Introduction

VL Sprachliche Informationsverarbeitung

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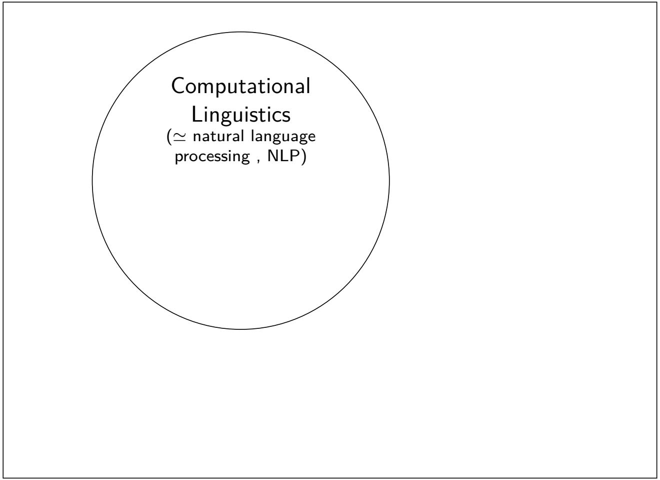
Winter term 2022/23

INSTITUT FÜR
DIGITAL HUMANITIES
UNIVERSITÄT ZU KÖLN

Disciplinary Placement


Computational Linguistics
(≃ natural language processing , NLP)

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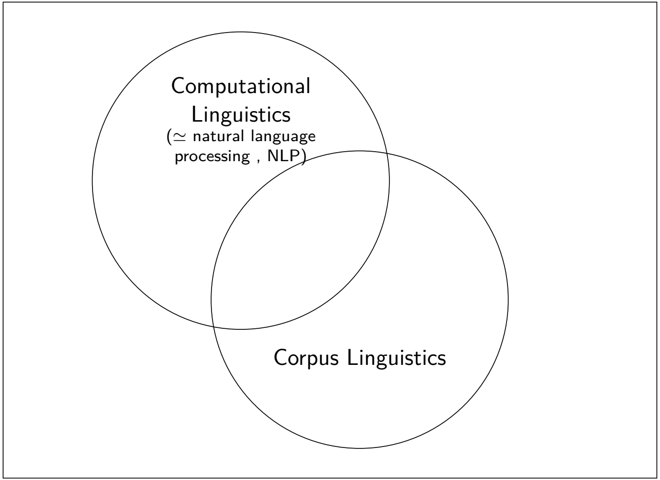
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Corpus Linguistics

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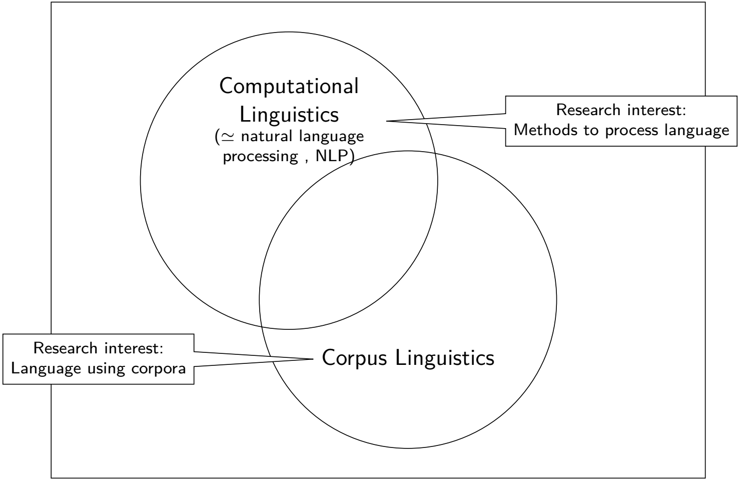
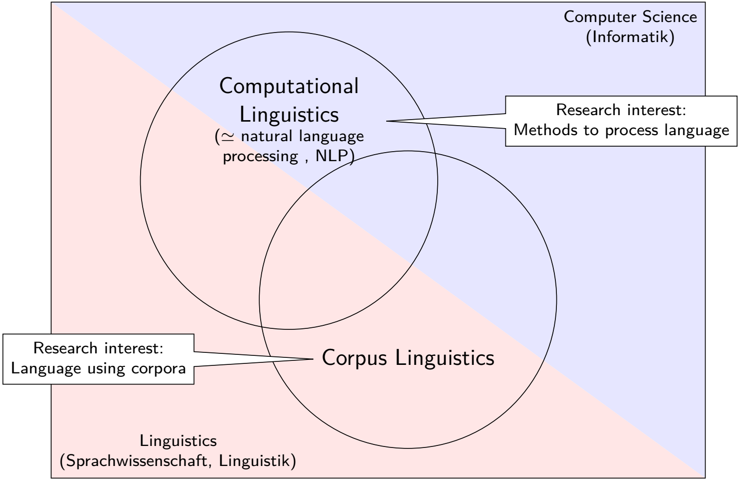


