REPORT for HOMEWORK4

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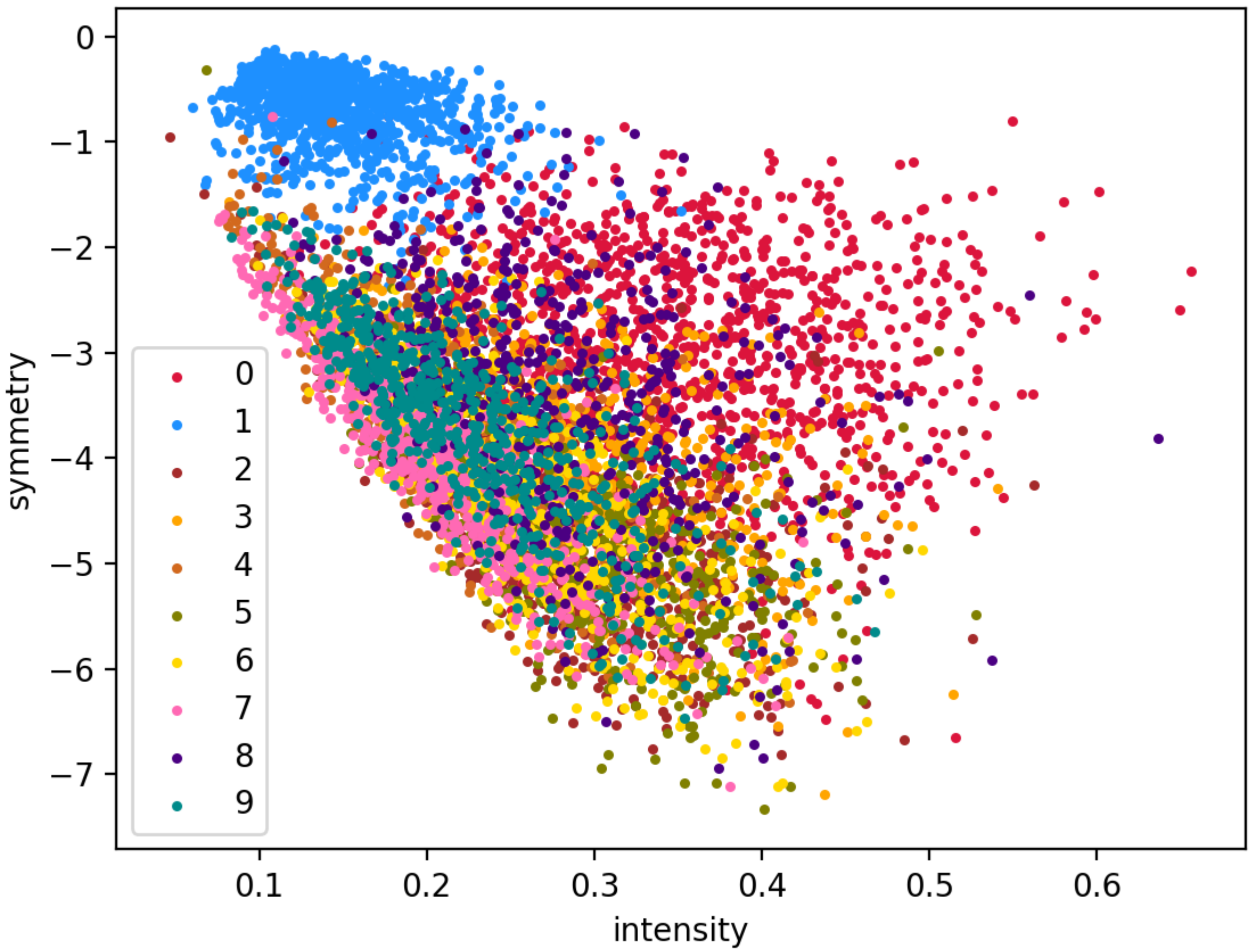
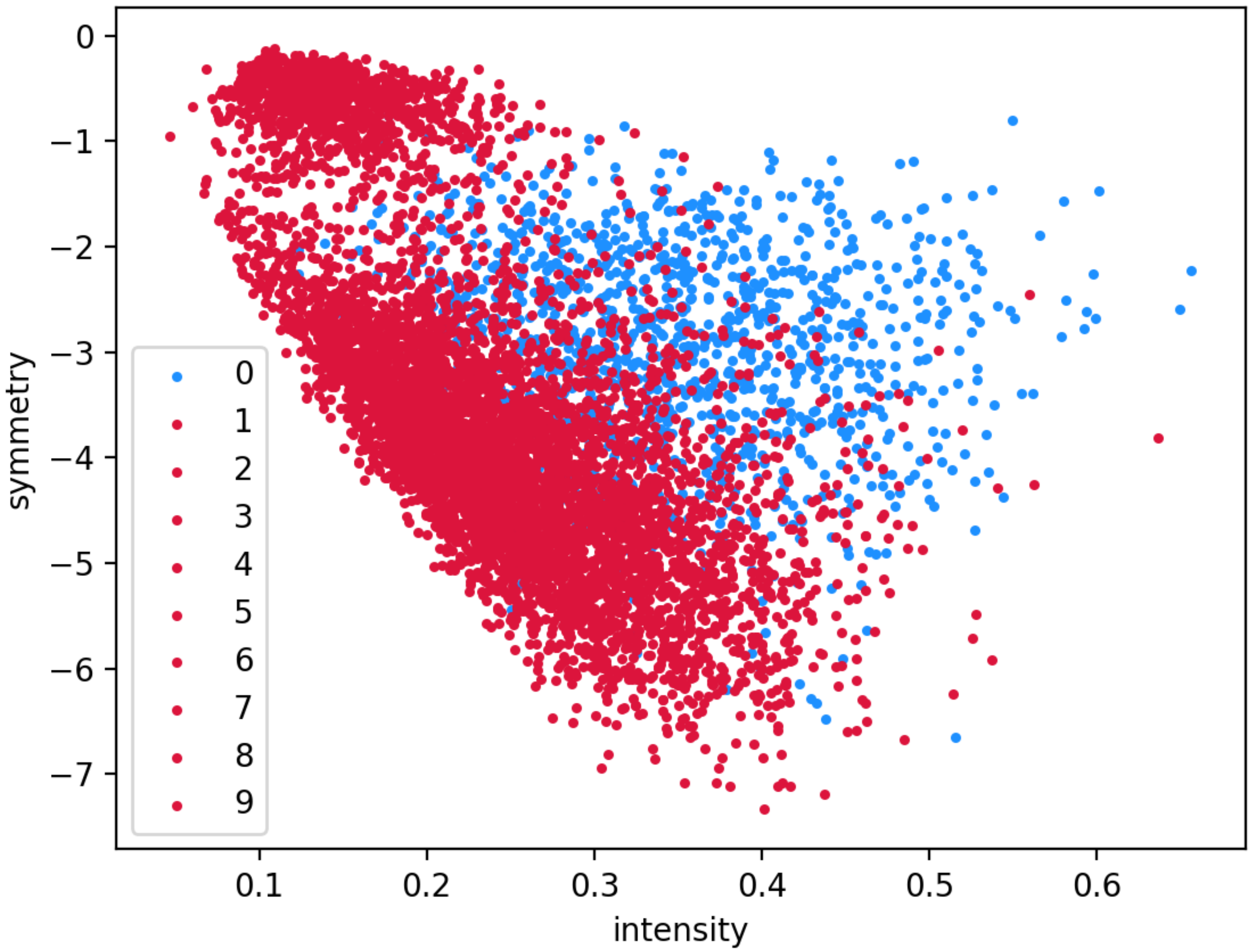
Problem1

