데이터과학을 위한 R프로그래밍

10주차. 서포트벡터머신

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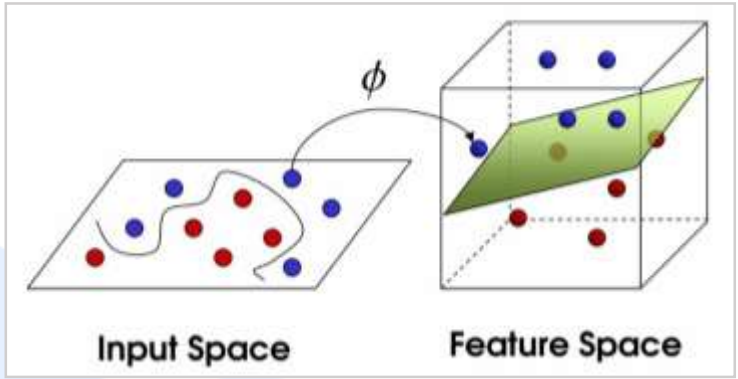
서포트벡터머신 II

-커널함수-

POSTECH

서포트벡터머신(kernel 함수)

커널(kernel)이란?



$$f(x) = \Phi(x)^T w + b$$

커널함수(kernel function)

- 저차원을 고차원으로 변환시켜 주는 함수
- 변환을 통해 x에 대한 새로운 특징을 추출할 수 있도록 함

커널함수 : $K(x_i, x_j) = \Phi(x_i)'\Phi(x_j)$

- radial : $K(x_i, x_j) = \exp(-\gamma \|x_i - x_j\|^2)$
- polynomial : $K(x_i, x_j) = (x_i' x_j + 1)^r$
- sigmoid : $K(x_i, x_j) = \tanh(k x_i' xj - \delta)$

POSTECH

서포트벡터머신(kernel 함수)

- 서포트벡터머신을 수행하기 위한 패키지 : e1071
- 오분류율 교차표(confusion matrix) 생성을 위한 패키지 : caret

lec10_2_svm.R

```
# install package for support vector machine
install.packages("e1071")
library (e1071)
#help(svm)

# install package for confusionMatrix
#install.packages("caret")
library(caret)

# set working directory
setwd("D:/tempstore/moocr")

# read data
iris<-read.csv("iris.csv",stringsAsFactors = TRUE)
attach(iris)
```

e1071 : svm함수 사용을 위한 패키지

caret : confusionMatrix 사용을 위한 패키지

POSTECH

서포트벡터머신(kernel 함수)

Iris 데이터(학습데이터와 검증데이터의 분할)

```
# training (100) & test set (50)
set.seed(1000)
N=nrow(iris)
tr.idx=sample(1:N, size=N*2/3)
```

데이터분할
(학습데이터 2/3, 검증데이터 1/3)

```
# target variable
y=iris[,5]
# split train data and test data
train=iris[tr.idx,]
test=iris[-tr.idx,]
```

train (100개의 데이터)
test (50개의 데이터)

POSTECH

kernel 함수에 따른 결과비교

iris 데이터(학습데이터와 검증데이터의 분할)

```
#svm using kernel
help("svm")
m1<-svm(Species~., data = train)
summary(m1)
m2<-svm(Species~., data = train,kernel="polynomial")
summary(m2)
m3<-svm(Species~., data = train,kernel="sigmoid")
summary(m3)
```

m1-kernel : radial
m2-kernel : polynomial
m3-kernel : sigmoid

help("svm")

`kernel`	the kernel used in training and predicting. You might consider changing some of the f depending on the kernel type. linear: *u'*v* polynomial: *(gamma*u'*v + coef0)^degree* radial basis: *exp(-gamma*|u-v|^2)* sigmoid: *tanh(gamma*u'*v + coef0)*
`degree`	parameter needed for kernel of type `polynomial` (default: 3)
`gamma`	parameter needed for all kernels except `linear` (default: 1/(data dimension))
`coef0`	parameter needed for kernels of type `polynomial` and `sigmoid` (default: 0)

