Digital Speech Processing

Homework 3

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To complete this homework, you need to…

- Build a character-based language model with toolkit SRILM.
- Decode the ZhuYin-mixed sequence.

Outline

- Introduction
- Flowchart
- SRILM
- Step by Step
- Submission and Grading

Introduction

讓 他 十分 ㄏ怕
只 ㄒ望 ㄗ己 明ㄋ 度 別 再 這ㄇ ㄎ命 了
演ㄧ ㄩ樂 產ㄧ ㄐ入 積ㄐ ㄓ型 提ㄕ 競爭ㄌ

HW3：注音文修正

讓 他 十分 害怕
只 希望 自己 明年 度 別 再 這麼 苦命 了
演藝 娛樂 產業 加入 積極 轉型 提升 競爭力

Introduction (cont'd)

- Imperfect acoustic models with phoneme loss.
- The finals of some characters are lost.

Introduction (cont'd)

- Proposed methods:
  - Reconstruct the sentence by language model.

Introduction (cont'd)

- For example, let Z = 演一 ㄩ樂 產一

$$W^* = \arg\max_W P(W \mid Z)$$

$$= \arg\max_W \frac{P(W)P(Z \mid W)}{P(Z)}$$

P(Z) is independent of W

$$= \arg\max_W P(W)P(Z \mid W)$$

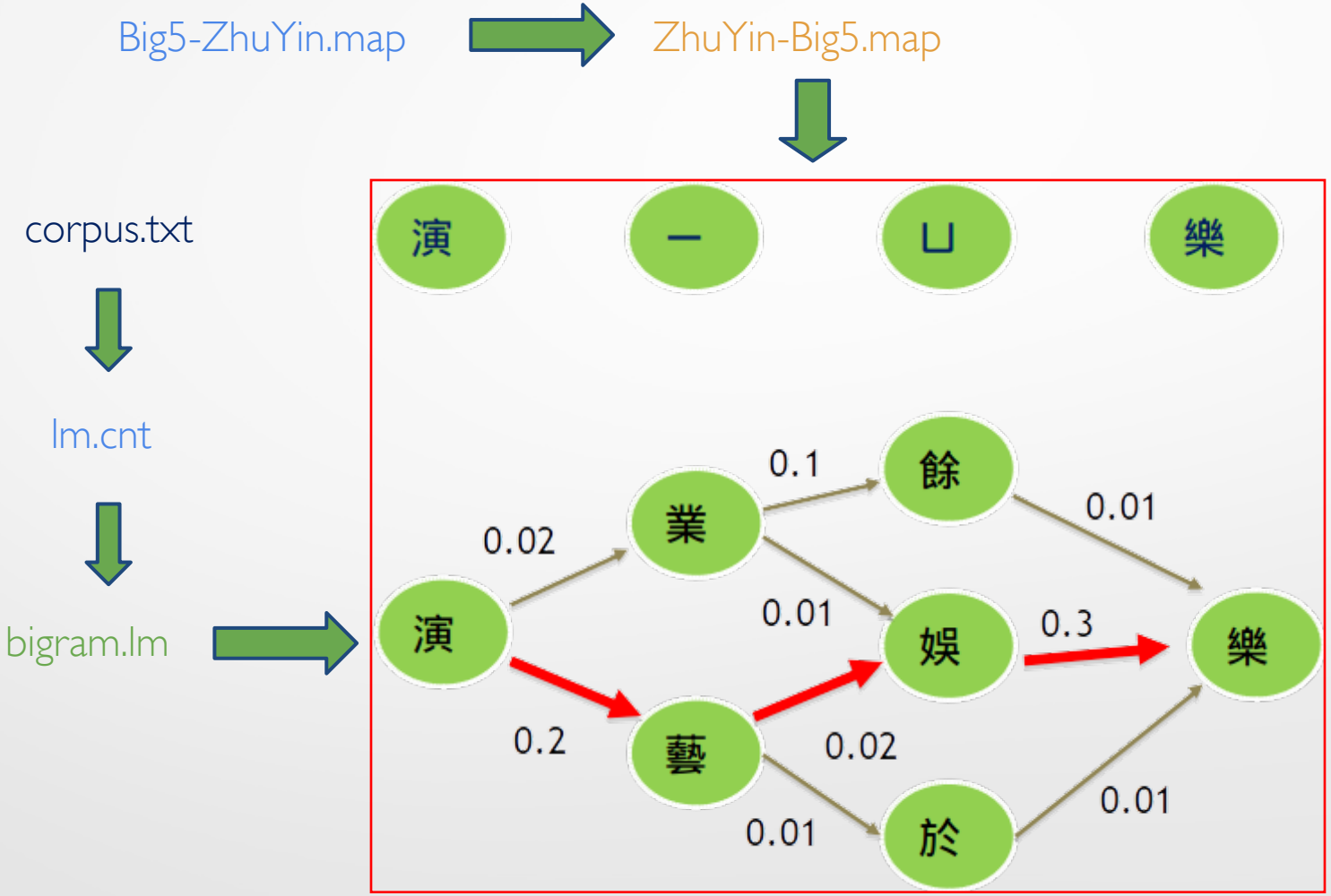
$W=w_1w_2w_3w_4...w_n$, $Z=z_1z_2z_3z_4...z_n$

