G2P with CRF (Tutorial)

Ye Kyaw Thu
Visiting Researcher, Waseda University, Japan
Visiting Professor, NECTEC, Thailand

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- G2P Modeling with CRFSuite
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Introduction to G2P

- G2P (Grapheme to Phoneme)
- Conversion of Myanmar text into correct pronunciation
- Word level conversion examples

ကဗျာ	က	ဗျာ	ga-	bja
ကဗျာစပ်	က	ဗျာ	စပ်	ga- bja sa'
ကဗျာဆရာ	က	ဗျာ	ဆ ရာ	ga- bja hsa- ja
ကဗျာဆန်	က	ဗျာ	ဆန်	ga- bja hsan

Introduction to G2P

- Word level G2P examples with some grammatical information:

N + N

ဆေး + ခန်း (အခန်း) ---> ဆေးဂန်း

ဈေး + တန်း (အတန်း) ---> ဈေးဒန်း

မီး + ခိုး (အခိုး) ---> မီးဂိုး

မဲဧလီ + ဖူး (အဖူး) ---> မဲဧလီဗူး

ယဉ် + ကြော (အကြော) ---> ယဉ်ဂျော

ရင် + ခေါင်း (အခေါင်း) ---> ရင်ဃေါင်း

အိမ်ကြို + အိမ်ကြား (အကြား) ---> အိမ်ဂျိုအိမ်ဂျား

(Thein Tun, Acoustic Phonetics and The Phonology of the Myanmar Language, 2nd Edition, pp. 248-249)

Introduction to G2P

- Word level G2P examples with some grammatical information:

N + V + N

ဖင် + ထိုင် + ခုံ ---> ဖင်ဒိုင်ဂုံ

ရေ + ကူး + ကန် ---> ရေကူးဂန်

ကုန် + တင် + ကား ---> ကုန်ဒင်ဂါး

V + V + N

နေ + ချင် + စိတ် ---> နေဂျင်ဇိတ်

မြင် + ခဲ့ + တာ ---> မြင်ဂဲ့ဒါ

ပြော + ချင် + တာ ---> ပြောဂျင်ဒါ

(Thein Tun, Acoustic Phonetics and The Phonology of the Myanmar Language, 2nd Edition, pp. 251-252)

Introduction to G2P

- Many patterns exists and some of them are:

  $[N+V_f]^{cl\ N\ ph}$, $[N+V_s]^{cl\ N\ ph}$, $[for\ N+V_s]^{cl\ N\ ph}$,

  $[N+V]^{cl\ N\ ph}$, $[V+N^{cls}/\ for\ N]^{cl\ N\ ph}$, $[V+N]^{cl\ N\ ph}$,

  $[N+N]^{cl\ N\ ph}$, $[N+N_{cls}/\ for\ N]^{cl\ N\ ph}$, $[N+N_{cls}]^{cl\ N\ ph}$,
  $[N+V+N]^{cl\ N\ ph}$, $[N+N_{par}+N]^{cl\ N\ ph}$, $[N+N_{cls}+N_{par}]^{cl\ N\ ph}$,
  $[N+N_{par}+V]^{cl\ N\ ph}$, $[N+V+V]^{cl\ N\ ph}$, $[N+V+V]^{cl\ N\ ph}$

(Thein Tun, Acoustic Phonetics and The Phonology of the Myanmar Language, 2nd Edition, pp. 226-227)

Introduction to G2P

- If the vowel combination of 1st syllable is "ိင်/in/aun" or "ည်/in" or "ိန်/an/un" or "ိမ်/an/ein" or "ယ်/e" or "ဲ/e:" or "ံ/an", and the consonant of 2nd syllable is an unaspairated or an aspirated consonant that is unvoiced, then that 2nd syllable's pronunciation is voiced.Example pronunciations of some words are as follows:

တောင်ပြုံး (taun pjoun:) => တောင်ဗြုံး (taun bjoun:)
ပိုင်းခြေ (pain: chei) => ပိုင်းဂျေ (pain: gyei)

(Ye Kyaw Thu et. al., Syllable Pronunciation Features for Myanmar Grapheme to Phoneme Conversion", In Proceedings of the 13th International Conference on Computer Applications (ICCA 2015), February 5~6, 2015, Yangon, Myanmar, pp. 161-167)

Introduction to G2P

- There are many exceptions:

ရင်ခုန် (j in khoun) => ရင်ခုန် (j in khoun)
စည်းကမ်း (si: kan:) => စည်းကမ်း (si: kan:)

(Ye Kyaw Thu et. al., Syllable Pronunciation Features for Myanmar Grapheme to Phoneme Conversion", In Proceedings of the 13th International Conference on Computer Applications (ICCA 2015), February 5~6, 2015, Yangon, Myanmar, pp. 161-167)

