# FoLT Lecture 1 Summary
# PART 1:

- Linguistic Analysis:
  I/*Morphology*
  II/*Syntax*
  III/*Semantics*
  IV/*Pragmatics*
  V/*Discourse*

## *I/ Morphology*:

*Definition*

- Morphology is the study of words, how they are built up from smaller meaning-bearing units, and how they are related to other words of the same language.
  - Examples:
    - cat(s)
    - read(ing)
    - (un)break(able)
    - (im)poss(ible)

*Two types of morphemes:*

1. Free morphemes: can stand alone as words

- Examples: cat, read, break...(basically stems)

2. Bound morphemes: cannot stand alone as words

- Examples: -s, -ing, un-, im- (basically affixes)

*Types of affixes:*

- Examples:
  1. Prefixes: un-, im-
  2. Suffixes: -s, -ing
  3. Infixes: -freakin'-, -freakin'-in-
  4. Circumfixes: en-...-en

*Stemming:*

- The process of removing affixes from a word to get its stem
  - Examples:
    - cats -> cat
    - reading -> read
    - impossible -> possible

*Lemmatization:*

- determines that two words have the same root, despite their surface differences
  - Examples:
    - is, are, am -> be
    - car, cars, car's, cars' -> car

## *II/ Syntax:*

*Definition*

- Syntax refers to the way words are arranged together.
- Syntax == Ordering of sequences of words
  - Example:
    cats chase mice VS mice chase cats
- Probabalities of sequences of words:
  - Example
    cats eat fish VS fish eat cats VS eat cats fish
- Part of speech of words:
  - Example:
    noun, verb, adjective, adverb, preposition, conjunction, interjection

*The use of "Part of speech" tagging:*

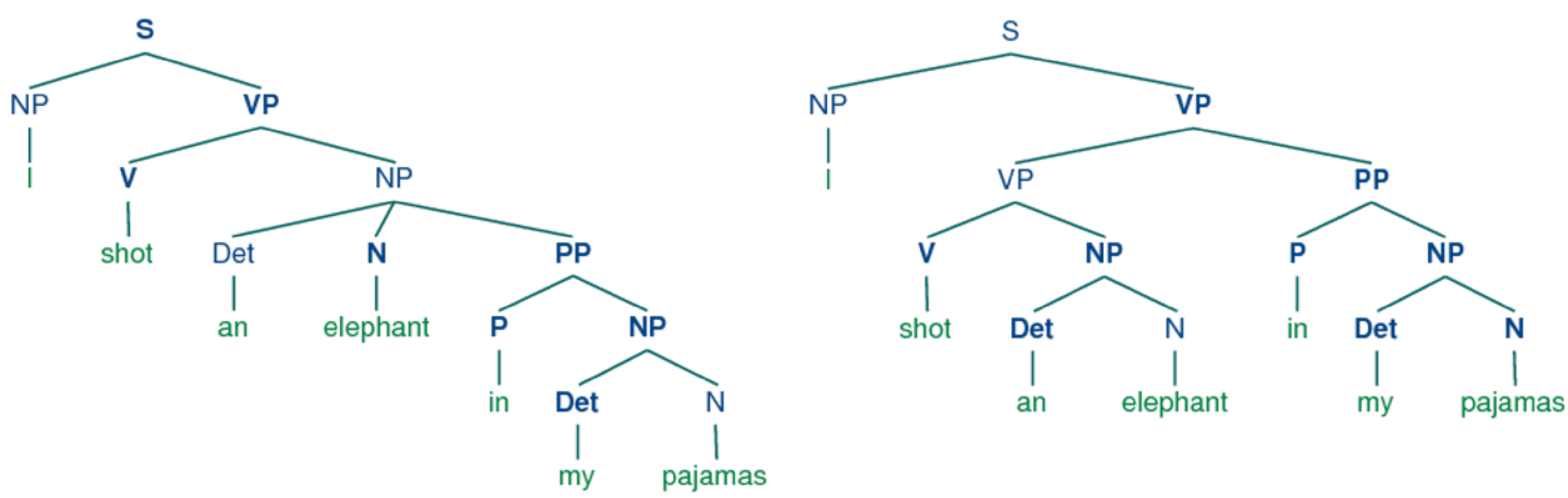
- For NLP tasks:
  - Examples:
    sentiment analysis
    question answering
    text summarization
    machine translation etc.
- For lingustic or language-analytic tasks:
  - study linguistic change, eg. new words, new meanings, etc.