$$= \arg\max_W \left[P(w_1)\prod_{i=2}^{n} P(w_i \mid w_{i-1}) \right]\left[\prod_{i=1}^{n} P(z_i \mid w_i) \right]$$

$$= \arg\max_{W,\, P(Z|W)\neq 0} \left[P(w_1)\prod_{i=2}^{n} P(w_i \mid w_{i-1}) \right]$$

Bigram language model

Flowchart


Big5-ZhuYin.map
ZhuYin-Big5.map
corpus.txt
lm.cnt
bigram.lm
演
ㄧ
ㄩ
樂
0.1
餘
0.01
業
0.02
0.01
演
娛
0.3
樂
0.2
藝
0.02
0.01
於
0.01

SRILM

- SRI Language Model toolkit
  - http://www.speech.sri.com/projects/srilm/
- A toolkit for building and applying various statistical language models
- Useful C++ classes
- Using/Reproducing some of SRILM

SRILM (cont'd)

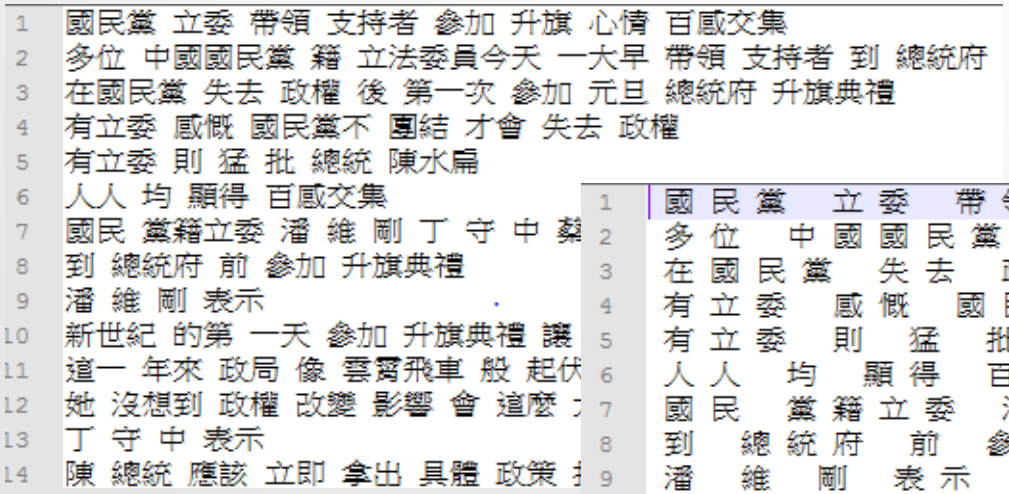
- Build it from source code (Provided on course website)
  - Allows you to use SRILM library
- Or download the executable from the course website to finish the first part of HW3
  - Different platform:
    - i686 for 32-bit GNU/Linux
    - i686-m64 for 64-bit GNU/Linux (CSIE workstation)
    - Cygwin for 32-bit Windows with cygwin environment