Introduction to G2P

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Introduction to G2P

- Word level + Sentence level conversion examples

(Thein Tun, Acoustic Phonetics and The Phonology of the Myanmar Language, 2nd Edition, pp. 290, 294, 297)

- Note: G2P is not only for word level, we have to prepare for sentence level conversions

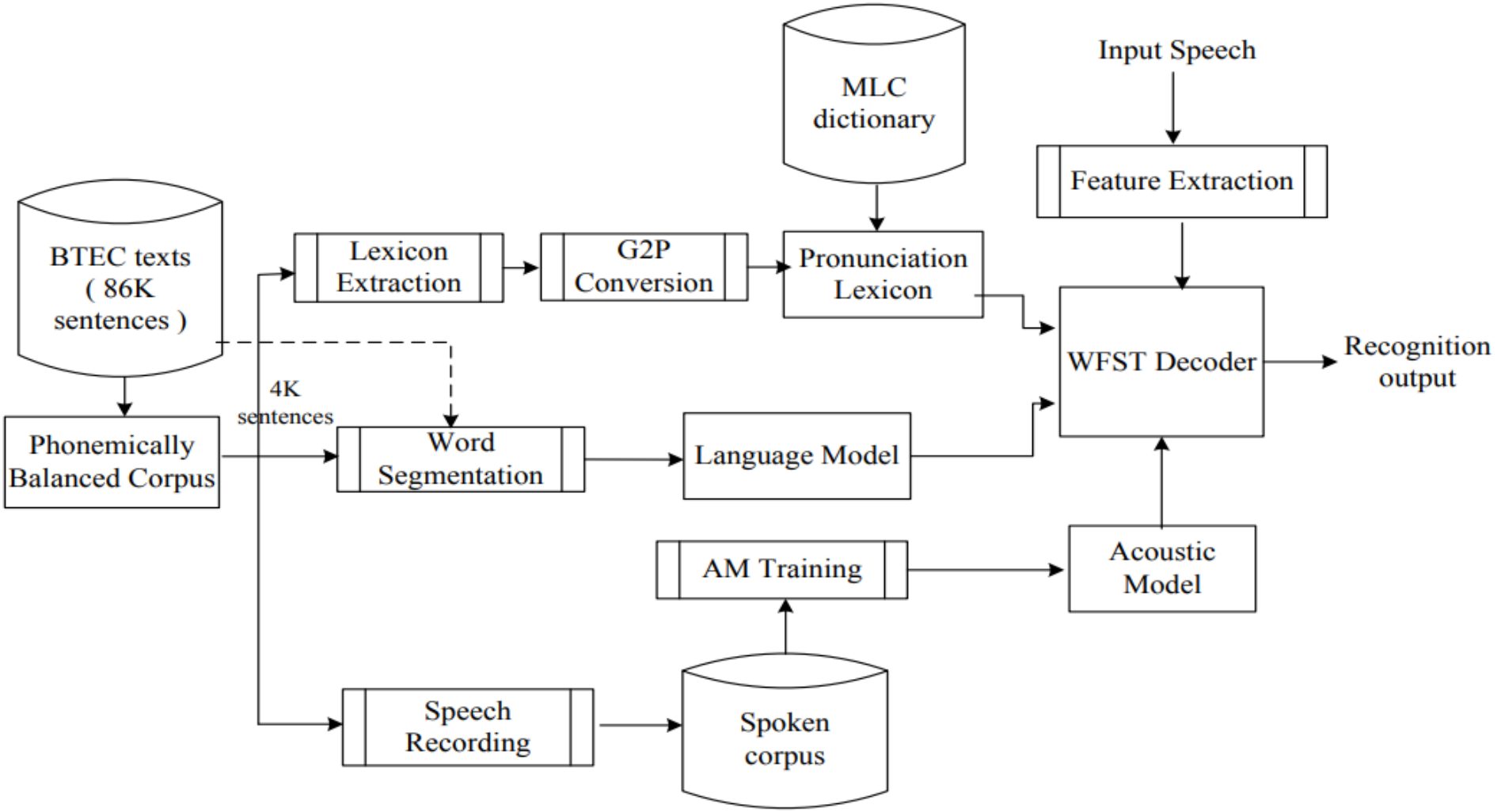
G2P Dictionary

- Knowing how words are pronounced is an essential for building automatic speech recognition (ASR) and text-to-speech (TTS) systems
- Middle layer:

  ASR Model --→ G2P Model --→ TTS Model
- Several approaches already proposed
- How about doing G2P conversion for Myanmar language?

