CE4045 CZ4045 SC4002 Natural Language Processing

Review of first half topics

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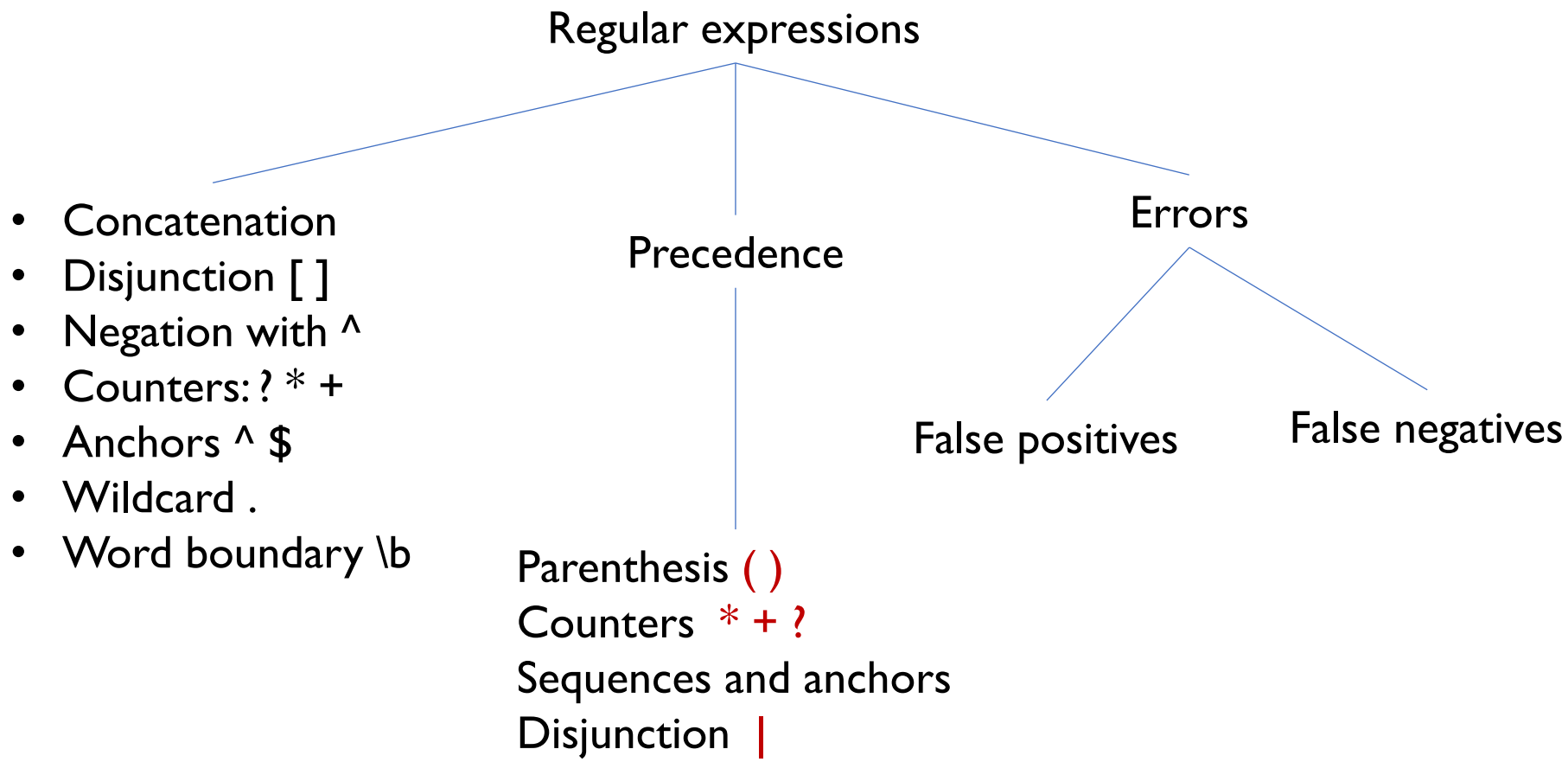
Summary: UTF-8

