实 验 报 告

(2017 / 2018 学年 第 2 学期)

课程名称	机器学习导论
实验名称	Location Assignment
实验时间	2018 年 6 月 20 日
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1 问题重述

- 如下图 1 所示，为南一楼二楼局部区域室内布局图。绿色区域为数据采集区域。共包括四个教室和室外的走廊。如下所示建立坐标轴，规定左上角坐标为（0,0）。现收集各坐标的不同 BSSID 的信号强度值，拟据此推断其位置坐标。

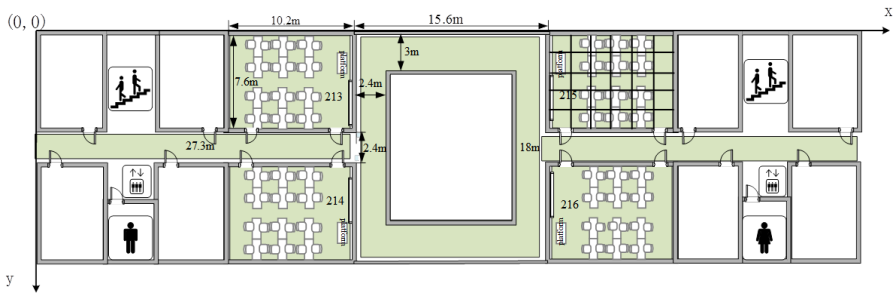


Figure 1: 南一楼局部区域室内布局图

- 训练集一共有 14798 个样本，为了模拟实际场景中收集的样本标注位置存在误差，因此给每个样本的实际坐标添加一定的扰动。具体地，x，y 轴分别添加的扰动为：均值为 0，标准差为 1.2m 的一组随机生成的值。训练集中共接收到 577 个 BSSID，文件中‘负值’表示相应样本接收到相应 BSSID 的信号强度值，’0 值’表示相应样本未接收到该 BSSID 的值。文件中 x, y 分别表示样本实际采集位置添加扰动后的坐标。
- 测试集一共包括 652 个测试指纹，每个测试指纹是 10 个测试样本的均值，测试集共接收到 458 个 BSSID。

2 问题分析

- 首先观察训练集 $ 的特征向量，发现其特征向量并不一致，故取其交集（相较与取并集预测精度有显著提高）。
- 对数据集中特殊点的处理：由于数据集中存在 0 值，可将其变为极弱信号（-100）以便于算法预测精度的提升。
- 算法选择方面：考虑该具体问题的性质，虽然是回归问题，但不适合使用 svm、neural network 等强拟合算法。外加噪声会极大地影响其效果，平均可在一定程度上弱化噪声的影响，但综合考虑使用 K 个最近邻样本输出的平均值作为回归预测值（KNN）即简单高效，避免复杂计算，又可以得到不错的结果，为上策。

3 算法设计

- main-idea: 用 K 个最近邻样本输出的平均值作为回归预测值。

4 Python Code for Location Assignment

4.1 data

```python
# -*- coding: utf-8 -*-
"""
@author : Haoran You

"""
import csv
import random
import numpy as np