Introduction to G2P

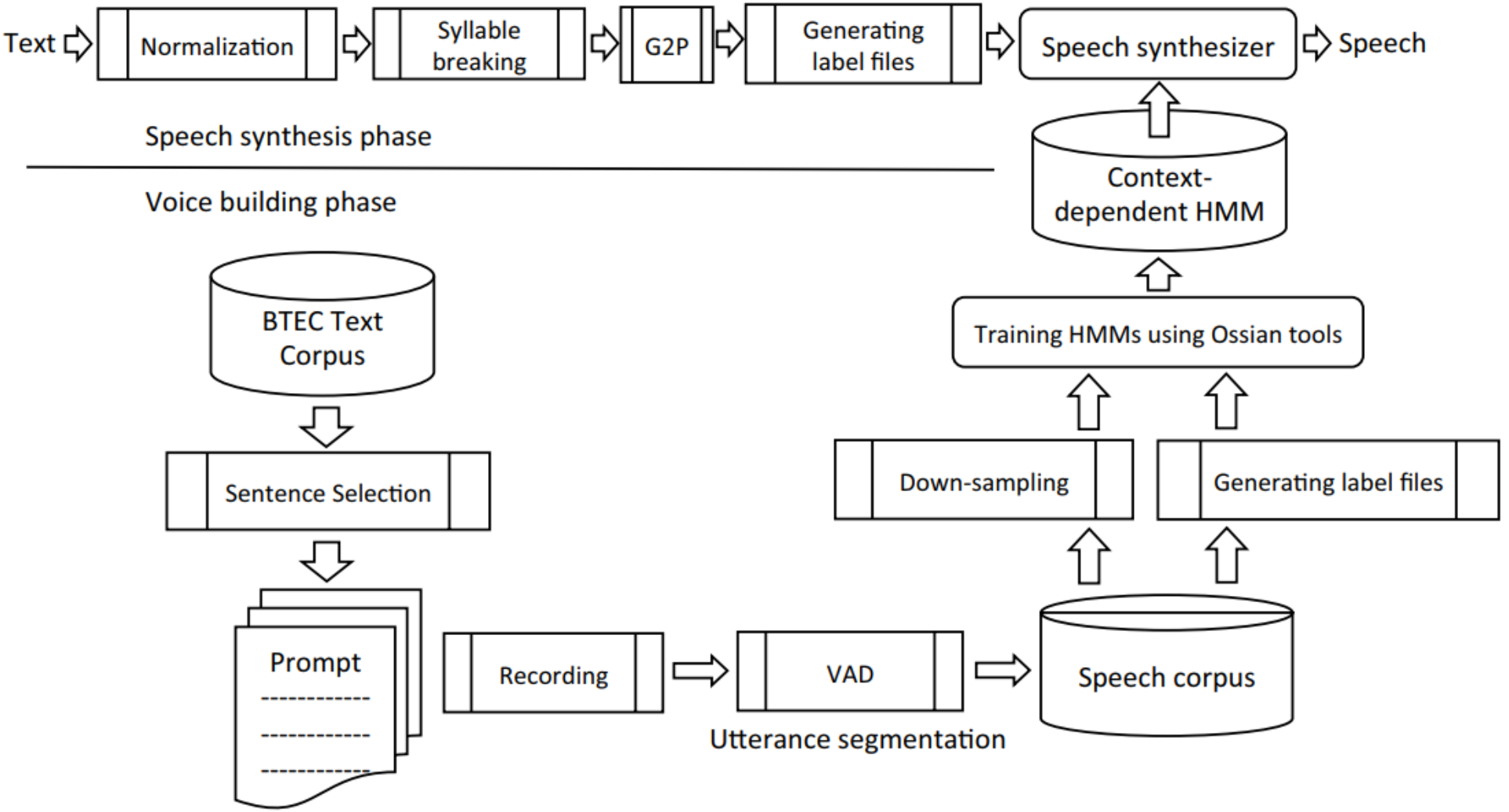
- An Example of using G2P for Myanmar ASR



(Hay Mar Soe Naing et. al., "A Myanmar Large Vocabulary Continuous Speech Recognition System", In Proceedings of APSIPA Annual Summit and Conference (APSIPA ASC 2015), December 16–19, 2015, Hong Kong, pp. 320-327)

Introduction to G2P

- An example of using G2P for Myanmar TTS



(Ye Kyaw Thu et. al., "HMM Based Myanmar Text to Speech System", In Proceedings of the 16th Annual Conference of the International Speech Communication Association (INTERSPEECH 2015), September 6-10, 2015, Dresden, Germany, pp. 2237-2241)

