Part1

1.
when k = 1, classification accuracy = 0.9066666666666666. predicted class labels of each instance in the test shows below.
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-setosa
Iris-versicolor
Iris-versicolor
Iris-virginica
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-virginica
Iris-versicolor
Iris-versicolor
Iris-versicolor

Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-versicolor
Iris-virginica
Iris-virginica
Iris-versicolor
Iris-virginica
Iris-virginica
Iris-virginica
Iris-virginica
Iris-virginica
Iris-versicolor
Iris-versicolor
Iris-virginica
Iris-virginica
Iris-virginica
Iris-versicolor
Iris-virginica
Iris-virginica
Iris-virginica
Iris-virginica
Iris-virginica
Iris-virginica
Iris-virginica
Iris-virginica
Iris-virginica
Iris-versicolor

2.
When k = 1
classification accuracy = 0.9066666666666666
time = 41300(microseconds)
when k = 3

classification accuracy = 0.96
time = 41987(microseconds)
when the k=3, the classification accuracy increasing approximately 6% the performances are approaching for k=1 (41300 microseconds) and k=3(41987 microseconds). When k = 1, it will be Overfitting. Which means that it may easy to add noisy to model.

3.
Advantage:
(1) effective if the training data is large, easy to use No training required.
(2) Insensitive to outliers
(3) Suitable for classifying rare events
(4) Suitable for multi-model
Disadvantage:
(1) Computation cost and memory cost is quite large. Because we need find distance to all known samples for each text
(2) Poor interpretability, cannot tell which variable is more important, and cannot give rules like decision trees
(3) Negative learning method, lazy algorithm
(4) Need to determine value of parameter k. When the sample is unbalanced, such as the sample size of one class is large, and the sample size of other classes is very small, it may cause that when a new sample is input, the sample of the large-capacity class among the K neighbors of the sample accounts for most

4.
K-fold Cross Validation is used to splitting dataset into training data and testing data
Steps:
(1) chop the data into 5 equal subsets
For each subset:
– Treat it as the test set
– Treat the rest 4 subsets as the training set
– Train classifier using the training set, apply it to the test set
(2) The training/test process is repeated 4 times (the folds), with each of the 4 subsets used exactly once as the test set
(3) The 4 results from the folds can be then averaged (or
otherwise combined) to produce a single estimation

5.
If class labels are not available, use the K Means Clustering method to group the examples
(1) Set 3 initial “means” randomly from the data set.
(2) Create 3 clusters by associating every instance with the nearest mean based on a distance measure.
(3) Replace the old means with the centroid of each of the 3 clusters (as the new means).
(4) Repeat the above two steps until convergence (no change in each
cluster center).

Part2

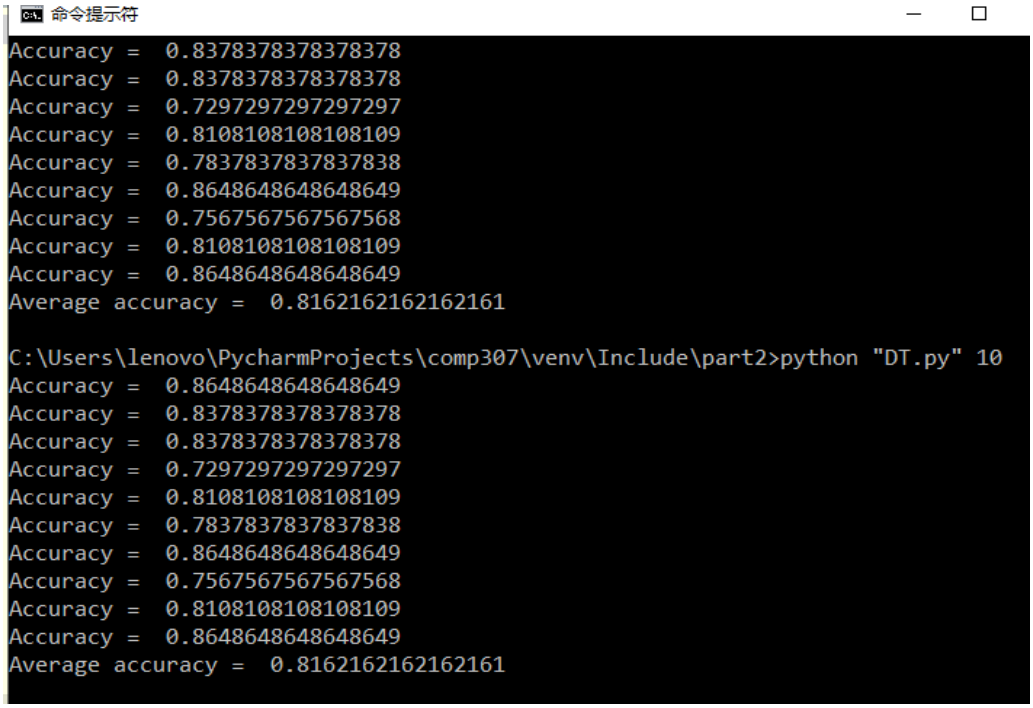
1.

```
Baseline classifier accuracy: 0.8518518518518519
Accuracy =  0.7777777777777778
2 categories
16 attributes
Read 100 instances
FEMALE = false
  FATIGUE = false
    ASCITES = false
      BIGLIVER = false
        Class = live, prob = 1.0
      BIGLIVER = true
       ANTIVIRALS = true
        BILIRUBIN = false
          Class = die, prob = 1.0
        BILIRUBIN = true
         AGE = false
          HISTOLOGY = false
            Class = live, prob = 1.0
          HISTOLOGY = true
           MALAISE = false
            SPLEENPALPABLE = true
             SPIDERS = false
              SGOT = false
                Class = die, prob = 1.0
              SGOT = true
               ANOREXIA = false
               ANOREXIA = true
                 Class = die, prob = 1.0
             SPIDERS = true
               Class = die, prob = 1.0
           MALAISE = true
             Class = die, prob = 1.0
         AGE = true
           Class = die, prob = 1.0
    ASCITES = true
     SPIDERS = false
      SPLEENPALPABLE = false
       ANTIVIRALS = true
```

```
      BILIRUBIN = true
        BIGLIVER = false
          Class = die, prob = 1.0
        BIGLIVER = true
          AGE = false
            Class = die, prob = 1.0
          AGE = true
    SPLEENPALPABLE = true
      AGE = false
        VARICES = false
          Class = live, prob = 1.0
        VARICES = true
          ANOREXIA = false
            Class = live, prob = 1.0
          ANOREXIA = true
            MALAISE = false
              STEROID = false
                ANTIVIRALS = false
                  Class = die, prob = 1.0
                ANTIVIRALS = true
              MALAISE = true
                ANTIVIRALS = false
                  Class = live, prob = 1.0
                ANTIVIRALS = true
      AGE = true
        Class = die, prob = 1.0
  SPIDERS = true
    VARICES = false
      Class = die, prob = 1.0
    VARICES = true
      SPLEENPALPABLE = false
        Class = live, prob = 1.0
      SPLEENPALPABLE = true
        BIGLIVER = false
          Class = live, prob = 1.0
        BIGLIVER = true
          ANOREXIA = false
            Class = live, prob = 1.0
          ANOREXIA = true
            SGOT = false
              HISTOLOGY = false
                AGE = false
                  MALAISE = false
                  MALAISE = true
```

```
                    Class = live, prob = 1.0
                AGE = true
                  Class = live, prob = 1.0
              HISTOLOGY = true
                Class = live, prob = 1.0
            SGOT = true
              Class = live, prob = 1.0
  FATIGUE = true
    MALAISE = true
      ANOREXIA = true
        ASCITES = true
          SPLEENPALPABLE = false
            Class = live, prob = 1.0
          SPLEENPALPABLE = true
            BIGLIVER = false
              Class = live, prob = 1.0
            BIGLIVER = true
              ANTIVIRALS = false
                Class = live, prob = 1.0
              ANTIVIRALS = true
                SGOT = false
                  VARICES = false
                    Class = die, prob = 1.0
                  VARICES = true
                    SPIDERS = false
                      Class = live, prob = 1.0
                    SPIDERS = true
              SGOT = true
                Class = live, prob = 1.0
  FEMALE = true
    Class = live, prob = 1.0
```