*Syntactic Parsing:*

- The process of analyzing a sentence into its component parts and describing their syntactic roles.
  - Examples:
    cats chase mice -> (S (NP (NNS cats)) (VP (VBP chase) (NP (NNS mice))))

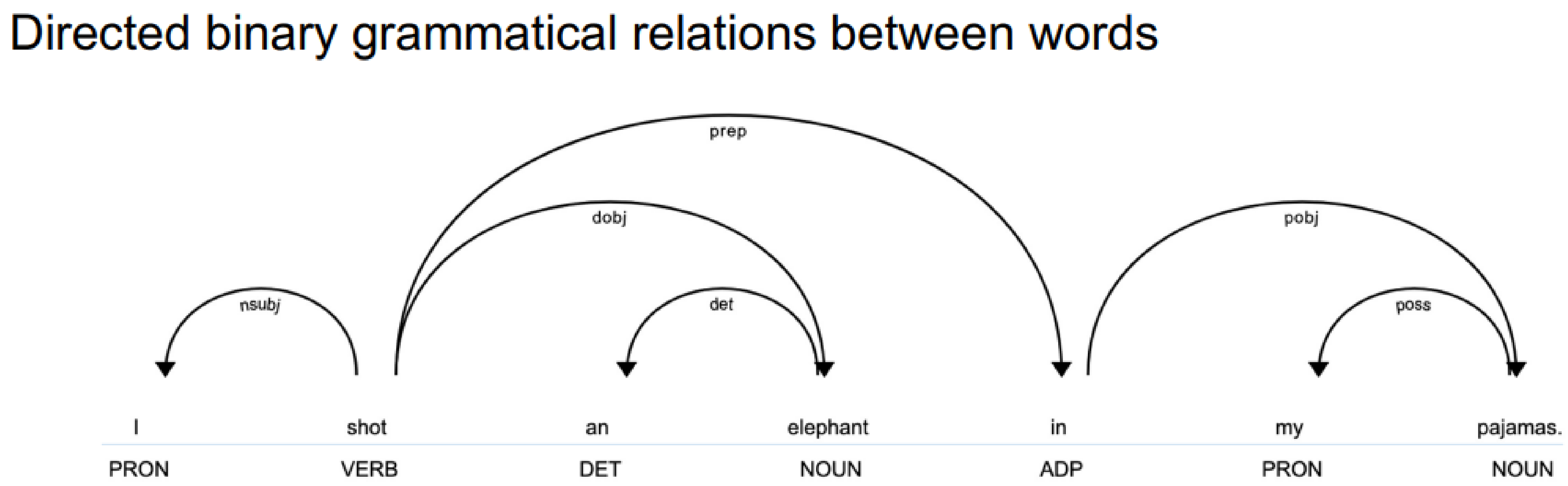
*Constituent grammar:*

- A grammar that describes the syntactic structure of well-formed sentences.
  - Example:




*Dependecy grammar:*

- Basically the relationship between words in a sentence
- SpaCy uses dependency grammar: [https://spacy.io/usage/linguistic-features#dependency-parse](https://spacy.io/usage/linguistic-features#dependency-parse)
  - Spacy Example:




SpaCy

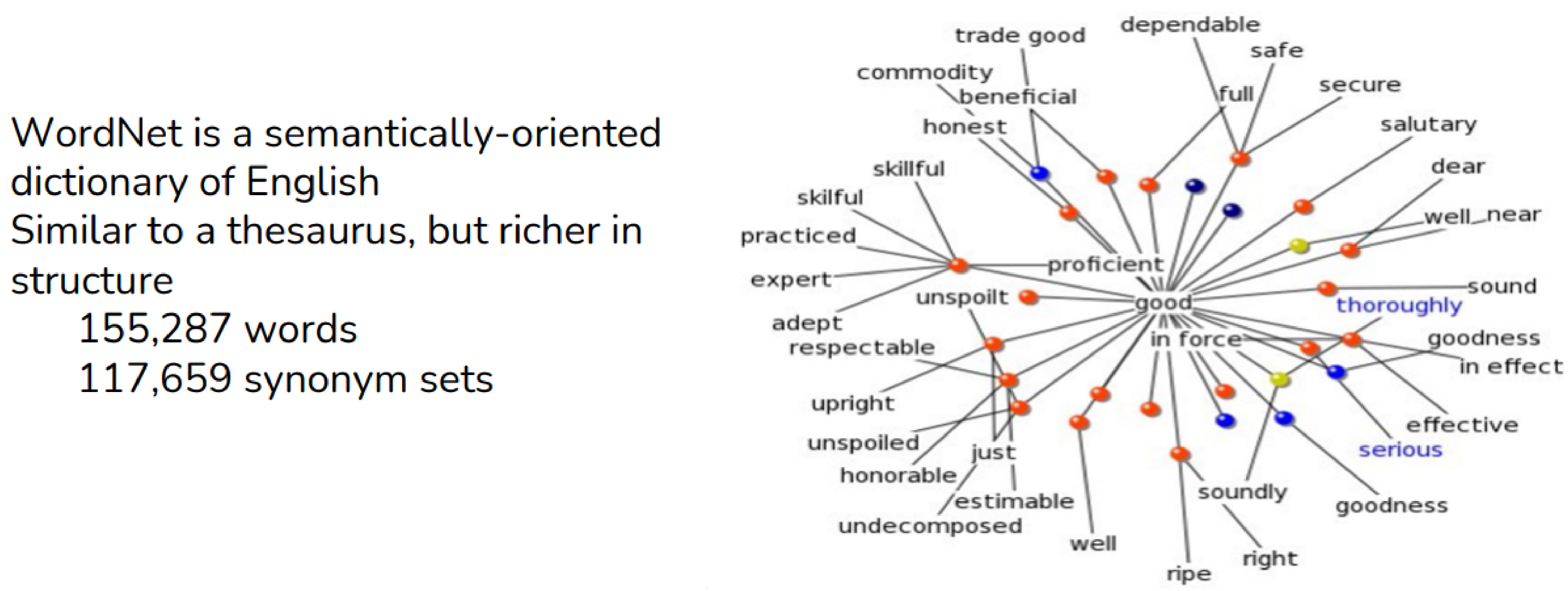
**Why is parsing important?**

- Grammar checker
- Information extraction
- Question answering
- Machine translation, etc.

## III/ Semantics:

*Definition:*

- Semantics are the study of words, phrases, sentences, or documents.
  - Lexical semantics: the meaning of words; Eg. how close are words in meaning?
  - Semantic role labeling: the meaning of the predicate with respect to its arguments; Eg. who did what to whom?
- Example (WordNet):




## IV/ Pragmatics:

*Definition:*

- Pragmatics are the study of language use in context, and the context-dependence of various aspects of linguistic interpretation.
- Example:
  - Utterance: "It's hot in here."
    Implicature: "Please open the window."
  - Exchange: Have you seen spider man? I don’t like Marvel.
    Premise: Spider man is from Marvel.
    Conclusion: I has not seen it and, maybe, does not intend to see it.

## V/ Discourse:

*Definition:*

- A discourse is a coherent structured group of sentences.
- Coherence is the relationship between sentences that makes real discourses different than just random assemblages of sentences.
  Example:
  - The movie is interesting. → Tim wants to watch it.
  - The movie is interesting. ✕ Tim likes pizza.