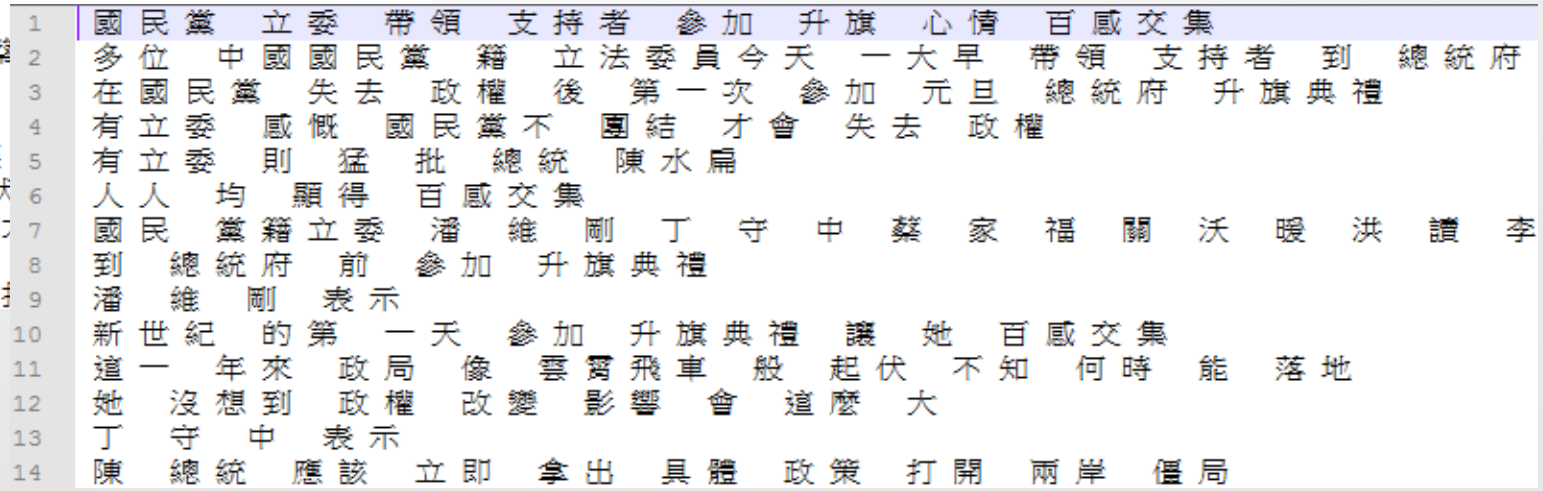
SRILM (cont'd)

- You are strongly recommended to read FAQ on the course website
- Possibly useful codes in SRILM
  - $SRIPATH/misc/src/File.cc (.h)
  - $SRIPATH/lm/src/Vocab.cc (.h)
  - $SRIPATH/lm/src/ngram.cc (.h)
  - $SRIPATH/lm/src/testError.cc (.h)

SRILM (cont'd)

- Big5 Chinese Character separator written in perl:
  - perl separator_big5.pl corpus.txt > corpus_seg.txt
  - Why we need to separate it? (Use char or word?)





SRILM (cont'd)

- ./ngram-count -text corpus_seg.txt -write lm.cnt -order 2
  - **-text:** input text filename
  - **-write:** output count filename
  - **-order:** order of ngram language model

- ./ngram-count -read lm.cnt -lm bigram.lm -unk -order 2
  - **-read:** input count filename
  - **-lm:** output language model name
  - **-unk:** view OOV as <unk>. Without this, all the OOV will be removed

Example

corpus_seg.txt

在 國 民 黨 失 去 政 權 後 第 一 次 參 加 元 旦 總 統 府 升 旗 典 禮
有 立 委 感 慨 國 民 黨 不 團 結 才 會 失 去 政 權
有 立 委 則 猛 批 總 統 陳 水 扁
人 人 均 顯 得 百 感 交 集

lm.cnt

夏 11210
俸 267
鴆 7
衹 1
微 11421
檎 27
.....

bigram.lm

\data\
ngram 1=6868
ngram 2=1696830

\1-grams:
-1.178429 </s>
-99 <s> -2.738217
-1.993207 一 -1.614897
-4.651746 乙 -1.370091
.....

(log probability) (backoff weight)

SRILM (cont'd)

- ./disambig -text testdata/xx.txt -map ZhuYin-Big5.map -lm bigram.lm -order 2 > $output
  - **-text:** input filename, xx = 1, 2, …, 10
  - **-lm:** input language model
  - **-map:** a mapping from (注音/國字) to (國字)
  - You should generate this mapping by yourself from the given Big5-ZhuYin.map.
  - Do not directly copy this command, please replace xx.txt with 1.txt~10.txt.

Generate Map

Big5-ZhuYin.map

```
一 ㄧˊ/ㄧˋ/ㄧ_
乙 ㄧˇ
丁 ㄉㄧㄥ_
柒 ㄑㄧ_
乃 ㄋㄞˇ
玖 ㄐㄧㄡˇ
…
…
長 ㄔㄤˊ/ㄓㄤˇ
行 ㄒㄧㄥˊ/ㄏㄤˊ
…
```