Pictures

all



for every label



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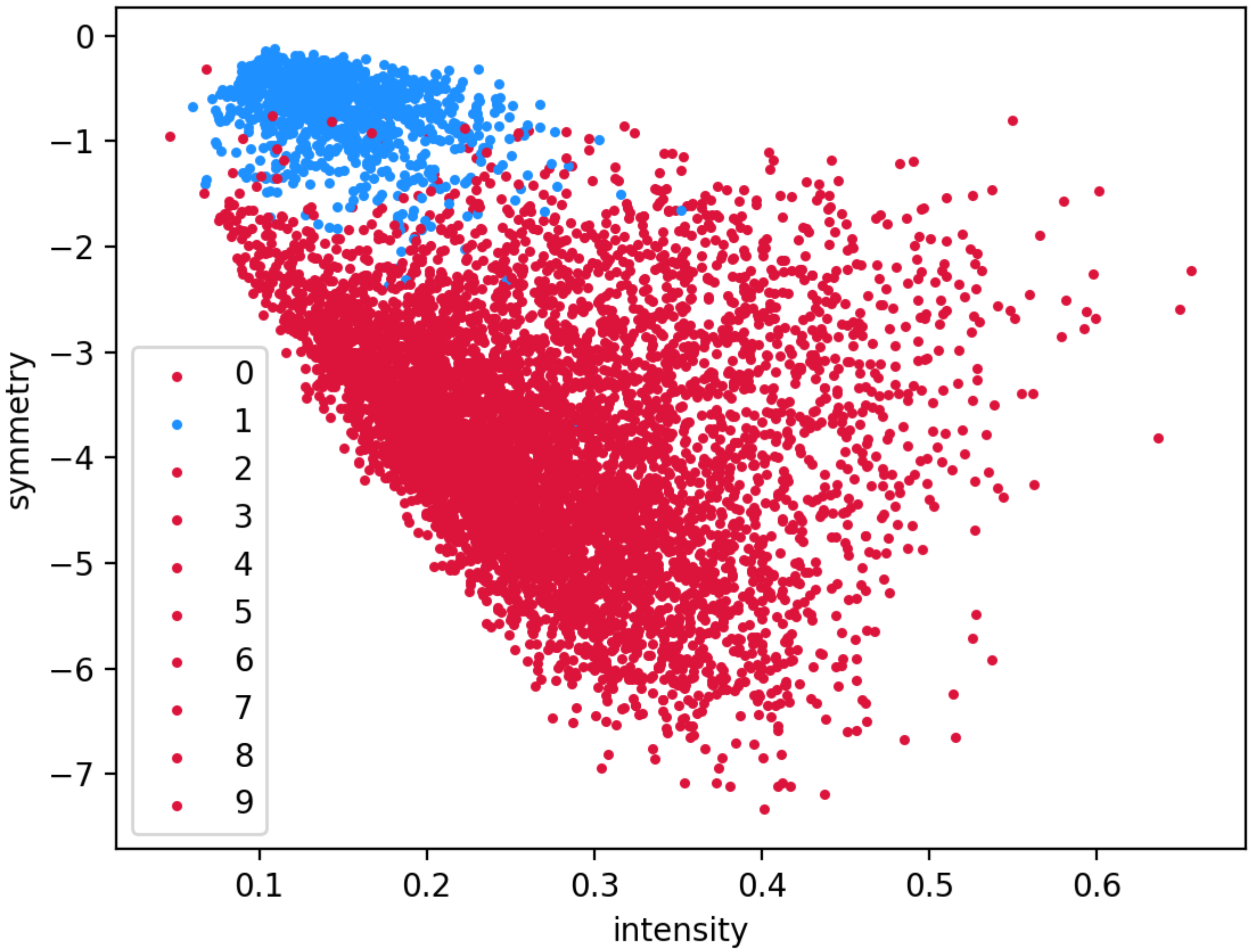