Introduction to G2P

- Grapheme to phoneme mapping for consonants

ဇယား:နံပါတ်(၁) - ဗျည်း အုပ်စုများ နှင့် သူတို့၏ အသံထွက်များ

Grouped consonants				
Unaspirated	**Aspirated**	**Voiced**		**Nasal**
က /k/	ခ /kh/	ဂ /g/	ဃ /g/	င /ng/
စ /s/	ဆ /hs/	ဇ /z/	ဈ /z/	ဉ/ည /nj/
ဋ /t/	ဌ /ht/	ဍ /d/	ဎ /d/	ဏ /n/
တ /t/	ထ /ht/	ဒ /d/	ဓ /d/	န /n/
ပ /p/	ဖ /hp/	ဗ /b/	ဘ /b/	မ /m/
ယ /j/	ရ /j/ or /r/	လ /l/	ဝ /w/	သ /th/
	ဟ /h/	ဠ /l/	အ /a/	

- Ref: https://github.com/ye-kyaw-thu/myG2P

Introduction to G2P

- Some examples of vowel combinations and their pronunciations

ဧယားနံပါတ်(၂) - "အ" ဗျည်း နှင့် သရ ပေါင်းစပ်မှု ပုံစံများ နှင့် သူတို့၏ အသံထွက်များ

အီ i	အိ i.	အီး i:	အစ် i’	အင် in	အင့် in.	အင်း in:
အေ ei	အေ့ ei.	အေး ei:	အိတ် ei’	အိန် ein	အိန့် ein.	အိန်း ein:
အယ် e	အယ့် e.	အဲ e:	အိုက် ai’	အိုင် ain	အိုင့် ain.	အိုင်း ain:
အာ a	အာ့ a.	အား a:	အတ် a’	အန် an	အန့် an.	အန်း an:
အော် o	အော့ o.	အော o:	အောက် au’	အောင် aun	အောင့် aun.	အောင်း aun:
အု u	အု့ u.	အူး u:	အုတ် u’	အုန် un	အုန့် un.	အုန်း un:
အို ou	အို့ ou.	အိုး ou:	အုပ် ou’	အုန် oun	အုန့် oun.	အုန်း oun:

Introduction to G2P

- G2P is a very good Lab. exercise for Myanmar language NLP
- We will use one of the sequence modelings, CRF (Conditional Random Fields)
- Toolkits: I recommend to use CRF++ or CRFSuite
- For this exercise we will use CRFSuite
- Refer following CRFSuite Tutorial:

  http://www.chokkan.org/software/crfsuite/tutorial.html

G2P Dictionary

- We will use myG2P Dictionary (Version 1) for this Lab exercise

  https://github.com/ye-kya-thu/myG2P/tree/master/ver1

Ye Kyaw Thu
ye-kyaw-thu

myG2P

Myanmar (Burmese) Language Grapheme to Phoneme (myG2P) Conversion Dictionary for speech recognition (ASR) and speech synthesis (TTS).

grapheme-to-phone | g2p | myanmar | dictionary | myanmar-grapheme

★ 15 2 Updated on Jul 29, 2017

Preprocessing (Installation of CRFSuite)

- Link of CRFsuite:

  http://www.chokkan.org/software/crfsuite/

- After you download CRFsuite, untar:

  $ tar -xzvf ./crfsuite-0.12.tar.gz

Preprocessing (Installation of CRFSuite)

- $ ./autogen.sh

  libtoolize: error: One of these is required:

  libtoolize: gm4 gnum4 m4

  libtoolize: error: Please install GNU M4, or 'export M4=/path/to/gnu/m4'.

  ./autogen.sh: 20: ./autogen.sh: aclocal: not found

  aclocal failed!

- If you got above error, you need to install automake:

  $ sudo apt-get install automake

Preprocessing (Installation of CRFSuite)

- After running “autogen.sh” successfully
- Run as usual:
  - ./configure
  - make
  - sudo make install
- You might need to run ./configure with some options
  - $ ./configure --with-liblbfgs=/home/yekyawthu/tool/liblbfgs-1.10

Preprocessing (Installation of CRFSuite)

- After installation, when you run “crfsuite –help”, if you got following error:
  - crfsuite: error while loading shared libraries: libcrfsuite-0.12.so: cannot open shared object file: No such file or directory
- You might need to update “ld.so.conf” file:
  - $ sudo vi /etc/ld.so.conf
- I added following line:
  - LIBDIR=/home/yekyawthu/local/lib/

Preprocessing (Installation of CRFSuite)

- If you installed successfully

```
lar@lar-air:~$ crfsuite -h
CRFSuite 0.12  Copyright (c) 2007-2011 Naoaki Okazaki

USAGE: crfsuite <COMMAND> [OPTIONS]
    COMMAND     Command name to specify the processing
    OPTIONS     Arguments for the command (optional; command-specific)

COMMAND:
    learn       Obtain a model from a training set of instances
    tag         Assign suitable labels to given instances by using a model
    dump        Output a model in a plain-text format

For the usage of each command, specify -h option in the command argument.
lar@lar-air:~$
```