ZhuYin-Big5.map

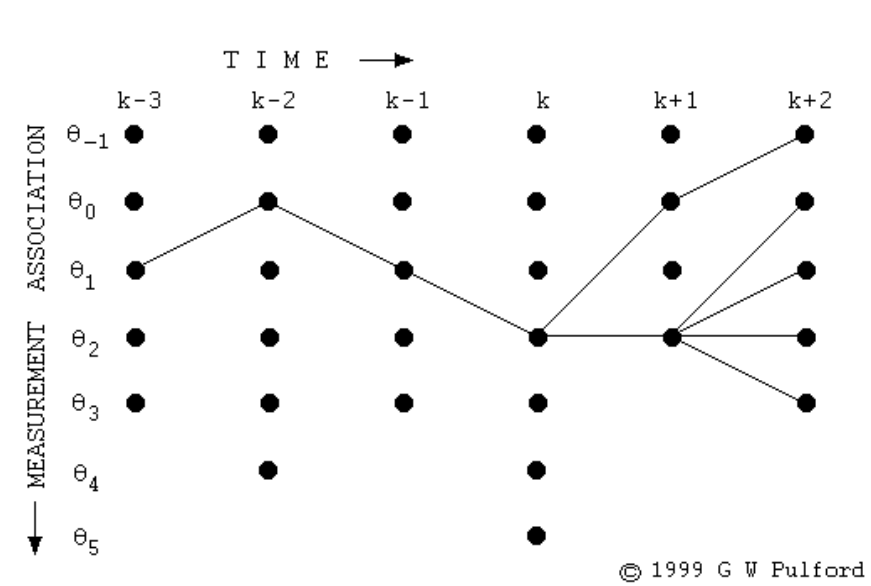
```
ㄅ　　八 匕 卜 不 卞 巴 比 丙 包 …
八　　八
匕　　匕
卜　　卜
…
…
ㄆ　　仆 匹 片 丕 叵 平 扒 扑 疋 …
仆　　仆
匹　　匹
…
…
```

Generate Map (cont'd)

- Be aware of polyphones(**破音字**)
- There could be arbitrary spaces between all characters.
- Key - value pairs
- Can be random permutation

My Disambig

- Implement your version of disambig.
- Use dynamic programming (Viterbi).
- The vertical axes are candidate characters.



Step by Step

- **Segment corpus and all test data into characters**
  - ./separator_big5.pl corpus.txt > corpus_seg.txt
  - ./separator_big5.pl testdata/xx.txt > testdata/seg_xx.txt
  - You should rename the segmented testdata as testdata/1.txt, testdata/2.txt… and use them in the following task.
- **Train character-based bigram LM**
  - Get counts:
  - ./ngram-count -text corpus_seg.txt -write lm.cnt -order 2
  - Compute probability:
  - ./ngram-count -read lm.cnt -lm bigram.lm -unk -order 2

Step by Step (cont'd)

- Generate ZhuYin-Big5.map from Big5-ZhuYin.map
  - See FAQ 4
- Using disambig to decode testdata/xx.txt
  - ./disambig -text testdata/xx.txt -map ZhuYin-Big5.map -lm bigram.lm -order 2 > $output
- Using mydisambig to decode testdata/xx.txt

Tips

- **C++ is Required**
  - Speed
  - SRILM compatibility and utility
  - You must provide **Makefile** for execution (See. Grading Procedure for details)
- **Dual OS or VirtualBox with Ubuntu strongly recommended**
- **Your output format should be consistent with SRILM**
  - <s> 這 是 一 個 範 例 格 式 </s>
  - There are an <s> at the beginning of a sentence, a </s> at the end, and whitespaces in between all characters.
  - Zero credit if your format is incorrect

How to deal with Chinese char?

- Chinese character: You should use Big5 encoding
- All testing files are encoded in Big5
- A Chinese character in Big5 is always 2 bytes, namely, char[2] in C++

Submission Example: student ID: r04922167

- r04922167/ (see submit_files_template/ in dsp_hw3.zip)
  - result1/1.txt~10.txt (generated from SRILM disambig with your LM by yourself)
  - your codes
  - Makefile
  - report.pdf
- Compress the folder to a zip file and upload it to Ceiba.
- 20% of the final score will be taken off for wrong format.

Makefile

Makefile

```
# The following two variable will be commandline determined by TA
# For testing, you could uncomment them.
SRIPATH ?= /data/DSP_HW3/103_2/srilm-1.5.10
MACHINE_TYPE ?= i686-m64
LM ?= bigram.lm

CXX = g++
CXXFLAGS = -O3 -I$(SRIPATH)/include -w --std=c++11
vpath lib%.a $(SRIPATH)/lib/$(MACHINE_TYPE)

TARGET = mydisambig
SRC = mydisambig.cpp
OBJ = $(SRC:.cpp=.o)
TO = ZhuYin-Big5.map
FROM = Big5-ZhuYin.map
.PHONY: all clean map run

all: $(TARGET)

$(TARGET): $(OBJ) -loolm -ldstruct -lmisc
    $(CXX) $(LDFLAGS) -o $@ $^

%.o: %.cpp
    $(CXX) $(CXXFLAGS) -c $<
run:
    @#TODO How to run your code toward different txt?
    @for i in $(shell seq 1 10) ; do \
            echo "Running $$i.txt"; \
            ./mydisambig -text testdata/$$i.txt -map $(TO) -lm $(LM) -order 2 > result2/$$i.txt; \
        done;
map:
    @#TODO How to map?
    @echo "Mapping!"
    @./mapping $(FROM) $(TO)
    @#python mapping.py $(FROM) $(TO)
    @#sh mapping.sh $(FROM) $(TO)
    @#perl mapping.pl Big5-ZhuYin.map ZhuYin-Big5.map
clean:
    $(RM) $(OBJ) $(TARGET)