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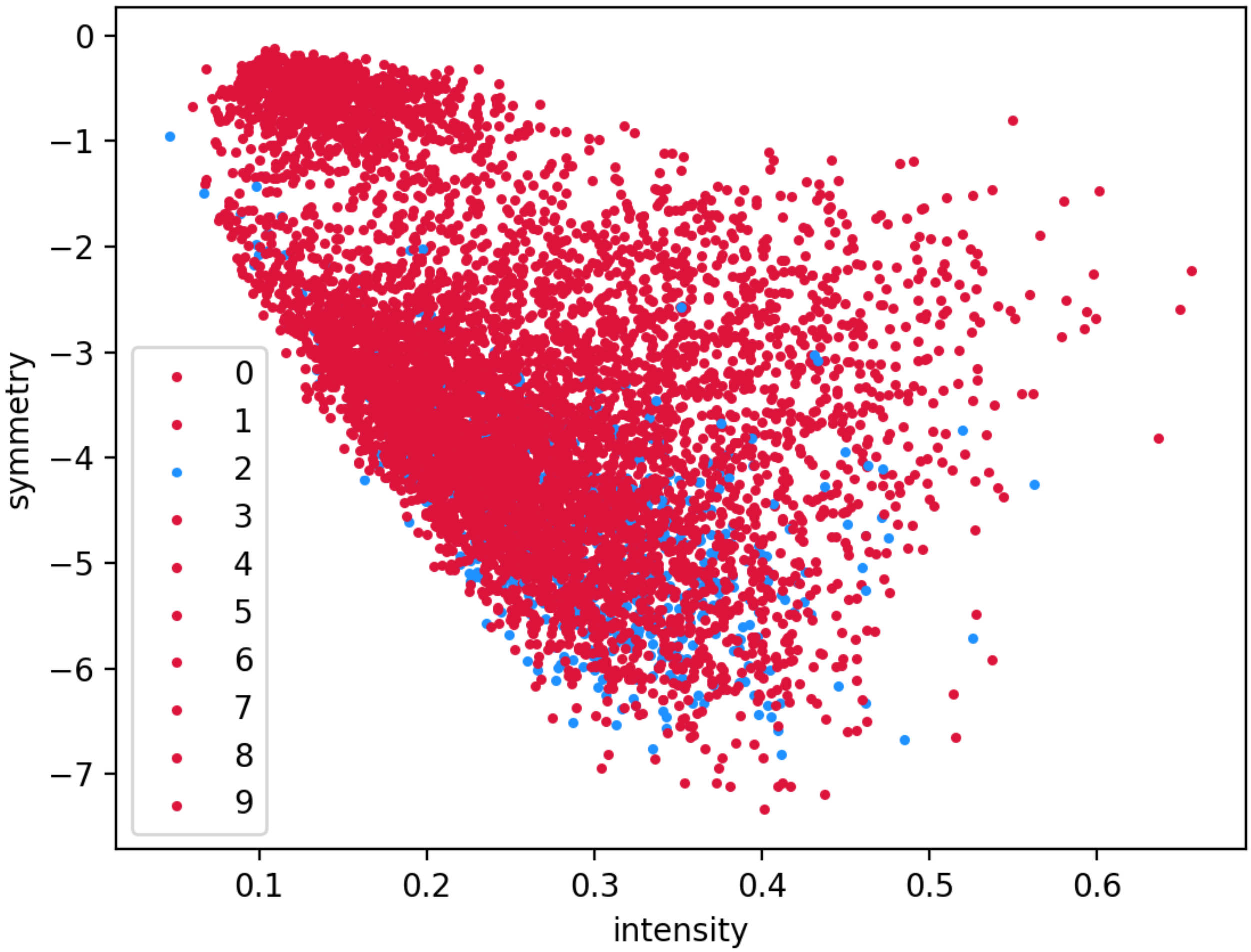
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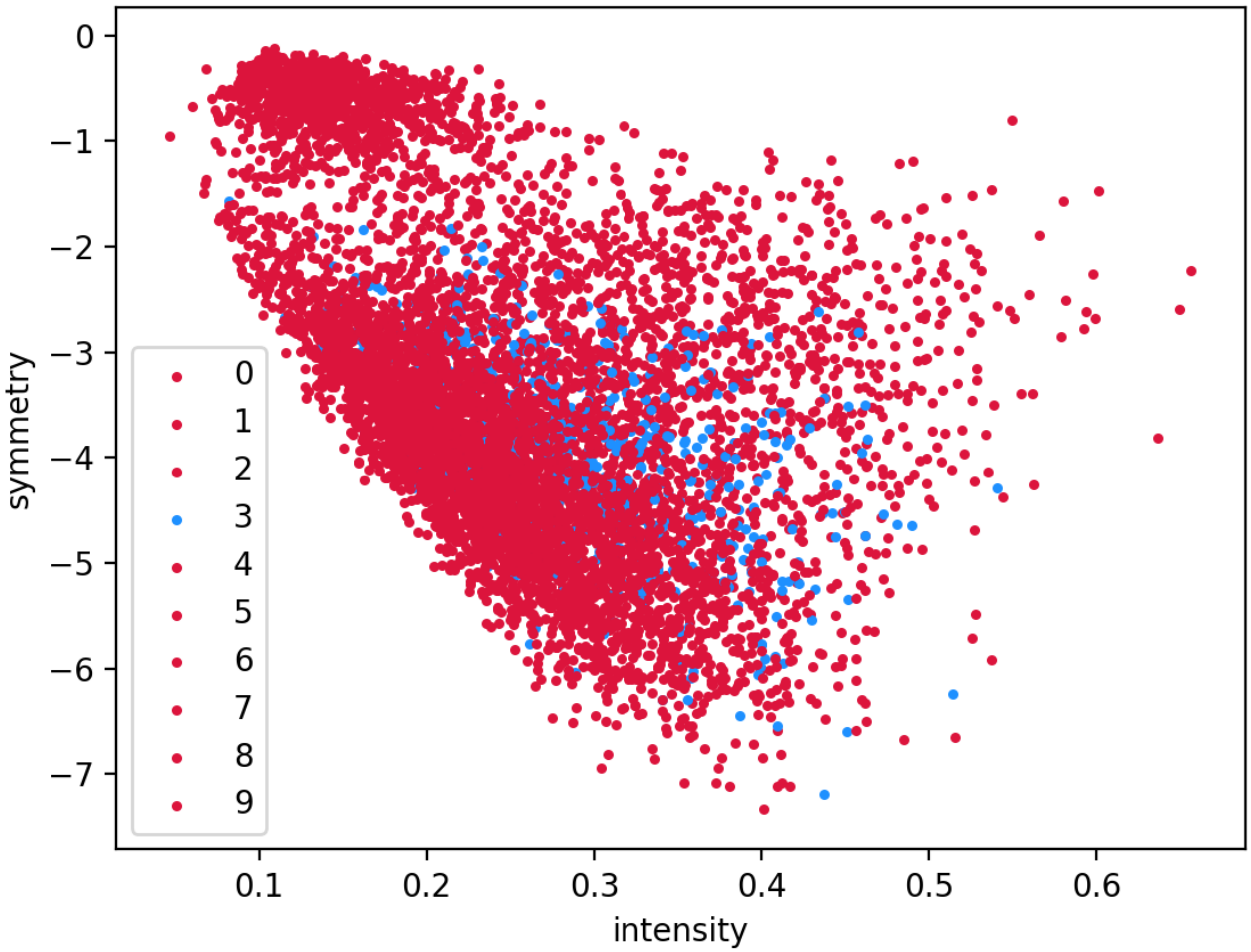
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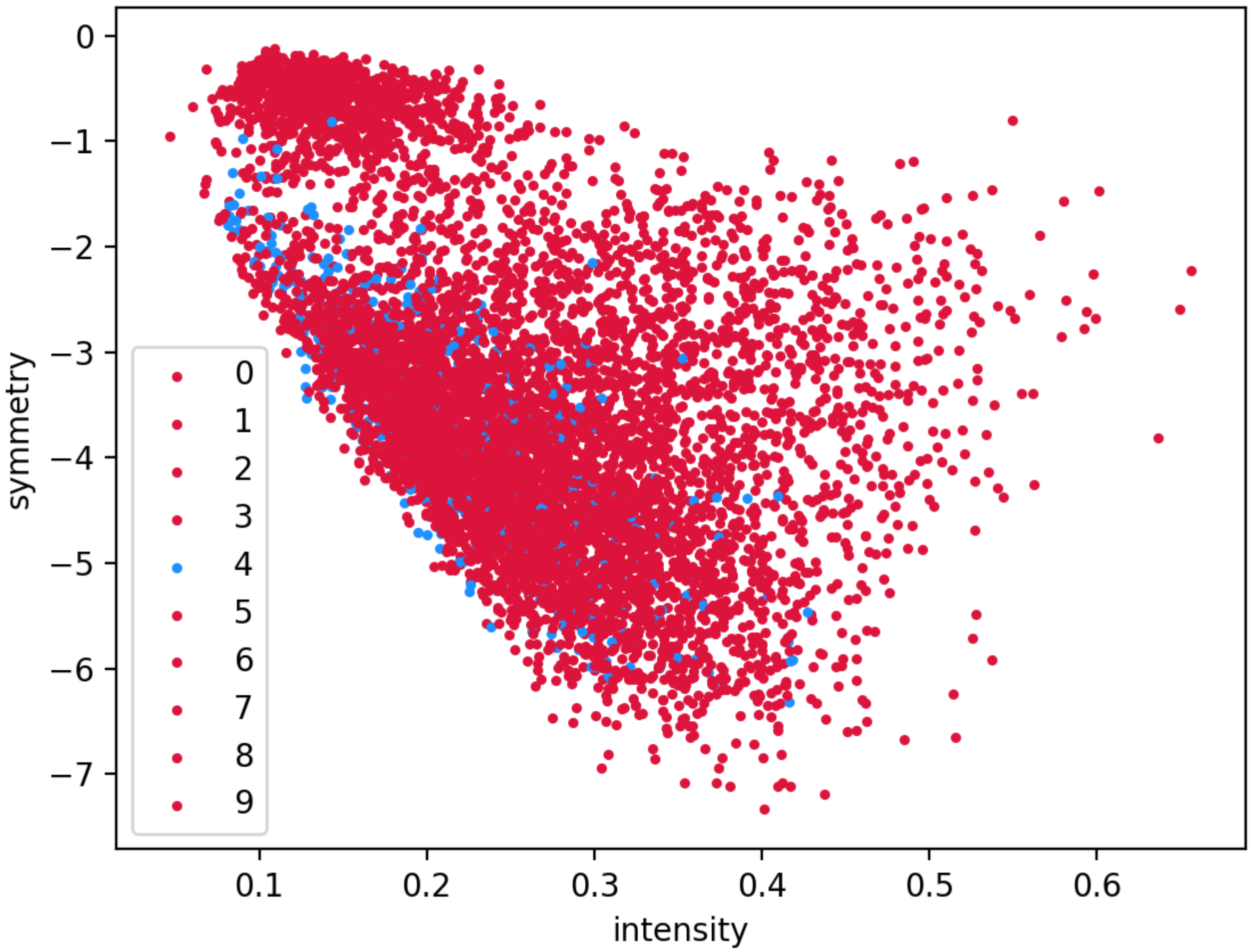
