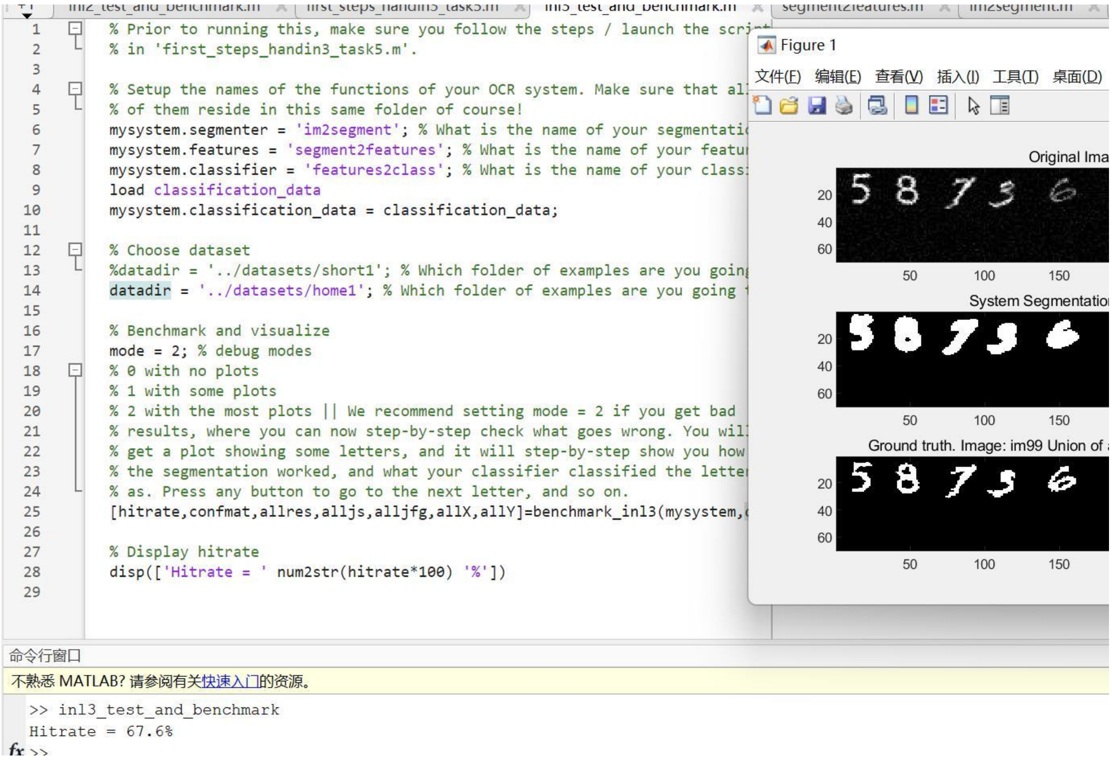
```
% Prior to running this, make sure you follow the steps / launch the script
% in 'first_steps_handin3_task5.m'.

% Setup the names of the functions of your OCR system. Make sure that all
% of them reside in this same folder of course!
mysystem.segmenter = 'im2segment'; % What is the name of your segmentation-algorit
mysystem.features = 'segment2features'; % What is the name of your features-algori
mysystem.classifier = 'features2class'; % What is the name of your classification-
load classification_data
mysystem.classification_data = classification_data;

% Choose dataset
datadir = '../datasets/short1'; % Which folder of examples are you going to test i
%datadir = '../datasets/home1'; % Which folder of examples are you going to test i

% Benchmark and visualize
mode = 2; % debug modes
% 0 with no plots
% 1 with some plots
% 2 with the most plots || We recommend setting mode = 2 if you get bad
% results, where you can now step-by-step check what goes wrong. You will
% get a plot showing some letters, and it will step-by-step show you how
% the segmentation worked, and what your classifier classified the letter
% as. Press any button to go to the next letter, and so on.
[hitrate,confmat,allres,alljs,alljfg,allX,allY]=benchmark_inl3(mysystem,datadir,mo

% Display hitrate
disp(['Hitrate = ' num2str(hitrate*100) '%'])
```

命令行窗口

不熟悉 MATLAB? 请参阅有关快速入门的资源。

```
>> inl3_test_and_benchmark
Hitrate = 78%
```

For the home1, Hit rate =67.6 %


inl2_test_and_benchmark.m
first_steps_handin3_task5.m
inl3_test_and_benchmark.m
segment2features.m
im2segment.m
Figure 1
文件(F) 编辑(E) 查看(V) 插入(I) 工具(T) 桌面(D)
Original Ima
System Segmentatio
Ground truth. Image: im99 Union of
20
40
60
50
100
150

```
% Prior to running this, make sure you follow the steps / launch the scri
% in 'first_steps_handin3_task5.m'.

% Setup the names of the functions of your OCR system. Make sure that al
% of them reside in this same folder of course!
mysystem.segmenter = 'im2segment'; % What is the name of your segmentati
mysystem.features = 'segment2features'; % What is the name of your featu
mysystem.classifier = 'features2class'; % What is the name of your class
load classification_data
mysystem.classification_data = classification_data;

% Choose dataset
%datadir = '../datasets/short1'; % Which folder of examples are you going
datadir = '../datasets/home1'; % Which folder of examples are you going 

% Benchmark and visualize
mode = 2; % debug modes
% 0 with no plots
% 1 with some plots
% 2 with the most plots || We recommend setting mode = 2 if you get bad
% results, where you can now step-by-step check what goes wrong. You will
% get a plot showing some letters, and it will step-by-step show you how
% the segmentation worked, and what your classifier classified the letter
% as. Press any button to go to the next letter, and so on.
[hitrate,confmat,allres,alljs,alljfg,allX,allY]=benchmark_inl3(mysystem,

% Display hitrate
disp(['Hitrate = ' num2str(hitrate*100) '%'])
```

命令行窗口

不熟悉 MATLAB? 请参阅有关快速入门的资源。

```
>> inl3_test_and_benchmark
Hitrate = 67.6%
fx >>
```

When I test the short1 data, my segment function works well and give the 78% hit rate.

But when I test the home1 data, there are more noise in the image, so the segment function always recognizes some noise point as a digit, so I have to adjust the gaussian filter's standard deviation from 0.5 to 1.25, and then it can work.

We do not demand a complete report for these assignments, but more text and structure would have gotten you much further.

1) Comment your own classifier specifically, for example why we get exactly 0 for training error.

3) Comment the method, ex model complexity, running times etc.

4) "How is the line model estimated for the minimal dataset in the RANSAC approach?" I.e. how would you calculate the line if you do not use polyfit?

"Atleast2pointstosampletoestimatethelinemodelinRANSAC" No, exactly 2 points.

Please address my comments and resubmit.