For your info

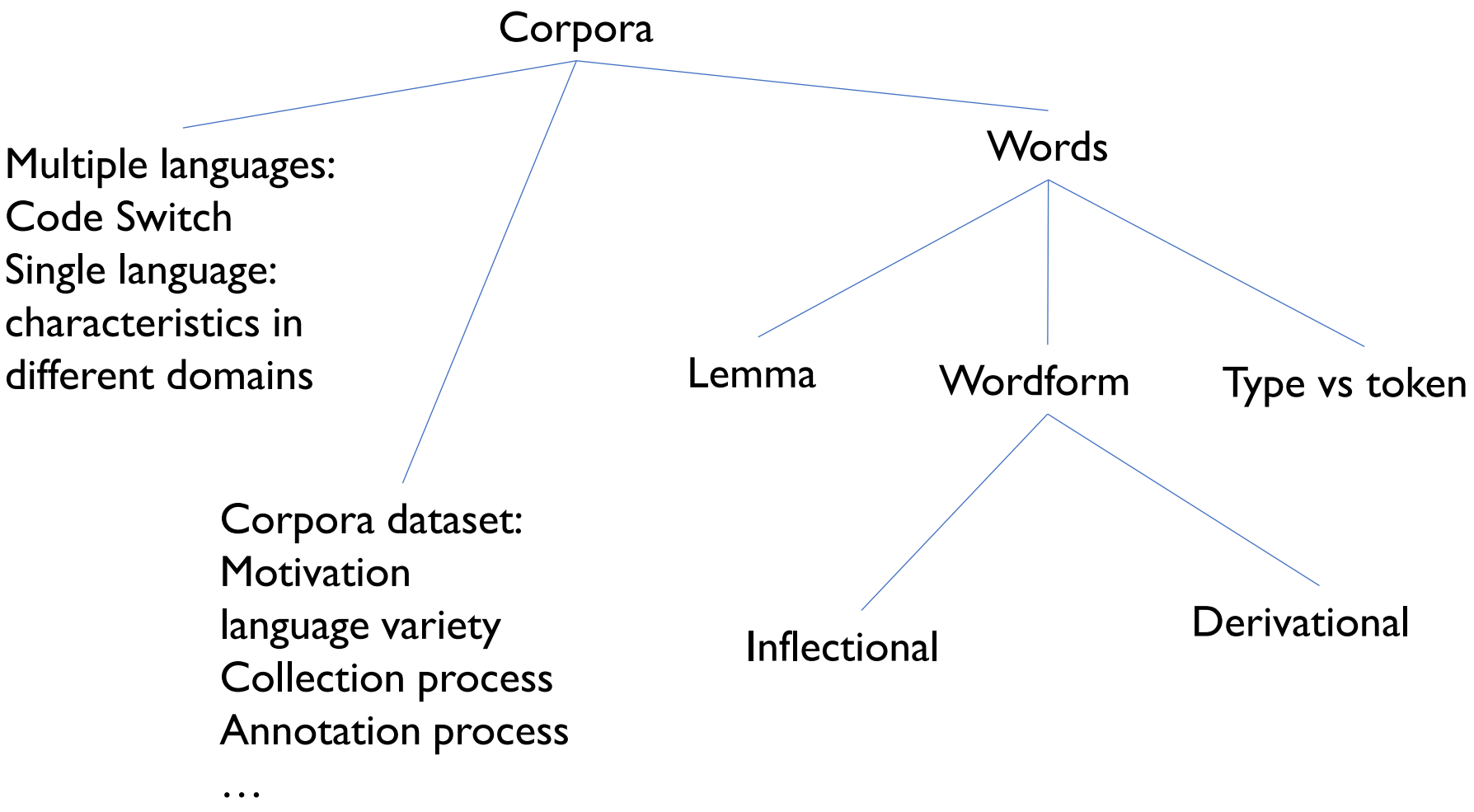
Unicode
- Each char is a unique integer code
- Unicode Transformation Format (UTF)
  - UTF-8: Unicode are represented in 8-bit blocks