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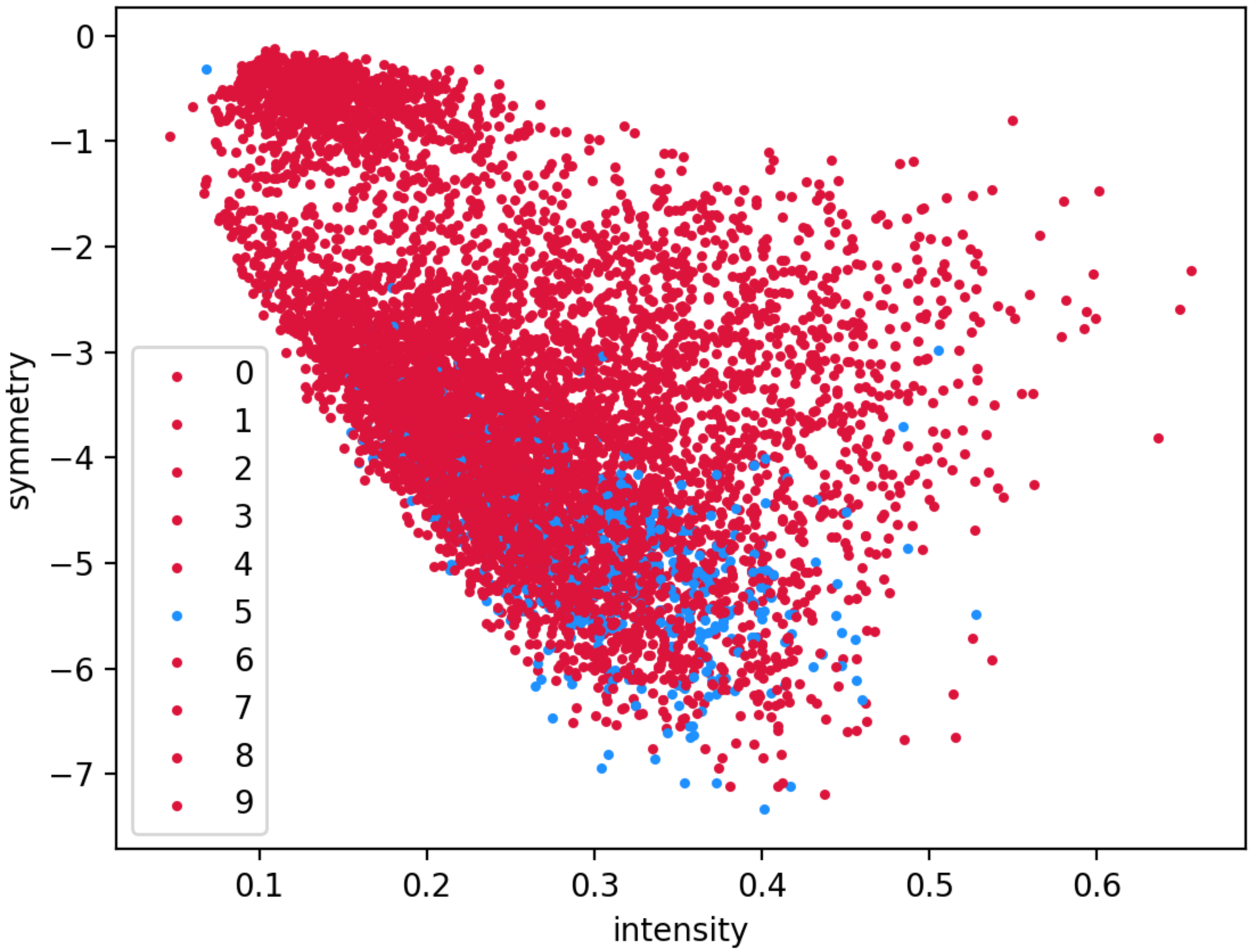
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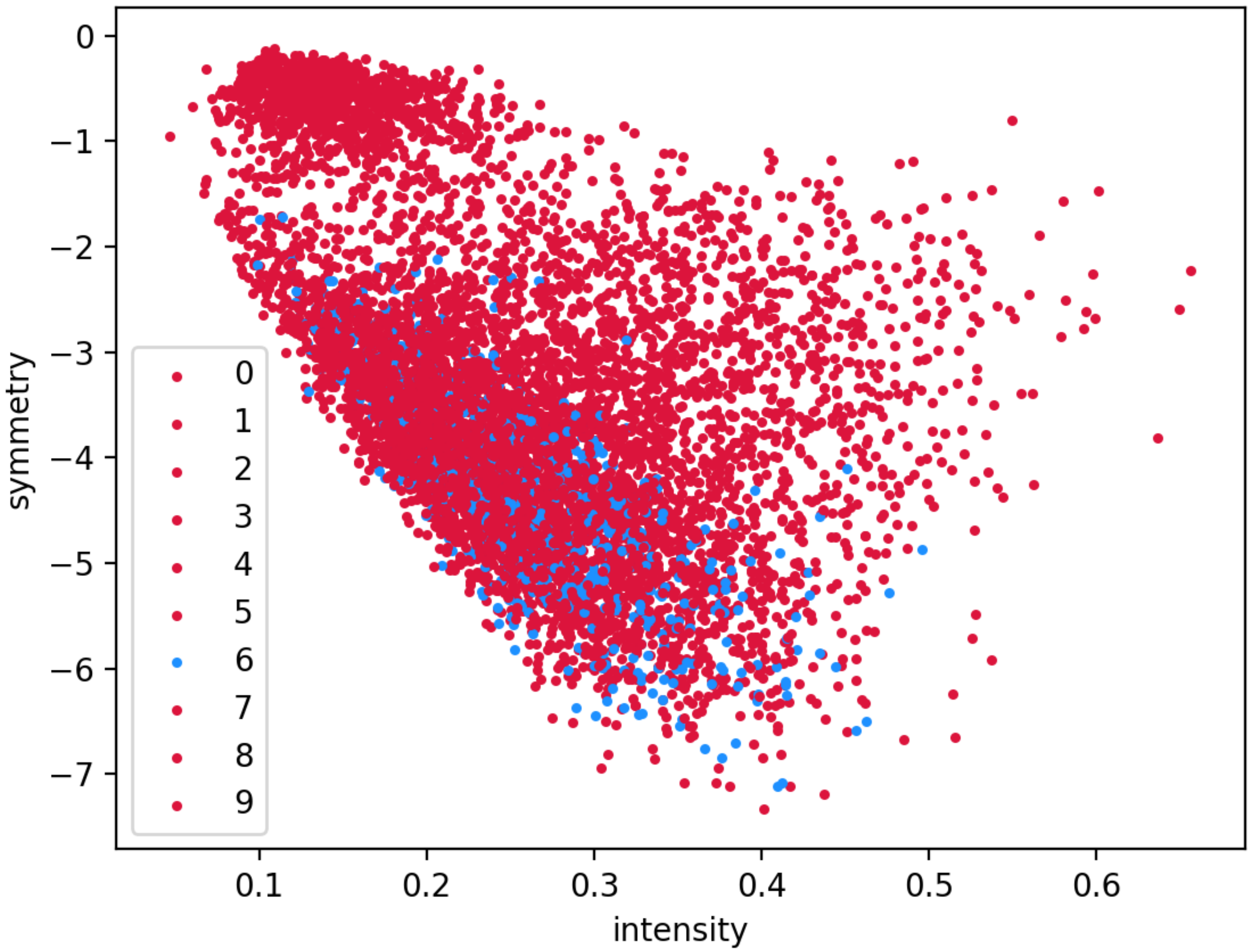