Computational Linguistics
(≃ natural language processing , NLP)
Research interest:
Methods to process language
Research interest:
Language using corpora
Corpus Linguistics

Disciplinary Placement



Brief history of Computational Linguistics I

- 1950s: DARPA Projects to automatically translate Russian into English
- 1957/65: Linguistics shifts focus from describing to generating Chomsky (1957, 1965)
- 1959: Theo Lutz for the first time generates a German poem with a computer Lutz (1959)
- 1962: Foundation of the „Association for Machine Translation and Computational Linguistics“, 1968 renamed to „Association for Computational Linguistics (ACL)“
- 1966, ALPAC report: MT more expensive, less accurate and slower than human translation ALPAC (1966)
- 1968: Foundation of SYSTRAN, first MT company
- 1975: European commission uses SYSTRAN software (first use of MT on EU level)

Brief history of Computational Linguistics II

- 1984: First corpus-based commercial MT system Nagao (1984)
- 1992: Study programs established in Germany (Saarbrücken/Stuttgart)
- 2011: IBM Watson beats two humans in Jeopardy YouTube / Apples Siri launched
- 2013: Word embeddings (e.g., word2vec) Mikolov u. a. (2013)
- 2017: Launch of the DeepL Translator
- 2018: Transformer models: BERT Devlin u. a. (2019)

Digital Humanities and Computational Linguistics

Today

- Digital Humanities, broadly: Working with ‚digital methods' on humanities subjects
- Linguistics: Study of language
- Computational Linguistics: Pioneer DH area Reiter (2014, 4)
  - … but this is a minority position in CL, often also seen as part of AI

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  - Historically (and still today) split between engineering (natural language processing, NLP) and science/scholarship (computational linguistics, CL)
  - ⚠ Neurolinguistic programming and natural language processing are not the same (both use ‚NLP‘ as abbreviation)

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University of Cologne

For historic reasons, CL and NLP are called „Sprachliche Informationsverarbeitung“

Institut für Digital Humanities

Historisch-Kulturwissenschaftliche Informationsverarbeitung

- Prof. Dr. Øyvind Eide
- Keywords
  - Maps
  - Models and modeling
  - Cultural heritage
  - Simulation

Sprachliche Informationsverarbeitung

- Prof. Dr. Nils Reiter
- Keywords
  - Geschriebene und gesprochene Sprache
  - Textanalyse
  - Machine/deep learning
  - Operationalisierung