Computer stores text in a string of Zeros and Ones

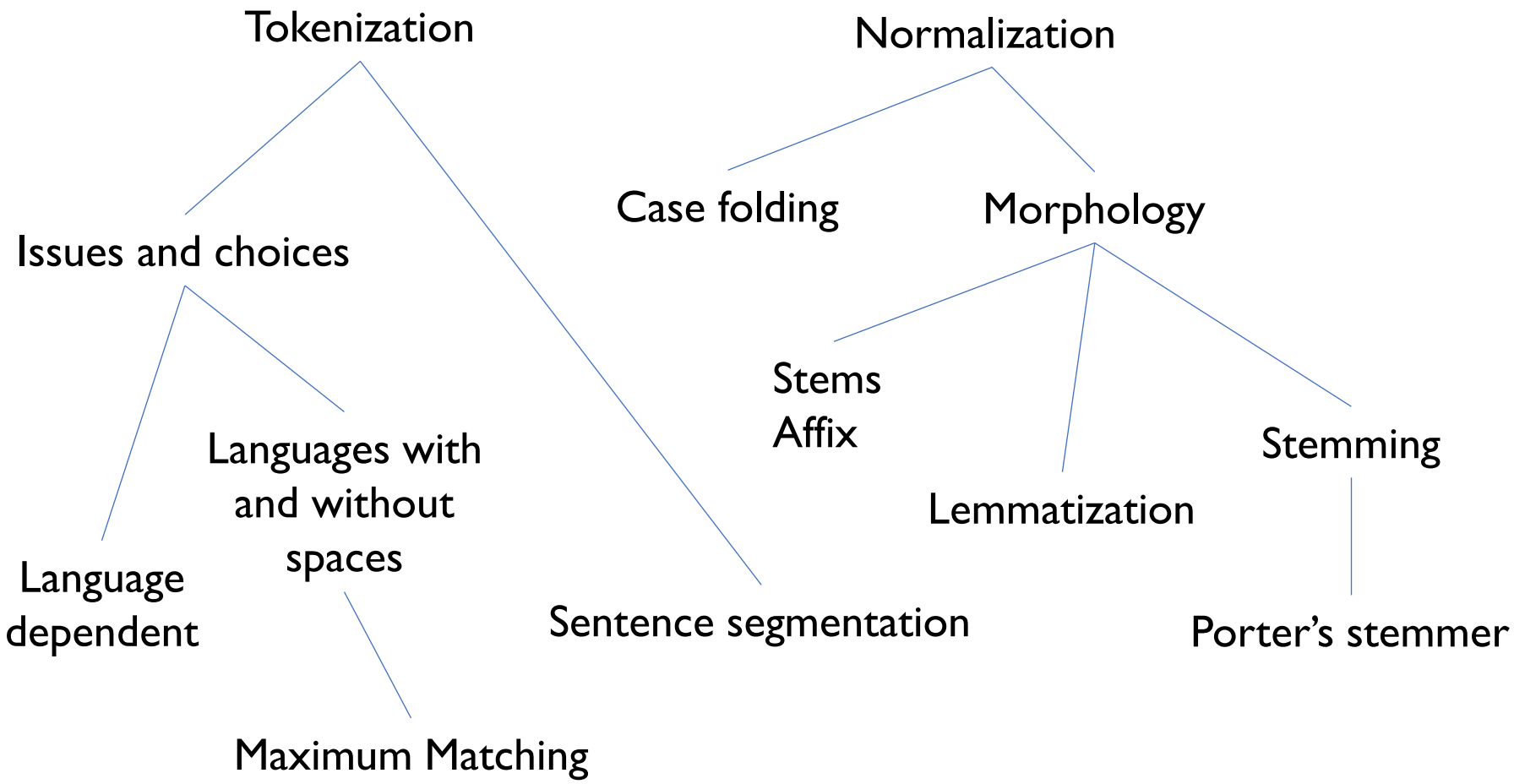
Summary: Regular expressions