POSTECH

kernel 함수에 따른 결과비교

서포트벡터머신 결과(kernel-radial basis function)

```
> summary(m1)

Call:
svm(formula = Species ~ ., data = train)


Parameters:
   SVM-Type:  C-classification
 SVM-Kernel:  radial
       cost:  1

Number of Support Vectors:  38

 ( 5 16 17 )


Number of Classes:  3

Levels:
 setosa versicolor virginica
```

$$K(x_i, x_j) = \exp(-\gamma \|x_i - x_j\|^2)$$

✻ 정확도 측정
pred11← predict(m1,test)
confusionMatrix(pred11, test$Species)

```
> confusionMatrix(pred11, test$Species)
Confusion Matrix and Statistics

          Reference
Prediction    setosa versicolor virginica
  setosa          19          0         0
  versicolor       0         18         1
  virginica        0          1        11

Overall Statistics

               Accuracy : 0.96
                 95% CI : (0.8629, 0.9951)
```

예측범주

실제범주

POSTECH

kernel 함수에 따른 결과비교

서포트벡터머신 결과(kernel-polynomial)

```
> summary(m2)

Call:
svm(formula = Species ~ ., data = train, kernel
 = "polynomial")


Parameters:
   SVM-Type:  C-classification
 SVM-Kernel:  polynomial
       cost:  1
     degree:  3
      coef.0:  0

Number of Support Vectors:  45

 ( 3 20 22 )


Number of Classes:  3

Levels:
 setosa versicolor virginica
```

$K(x_i, x_j) = (x_i' x_j + 1)^r$

✻ 정확도 측정
pred12 ← predict(m2,test)
confusionMatrix(pred12, test$Species)

```
> confusionMatrix(pred12, test$Species)
Confusion Matrix and Statistics

            Reference
Prediction   setosa versicolor virginica
  setosa         19          0         0
  versicolor      0         19         5
  virginica       0          0         7

Overall Statistics

               Accuracy : 0.9
                 95% CI : (0.7819, 0.9667)
```

예측범주

실제범주

POSTECH

kernel 함수에 따른 결과비교

서포트벡터머신 결과(kernel-sigmoid)

```
> summary(m3)

Call:
svm(formula = Species ~ ., data = train,
    kernel = "sigmoid")


Parameters:
   SVM-Type:  C-classification
 SVM-Kernel:  sigmoid
       cost:  1
      coef.0:  0

Number of Support Vectors:  44

 ( 4 17 23 )


Number of Classes:  3

Levels:
 setosa versicolor virginica
```

$$K(x_i, x_j) = \tanh(kx_i'xj - \delta)$$

✻ 정확도 측정
pred13 ← predict(m3,test)
confusionMatrix(pred13, test$Species)

```
> confusionMatrix(pred13, test$Species)
Confusion Matrix and Statistics

          Reference
Prediction    setosa versicolor virginica
  setosa          19          0         0
  versicolor       0         15         1
  virginica        0          4        11

Overall Statistics

               Accuracy : 0.9
                 95% CI : (0.7819, 0.9667)
```

예측범주

실제범주

POSTECH

kernel 함수에 따른 결과비교

서포트벡터머신 결과(kernel-linear)

```
> summary(m4)

Call:
svm(formula = Species ~ ., data = train, kernel = "linear")


Parameters:
   SVM-Type:  C-classification
 SVM-Kernel:  linear
       cost:  1

Number of Support Vectors:  25

 ( 2 13 10 )


Number of Classes:  3

Levels:
 setosa versicolor virginica
```

✻ 정확도 측정
pred14 ← predict(m4,test)
confusionMatrix(pred14, test$Species)

```
> confusionMatrix(pred14, test$Species)
Confusion Matrix and Statistics

            Reference
Prediction   setosa versicolor virginica
  setosa         19          0         0
  versicolor      0         17         0
  virginica       0          2        12

Overall Statistics

               Accuracy : 0.96
                 95% CI : (0.8629, 0.9951)
```