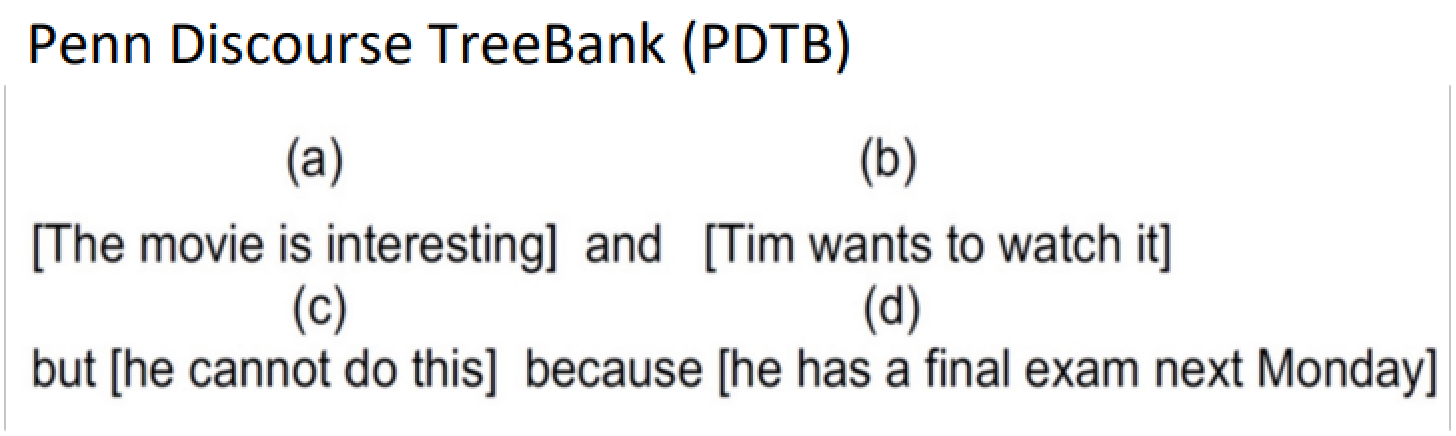
*Types of Coherence:*

- Local coherence: sentence/clause coherence, entity-based coherence; topical coherence
  - Example:
    The movie(1) is interesting. Tim wants to watch it(1).
- Global coherence: conventional discource structures.
  - Examples:
    Academic articles: abstract->introduction->method->result->discussion->conclusion

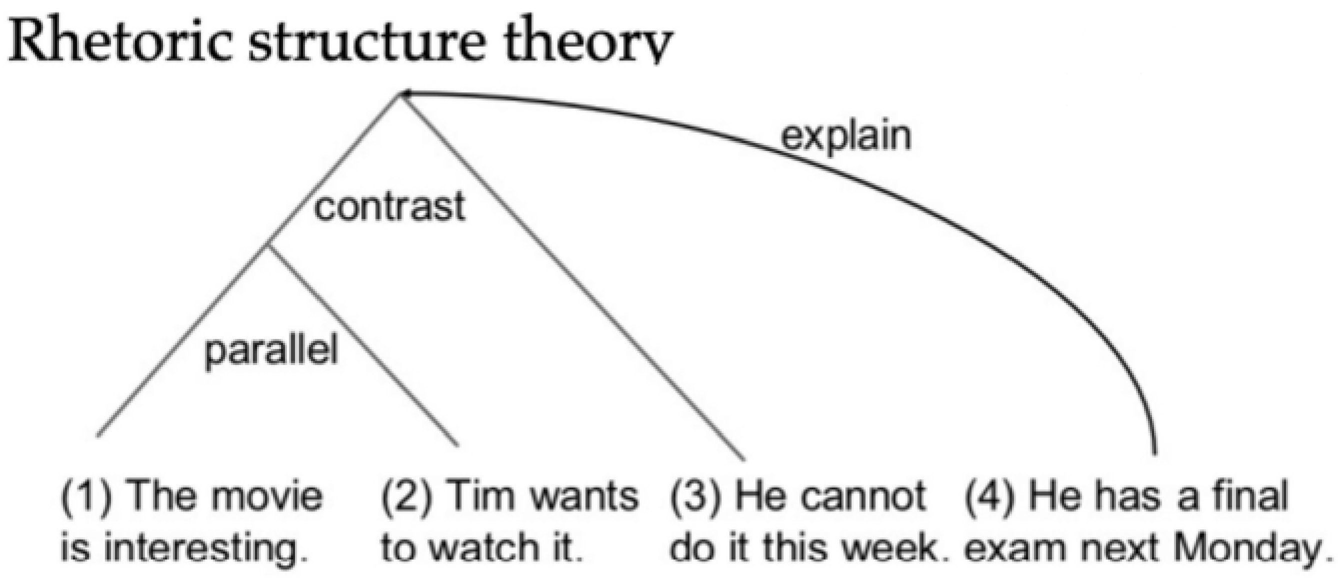
*Discource parsing:*

- The process of analyzing the discourse structure of a text.
- Examples:

Penn Discourse Treebank (PDTB) with examples: https://www.seas.upenn.edu/~pdtb/




Rhetoric structure theory (RST): https://www.aclweb.org/anthology/J93-2002.pdf




# PART 2:

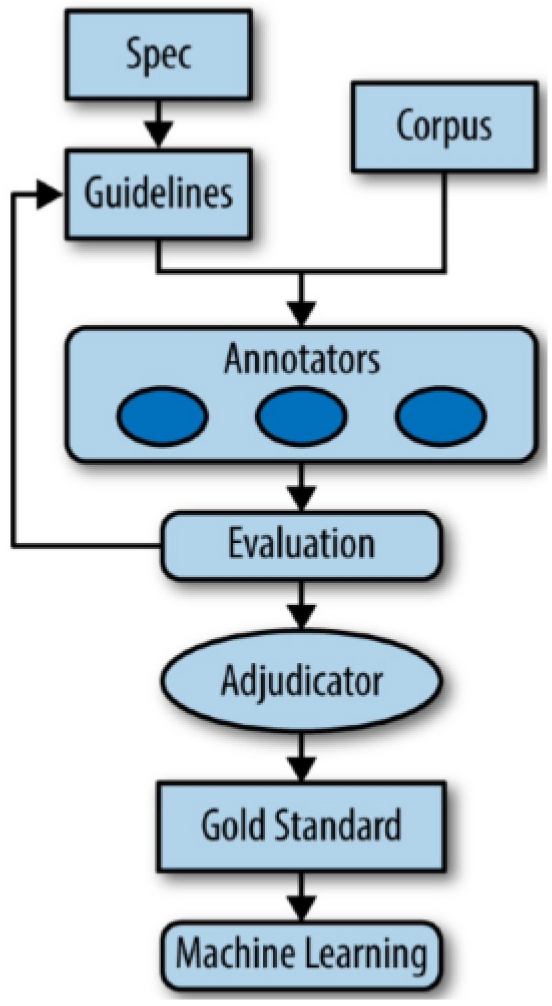
***Data Annotation:***

- Meta Data about the text: author, title, date, etc.
- User contributed data: comments, ratings, etc.
- Factors in human annotation:
  - source data(genre,size?)

    - annotation scheme(guidelines? ambiguities?)
    - annotators(with training?)
    - annotation tool
    - quality control(multiple?), etc.

- Annotation is not easy: any annotation scheme for language will have some diffucult cases, grey areas, and ambiguities, because human langauge need to be flexible, it cuts corners and is reshaped over time.

***Annotation pipeline:***




- Annotation Quality: Gold data will have some tarnish, how can we measure it?
    - Inter-annotator agreement: the degree to which two or more annotators give the same annotation to the same data.
    - The agreement rate can be thoguht off as an upper bound on accuracy of a asystem evaluated on the same data.
- Validity and Reliability:
    - Validity is the degree to which an annotation scheme measures what it is supposed to measure.
    - Reliability is the degree to which an annotation scheme produces consistent results.
    - Higher reliability is a prerequisite for higher validity.

***Measuring agreement:***

- Formula for Observed Agreement:

$$\frac{agreement(item1)+agreement(item2)+...+agreement(itemN)}{item1+item2+...+itemN}$$

- Example:

**Observed Agreement:** proportion of items on which the two annotators agree

| | Apple | Orange | Total |
|---|---|---|---|
| Apple | 30 | 15 | 45 |
| Orange | 10 | 45 | 55 |
| Total | 40 | 60 | 100 |

Agreement:
(30 + 45) / 100 = 0.75

- Chance Agreement:
  - Some agreement is expected by chance: two annotators are asked to pick Apple and Orange randomly, they might agree with each other half of the time
- Chance-corrected agreement:
  - Agreement beyond chance
    - Obeserved agreement $A_0$: proportion of actual agreement
    - Expected agreement $A_e$: expected value of $A_0$
    - Amount of agreement beyond chance: $A_0 - A_e$
    - Maximum agreement beyond chance: $1 - A_e$
  - Proportion of the possible agreement beyond chance: $\frac{A0-Ae}{1-Ae}$
- **How to get expected Agreement $A_e$**