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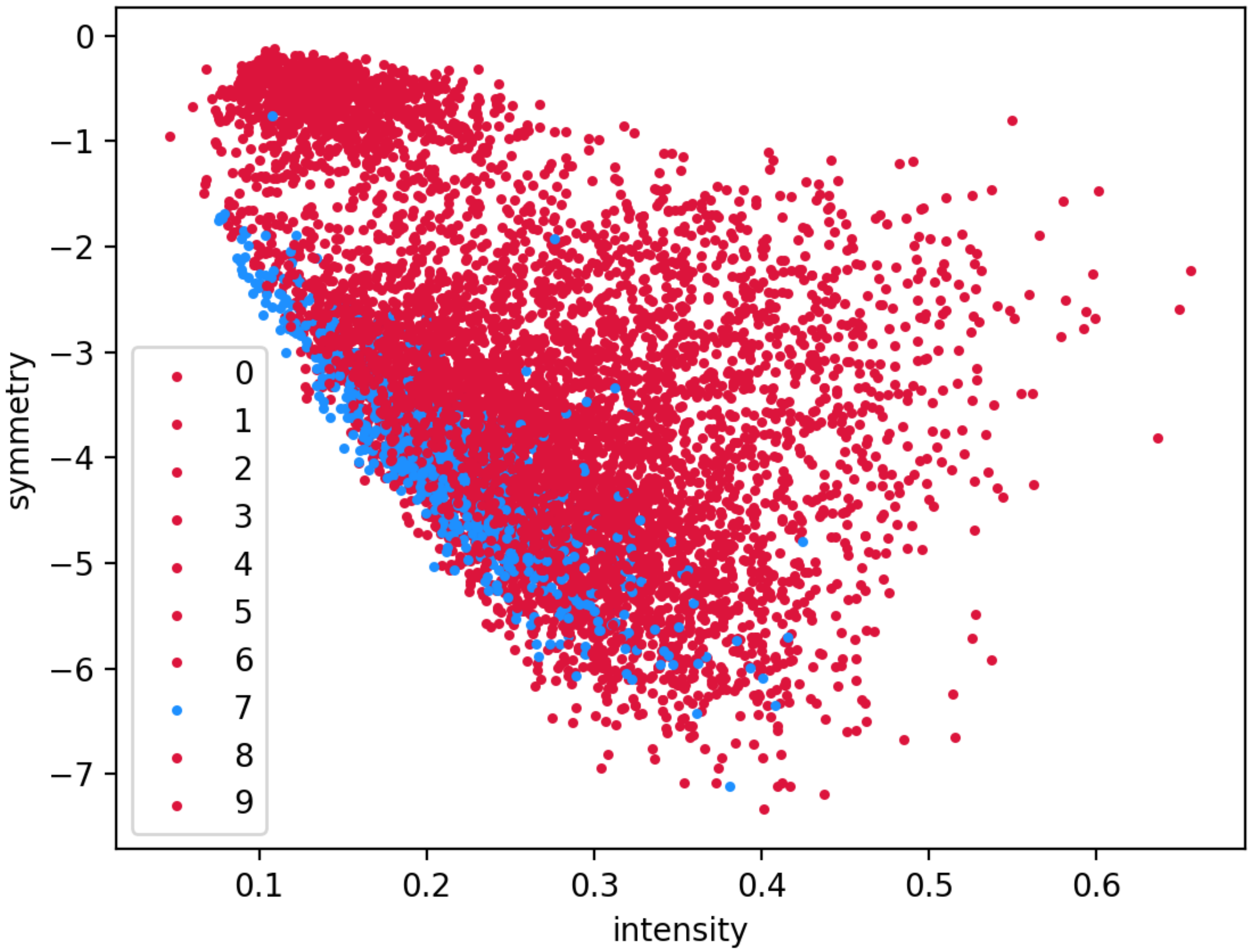
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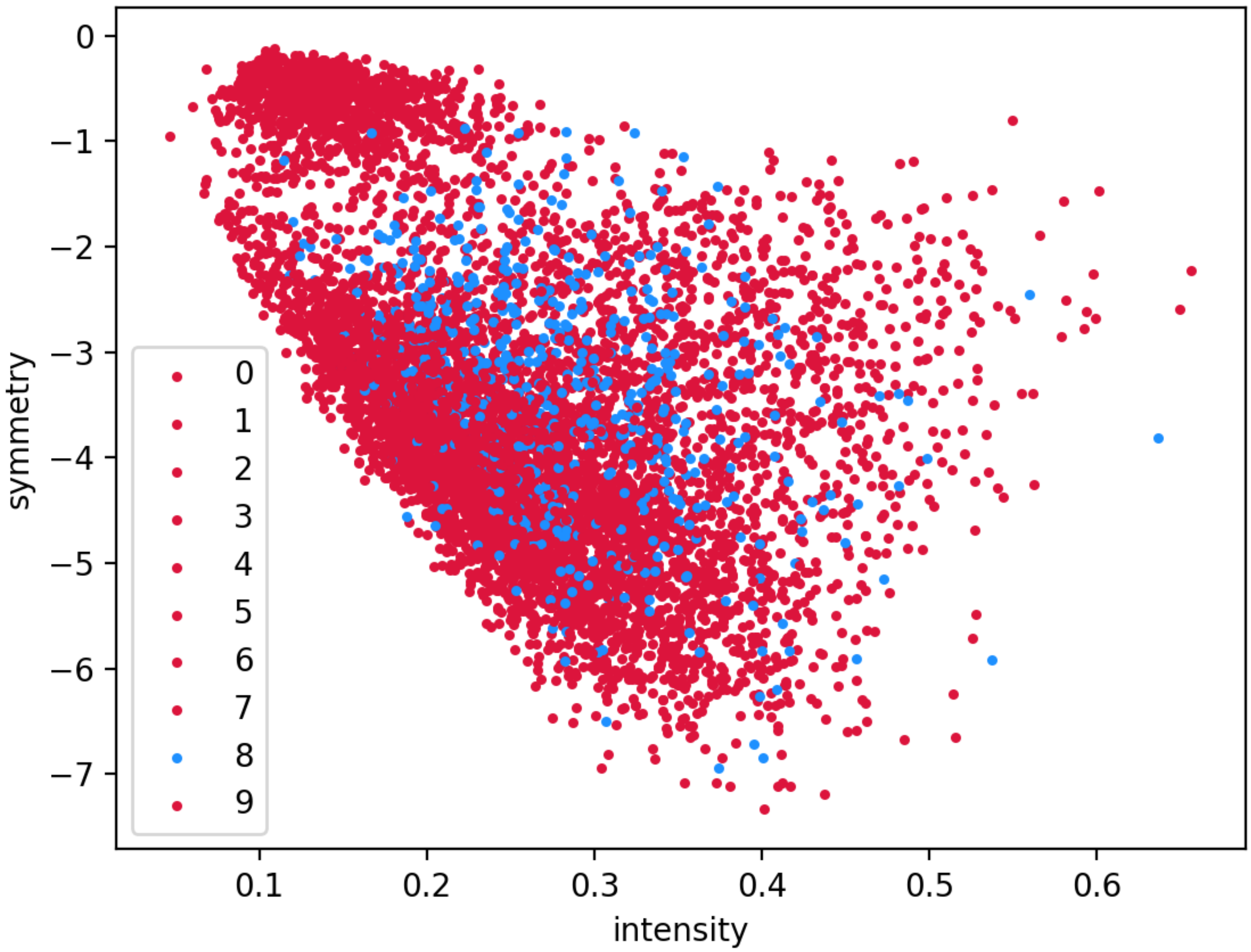
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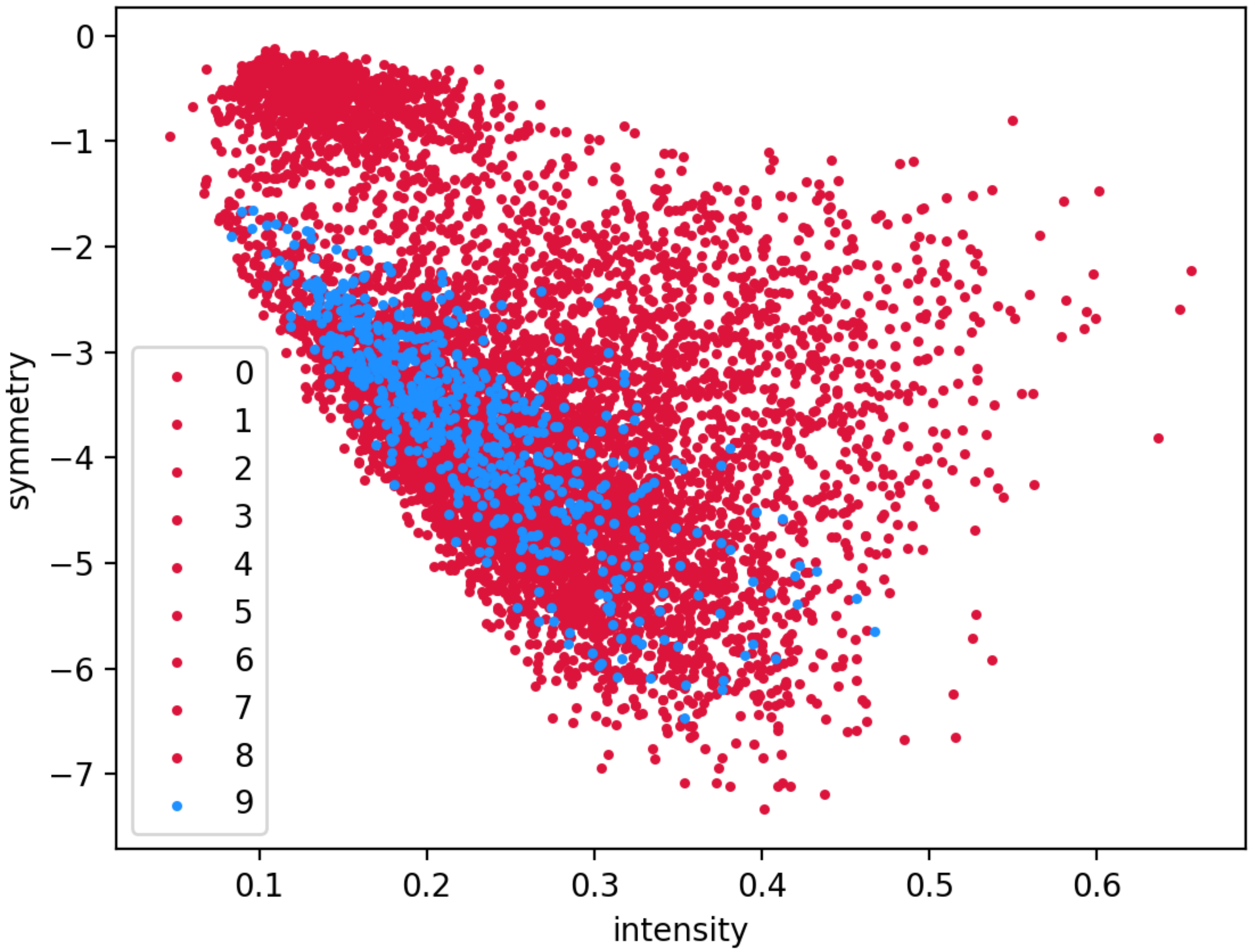