Preprocessing (Cloning myG2P dictionary)

- You can get the myG2P data with following command:

  git clone https://github.com/ye-kyaw-thu/myG2P

- Dictionary is under following path:

  ./myG2P/ver1/

- Dictionary filename: myg2p.ver1.txt

Preprocessing (Check myG2p dictionary)

```
$ head ./myg2p.ver1.txt
1       ...ဖြစ်စေ...ဖြစ်စေ      ... ဖြစ် စေ... ဖြစ် စေ  ... hpji' sei ... hpji' sei
2       ...ရို..စဉ်      ... ရို.. စဉ်   jou: ... sin
3       ...ရို..စဉ်      ... ရို.. စဉ်   jou: ... zin
4       ...လို...ငြ      ... လို... ငြ   ... lou ... nja:
5       ကကတစ်   က က တစ် ka. ga- di'
6       ကကတို   က က တို  ka. ga- dou:
7       ကကုသန်   က ကု သန် ka. ku. than
8       ကကုသန်   က ကု သန် kau' ka- than
9       ကကူရုံ   က ကူ ရုံ  ka. ku jan
10      ကကြို   က ကြို  ka. gyou:
```

- We should remove top 4 lines from the original myG2p dictionary

Preprocessing (Cutting only column-3 and 4)

- $cut -f2,3 ./myg2p.ver1.txt > f23
- $ head f34

  က က တစ် ka. ga- di'

  က က တို ka. ga- dou:

  က ကူ သန် ka. ku. than

  က ကူ သန် kau' ka- than

  က ကူ ရံ ka. ku jan

  က ကြို ka. gyou:

  က ကြို တန် ဆ ka. gyou: da- za

  က ကြီ က ကြောင် လုပ် ga- gyi ga- gyaun lou'

  က ကြီ ka. gyi:

  က ကြီ ထွန် ka. gyi: htun

Preprocessing (Dividing training and test data)

- Use “shuf” command for shuffling

  $shuf f34 > f34.shuf

- Use “head” and “tail” commands for splitting training and test data (80% for training and 20% for testing)

  $head -n 19830 ./f34.shuf > ./myg2p.dictver1.train

  $tail -n 4957 ./f34.shuf > ./myg2p.dictver1.test

- Check no. of lines with “wc” command:

  $wc myg2p.dictver1.train

  19830 56820 867421 myg2p.dictver1.train

  $wc myg2p.dictver1.test

  4957 14199 216868 myg2p.dictver1.test

Preprocessing (grapheme phoneme y format)

- For training data

  $perl ch2col2.pl ./myg2p.dictver1.train > ./myg2p.dictver1.train.col

- For testing data

  $perl ch2col2.pl ./myg2p.dictver1.test > ./myg2p.dictver1.test.col

- Check the format of training:

  $head myg2p.dictver1.train.col

  စ sa- sa-

  ရွေ jwei_ jwei_

  တံ dan dan

  ကြွက် kywe_ kywe_

  မြီ mi_ mi_

  တန် tan_ tan_

  သ tha- tha-

  မက် me' me'

Preprocessing
(Change to CRFSuite format)

- For Training

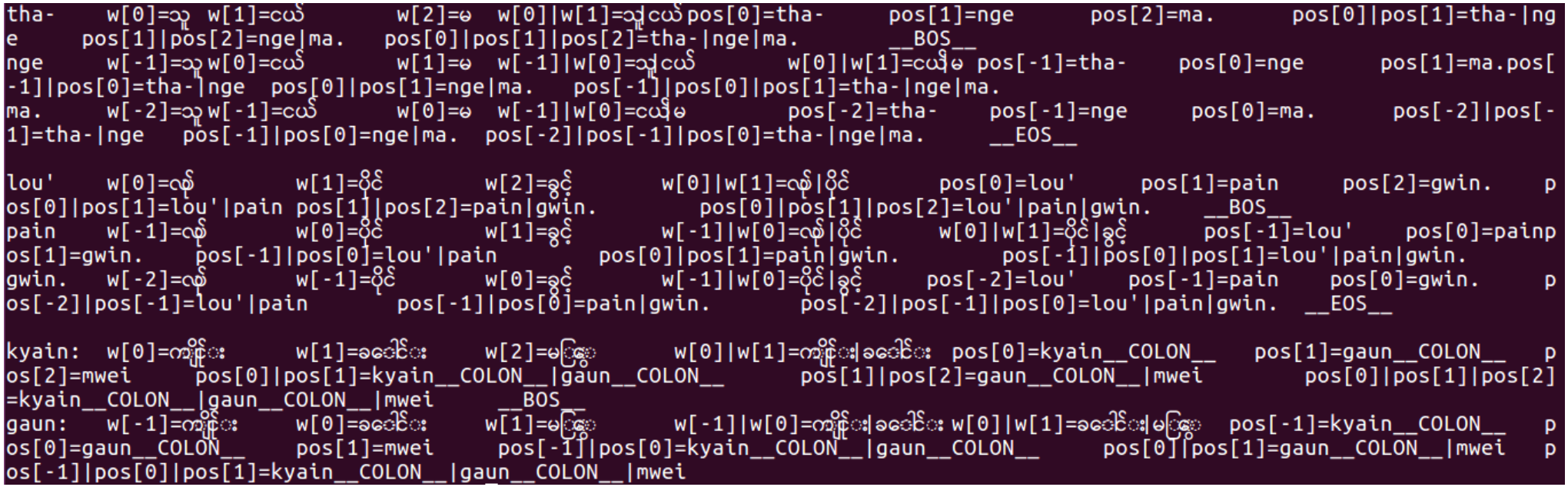
  $cat myg2p.dictver1.train.col | perl ./chunking.py > train