Experiments

- Cornerstone of the ‚scientific method‘
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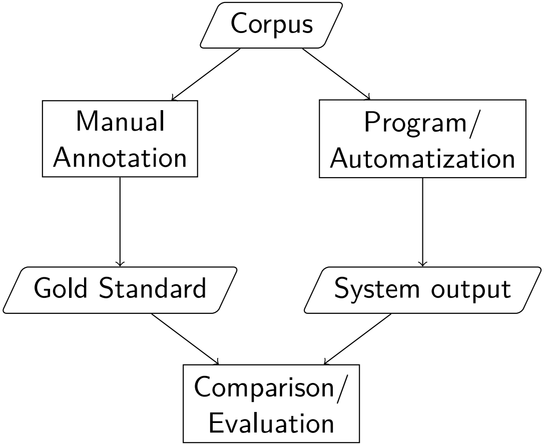
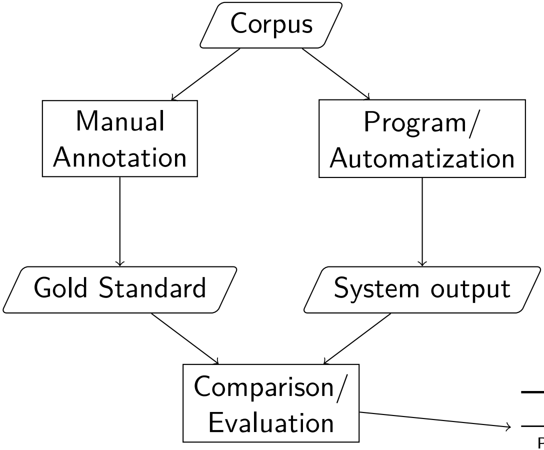
- CL: Hypotheses about the operationalisation of language/text phenomena

Example

Position within a sentence is indicative for the part of speech


Corpus
Manual Annotation
Program/ Automatization
Gold Standard
System output
Comparison/ Evaluation



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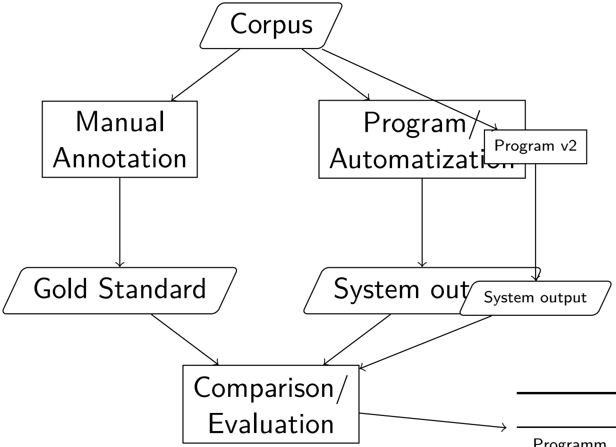
Comparison/ Evaluation

	P	R	F
Programm	5.7	9.2	...



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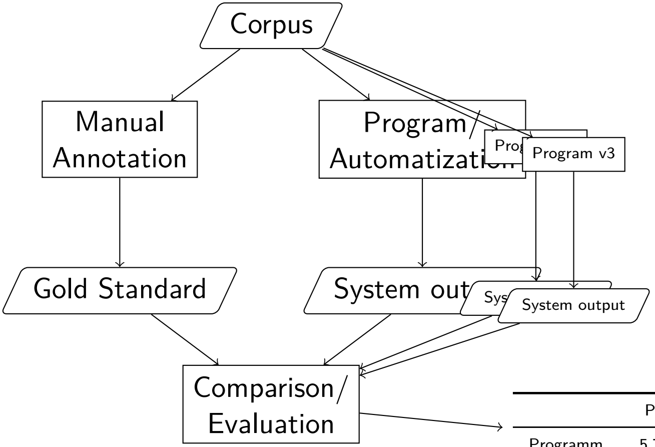
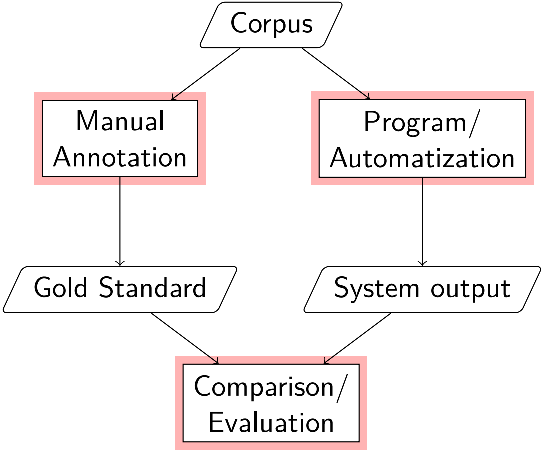