analysis

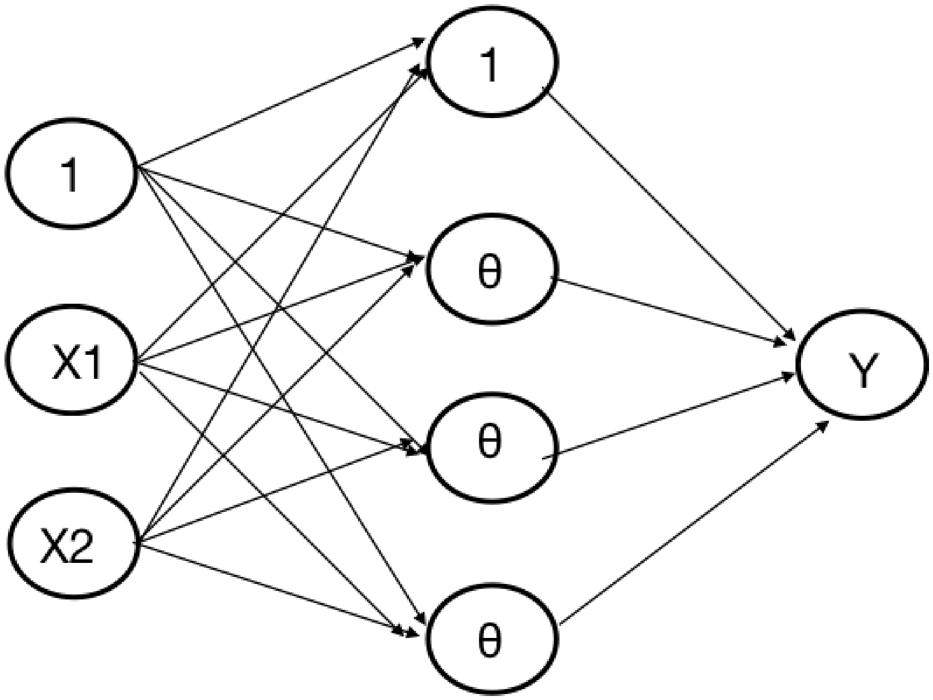
From the plot we can tell these data are croweded under 2 dimensions of intensity and symmetry. With these two features, only 0 and 1 can be divided from others better.

Problem2

model structure

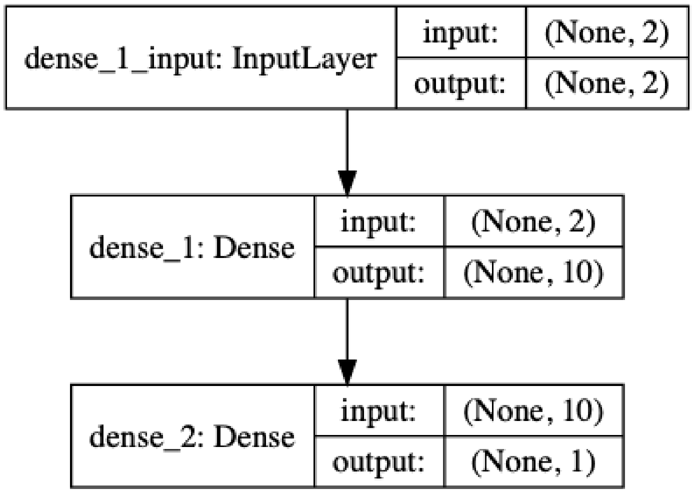
activition function: sigmoid
optimizier: SGD
model1:[2,10,1]
model2:[2,6,1]
model3:[2,3,1]

use model3 as example:

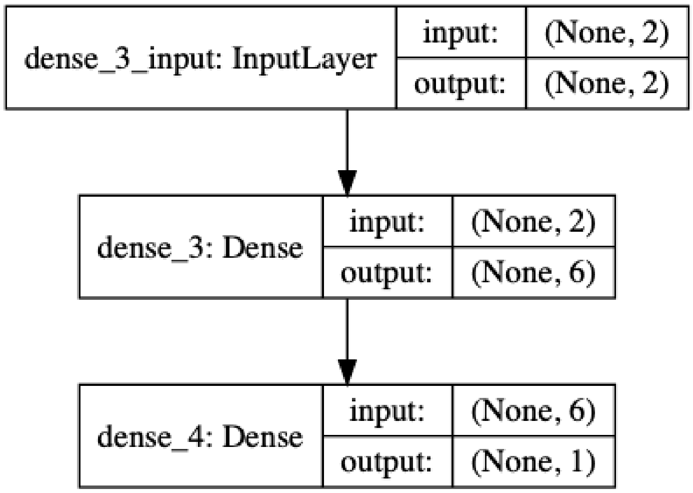


the structure program draw :

