IR Homework#3
Text/Spoken Document Using SVM

Reference:

-S. H. Lin, B. Chen, H.M. Wang, "A comparative study of probabilistic ranking models for Chinese spoken document summarization," *ACM Transactions on Asian Language Information Processing*, March 2009.

-Libsvm- A Library for Support Vector Machines ,Chih-Chung Chang and Chih-Jen Lin

http://www.csie.ntu.edu.tw/~cjlin/libsvm/

- ROUGE- Recall-Oriented Understudy for Gisting Evaluation, Chin-Yew Lin http://berouge.com/

Features Used for Summarization

- **Acoustic Features**
  - *PITCH: Min/max/mean/difference pitch values of a spoken sentence*
  - *ENERGY: Min/max/mean/difference value of energy features of a spoken sentence*
  - *CONFIDENCE: Posterior probabilities*
- **Lexical Features**
  - *BIGRAM_SCORE: Normalized bigram language model scores*
  - *SIMILARITY: Similarity scores between a sentence and its preceding/following neighbor sentence*
  - *NUM_NAME_ENTITIES: Number of named entities (NEs) in a sentence*
- **Other Features**
  - *POSITION: Sentence position*
  - *DURATION: Duration of the preceding/current/following sentence*
  - *R-VSM: Relevance score obtained by using the VSM summarizer*
  - *R-LSA: Relevance score obtained by using the LSA summarizer*

An Example for the Feature Sets of Sentences

- PSTN_Acoustic_Fea_Text (PTSND20011107_1.txt) 10 dim

```
10 1 1.000000 2 0.611535 3 16.384858 4 0.827898 5 0.004138 6 0.655459 7 0.590436 8 1.834960 9 0.002641 10 5.000000
10 1 0.500000 2 0.472137 3 16.466534 4 0.761306 5 0.003814 6 0.675514 7 0.594440 8 12.355190 9 0.003260 10 13.000000
10 1 0.333333 2 0.615447 3 16.527532 4 0.762232 5 0.026254 6 0.736452 7 0.447173 8 11.578128 9 0.005489 10 10.000000
10 1 0.250000 2 0.690202 3 16.686328 4 0.778751 5 0.017785 6 0.642357 7 0.539867 8 12.175520 9 0.002433 10 11.000000
10 1 0.200000 2 0.676445 3 16.215265 4 0.754912 5 0.009893 6 0.833333 7 0.603759 8 17.752199 9 0.009719 10 8.000000
```

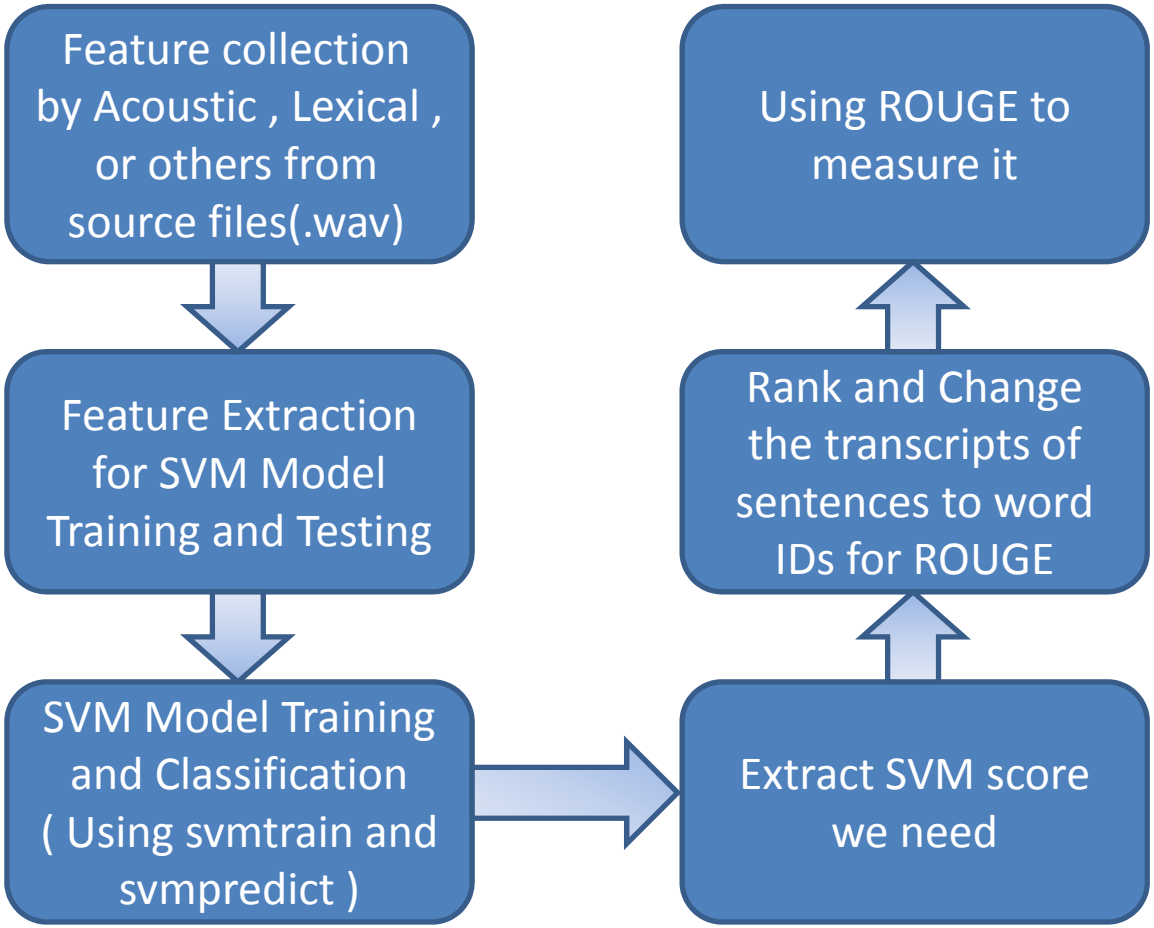
- PSTN_Lexical_Fea_Text (PTSND20011107_1.txt) 9 dim

```
24
7 0 5 1 0 0 0.000000 0.000000 1.000000
5 7 19 3 1 1 0.004386 0.000000 1.000000
19 5 19 3 2 2 0.008772 0.641470 0.000000
19 19 10 3 4 2 0.008772 0.784019 0.641470
```