  Expected agreement $A_e$ is the probability of the two annotators $c_1$ and $c_2$ agreeing on any given category $k$

$$A_e = \sum_{k \in K} P(k|c_1) \cdot P(k|c_2)$$

- **How to get Cohen's Kappa**

  Cohen's $\kappa$ assumes the random assignment of categories to items is governed by prior distributions that are unique to each other (annotator bias).

$$P(k|c_i) = \hat{P}(k|c_i) = \frac{\mathbf{n}_{c_i k}}{\mathbf{i}}$$

*The actual number of assignment to k by $c_i$*

*The number of items*

$$A_e^{\kappa} = \sum_{k \in K} \hat{P}(k|c_1) \cdot \hat{P}(k|c_2) = \sum_{k \in K} \frac{\mathbf{n}_{c_1 k}}{\mathbf{i}} \cdot \frac{\mathbf{n}_{c_2 k}}{\mathbf{i}} = \frac{1}{\mathbf{i}^2} \sum_{k \in K} \mathbf{n}_{c_1 k} \mathbf{n}_{c_2 k}$$

- Cohen's Kappa quality table:

"Good" values are subject to interpretation, but rule of thumb:

| | |
|---|---|
| 0.80-1.00 | Very good agreement |
| 0.60-0.80 | Good agreement |
| 0.40-0.60 | Moderate agreement |
| 0.20-0.40 | Fair agreement |
| < 0.20 | Poor agreement |

- Cohen's Kappa examples with steps and illustrations:

$$\kappa = \frac{p_o - p_e}{1 - p_e}$$

$$\kappa = \frac{0.88 - p_e}{1 - p_e}$$

annotator A

annotator B

| | puppy | fried chicken |
|---|---|---|
| puppy | 7 | 4 |
| fried chicken | 8 | 81 |

$$p_e = P(A = \text{puppy}, B = \text{puppy}) + P(A = \text{chicken}, B = \text{chicken})$$

$$= P(A = \text{puppy})P(B = \text{puppy}) + P(A = \text{chicken})P(B = \text{chicken})$$

| | |
|---|---|
| P(A=puppy) | 15/100 = 0.15 |
| P(B=puppy) | 11/100 = 0.11 |
| P(A=chicken) | 85/100 = 0.85 |
| P(B=chicken) | 89/100 = 0.89 |

| | | annotator A | |
|---|---|---|---|
| | | puppy | fried chicken |
| annotator B | puppy | 7 | 4 |
| | fried chicken | 8 | 81 |

$$= 0.15 \times 0.11 + 0.85 \times 0.89$$
$$= 0.773$$

$$\kappa = \frac{p_o - p_e}{1 - p_e}$$

$$\kappa = \frac{0.88 - p_e}{1 - p_e}$$

$$\kappa = \frac{0.88 - 0.773}{1 - 0.773}$$

$$= 0.471$$


| | | annotator A | |
|---|---|---|---|
| | | puppy | fried chicken |
| annotator B | puppy | 7 | 4 |
| | fried chicken | 8 | 81 |


- Adjudication:
  - The process of deciding on a single annotation for a piece of text, using information about the independent annotations.

## Part 3 (Corpus Statistics):

*Definitions:*

- Token: a sequence of characters that we want to treat as a group.
  - Example:
    - "I love you" -> "I", "love", "you"
    - "Learn from yesterday" -> "Learn", "from", "yesterday"
- Tokenization: Segmenting a text into an ordered sequence of tokens.
  - A system which splits texts into word tokens is called a tokenizer.
    - Very simple example:
      - Input text: Learn from yesterday
        - Tokens: {"Learn", "from", "yesterday"}
  - Issues in tokenization: periods don't always mean the end of a sentence, single quotes, Celtics (We're = We are), Multiword Expressions (New York, Rock 'n' Roll)
- How to deal with periods:
  - Common Solution:

Common algorithm:

- Tokenize first: use rules or ML to classify a period as either
  - (a) part of the word
  - (b) a sentence-boundary
- An abbreviation dictionary can help