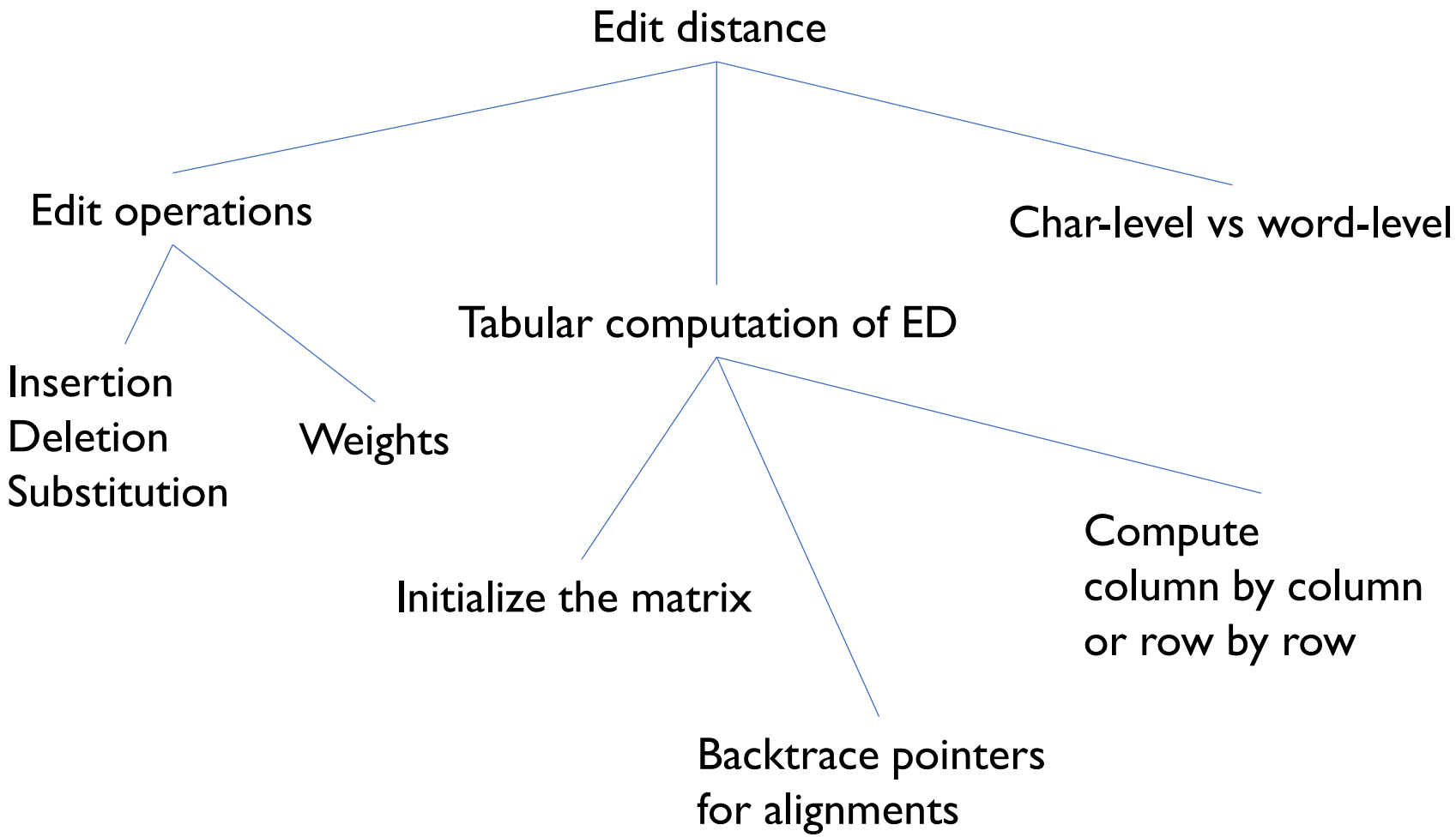
Summary: Text Normalization



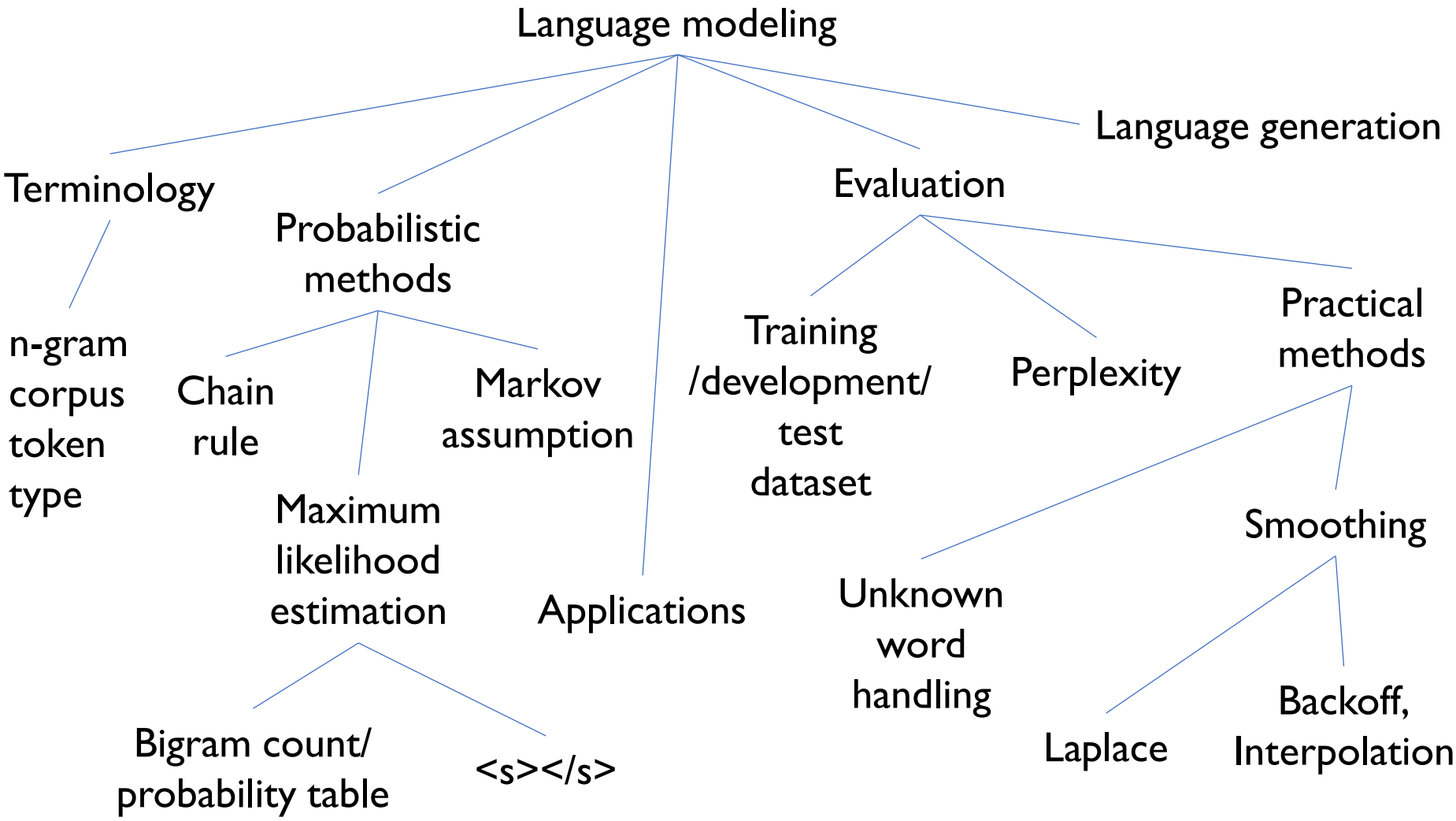
Summary: Text Normalization



