Team : Echo Chen /Xianchi Zhang

Tagging accuracies:

The accuracy of this Viterbi Algorithm for the test case is: 93.62%

List down cases which were incorrectly tagged:

- Coming wrongly tagged as Noun
- Face-to-face wrongly tagged as Noun
- Another wrongly tagged as Noun

Evaluation:

These wrongly tagged issues are based on rules of unknown words, the rule based tagger assigns 'NOUN' by default if word does not fall in any rule, to correct this we can assign the tags for any such word based purely on transition probability of tags.

```
# specify patterns for tagging
patterns = [
    (r'.*ing$', 'VERB'),              # gerund
    (r'.*ed$', 'VERB'),               # past tense
    (r'.*es$', 'VERB'),               # verb
    (r'.*\'s$', 'NOUN'),              # possessive nouns
    (r'.*s$', 'NOUN'),                # plural nouns
    (r'\*T?\*?-[0-9]+$', 'X'),        # X
    (r'^-?[0-9]+(.[0-9]+)?$', 'NUM'), # cardinal numbers
    (r'^[A-Z][a-z].*', 'NOUN'),       # NOUN
    (r'.*', 'NN')                     # default
]

# rule based tagger
rule_based_tagger = nltk.RegexpTagger(patterns)
```

Methods for pos tagging:

- Forward-Backward Maximum Matching based on rules
- HMM CRF based on statistics
- BILSTM+ CRF based on deep learning

HMM algorithm we use given a sequence of words to be tagged, the task is to assign the most probable tag to the word. In other words, to every word w, assign the tag t that maximizes the likelihood P(t/w).

- P(w/t): is the emission probability of a given word for a given tag. This can be computed based on the fraction of given word for given tag to the total count of that tag, ie: P(w/t) = count(w, t) / count(t).

- P(t): is the probability of tag (also transition probability), and in a tagging task, we assume that a tag will depend only on the previous tag (Markov order 1 assumption). In other words, the probability of say a tag being NN will depend only on the previous tag t(n-1).

Detailed comparison shown below:

INPUT	ANSWER	INFERENCE	
Those	DET	DET	True
coming	VERB	NOUN	False
from	ADP	ADP	True
other	ADJ	ADJ	True
denominations	NOUN	NOUN	True
will	VERB	VERB	True
welcome	VERB	VERB	True
the	DET	DET	True
opportunity	NOUN	NOUN	True
to	PRT	PRT	True
become	VERB	VERB	True
informed	VERB	VERB	True
.	.	.	True
The	DET	DET	True
preparatory	ADJ	ADJ	True
class	NOUN	NOUN	True
is	VERB	VERB	True
an	DET	DET	True
introductory	ADJ	ADJ	True
face-to-face	ADJ	NOUN	False
group	NOUN	NOUN	True
in	ADP	ADP	True
which	DET	DET	True
new	ADJ	ADJ	True
members	NOUN	NOUN	True
become	VERB	VERB	True
acquainted	VERB	VERB	True
with	ADP	ADP	True
one	NUM	NUM	True
another	DET	NOUN	False
.	.	.	True
It	PRON	PRON	True
provides	VERB	VERB	True
a	DET	DET	True
natural	ADJ	ADJ	True
transition	NOUN	NOUN	True
into	ADP	ADP	True
the	DET	DET	True
life	NOUN	NOUN	True
of	ADP	ADP	True
the	DET	DET	True
local	ADJ	ADJ	True
church	NOUN	NOUN	True
and	CONJ	CONJ	True
its	DET	DET	True
organizations	NOUN	NOUN	True
.	.	.	True

Overall Accuracy: 93.62%