TDT4173 – Assignment 4

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10 April 2018

1 Theory

1.1 1)

The core idea of deep learning is...

1.2 2)

1.3 3)

2 Programming

```
# Extract data
knn_class <- read.csv("dataset/dataset/knn_classification.csv")
knn_reg <- read.csv("dataset/dataset/knn_regression.csv")
ada_train <- read.csv("dataset/dataset/adaboost_train.csv")
ada_test <- read.csv("dataset/dataset/adaboost_test.csv")
```

2.1 2.1)

We implement a k-NN algorithm from scratch. Then the program is reused in order to implement a k-NN regression and classification. The code can be seen below

```
# Euclidian distance function
eucDist <- function(all_points, point){

  res <- sweep(all_points, 2, point, "-")
  res <- res^2
  res <- apply(res, 1, sum)
  res <- sqrt(res)

  return(res)
}


# Find k nearest neighbours
findKnn <- function(all_points, point, distFunc, k, values){

  distances <- distFunc(all_points, point)

  ord <- order(distances)

  res <- list(distances = distances[1:k],
```

```
              values = values[ord][1:k])

  return(res)

}


# Classification by voting
vote <- function(closest){

  t <- table(closest$values)

  or <- order(t, decreasing = TRUE)

  if(t[or[1]] == t[or[2]]){
    # return("You need to fix voting when two or more classes
           # are equally well represented")
    equal_votes <- t[which(t == t[or[1]])]

    for(i in 1:k){
      p <- which(names(equal_votes) == as.character(closest$values[i]))
      if(p){
        return(names(equal_votes)[p])
      }
    }
  }

  return(names(t)[or[1]])
}


knn <- function(k, data, point, type){

  all_points <- as.matrix(data[, -dim(data)[2]])
  values <- data[, dim(data)[2]]

  closest <- findKnn(all_points = all_points,
                     point = point,
                     k = k,
                     values = values,
                     distFunc = eucDist)

  if(type == "reg"){
    return(mean(closest$values))
  } else if(type == "class"){
    return(vote(closest))
  }

  return("This type is not accepted")
}
```

We now use the algorithms with $k = 10$ for the 124^{th} example of the given data sets. As seen below, the algorithm predicts a value of 1.6 for the regression and 2 for the classification.

```r
knn(k = 10,
    data = knn_reg,
    point = as.vector(as.matrix((knn_reg[124, 1:3]))),
    type = "reg")
```

```
## [1] 1.6
```

```r
knn(k = 10,
    data = knn_class,
    point = as.vector(as.matrix((knn_class[124, 1:4]))),
    type = "class")
```

```
## [1] "2"
```

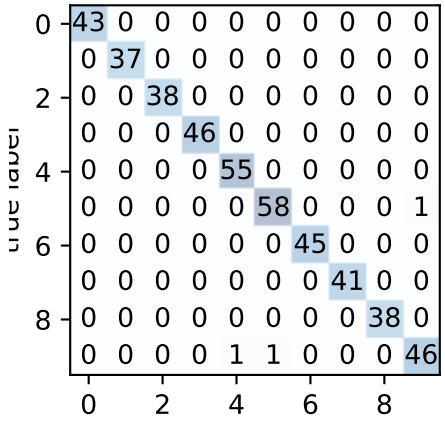
```python
# -*- coding: utf-8 -*-
import sys
import numpy as np
import os
import sklearn
import matplotlib.pyplot as plt
cwd = os.getcwd()
sys.path.insert(0, cwd)
import stupidname as ss
knn_class = np.genfromtxt("dataset/dataset/knn_classification.csv",
delimiter=",", skip_header=1)
knn_reg = np.genfromtxt("dataset/dataset/knn_regression.csv",
delimiter=",", skip_header=1)
ada_test = np.genfromtxt("dataset/dataset/adaboost_test.csv",
delimiter=",", skip_header=1)
ada_train = np.genfromtxt("dataset/dataset/adaboost_train.csv",
delimiter=",", skip_header=1)
```

```python
err = ss.testAdaBoost(15, ada_train, ada_test)
for e in err:
  print("%.2f" % e)
```

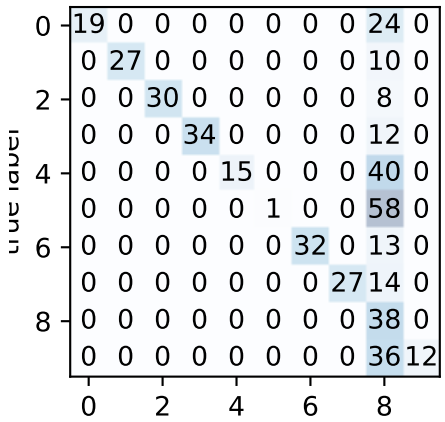
```
## 0.46
## 0.46
## 0.43
## 0.43
## 0.39
## 0.39
## 0.37
## 0.37
## 0.35
## 0.35
## 0.36
## 0.33
## 0.38
## 0.32
## 0.35
```

```python
X_train, X_test, y_train, y_test = ss.getData()
from sklearn.neighbors import KNeighborsClassifier as KNN
neigh = KNN()
neigh.fit(X_train, y_train)
```

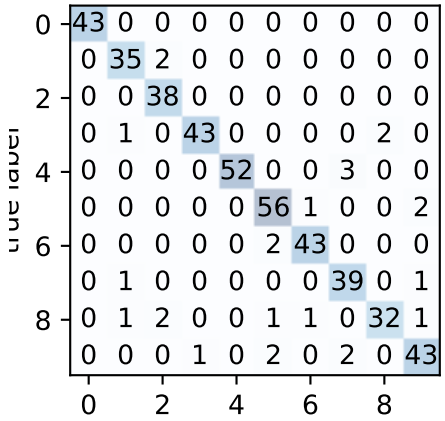
```
pred_neigh = neigh.predict(X_test)
from sklearn import svm
clf = svm.SVC()
clf.fit(X_train, y_train)
pred_svm = clf.predict(X_test)
from sklearn.ensemble import RandomForestClassifier as RFC
forest = RFC()
forest.fit(X_train, y_train)
pred_forest = forest.predict(X_test)
from sklearn.metrics import confusion_matrix
from mlxtend.plotting import plot_confusion_matrix
cnf_neigh = confusion_matrix(y_test, pred_neigh)
cnf_svm = confusion_matrix(y_test, pred_svm)
cnf_forest = confusion_matrix(y_test, pred_forest)
fig_neigh, ax = plot_confusion_matrix(conf_mat = cnf_neigh)
plt.show()
```




```
fig_svm, ax = plot_confusion_matrix(conf_mat = cnf_svm)
plt.show()
```




```
fig_forest, ax = plot_confusion_matrix(conf_mat = cnf_forest)
plt.show()
```


True label
0
2
4
6
8
43 0 0 0 0 0 0 0 0 0
0 35 2 0 0 0 0 0 0 0
0 0 38 0 0 0 0 0 0 0
0 1 0 43 0 0 0 0 2 0
0 0 0 0 52 0 0 3 0 0
0 0 0 0 0 56 1 0 0 2
0 0 0 0 0 2 43 0 0 0
0 1 0 0 0 0 0 39 0 1
0 1 2 0 0 1 1 0 32 1
0 0 0 1 0 2 0 2 0 43
0
2
4
6
8