LING 120: Language and Computers

Semester: Fall 2017

Instructor: Sowmya Vajjala

Iowa State University, USA

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Class Outline

1. Last class' question
2. Context sensitive spelling correction
3. Assignment 2 description

Question from last class

Visit `www.eogn.com/soundex/` and list a few examples of where Soundex will fail. Use some non-word errors and their correct versions and check which pairs have the same soundex and which pairs don't. Try to come up with 2 examples for each case and analyse why are the soundex codes same or different.
Example: Assignment can have two mis-spellings (among others).
Asignment, Assingment - First one will have the same soundex as the original word. Second one won't have. Why? (sounds are different)

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   - laf, laugh - L100 and L200
   - night, nite - N-230, N-300
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3. Another major problem: For long words, you may never get right suggestions (Why?) Revolution, Revolutionize, Revolutionary, Revolutionist, Revolutionization- all get the same Soundex!

Today's topic: Context Sensitive Spelling Correction

What is the problem to solve?

- ... detecting and correcting real word spelling errors.
- i.e., words are not spelt wrong - they are spelt wrong in that context.
- Grammar checking is considered a context sensitive spelling correction process.
- Since everything is dependent on context, can we say every word is a potential error? (What? How?)

Some examples

- Let us take this sentence: "There house is nice". There are two possible "correct" options.
  - The house is nice.
  - Their house is nice. (more likely)
  - The house there is nice.
- Or another: "The teams was successful". There are again two possible "correct" options.
  - The team was successful.
  - The teams were successful. (can we say for certain what is more likely?)
- How does a computer go about detecting such errors?

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- Gender errors due to native language background (e.g, one language has the Gender for Sun as male. The other one has female.)

...

Correcting such errors

- Grammar based word correction
- Error pattern based word correction
- Probability based word correction
- Meaning based word correction

Grammar based word correction

- Idea: encode the rules of language into a computer program. As the program tries to build a syntactic structure of the language, if there is no matching grammar rule, then it breaks, which is an indication that the sentence has an error.

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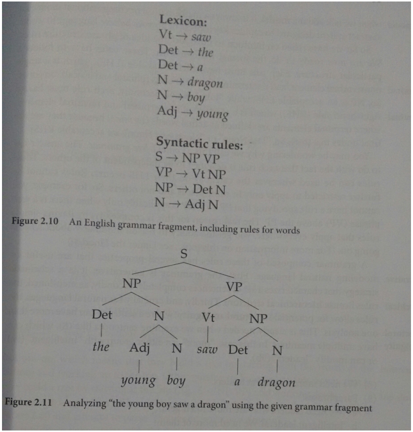
- This is what I mean when I said "syntactic structure".



Lexicon:
Vt → *saw*
Det → *the*
Det → *a*
N → *dragon*
N → *boy*
Adj → *young*

Syntactic rules:
S → NP VP
VP → Vt NP
NP → Det N
N → Adj N

Figure 2.10 An English grammar fragment, including rules for words

S
NP
VP
Det
N
Vt
NP
the
Adj
N
saw
Det
N
young
boy
a
dragon

Figure 2.11 Analyzing "the young boy saw a dragon" using the given grammar fragment

Pros and Cons

- Pros: Very effective - specific error identification and feedback is possible.
- Cons: Such a grammar has to be painstakingly prepared first, and suiting to the needs of a computational approach (which is time consuming and expensive)
- Language is continuously changing - so new expressions, new syntactic structures keep coming. This approach will not work if we don’t keep updating.

Error pattern based word correction

- Idea: Prepare a large set of rules of error patterns in language. Whenever there is a match to a rule, flag an error and suggest a solution (e.g. rule: if a plural word is followed by *is*, flag an error, and suggest using *are* instead).

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- Idea: Prepare a large set of rules of error patterns in language. Whenever there is a match to a rule, flag an error and suggest a solution (e.g. rule: if a plural word is followed by *is*, flag an error, and suggest using *are* instead).
- Pros: As long as we know what kind of errors the users make, this is a straight forward and effective process
- Cons: Rule making takes time and expertise and money. Again, may be it is difficult to exhaustively cover every single error pattern.
- However, all spell checkers you use today have some kind of a rule-engine inside it, along with something based on an n-gram approach.

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- Idea: use frequencies of word n-grams in a large collection of texts to estimate what are the likely and unlikely n-grams in the language.
- E.g, Let us take this sentence: "John came form the house".
- Since we don't know what word is an error in this context, let us start with the assumption that each word is a potential error.
- Candidate words: let us leave John (poor guy!). Came - come, lame, tame, tame, cane etc; form: from, dorm, norm etc.; house - hos

getting from word level candidates to sentence level suggestions

- Try to make sentences with all these possible candidates replacing one candidate word at a time.
- From a large corpus of English texts, estimate the likelihood of seeing each sentences (probability)
- The sentence with highest probability gets the top-rank in suggestion list.

Pros and Cons

- Pros: Works around the problem of writing a lot of language specific rules which requires time and effort.
- Cons: Lot of calculations with large corpus-computationally intensive! (thankfully, computer programs have efficient way of organizing and retrieving data)
- Cons: No direct way to handle unknown words or phrases

Note: Real life spelling and grammar checkers use a combination of error pattern based and probability based methods.

Meaning based word correction

- Idea: Find words that do not fit into the meaning of the rest of the sentence. Replace them with words that are "semantically appropriate"
- e.g., "It is my sincere *hole* that you will recover swiftly" - hole seems semantically inappropriate.
- "hope" suits better here.
- Problem: How do you choose the related word given a context? - this is studied in natural language processing under something called "distributional representation of language".

Assignment 2 Description

- Two questions - one each on isolated and contextual spelling correction
- Requires you to analyze what the word processor tools show you and interpret the causes of the errors and suggestions.
- Carries 10 marks.
- Guidelines are on Canvas.
- Deadline: 23 September 2017

Next Week

- Topic 3: Language Tutoring Systems
- Readings: Chapter 3 from the Textbook
- Reminder: Submit Assignment 1!

Attendance Question for today

Write answers to any two of these scenarios on a sheet of paper and return it to me with your name on it.

- 2 examples of grammar errors caused due to a change in word order
- 2 examples of grammar errors caused due to usage of wrong tense
- 2 examples of grammar errors caused because of gender-differences between the author's native language and English
- 2 examples of using similar sounding words instead of each other (e.g., their-there, hole-whole -now, don't use these examples!)