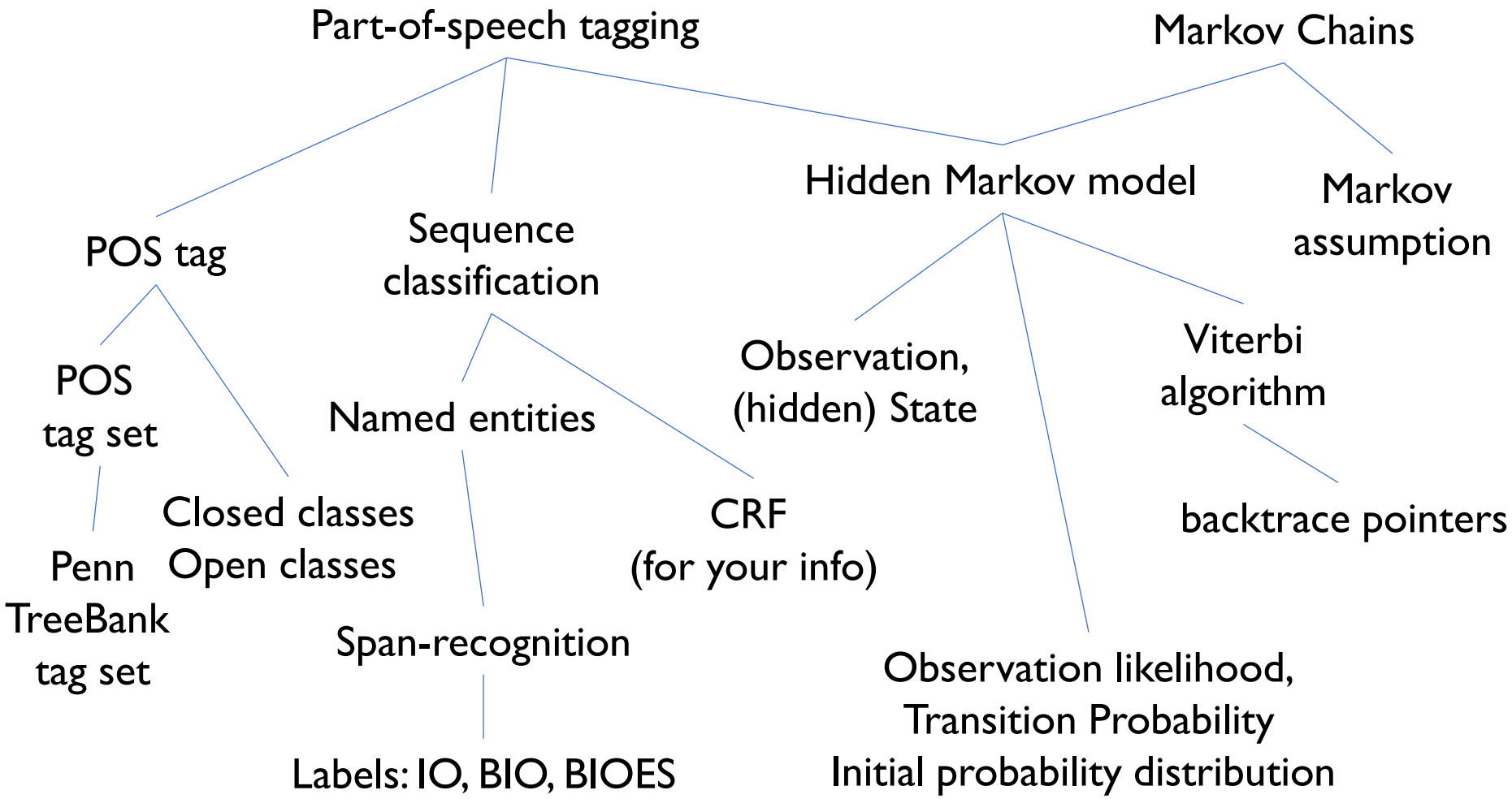
Summary: Edit distance



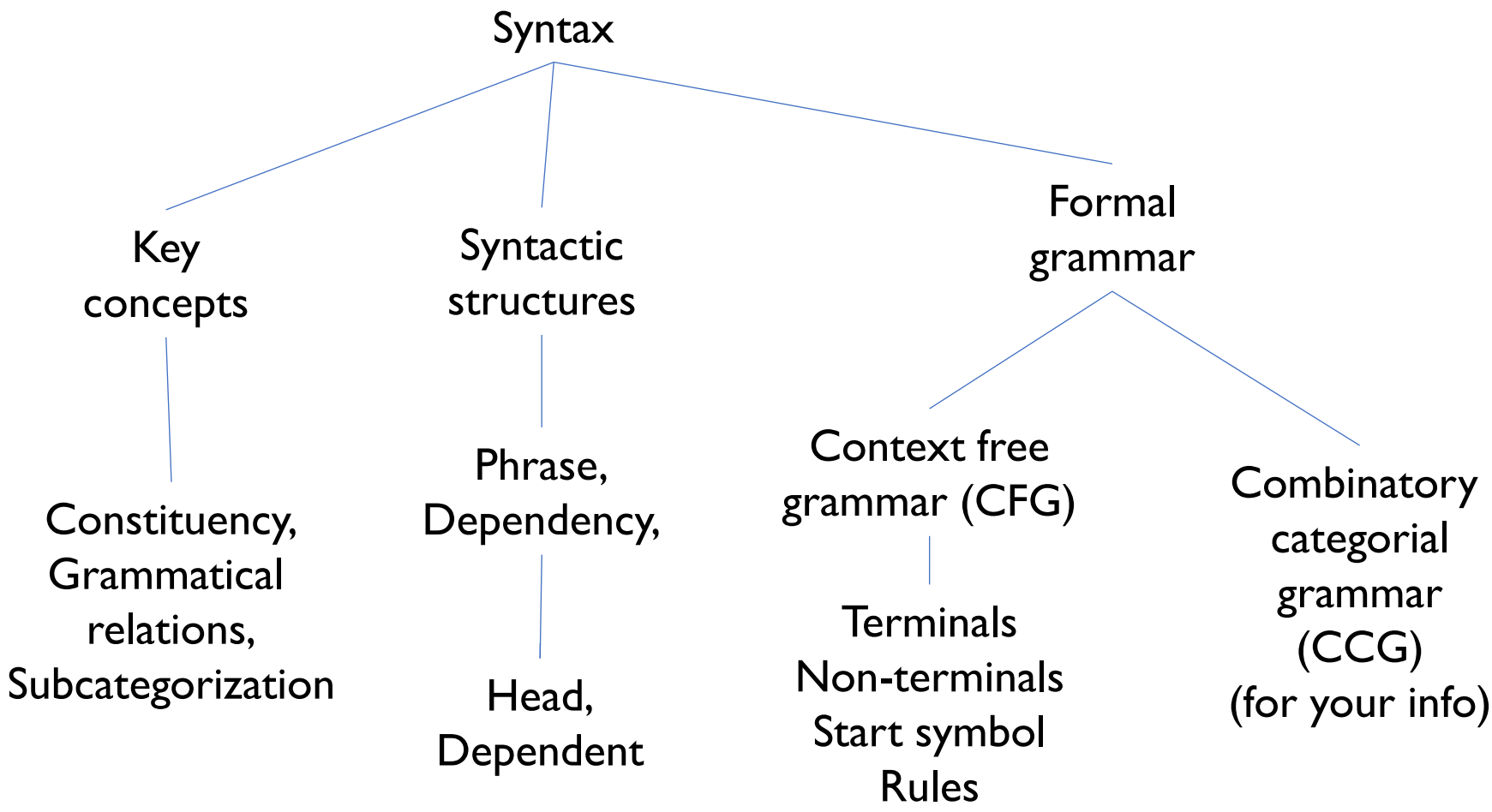