- For Testing

  $cat myg2p.dictver1.test.col | perl ./chunking.py > test

Preprocessing
(Change to CRFSuite format)

- When you check the format with “head” command:



G2P Modeling with CRFSuite

- “crfsuite learn” command is for modeling or training
- “crfsuite tag” command is for tagging or testing
- Check the option with following commands:

  $crfsuite learn --help

  $crfsuite tag --help

G2P Modeling with CRFSuite

- Building g2p model with following command:

  $crfsuite learn -m ./g2p.model -e2 ./train ./test

  - Here,

    -m, --model=FILE for output model name

    Note: By default, this utility does not store the model and thus you should use “-m or –model” option

    -e2 option performs a holdout evaluation on the data set #2

    (i.e. ./test)

G2P Modeling with CRFSuite

- When you run:

  $crfsuite learn

  -m ./g2p.model

  -e2 ./train ./test

- Training time will be depends on your data size, no. of features and learning options

```
CRFSuite 0.12  Copyright (c) 2007-2011 Naoaki Okazaki

Start time of the training: 2019-01-07T11:51:16Z

Reading the data set(s)
[1] ./train
0....1....2....3....4....5....6....7....8....9....10
Number of instances: 19831
Seconds required: 0.558
[2] ./test
0....1....2....3....4....5....6....7....8....9....10
Number of instances: 4958
Seconds required: 0.155

Statistics the data set(s)
Number of data sets (groups): 2
Number of instances: 24787
Number of items: 71019
Number of attributes: 221448
Number of labels: 1868

Holdout group: 2

Feature generation
type: CRF1d
feature.minfreq: 0.000000
feature.possible_states: 0
feature.possible_transitions: 0
0....1....2....3....4....5....6....7....8....9....10
Number of features: 362629
Seconds required: 0.419

L-BFGS optimization
c1: 0.000000
c2: 1.000000
num_memories: 6
max_iterations: 2147483647
epsilon: 0.000010
stop: 10
delta: 0.000010
linesearch: MoreThuente
linesearch.max_iterations: 20
```

Testing

- Run following command for testing:

  $crfsuite tag -m ./g2p.model ./test | tee test1.out

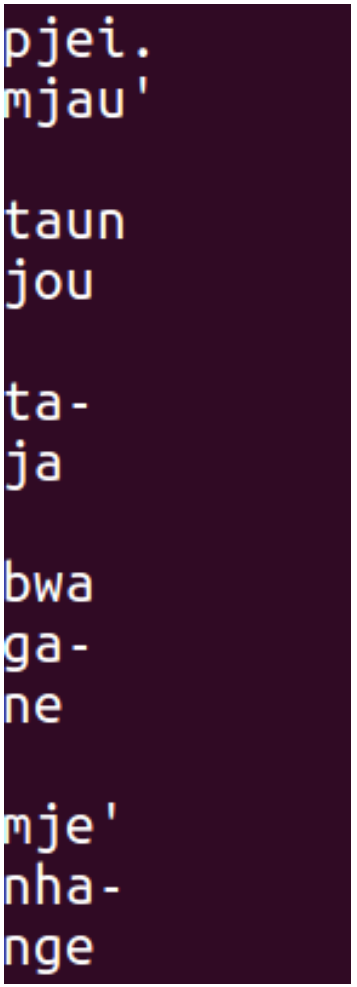
- Here,

  -m or –model option is for the model name that you built

  “tee” command is for reading standard input and write to standard output and files

Testing

- You will get predicted “phonemes” or “y” as one column:



- And thus, you have to make parallel data with grapheme parts for evaluation process