2.



3.

(a)

Reduced Error Pruning

Step1: Use leaf node to replace subtree,

Step2: Check whether it is beneficial, if the error rate is reduced or unchanged after pruning

Step3: repeat step1 and 2, until the error rate has risen

(b) because we delete some dataset from train dataset when decision tree prune, thus for original train dataset the accuracy of train dataset will decreasing.

(c) Shrink the tree, make it smaller/simpler, to reduce overfitting, thus the accuracy of test dataset may improve.

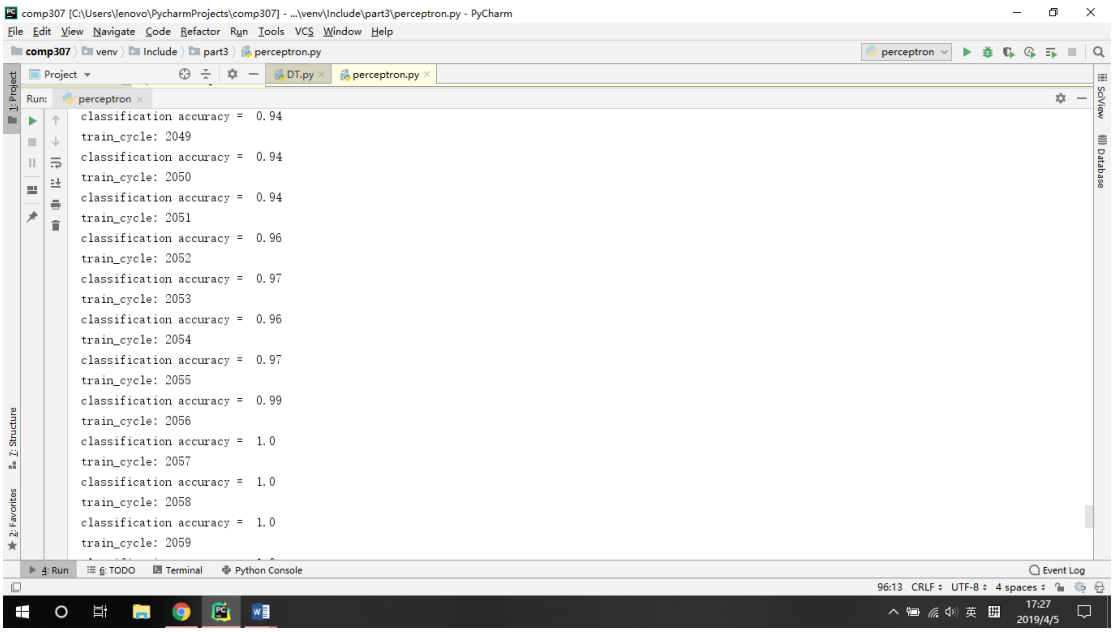
4.

when there are three or more classes, impurity measure may cause false positive if the one of class probability is zero. Then the weighted average impurity will be zero which means it is pure, but the result is incorrect.

Part3

1.

Accuracy will increase when the train-times big enough. Which means it would find correct set of weights.



2.

the perceptron's performance on the training data is not a good measure of its effectiveness because if use train data to train it will be overfitting and match result perfectly.