	P	R	F
Programm	5.7	9.2	…
v2	9.9	16.7	…
v3	15.3	21.8	…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Section 2

Organisatorisches

Introduction

Organisatorisches

Language and Linguistics

- Phonology and Phonetics
- Morphology
- Syntax

Orga

- Donnerstag, 12:00-13:30
- Module: ...
- Studienleistung: fünf Hausaufgaben, Abgabe via Ilias
- Prüfung: Klausur (02.02.2023)

Kurswebseite

Section 3

Language and Linguistics

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Prescriptive vs. descriptive

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- Descriptive: Observing and analysing how people do use language

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- Academic linguistics: Nowadays mostly descriptive

What is Language?

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  - Only partially authoritative

What is Language?

- Communication system
- Conventionalised: We agree (mostly)
  - Only partially authoritative
- What do we agree on?
  - Relation between *sign*s and its *meaning* (which is not the same!)
    - Saussure: Semiotics
  - E.g.: ‚the students in this class‘ *means* all of you

Linguistic sign

- Abstract notion
- Different levels
  - Texts
  - Sentences
  - Words
  - Syllables, morphemes
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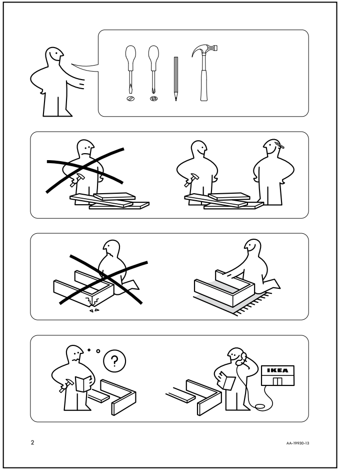
    - Assembly instructions



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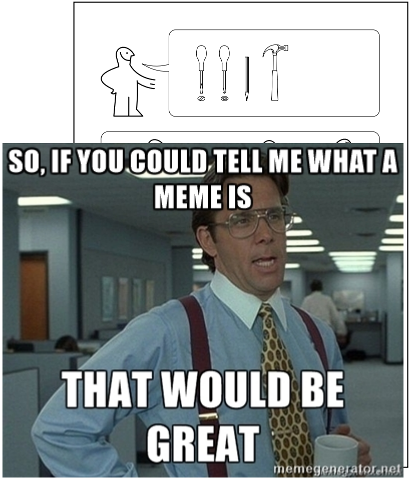
    - Assembly instructions
    - Memes
    - ...



Linguistic sign

Meaning is arbitrary

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- The sign could be different, e.g., ‚cat‘
- No inherent meaning in signs
  - …but strongly conventionalised
- Interpreting signs (and language) is something we learn
- Language is a social construct
  - Studying language is different from studying gravity

Ambiguities

- Der Jäger traf den Mann mit dem Gewehr.

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Linguistics: Let's explain / represent / reproduce these ambiguities

Introduction

Organisatorisches

Language and Linguistics

Phonology and Phonetics

Morphology

Syntax

Phonology and Phonetics

Phonetics

- How are language sounds produced and understood/processed?
- Focus: Practical, verbal and gestural use of language
- Links to biology, acoustics

Phonology

- Which function have certain phonemes within a language?
- Focus: Relation to other areas of linguistics and grammar
- Abstraction over concrete phonemes