- PSTN_Other_Fea_Spoken(PTSND20011107_1.txt) 4 dim

```
-3363.491699 -3404.175781 0.000001 0.380121
-3346.184814 -3383.830322 0.010119 0.739739
-3294.791260 -3348.673340 5.051671 1.917458
-3285.574707 -3344.844238 4.304012 1.573014
-3291.159912 -3345.663086 3.953468 1.756150
```

Flow chart


Feature collection by Acoustic , Lexical , or others from source files(.wav)
Feature Extraction for SVM Model Training and Testing
SVM Model Training and Classification (Using svmtrain and svmpredict)
Extract SVM score we need
Rank and Change the transcripts of sentences to word IDs for ROUGE
Using ROUGE to measure it

Step 1: Feature Extraction for SVM Model Training

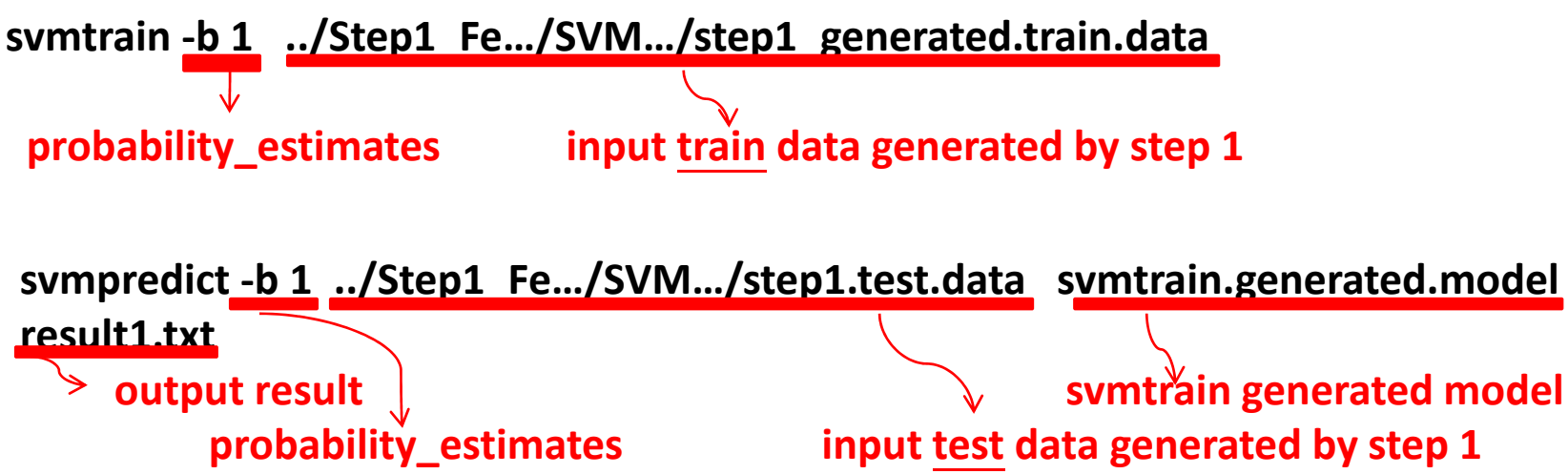
- Accumulate the statistics from feature sets and convert them into the input format of the “svmtrain” and “svmpredict” tool.