```

```
def getFeat():
    # train datasest
    trainDT = csv.reader(open('train.csv', 'r'))
    dataset = []
    for line in trainDT:
        dataset.append(line)
    train_feat_index = dataset[0][1:-2]
    del (dataset[0])
    # test dataset
    testDT = csv.reader(open('test.csv', 'r'))
    test_feature = []
    for line in testDT:
        test_feature.append(line)
    test_feat_index = test_feature[0][1:]
    del (test_feature[0])
    # all feature
    all_feat = list(set(train_feat_index).intersection(set(test_feat_index)))
    train_index, test_index = [], []
    for item in train_feat_index:
        if item in all_feat:
            train_index.append(all_feat.index(item))
        else:
            train_index.append(-1)
    for item in test_feat_index:
        if item in all_feat:
            test_index.append(all_feat.index(item))
        else:
            test_index.append(-1)
    num_feat = len(all_feat)
    return num_feat, train_index, test_index, dataset, test_feature

def traincsv(dataset, train_index, num_feat):
    feature = []; x = []; y = []
    for item in dataset:
        feature.append(item[1:-2])
        x.append(item[-2])
        y.append(item[-1])
    feature = [[float(j) for j in i] for i in feature]
    train_feature = []
    for i in range(len(feature)):
        _feature = list(np.zeros(num_feat))
        for j in range(len(feature[i])):
            if feature[i][j] < 0.0:
                if train_index[j] == -1:
                    pass
                else:
                    # _feature[train_index[j]] = 1.0
                    _feature[train_index[j]] = feature[i][j]
            else:
                if train_index[j] == -1:
                    pass
                else:
                    _feature[train_index[j]] = -100
        train_feature.append(_feature)
    x = [float(i) for i in x]
    y = [float(i) for i in y]
    return train_feature, x, y

def testcsv(feature, test_index, num_feat):
    for i in range(len(feature)):
        feature[i] = feature[i][1:]
    feature = [[float(j) for j in i] for i in feature]
    test_feature = []
    for i in range(len(feature)):
        _feature = list(np.zeros(num_feat))
        for j in range(len(feature[i])):
            if feature[i][j] < 0.0:
                if test_index[j] == -1:
                    pass
                else:
                    # _feature[test_index[j]] = 1.0
                    _feature[test_index[j]] = feature[i][j]
            else:
                if test_index[j] == -1:
                    pass
                else:
                    _feature[test_index[j]] = -100
        test_feature.append(_feature)
    return test_feature

def divideTrainVal(feature, x, y, ratio):
    num_dataset = len(x)
    index_train = random.sample(range(num_dataset), int(num_dataset*ratio))
    train_feature, train_x, train_y = [], [], []
    val_feature, val_x, val_y = [], [], []
    for i in range(num_dataset):
        if i in index_train:
            train_feature.append(feature[i])
```

```
            train_x.append(x[i])
            train_y.append(y[i])
        else:
            val_feature.append(feature[i])
            val_x.append(x[i])
            val_y.append(y[i])
    return train_feature, train_x, train_y, val_feature, val_x, val_y

def dataset():
    num_feat, train_index, test_index, dataset, test_feature = getFeat()
    feature, x, y = traincsv(dataset, train_index, num_feat)
    train_feature, train_x, train_y, val_feature, val_x, val_y = \
    divideTrainVal(feature[:], x[:], y[:], ratio=0.9)
    test_feature = testcsv(test_feature, test_index, num_feat)
    print('num of trainset : ', len(train_feature))
    print('num of valset   : ', len(val_feature))
    print('num of testset  : ', len(test_feature))
    print('total features  : ', num_feat)
    return train_feature, train_x, train_y, val_feature, val_x, val_y, test_feature
```

4.2 Main

```
# -*- coding: utf-8 -*-
"""
@author : Haoran You

"""
import os
import csv
from data import *
import matplotlib.pyplot as plt

# load data
train_feat, train_x, train_y, val_feat, val_x, val_y, test_feat = dataset()

# train
def calDistance(x, y):
    return np.sqrt(np.square(x) + np.square(y))
def method(model_x, model_y):
    model_x.fit(train_feat, train_x)
    score = model_x.score(val_feat, val_x)
    result_val_x = model_x.predict(val_feat)
    result_test_x = model_x.predict(test_feat)
    print('score of val_x : ', score)
    model_y.fit(train_feat, train_y)
    score = model_y.score(val_feat, val_y)
    result_val_y = model_y.predict(val_feat)
    result_test_y = model_y.predict(test_feat)
    print('score of val_y : ', score)
    print('average deviation of val_x : ', np.average(abs(val_x - result_val_x)))
    print('average deviation of val_y : ', np.average(abs(val_y - result_val_y)))
    print('average deviation of val distance : ', np.average(calDistance(val_x - result_val_x, val_y - result_val_y)))
    if os.path.exists('result.csv'):
        os.remove('result.csv')
    f = open('result.csv', 'a', newline='')
    csv_write = csv.writer(f, dialect='excel')
    for i in range(len(result_test_x)):
        result = []
        result.append(i)
        result.append(result_test_x[i])
        result.append(result_test_y[i])
        csv_write.writerow(result)

    # plot val result figure
    plt.figure(1)
    plt.subplot(131)
    plt.plot(train_x, train_y, 'ro', label='real')
    plt.title('trainset distribution')
    plt.xlabel('x'); plt.ylabel('y')
    plt.legend(loc='upper right', ncol=1)
    plt.subplot(132)
    plt.plot(val_x, val_y, 'ro', label='real')
    plt.plot(result_val_x, result_val_y, 'bo', label='predict')
    plt.title('valset distribution')
    plt.xlabel('x'); plt.ylabel('y')
    plt.legend(loc='upper right', ncol=1)
    plt.subplot(133)
    plt.plot(result_test_x, result_test_y, 'bo', label='predict')
    plt.title('testset distribution')
    plt.xlabel('x'); plt.ylabel('y')
    plt.legend(loc='upper right', ncol=1)
    plt.show()

def run(type):
```

```
    if type == 'decision_tree':
        from sklearn import tree
        model = tree.DecisionTreeRegressor()
    elif type == 'linear':
        from sklearn import linear_model
        model = linear_model.LinearRegression()
    elif type == 'svm':
        from sklearn import svm
        model = svm.SVR()
    elif type == 'KNN':
        from sklearn import neighbors
        model = neighbors.KNeighborsRegressor()
    elif type == 'random_forest':
        from sklearn import ensemble
        model = ensemble.RandomForestRegressor(n_estimators=20)
    elif type == 'adaboost':
        from sklearn import ensemble
        model = ensemble.AdaBoostRegressor(n_estimators=50)
    elif type == 'extra_tree':
        from sklearn.tree import ExtraTreeRegressor
        model = ExtraTreeRegressor()
    method(model, model)

run('KNN')
```