Understanding Spoken Language

Relevant and irrelevant differences

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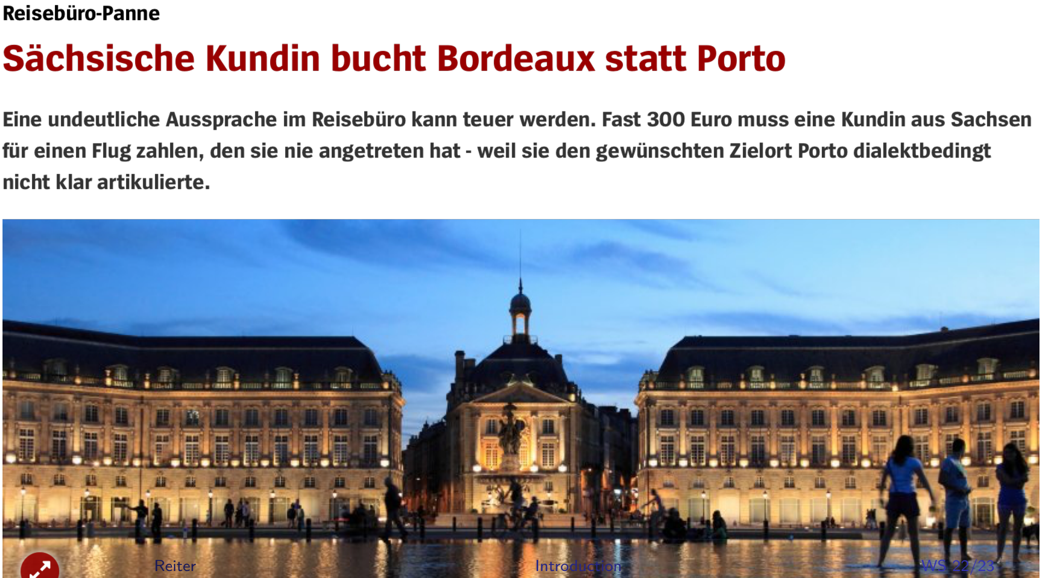
International Phonetic Alphabet (IPA)

https://www.internationalphoneticassociation.org

- Symbols defined via physiological properties of the pronounciation

Pronunciation mishaps



Reisebüro-Panne

Sächsische Kundin bucht Bordeaux statt Porto

Eine undeutliche Aussprache im Reisebüro kann teuer werden. Fast 300 Euro muss eine Kundin aus Sachsen für einen Flug zahlen, den sie nie angetreten hat - weil sie den gewünschten Zielort Porto dialektbedingt nicht klar artikulierte.

Pronunciation mishaps

Bordeaux vs. Porto

- Porto: [ˈpɔʁto]
- Bordeaux: [bɔʁˈdoː]

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  - /p/, /t/: voiceless (stimmlos)
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Voice and Plosives

- Voice
  - Sounds with the use of the larynx (dt. Stimmlippen)
  - Example: Phase (voiceless: /f/) vs. Vase (voiced: /v/)
  - You can feel voice if you touch your throat

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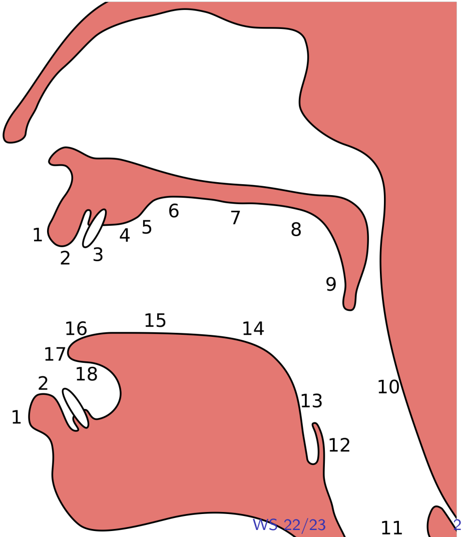
  - Example: Phase (voiceless: /f/) vs. Vase (voiced: /v/)
  - You can feel voice if you touch your throat
- Plosive
  - Air stream is blocked, but suddenly re-opened
  - Example: /bʊs/ (plosive) vs. /mʊs/ (nasal)