Step 1: Feature Extraction for SVM Model Training (Example: Path Setup)

```
#define TRAINING_MODE        1                          //是否有使用人工摘要
const char *Acoustic_Path   = "../PSTN_Acoustic_Fea_Text/";
      //Acoustic feature path
const char *Lexical_Path    = "../PSTN_Lexical_Fea_Text/";
      //Lexical feature path
const char *Unsupervised_Path = "../PSTN_Unsupervised_Fea_Text/";
    //Unsupervised feature path
const char *List_Path       = "./train_ds2.txt";
    //training data list path
const char *SUMMARYResult   = "../Label/human_train_ds2";
    //參考的 label 檔案
const char *feaOutput       = "../SVM_Data/train_0.2_text_Human.data";
    //產生出 SVM output 的路徑
#define LABEL_RATIO          0.2                        //人工摘要比率
```

Step 2:SVM Model Training and Classification

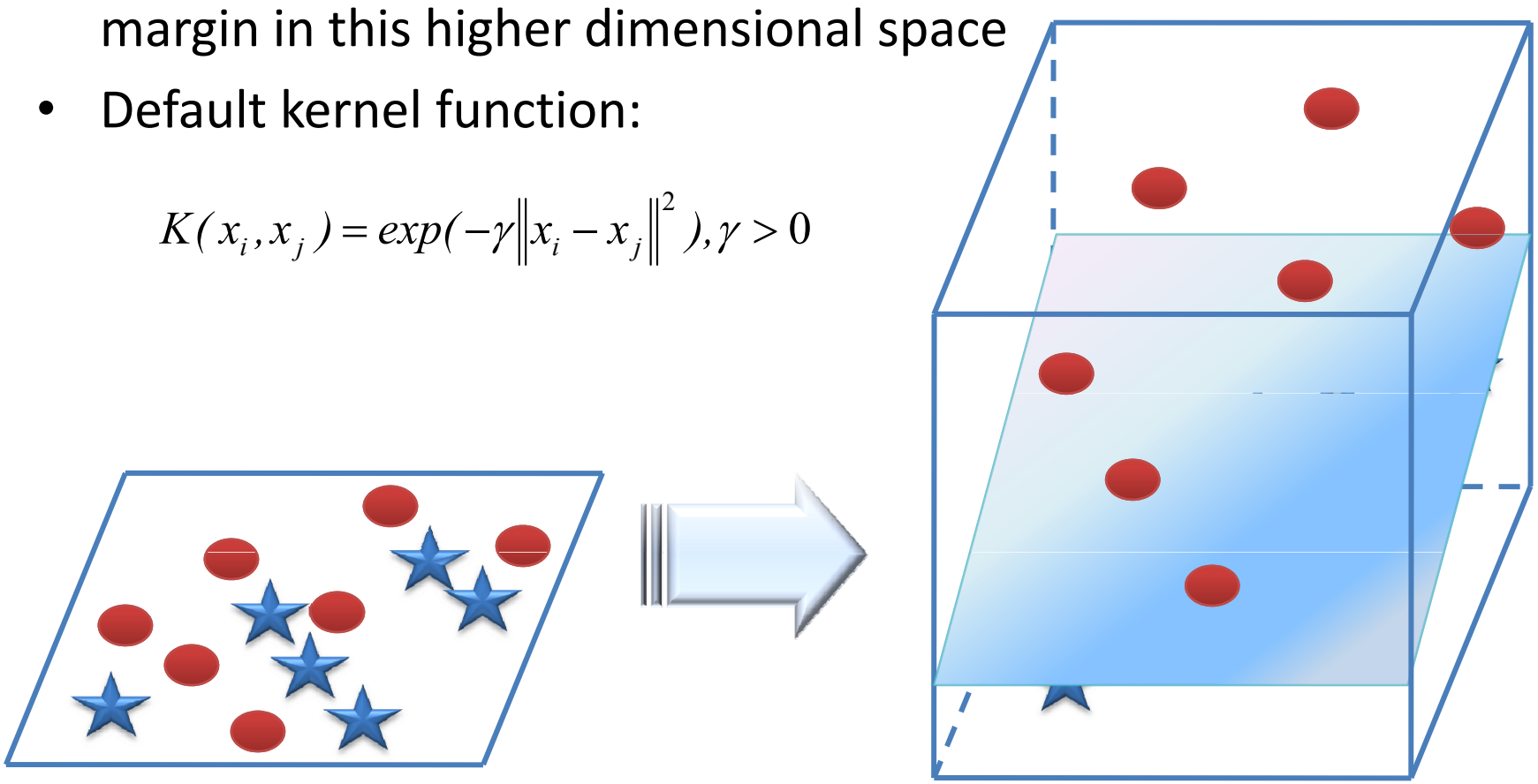
- Using Libsvm to model training and classification