Summary: N-gram Language Models



Summary: Part-of-speech and Named entities



Summary: Constituency Grammars and Parsing



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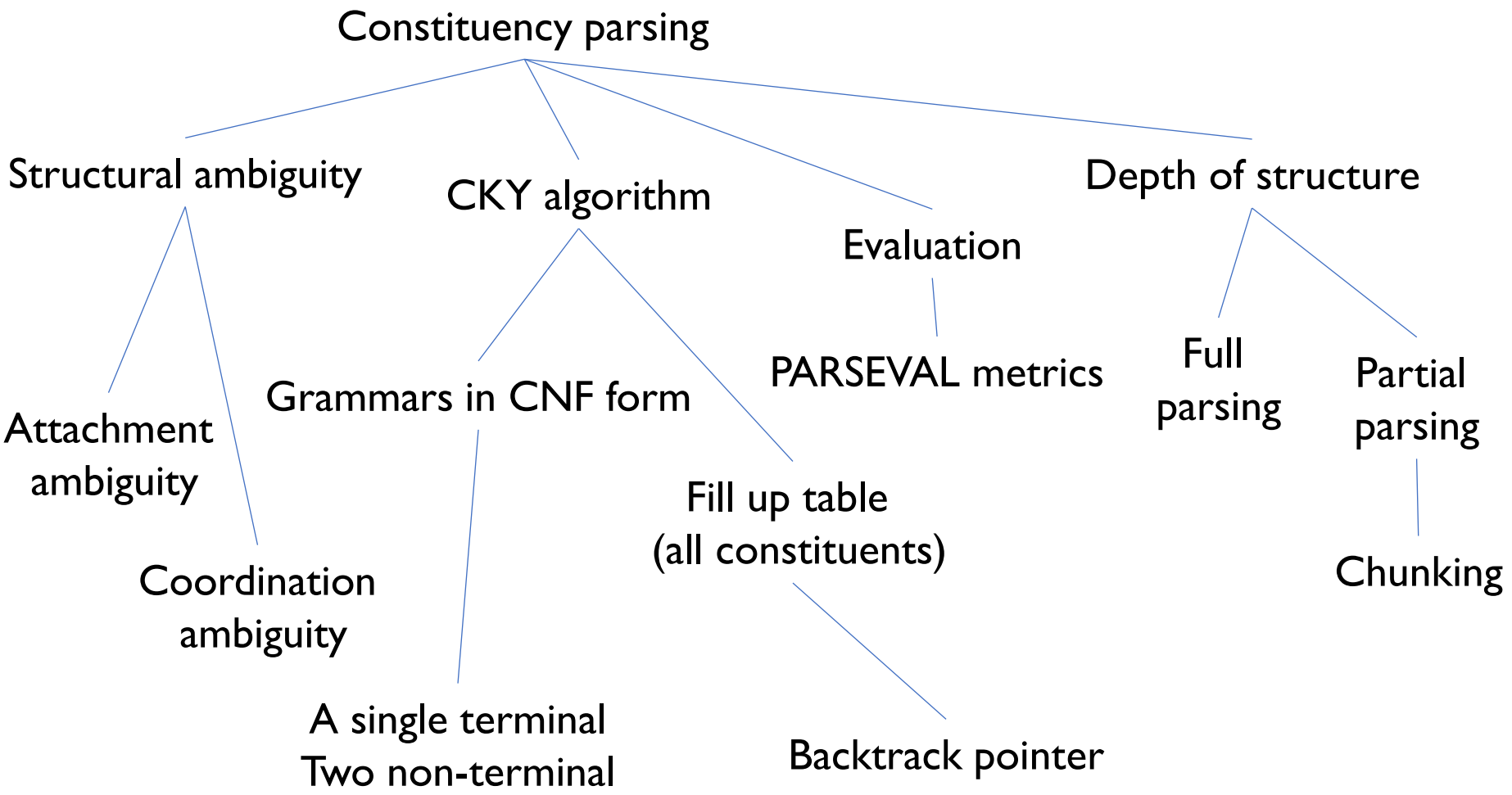
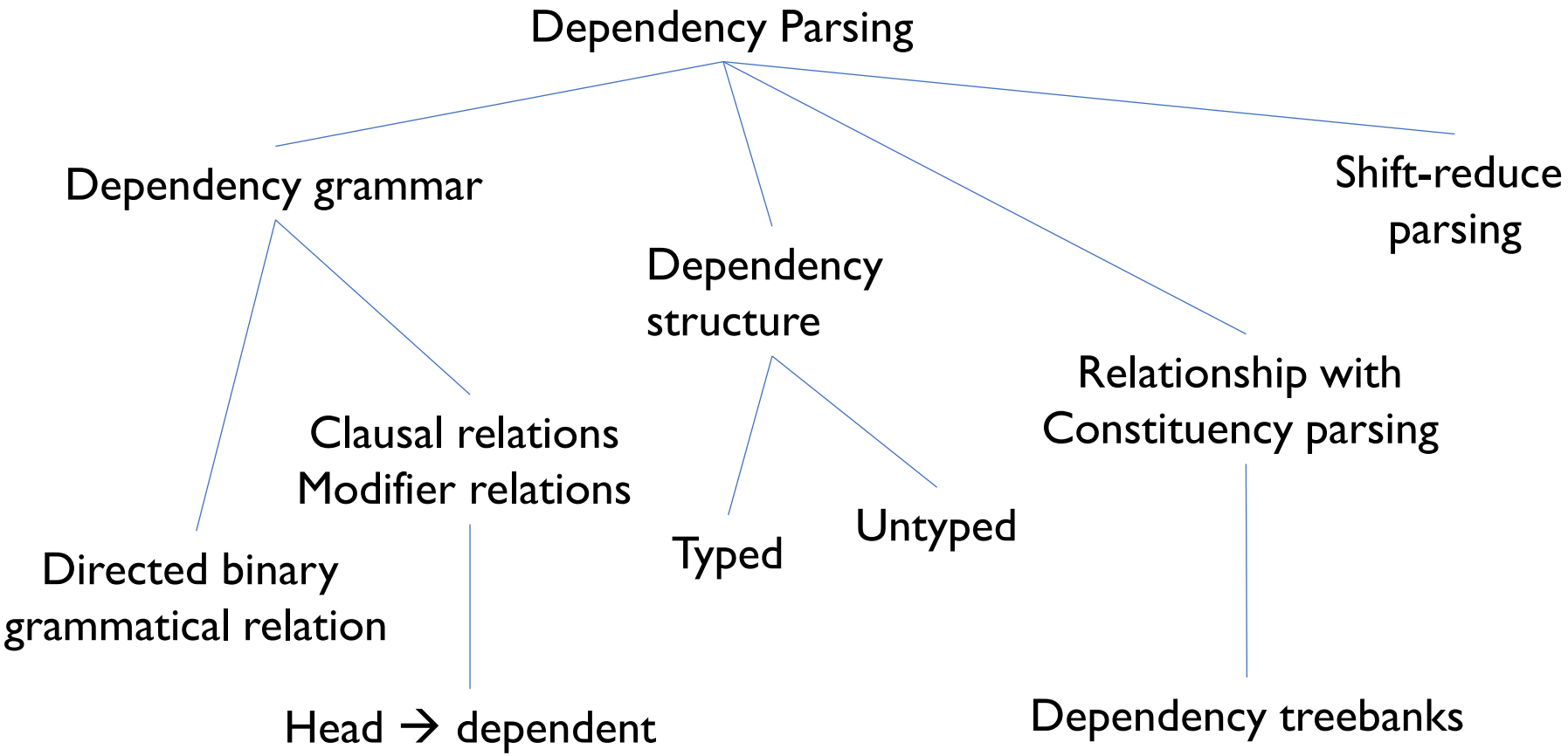