5 结果讨论

5.1 Location Distribution

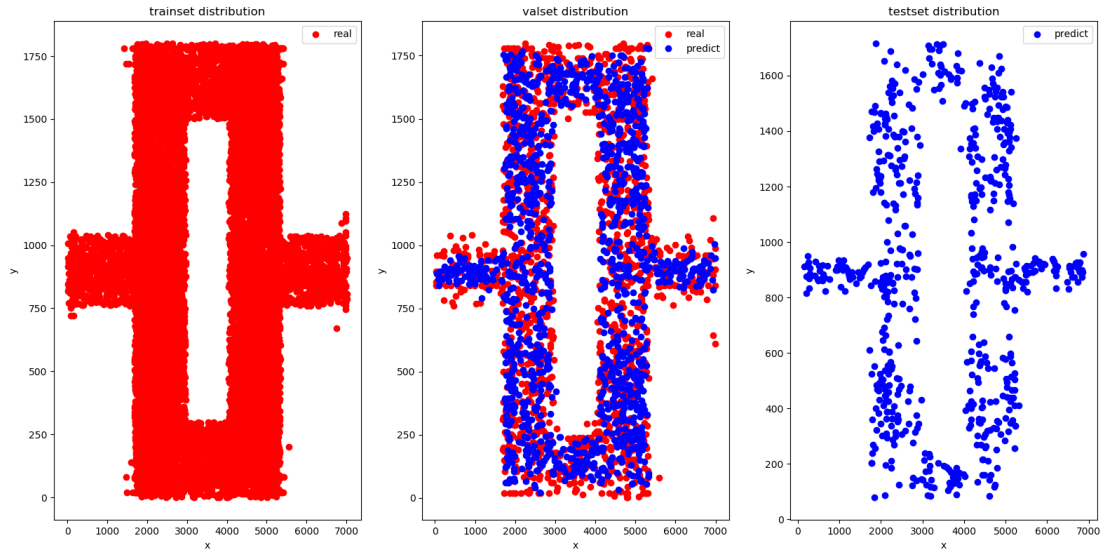


Figure 2: Location Distribution

5.2 CDF

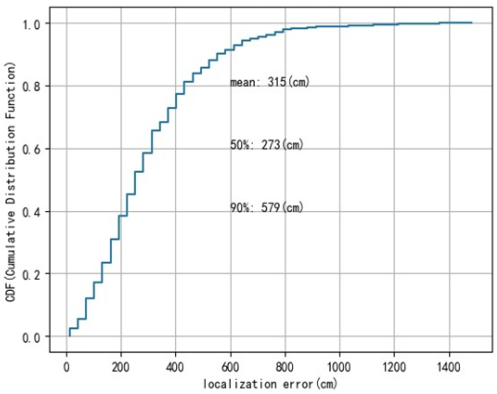
CDF 为累计分布函数，结果的平均定位误差为：

$$err = \frac{\sum_{n=1}^{N} \sqrt{(x_n^e - x_n)^2 + (y_n^e - y_n)^2}}{N} \tag{5.1}$$

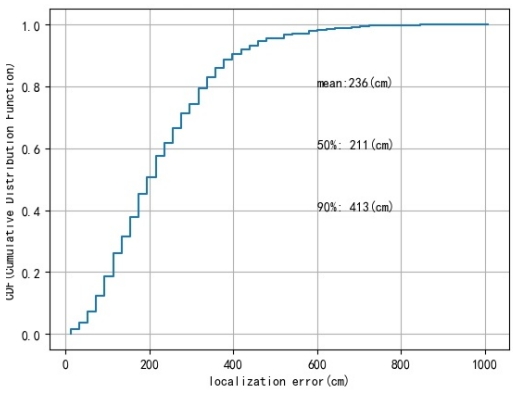
结果如图3所示。

6 课程评价

- 老师准备得很细，看得出画了很大的功夫，但是讲课风格不合我的口味，我比较偏向于原理部分而不是繁琐的计算，老师在讲原理的时候没有讲得很深入或者很形象，可以考虑将课堂的计算换



Union feature set



Intersection feature set

Figure 3: Cumulative Distribution Function

成更简单但也能体现原理的算例。

- 课后作业还可以，编程作业做了还是有收获的。但是 Neural Network 作业貌似没布置。
- 作为学院的第一次尝试来讲可以了。