Step 2: How SVM Model Classify

- SVM finds a linear separating hyperplane with the maximal margin in this higher dimensional space
- Default kernel function:

$$K(x_i, x_j) = exp(-\gamma \left\| x_i - x_j \right\|^2), \gamma > 0$$



Step 3: Preparation for ROUGE Evaluation

- Extract the sentence scores computed by “svmpredict” and rank the sentences accordingly by these scores

- Change the transcripts of sentences to word IDs (by looking up to a lexicon)

Step4:ROUGE

- perform the ROUGE-2 evaluation

Introduction to Rouge

- ROUGE (Recall-Oriented Understudy for Gisting Evaluation) is a package for automatic evaluation of summaries.

- There are four different ROUGE measures:
  - ROUGE-N (N-gram Co-Occurrence Statistics)
  - ROUGE-L (Longest Common Subsequence)
  - ROUGE-W (Weighted Longest Common Subsequence)
  - ROUGE-S (Skip-Bigram Co-Occurrence Statistics)

Install perl and package

- Install perl
  - 安裝檔為:ActivePerl-5.8.8.817-MSWin32-x86-257965.msi
    http://www.activestate.com/Products/activeperl/
  - 將ActivePerl-5.8.8.817-MSWin32-x86-257965.msi 打開安裝完成，如果沒有更改路徑，就會在C槽底下出現一個Perl的資料夾，Perl就已經安裝完成。

Install package

- 現在要安裝兩個package，這是為了之後執行ROUGE時，可以讀入xml檔以及讀入.db的資料庫檔。
  - 在開始功能表的程式集中 找到ActivePerl 5.8.8 Build 817 裡面有 Perl Package Manager 將此檔打開。
  - 接著會出現視窗畫面為

    ppm>
  - 安裝第一個package。回到ppm> 在>後面打入

    install XML-DOM

    它就會自行完成安裝。
  - 安裝第二個package。回到ppm> 在>後面打入

    install DB_file
  - 都安裝完成之後，就可以開始使用ROUGE了。

ROUGE-N

- ROUGE-N is an n-gram recall between a candidate summary and a set of reference summaries.

$$ROUGE - N$$

$$= \frac{\sum_{S \in \{ReferenceSummaries\}} \sum_{gram_n \in S} Count_{match}(gram_n)}{\sum_{S \in \{ReferenceSummaries\}} \sum_{gram_n \in S} Count(gram_n)}$$

$$S : sentence$$

$$n : length\ of\ the\ n - gram$$

Usage of ROUGE

- Before evaluation, prepare …
  - Automatic generated summaries
  - Reference summaries by hand

- Command line argument
  - (-e) : Directory which contains a database (.db) file
  - (-n) : Length of the n-gram
  - (-a) : A description file in XML format about the paths of the corresponding result files.

  - An example：

perl ROUGE-1.5.5.pl -e dict_data -n 2 –a description file (XML)

An Example of the Description File

```
<ROUGE-EVAL version="1.0">
<EVAL ID="1">
 <PEER-ROOT>
  summaryRatioFile/SUM/01
 </PEER-ROOT>
 <MODEL-ROOT>
  summaryRatioFile
 </MODEL-ROOT>
 <INPUT-FORMAT TYPE="SPL">
 </INPUT-FORMAT>
 <PEERS>
  <P ID="1">N200108011200-01.txt</P>
 </PEERS>
 <MODELS>
  <M ID="1">Human1/01/N200108011200-01.txt</M>
  <M ID="2">Human2/01/N200108011200-01.txt</M>
  <M ID="3">Human3/01/N200108011200-01.txt</M>
 </MODELS>
</EVAL>
<ROUGE-EVAL>
```

Directory which contains automatic summaries

Directory which contains reference summaries

File of automatic summary

1st reference summary

2nd reference summary

3rd reference summary