Theoretical and practical metagenomic approaches to viral discovery

Practical Session: Practical Introduction to Machine Learning and SVMs

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WHOAMI

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- PhD student at Manja's Lab since 2017
- Interested in (RNA) viruses
- Focus on RNA secondary structures and ncRNAs
- Experience with Machine Learning, RNA structures, assemblies, alignments, SNP calling, ...

Introducing scikit-learn

BUILDING A SUPPORT VECTOR MACHINE WITH PYTHON3

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# Done.
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1 classifier = svm.SVC(kernel='linear')
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- create a classifier object with a linear kernel

Applying machine learning to real biological data

Our virus toy-data

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2 from sklearn import svm
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8    reader = csv.reader(inputStream, delimiter=',')
9    for idx, row in enumerate(reader):
10     if idx == 0:
11       continue
12   data.append(row[:4])
13   target.append(row[4])
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Let's make a Machine Learning model

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LET'S MAKE A MACHINE LEARNING MODEL

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# predict with our model
prediction = svmLinear.predict(data)

# check performance of our prediction and model
confusion_matrix(target, prediction)
accuracy_score(target, prediction)
```

EASY, RIGHT?

Problems...!?

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I used the same data for training and prediction (testing). This is very bad practice and should be avoided at all cost.

Our classifier learns based on the given training data - obviously, if the test data is identical to the training data, the model performs well.

We have to split our training set...

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5  # which are stored in the appropriate variables, respectively.
6  data_train, data_test, target_train, target_test = train_test_split(
7          data, target, test_size=0.33)
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14 # get the performance of this model
15 confusion_matrix(target_test, prediction)
16 accuracy_score(target_test, prediction)
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SVM Kernel and other Hyperparamter

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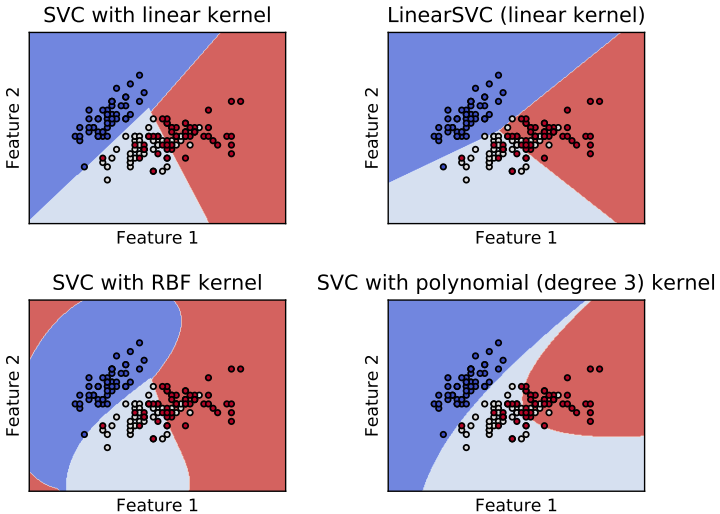

LET US CLASSIFY HANDWRITTEN DIGITS

```
1 from sklearn import svm, datasets
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4 # get the data
5 digits = datasets.load_digits()
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7  # split everything
8  data_train, data_test, target_train, target_test = train_test_split(
9          data, target, test_size=0.33)
10 # train the model with RBF kernel on the training set
11 digitSVM = svm.SVC(kernel='rbf').fit(data_train, target_train)
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13 prediction = digitSVM.predict(data_test)
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confusion_matrix(target_test, prediction)
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CHANGING THE DEGREE OF OUR KERNEL FUNCTION

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```
# init a for loop to change the hyperparamter 'degree'
for d in range(1,11):
  # train different SVMs with a different kernel each time
  digitSVM = svm.SVC(kernel='poly', degree=d, gamma='auto').
    fit(data_train, target_train)
  prediction = digitSVM.predict(data_test)
  # some output things
  print(f"Degree of polynomial kernel: {d}")
  print(f"Accuracy of digit classification:
    {accuracy_score(target_test, prediction)}")
```

Coffee Break