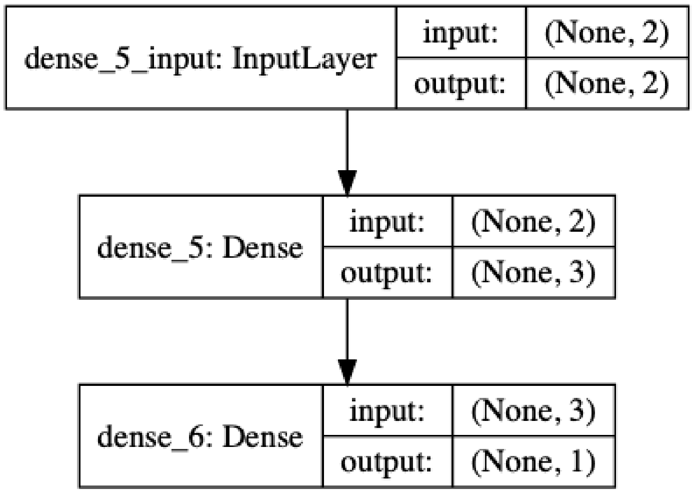
model1



model2



model3



compare

in-sample err

fold	model1	model2	model3
1	0.10424975546506735	0.13486736027094035	0.31666794556837813
2	0.11964598716049671	0.129807025552025	0.35231537946592034
3	0.13435564638901856	0.14421843574896784	0.22817056807157057
mean	0.11941712967152755	0.1362976071906444	0.2990512977019563

test-set err

fold	model1	model2	model3
1	0.1081075934181973	0.13911615114752024	0.32053642166553215

fold	model1	model2	model3
2	0.11976621609467726	0.12982253707372227	0.3516518171016987
3	0.12993708321681388	0.14026892552008996	0.22385613368107724
mean	0.11927029757656282	0.1364025379137775	0.29868145748276936

analysis

From the table above, we can tell model1's performance is the best, and model3 is the worest.
Maybe we can say with enough training, with larger number of units, model performs better.

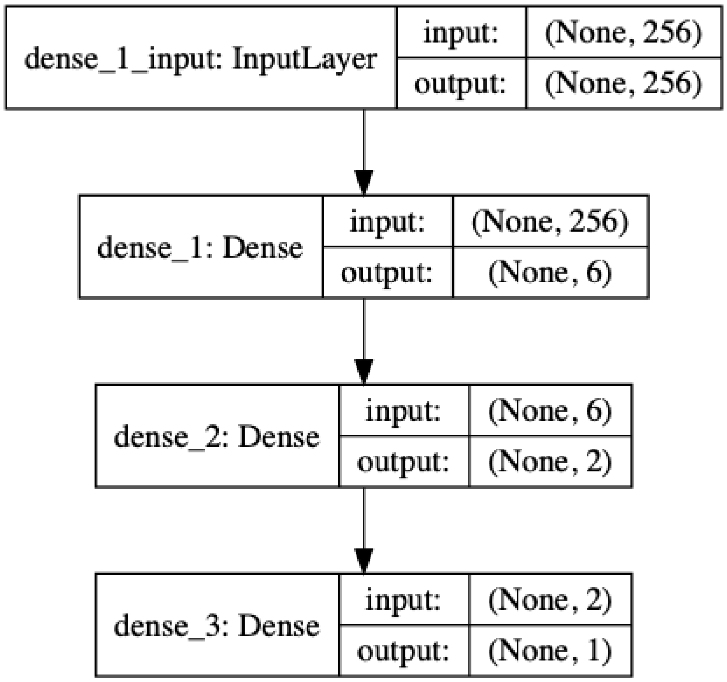
Problem3

model compare

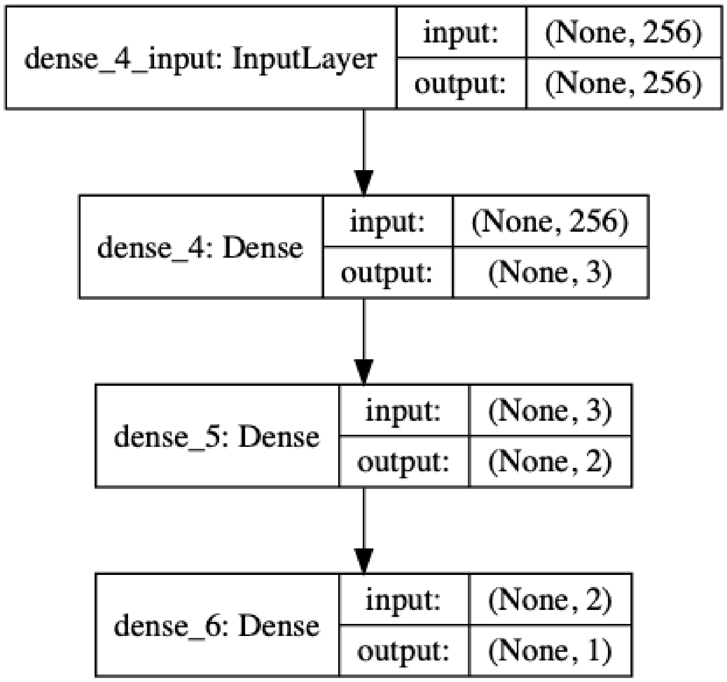
model1:[256,6,2,1]
model2:[256,3,2,1]

model structure

model1:



model2:



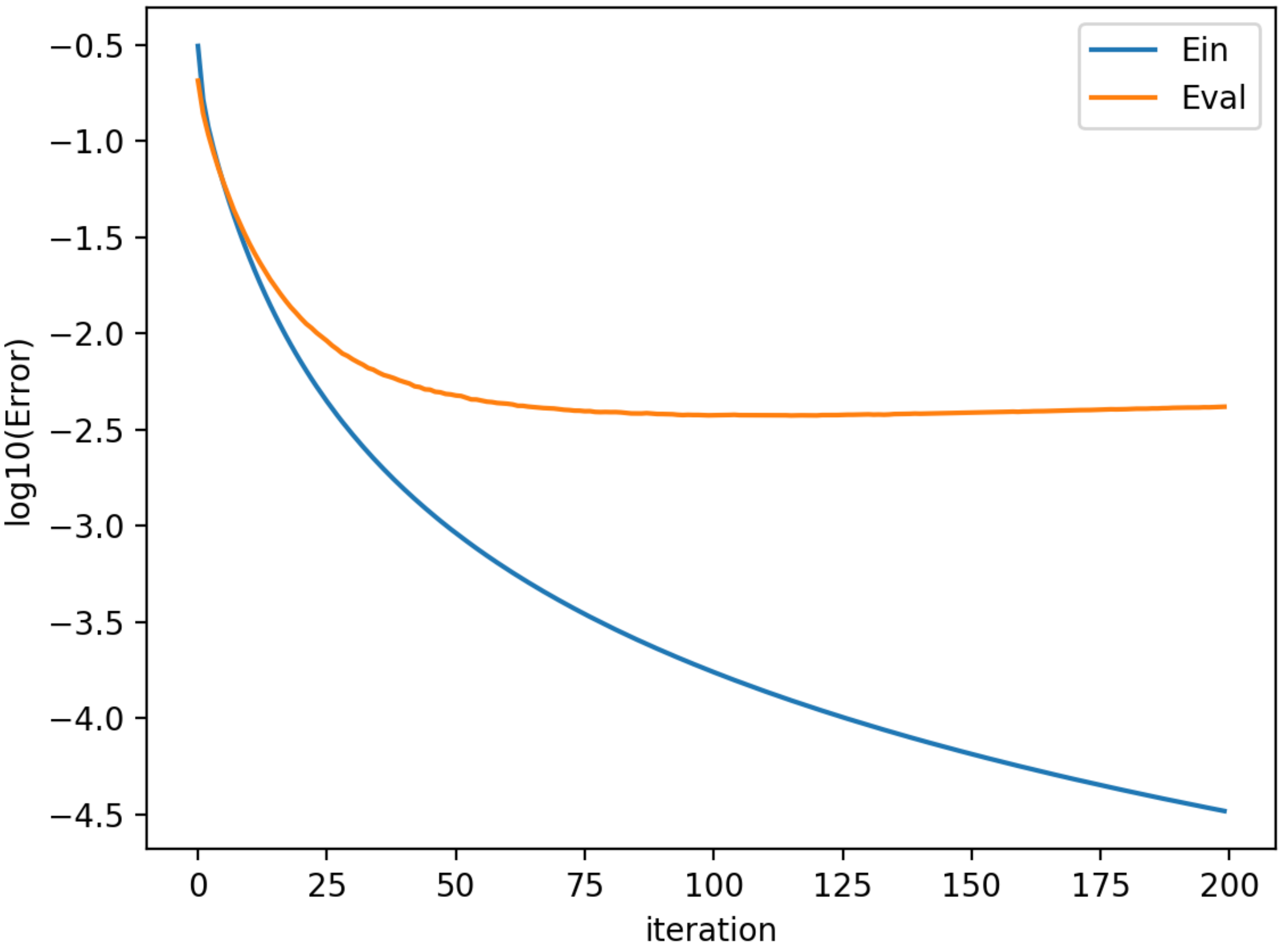
in-sample err

fold	model1	model2
1	0.034394051850988316	0.2286447992691627
2	0.001363789220765505	0.03837108826774685
3	0.04159947733800075	0.035572247763990095
mean	0.025785772803251523	0.10086271176696654

test-set err

fold	model1	model2
1	0.041843194743321634	0.23042585716480943
2	0.005192505216333442	0.039086641342594076
3	0.04771237906355124	0.0376400548678178
mean	0.03158269300773544	0.1023841844584071

plot change of in-sample err and test-set error for each iteration



analysis

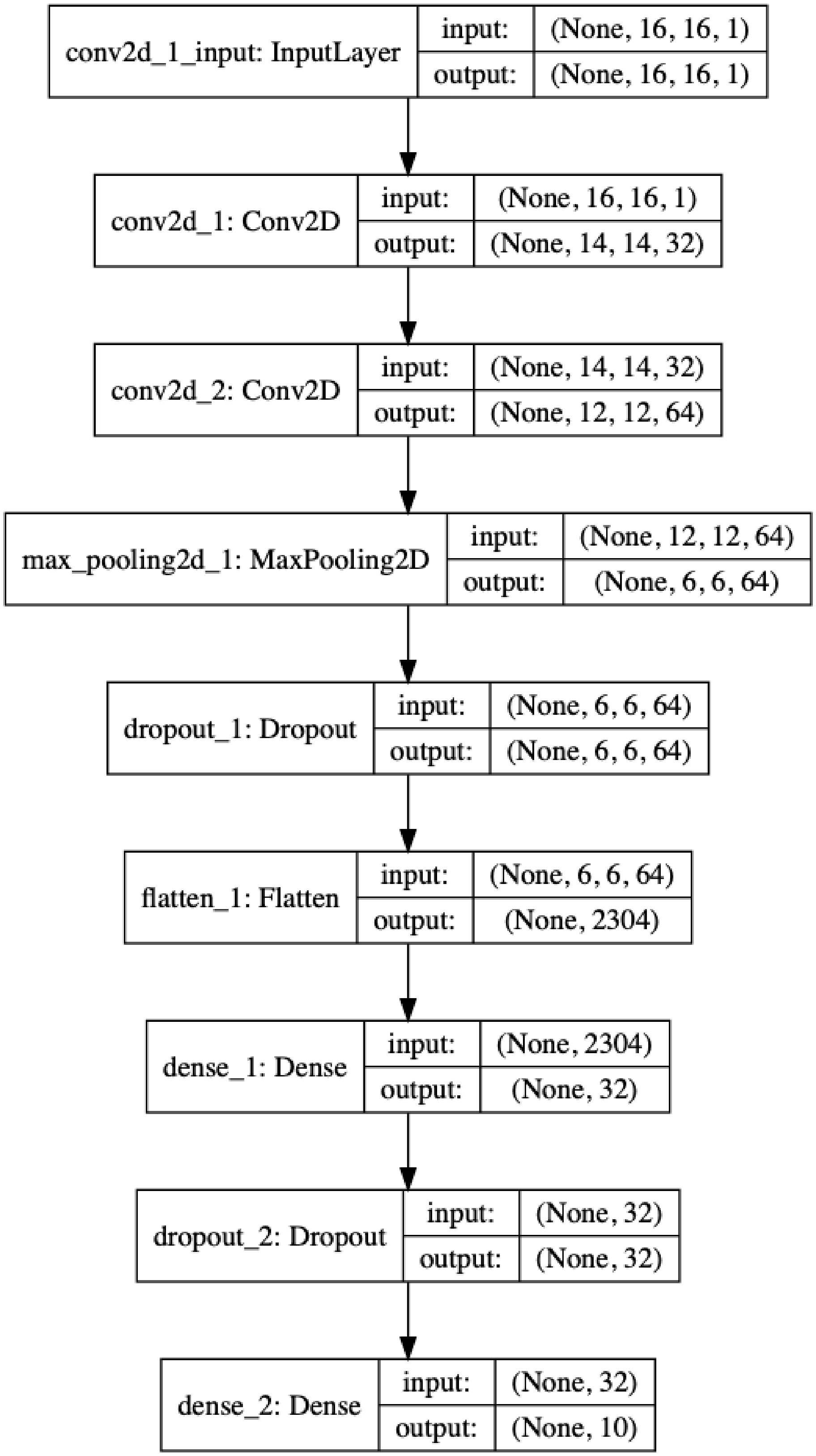
- From the table we could tell:
  1. For same iteration, with more layer, the model will performs better.
  2. With more units, the model performs better.
- From the line chart, we know:
  3. There is a number(for this task is about 50), before that number of iteration, Ein and Eval both decrease. But after that number of iteration, Eval increase while Ein decrease.

Probelm4

model structure

- algorithm: Convolutional Neural Network
- model structure'layer(activation)':
  [Conv(relu),Conv(relu),MaxPooling,Dropout,Flatten,Dense(relu),Dropout,Dense(softmax)]

- model units for each layer:[(16,16,1),(14,14,32),(12,12,64),(6,6,64),(2304),(32),(32),(10)]



conv2d_1_input: InputLayer | input: (None, 16, 16, 1) | output: (None, 16, 16, 1)

conv2d_1: Conv2D | input: (None, 16, 16, 1) | output: (None, 14, 14, 32)

conv2d_2: Conv2D | input: (None, 14, 14, 32) | output: (None, 12, 12, 64)

max_pooling2d_1: MaxPooling2D | input: (None, 12, 12, 64) | output: (None, 6, 6, 64)

dropout_1: Dropout | input: (None, 6, 6, 64) | output: (None, 6, 6, 64)

flatten_1: Flatten | input: (None, 6, 6, 64) | output: (None, 2304)

dense_1: Dense | input: (None, 2304) | output: (None, 32)

dropout_2: Dropout | input: (None, 32) | output: (None, 32)

dense_2: Dense | input: (None, 32) | output: (None, 10)

3-fold validation

accuracy:

fold	1	2	3	var
in-sample accuracy	0.9981470108032227	0.9973256587982178	0.9977384805679321	1.1243754253579634e-07
test-set accuracy	0.9880854487419128	0.9769547581672668	0.9806345105171204	2.1438814494937713e-05

Conclusion

```
 1. For same iteration, with more layer, the model will performs better.
 2. With more units, the model performs better.
 3. There is a number(for this task is about 50), before that number of iteration, Ein and Eval both
 4. Neural network is effective for digit classification.
```