Summary: Dependency Parsing



Summary

- RegExr: an online tool to learn, build, & test Regular Expressions
  - http://regexr.com/

- Java RegEx API and Tutorial
  - http://docs.oracle.com/javase/8/docs/api/java/util/regex/package-summary.html
  - http://docs.oracle.com/javase/tutorial/essential/regex/

- Reference: https://web.stanford.edu/~jurafsky/slp3/
  - **Chapter 2**, Regular Expressions, Text Normalization, Edit Distance

What can we do?

- Given a document, we are able to search for the matching strings with a query specified in Regular Expression
  - The given document is basically a sequence of characters
  - At this stage, we do not understand words or sentences in the document.

- Next, it would be useful to recognize the words, sentences in the document
  - With the words and sentences, we will be able to understand the structure or meaning of the sentences.

Summary

- Words and Corpora
  - Datasheet specifies properties of a dataset
  - Words: lemma, word forms
- Tokenization and normalization
  - Issues with tokenization
  - Case folding, lemmatization, stemming
  - Sentence segmentation
- Edit distance
  - Applications
  - Algorithm

- Reading: Chapter 2 https://web.stanford.edu/~jurafsky/slp3/

What can we do?

- Given a document we are able to segment its words and sentences.
  - The idea of word segmentation and sentence segmentation is similar, except the unit of processing is different, i.e., word vs sentence.
  - Depends on the characteristics of the document, we may need to select the most appropriate tokenizers.

- Given a word, we are able to perform normalization, to get the lemma or stem.

- Given two words, we are able to measure the similarity or distance between them, by Edit Distance
  - The same idea can be applied to measure two sentences, except the unit of processing is different, i.e., character vs word

N-gram Language Model

- Word prediction
  - Probability of a sequence of words $P(w_1 w_2 \ldots . w_n)$, or probability of a word given some history $P(w|h)$
- N-grams
  - Counting and basic concepts
- N-gram Language Model
  - Modeling unknown words
  - Smoothing to avoid assigning zero probabilities to unseen sequences
  - Evaluation
- Reference: https://web.stanford.edu/~jurafsky/slp3/
  - **Chapter 3**, N-gram Language Models

What can we do?

- Given a collection of documents, we are able to train a language model
- Given a language model, we are able to compute the probability of sentences
- Given a language model, we can also generate sentences

Summary

- POS tag: word types
  - POS tagging with HMM
  - The Viterbi algorithm
  - Conditional Random Fields
- Named entity
  - NER as a sequence labelling task

- Reference:
  - Chapter 17 https://web.stanford.edu/~jurafsky/slp3/

What can we do?

- Given a sentence, we can select POS taggers to tag the words in the sentence with their correct word categories
  - This would immediately enable us to select the words in certain categories
  - We can also combine with RegEx to find word sequences by patterns
  - For example, a noun phrase may have this pattern: an optional determiner, zero, one or more adjectives, then a noun.

- Given a sentence, we can also find the named entities from the sentence with a NER model.
  - This offers many more ways to understand the document, like linking the entities to Wikipedia to understand the background information for each entities

- We may also formulate other related problems to a sequence labelling task, by using the BIO tagging scheme.

Summary

- Structural ambiguity
- Parsing with CKY algorithm
- Evaluating parsers
- Partial or Shallow Parsing
- References
  - Chapter 18 https://web.stanford.edu/~jurafsky/slp3/

What can we do?

- Given a sentence, we can have its parse tree with the help from a parser
- We are able to traverse the parse tree to obtain various subtrees, corresponding to different segments of the sentence
- We can also compare the structural similarity between two sentences based on their parse trees.

Summary

- Dependency: Head-dependent
- Dependency formalism
- Dependency parsing
- Reference
  - Chapter 19 https://web.stanford.edu/~jurafsky/slp3/