Evaluation (preprocessing for evaluation)

- 1st Change column to line with “ch2line.pl”

  $perl ./ch2line.pl ./test1.out > ./test1.out.line

- Check the output with $head ./test1.out.line:

```
yekyawthu@bit-MS-7B09:~/exp/g2p/word$ head ./test1.out.line
tha- nge ma.
lou' pain gwin.
lhain gaun mwei
na- mji gwin
na' tha'
lun bjan
mwei mju jei
mje' nha- bei
khaun laun ti
kywe' kya.
```

Evaluation
(Preprocessing for evaluation)

$perl ./mk-wordtag.pl ./myg2p.dictver1.test "\/" w > ./myg2p.dictver1.test.word

$head ./myg2p.dictver1.test.word

သူ ငယ် မ
လုပ် ပိုင် ခွင့်
ကျိုင်း ခေါင်း မြွေ
နွား မြီး ကွင်း
နတ် သတ်
လွန်း ပြန်
မွေး မြူ ရေး
မျက် နှာ ပေး
ခေါင်း လောင်း တီး
ကြွက် ကျ

Evaluation (Preprocessing for evaluation)

$perl ./mk-pair.pl ./myg2p.dictver1.test.word ./test1.out.line > test1.out.line.wordtag

$head ./test1.out.line.wordtag

သူ/tha- ငယ်/nge မ/ma.
လုပ်/lou' ပိုင်/pain ခွင့်/gwin.
ကျိုင်း/lhain ခေါင်း/gaun မြွေ/mwei
နွား/na- မြီး/mji ကွင်း/gwin
နတ်/na' သတ်/tha'
လွန်း/lun ပြန်/bjan
မွေး/mwei မြူ/mju ရေး/jei
မျက်/mje' နှာ/nha- ပေး/bei
ခေါင်း/khaun လောင်း/laun တီး/ti
ကြွက်/kywe' ကျ/kya.

Evaluation (Measuring tagging accuracy%)

$perl ./gradepos.pl ./myg2p.dictver1.test ./test1.out.wordtag

```
Accuracy: 72.67% (10318/14199)

Most common mistakes:
မီး/mi: --> မီး/mi    66
လုံး/loun: --> လုံး/loun  50
ကြီး/gyi: --> ကြီး/gyi  47
ရေး/jei: --> ရေး/jei  45
လေး/lei: --> လေး/lei  38
ရိုး/jou: --> ရိုး/jou   36
ဦး/u: --> ဦး/u 35
စား/za: --> စား/za   33
သား/dha: --> သား/dha  33
စည်း/si: --> စည်း/si  33
```

Analysis on Current Tagging Errors

- Currently we only got 72.67%
- Most of the errors are relating to Myanmar tone character Visarga or WitSaNhaLone Pauk

```
Accuracy: 72.67% (10318/14199)

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ရေး/jei: --> ရေ/jei  45
လေး/lei: --> လေ/lei  38
ရိုး/jou: --> ရို/jou   36
ဦး/u: --> ဦ/u 35
စား/za: --> စာ/za   33
သား/dha: --> သာ/dha  33
စည်း/si: --> စည်/si  33
```

Practical Exercise with “_”

- It is strange and I think error occurred because of using colon character “:”
- When I run “head command on training data”:

```
$ head -5 train
sa-  w[0]=စ w[1]=ေရး:  w[2]=တဲ့ w[0]|w[1]=စ|ေရး:  pos[0]=sa-  pos
[1]=jwei__COLON__  pos[2]=dan  pos[0]|pos[1]=sa-|jwei__COLON__ pos[1]|pos
[2]=jwei__COLON__|dan pos[0]|pos[1]|pos[2]=sa-|jwei__COLON__|dan  __BOS__
jwei:  w[-1]=စ w[0]=ေရး:  w[1]=တဲ့ w[-1]|w[0]=စ|ေရး:  w[0]|w[1]=ေရး:|တဲ့  pos[-1]=sa-
pos[0]=jwei__COLON__  pos[1]=dan  pos[-1]|pos[0]=sa-|jwei__COLON__ pos[0]|pos
[1]=jwei__COLON__|dan pos[-1]|pos[0]|pos[1]=sa-|jwei__COLON__|dan
dan  w[-2]=စ w[-1]=ေရး:  w[0]=တဲ့ w[-1]|w[0]=ေရး:|တဲ့  pos[-2]=sa-  pos
[-1]=jwei__COLON__  pos[0]=dan  pos[-2]|pos[-1]=sa-|jwei__COLON__  pos[-1]|pos
[0]=jwei__COLON__|dan pos[-2]|pos[-1]|pos[0]=sa-|jwei__COLON__|dan  __EOS__

kywe:  w[0]=ကြက်  w[1]=မြီး:  w[2]=တန်:  w[0]|w[1]=ကြက်|မြီး:  pos[0]=kywe__COLON__
pos[1]=mi__COLON__  pos[2]=tan__COLON__  pos[0]|pos[1]=kywe__COLON__|mi__COLON__
pos[1]|pos[2]=mi__COLON__|tan__COLON__ pos[0]|pos[1]|pos[2]=kywe__COLON__|
mi__COLON__|tan__COLON__  __BOS__
```