```

Report

- Your report should include:
  - Your environment (CSIE workstation, Cygwin, …)
  - How to "compile" your program
  - How to "execute" your program
    - Not familiar with makefile is fine, tell me how to execute your program
    - However, you should also strictly follow the spec (regulations about filenames, input files and output files)
  - ex: ./program –a xxx –b yyy
  - What you have done
  - NO more than two A4 pages.

Grading Procedure

- There are some files provided by TA but you shouldn't upload them
  - Big5-ZhuYin.map, bigram.lm, testdata…
  - Strictly follow regulations about format
  - However, you can utilize the files in makefile
- test_env/ in dsp_hw3.zip shows locations of files during evaluation
- In the following slides, this color specify makefile commands of evaluation scripts

Grading Procedure (cont'd)

- (20%) You strictly follow format regulation
- Initialization
  - make clean
  - copy ta's bigram.lm, Big5-ZhuYin.map, testdata to your directory
- (10%) Your code can be successfully compiled
  - make MACHINE_TYPE=i686-m64 SRIPATH=/home/ta/srilm-1.5.10 all
  - i686-m64 is TA's platform
  - Your code should be machine-independent(system("pause") is invalid in my system) and the user can easily specify the platform and SRILM path

Grading Procedure (cont'd)

- (10%) Correctly generate ZhuYin-Big5.map
  - make map (it should generate r04922167/ZhuYin-Big5.map)
  - check if r04922167/ZhuYin-Big5.map is correct
  - (You have to write your own makefile to achieve it. Generation must be based on r04922167/Big5-ZhuYin.map)
  - (Your output in this step should be r04922167/ZhuYin-Big5.map)
  - (python/perl/C/C++/bash/awk permitted)
- (20%) Correctly use SRILM disambig to decode ZhuYin-mixed sequence
  - Check if result1/1.txt~10.txt is the same as expected

Grading Procedure (cont'd)

- (10%) mydisambig program can run with no errors and crashes
  - make MACHINE_TYPE=i686-m64 SRIPATH=/home/ta/srilm-1.5.10 LM=bigram.lm run
  - (it should run based on bigram.lm and generate result2/1.txt~10.txt)
- (20%) Your results decoded by your own program are the same as expected
  - check result2/1.txt~10.txt
  - TA's testdata will be segmented testdata, not the given raw testdata. DO NOT use "perl separator_big5.pl" in your makefile to separate testing data again.

Grading Procedure (cont'd)

- (10%) Your report contains required information
- (10% bonus!) Your program can support trigram language models with speed pruning.
  - Write down how to execute your trigram code in your report.

If there are runtime errors during TA's testing

- Like compilation error, crash…
  - TA will ask you to demo your program only with the files you uploaded.
  - If you can prove that you followed the rules correctly, you will get your credits.

Late Penalty

- 10% each 24 hours, according to the announced deadline instead of the deadline on Ceiba
- 100 -> 90 -> 80, not 100 -> 90 -> 81

Notes

- Follow the spec!!!!
- All of your program should finish the tasks assigned below 10 minutes
- Totally checking the correctness with good documents is YOUR JOB
- Only the latest files you uploaded to Ceiba will be evaluate (All of your previous uploaded version will be ignored)

Reminders and Suggestions

- Read the spec carefully
- Finish the first part (SRILM disambig) as early as possible
  - If everything goes well, you should finish the first part in an hour
  - Fix the issue of dependencies early
  - Big5 encoding issue, iconv not recommended
- Be sure that you prepare the correct Makefile
  - Grading procedure is in part automatically done by scripts. You can see the details in the previous slides
- See the FAQ in the website

Reminders and Suggestions

- Contact TA if needed
  - email：ntudigitalspeechprocessingta@gmail.com
    title: [HW3] bxxxxxxxx (your student number)
  - Check email-FAQ!
  - TA will not help you debug your program