Producing Sounds

Important Locations for German Sounds (Consonants)

2. labial (Lippen): [b], [p]
3. dental (Zähne): [v], [f]
4. alveolar (Zahnfach): [d], [t], ...
5. postalveolar: [ʃ]
7. palatal: [ç]
8. velar: [g], [k], ...
11. glottal: [ʔ]
    - ‚ein Echo‘: [aɪn ʔɛço]
    - ‚Student:in‘: [ʃtuˈdɛntʔɪn]



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- Consonant
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Producing Sounds

Consonants vs. Vowels

- Consonant
    - Produced with (complete or partial) closure of the vocal tract
    - labial/dental/... describes the position of the closure in the tract
- Vowel
    - Produced without closure of the vocal tract
    - Usually voiced
    - Shaped by tongue position and lip rounding
        - (this is a simplification)

Subsection 2

Morphology

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Morphology

- How do we create words?

Morphology

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- Ambiguity:
  - Order in which parts of words are assembled

Morphology

- How do we create words?
- Ambiguity:
  - Order in which parts of words are assembled
- Morphological processes are language-dependent
  - German: Nominal composition
    - Rindfleischetikettierungsüberwachungsaufgabenübertragungsgesetz

Subsection 3

Syntax

Introduction

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Syntax

- Syntax: How are words used to form sentences?
  - Related to ‚grammar'
  - Two ways to look at syntax
    - Phrase structure
    - Dependency (not today)

Phrase Structure

- Words are not put in any arbitrary order
- Parts of speech (Wortarten) are not enough to explain sentences

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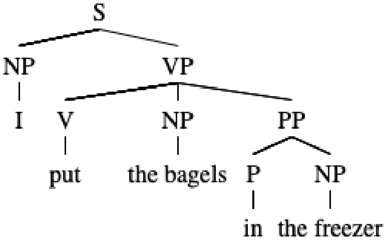
- Words are not put in any arbitrary order
- Parts of speech (Wortarten) are not enough to explain sentences
- Constituents
  - Words that are grouped together as a unit
  - What can appear in diff. positions of a sentence is a constituent

(1) I put the bagels in the freezer.

(2) The bagels, I put in the freezer.

(3) I put in the fridge the bagels (that John had given me).



Phrase Structure

Heads

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  - Agreement

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Examples

(1) $\overbrace{\text{Der} \quad \text{flauschige} \quad \underbrace{\text{Hund}}_{\text{Head}}}^{\text{Nominal phrase}} \quad \text{bellt} \quad .$

(2) $\overbrace{\text{Die} \quad \text{flauschigen} \quad \underbrace{\text{Hunde}}_{\text{Head}}}^{\text{Nominal phrase}} \quad \text{bellen} \quad .$

German Syntax

Peculiarities in German (*every* language has their share of oddities)

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- Free word order
  - ‚Den Hund hat er gestreichelt.'
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German Syntax

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- Free word order
    - ‚Den Hund hat er gestreichelt.‘
    - ‚Er hat den Hund gestreichelt.‘
- Separable verbs
    - aufstehen: ‚Sie steht jeden Tag früh auf.‘
        - *‚Sie aufsteht jeden Tag früh‘
    - bestehen: ‚Sie besteht die Prüfung.‘
        - *‚Sie steht die Prüfung be.‘
    - Mark Twain: ‘The Germans have another kind of parenthesis, which they make by splitting a verb in two and putting half of it at the beginning of an exciting chapter and the other half at the end of it. Can any one conceive of anything more confusing than that?’

German Syntax

Nominal Phrases

NP → Artikel? Adjektiv* Nomen (PP|Relativsatz)*

? 0 oder 1 mal
* 0 mal oder öfter
(|) Alternative