Practical Exercise with “_”

- How about replacing “:” symbol with “_”
- You can use sed or tr command

  $cat ./myg2p.dictver1.train | tr ':' '_'

```
စ/sa- ရွေး/jwei_ တံ/dan
ကြွက်/kywe_ မြီး/mi_ တန်း/tan_
သ/tha- မက်/me' ဖမ်း/hpan_
ဖော့/hpo. ဆို့/zou.
ခဲ/ge_ ဖိုး/bou_
လက်/le' စွပ်/su'
စ/sa- မြင်/mj in
ရာ/j a သီ/dhi ကုန်/goun
လမ်း/lan_ လျှောက်/shau' ပင်/pin
မာ/ma ဃ/ga.
```

- Don’t forget for test data also!

Practical Exercise with “_”

- Evaluation result with underscore model is 98.45%:

```
$ perl ./gradepos.pl ./myg2p.dictver1.test ./test1.out.line.wordtag
Accuracy: 98.45% (13979/14199)

Most common mistakes:
စွာ/swa --> စွာ/zwa   5
ပြု/bju. --> ပြု/pju.   3
ဟ/ha- --> ဟ/ha. 3
ကွာ/gwa --> ကွာ/kwa   3
ဆင့်/zin. --> ဆင့်/hsin.  2
/shi' --> ိ/shi.   2
/jwe. -->   2
ရိုက်/rai' --> ရိုက်/jai'  2
ပြု/pju --> ပြု/pju.   2
ငွေ့/gwei. --> ငွေ့/ngwei.    2
```

Published Works for Myanmar Language G2P

- Word level G2P papers:

  Ye Kyaw Thu, Win Pa Pa, Andrew Finch, Aye Mya Hlaing, Hay Mar Soe Naing, Eiichiro Sumita and Chiori Hori, "Syllable Pronunciation Features for Myanmar Grapheme to Phoneme Conversion", In Proceedings of the 13th International Conference on Computer Applications (ICCA 2015), February 5~6, 2015, Yangon, Myanmar, pp. 161-167. [Best Paper Award]

  Ye Kyaw Thu, Win Pa Pa, Yoshinori Sagisaka, Naoto Iwahashi, "Comparison of Grapheme–to–Phoneme Conversion Methods on a Myanmar Pronunciation Dictionary", In Proceedings of the 6th Workshop on South and Southeast Asian Natural Language Processing (WSSANLP), COLING 2016, December 11-17, 2016, Osaka, Japan, pp. 11–22.

Published Works for Myanmar Language G2P

- Sentence level G2P papers:

  Ye Kyaw Thu, Win Pa Pa, Andrew Finch, Jinfu Ni, Eiichiro Sumita and Chiori Hori, 2015, "The Application of Phrase Based Statistical Machine Translation Techniques to Myanmar Grapheme to Phoneme Conversion", In Proceedings of the Pacific Association for Computational Linguistics Conference (PACLING 2015), May 19~21, 2015, Legian, Bali, Indonesia, pp. 170-176. (revised paper has been published in Springer Communication in Computer and Information Science (CCIS), ISSN:1865-0929, pp. 238-250)

- Note: We used myG2P dictionary + extracted 5,276 sentences of BTEC corpus for this PACLING 2015 conference paper

Assignment: Sentence Level G2P

- 1st build a word-level G2P model
- Collect 1,000 Myanmar sentences from social media or web news domain
- Parse collected data with word level G2P model
- Manually fixed phoneme conversion errors of parsed sentences
- Shuffle your data and split (800 sentences for training and 200 sentences for testing)
- Build sentence-level G2P model with CRFSuite and make evaluation with 200 sentence test data
- Report the accuracy% of your sentence-level G2P in details

Myanmar Language G2P Research?!

- We need sentence level tagged corpus for several domains
- You can try with different modeling approaches to increase tagging accuracy %
- At first, try to finish my assignment
- You can also consider to add some more features (refer Ye Kyaw Thu et. al., ICCA2015)

ကောင်း	0	kaun:
ကောင်း	c	gaun:
ကန်	w	kan:
ကန်	c	gan:

ခံ	0 0 0 c	ga-
တွင်း	c 0 0 c	dwin:
ကောင်း	w 0 0 0	kaun: