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Middle Polish Dependency Treebank in Universal Dependencies Format: Design, Implementation, and Analysis

Master's thesis
in COGNITIVE SCIENCE

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Summary

This thesis presents a rule-based approach to converting the Middle Polish Dependency Treebank (MPDT), annotated in a Polish-specific scheme, into the Universal Dependencies (UD) format. After introducing the project motivation, data sources, and target standard, the thesis outlines general design assumptions behind the conversion, the mapping strategy, and the validation workflow. It reports overall outcomes of the conversion and sketches applications and extensions, including releasing MPDT-UD and implications for research in historical language processing within cognitive science.

Keywords

Middle Polish, dependency trees, treebank conversion, Universal Dependencies

The title of the thesis in Polish

Średniopolski Bank Drzew Zależnościowych w formacie Universal Dependencies: projekt, implementacja i analiza

Streszczenie

Praca przedstawia podejście regułowe do konwersji Średniopolskiego Banku Drzew Zależnościowych (MPDT), anotowanego w polskim schemacie, do formatu Universal Dependencies (UD). Po krótkim omówieniu motywacji, danych i standardu docelowego zaprezentowano ogólne założenia projektu, strategię odwzorowań oraz schemat walidacji. Przedstawiono ogólne wyniki konwersji oraz możliwe zastosowania i kierunki rozwoju, w tym udostępnienie MPDT-UD i znaczenie dla badań nad przetwarzaniem języka historycznego w kognitywistyce.

Słowa kluczowe

język średniopolski, drzewa zależnościowe, konwersja korpusu, Universal Dependencies

The title of the thesis in English

Middle Polish Dependency Treebank in Universal Dependencies Format: Design, Implementation, and Analysis

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Chapter 1

Introduction

1.1. Motivation

Natural-language preprocessing tools and comparative treebank research have standardized around Universal Dependencies (UD), which enables typologically informed analyses and cross-lingual transfer (Nivre et al. 2020). For Polish texts from the 17th and 18th centuries, however, key resources remain outside UD: texts in the KorBa corpus (Gruszczyński et al. 2022) and the emerging Middle Polish Dependency Treebank (MPDT) are annotated in a Polish-specific scheme (Wieczorek 2025). KorBa is a corpus of historical Polish texts, while MPDT adds a syntactic dependency layer to selected portions of this corpus. However, these resources being annotated in a different format creates challenges for interoperability with UD-based tools and limits straightforward comparative studies with other languages.

A natural solution is to convert these resources to the UD format. From an engineering perspective, however, a faithful, auditable conversion is non-trivial: historical orthography, abbreviations, clitic mobility, numeral complexes, and multiword conjunctions/prepositions interact with head rules and label inventories. Prior conversion experience for contemporary Polish (PDB → PDB-UD; NKJP1M → NKJP1M-UD) offers valuable guidance (Wróblewska 2018; Wróblewska 2020), yet historical data introduce additional phenomena that require explicit, rule-based handling and transparent traceability.

As Wieczorek (2025) notes, MPDT's current format is well-suited to comparative studies with contemporary Polish syntax; at the same time, she highlights the advantages of moving to UD for cross-linguistic comparability, wider intelligibility, and representational options such as enhanced dependencies for shared dependents and shared governors in coordination—even if some information may be lost in conversion. This thesis operationalizes that rationale by delivering a documented, UD-oriented converter for MPDT and preparing the current version of MPDT-UD suitable for validation and downstream use.

The intended users include historical linguists needing UD-compatible data and NLP practitioners interested in diachronic Polish or cross-lingual experiments.

1.2. Objectives

The thesis pursues the following research goals:

(R1) Design a UD-oriented conversion strategy for MPDT. Specify mapping principles that respect Middle Polish specifics while aligning with UD guidelines.

(R2) Implement an auditable conversion pipeline. Provide modular components for morphosyntax mapping and dependency restructuring, with token-level logging.

(R3) Ensure UD conformance and evaluability. Produce output that passes the official UD validator (on all levels) and supports downstream analysis.

(R4) Document decisions. Record non-obvious mapping choices and edge-case policies to enable maintenance and reuse.

1.3. Contributions

This project delivers concrete, reusable artifacts:

(C1) A rule-based MPDT → MPDT-UD converter. A modular pipeline with fine-grained logging, selectively adapting ideas from PDB→PDB-UD while targeting Middle Polish phenomena. The code will be released in a public repository under an open-source license, together with this thesis, which documents the design and implementation.

(C2) An initial public release of MPDT-UD. A set of MPDT (2018 sentences at the time of writing) converted automatically and validated with the official UD validator.

1.4. Structure of the Thesis

- **Chapter 2: Background.** Presents the foundational concepts and resources, including dependency grammar, Universal Dependencies, KorBa and MPDT.
- The remaining chapters will be incorporated here as they are finalized.

Chapter 2

Background

This chapter provides the essential background for understanding the Middle Polish Dependency Treebank conversion to Universal Dependencies. It begins with the theoretical foundations of dependency grammar and its specific Polish manifestation in the Polish Dependency Bank (PDB) scheme. Then it outlines Universal Dependencies as the target framework, highlighting its advantages for cross-linguistic research. Finally, it describes the key resources: KorBa as the source corpus and MPDT as the dependency-annotated dataset that forms the input to our conversion pipeline.

2.1. Dependency Grammar

Dependency grammar is a theory of syntactic structure organized around asymmetric governor–dependent relations. A *dependency* links two lexical items: a *governor* that selects and constrains a dependent, and a *dependent* that is licensed by the governor. One item can be a governor for multiple dependents, but each dependent has a single governor. Sentence structures are modeled as directed trees whose nodes correspond to tokens and whose edges encode these governor–dependent links. The tree has a single *root* (a node with no governor), and every other node is reachable from it along directed edges. In addition to purely structural links, dependency grammar is used here in a morphosyntactic sense, focusing on grammatical relations rather than semantic or prosodic dependency representations.

The dependency scheme used in Middle Polish follows the conventions established for the Polish Dependency Bank (PDB), which is adapted specifically for Polish syntax (Wróblewska 2023). The PDB annotation scheme uses a comprehensive set of morphological categories and dependency relations designed specifically for Polish morphosyntax.

The PDB tagset includes the following morphological categories:

- **Nouns:** `subst` (noun), `depr` (depreciative noun)

- **Pronouns:** `ppron12` (non-third person pronoun), `ppron3` (third person pronoun), `siebie` (reflexive pronoun)
- **Adjectives:** `adj` (adjective), `adja` (adjectival adjective), `adjc` (predicative adjective), `adjp` (prepositional adjective)
- **Verb forms:** `fin` (finite non-past), `praet` (past tense), `imps` (impersonal), `impt` (imperative), `inf` (infinitive), `aglt` (agglutinate of 'być'), `bedzie` (future form of 'być'), `winien` (modal verbs like 'winien'), `pred` (predicative), `ger` (gerund), `pcon` (contemporary adverbial participle), `pant` (anterior adverbial participle), `pact` (active adjectival participle), `ppas` (passive adjectival participle)
- **Numerals:** `num` (cardinal numeral), `numcomp` (numeral compound)
- **Conjunctions:** `comp` (subordinating conjunction), `conj` (coordinating conjunction)
- **Other categories:** `adv` (adverb), `brev` (abbreviation), `dig` (Arabic numeral), `romandig` (Roman numeral), `emo` (emoticon), `fill` (filler), `frag` (fragment), `interj` (interjection), `interp` (punctuation), `part` (particle), `prep` (preposition), `ign` (unrecognized form)

The PDB annotation scheme distinguishes several classes of dependency relations:

- **Core arguments:** `subj` (subject), `obj` (direct object), `obj_th` (thematic object), `comp` (complement), `comp_fin` (finite complement), `comp_inf` (infinitive complement), `comp_ag` (agent complement)
- **Adjuncts and modifiers:** `adjunct` with semantic subtypes such as `adjunct_temp` (temporal), `adjunct_loc` (locative), `adjunct_dur` (duration), `adjunct_caus` (causal), `adjunct_mod` (manner), `adjunct_emph` (emphatic particle), `adjunct_compar` (comparative)
- **Predicate-related:** `pd` (predicate), `aux` (auxiliary), `neg` (negation)
- **Coordination:** `conjunct` (coordinated element), `pre_coord` (pre-coordinator)
- **Multiword expressions:** `mwe` (multiword expression), `ne` (named entity), `ne_foreign` (foreign named entity)
- **Special relations:** `punct` (punctuation), `vocative` (vocative), `refl` (reflexive), `orphan` (orphaned dependent), `discourse` (discourse marker), `parataxis` (parataxis), `root` (sentence root)

The example dependency trees below illustrate the scheme of a PDB-annotated sentence alongside its UD counterpart, showing the structural differences.

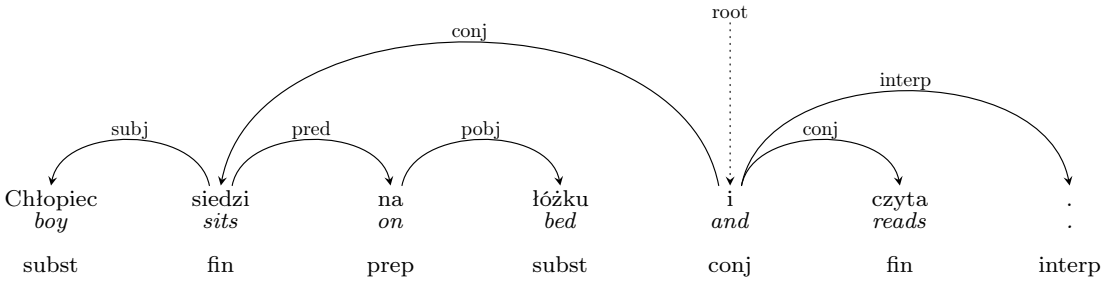

Figure 1: Example PDB dependency tree with morphological tags

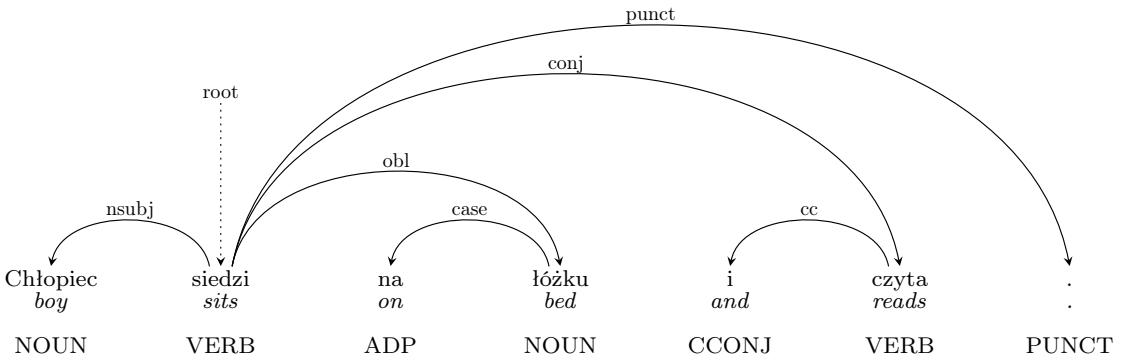

Figure 2: A dependency tree of the same sentence in UD format, showing tags

Dependency formalisms differ on certain design choices (e.g., whether adpositions are heads or dependents inside adpositional phrases; how to encode coordination; whether and how to mark valency vs. modification). The PDB scheme takes specific positions on these issues, treating prepositions as heads (note the on→bed relation in Figure 1), using a coordination-centric approach where conjunctions govern coordinated elements (*i* being the `root` of both *siedzi* and *czyta* in Figure 1), and distinguishing arguments from adjuncts through detailed semantic role marking.

2.2. Universal Dependencies

Universal Dependencies (hereafter UD) is a cross-linguistic annotation framework designed to harmonize morphosyntactic and syntactic representations across languages within a dependency-based, lexicalist model (Nivre et al. 2020; de Marneffe et al. 2021). UD serves as both a theoretical framework and a practical collection of treebanks—currently the largest repository of multilingual dependency trees with over 200

treebanks for more than 150 languages.[1] It is widely adopted in NLP and linguistic typology, and is maintained by an open community with regular releases.

The scheme provides three aligned layers for sentence-level annotation:

1. **Tokenization.** UD defines dependencies between *syntactic words*. To handle orthographic contractions or clitic clusters, it uses *multiword tokens*, ensuring a faithful word-level analysis. For example, German token *im* would be split into syntactic words *in* and *dem*, where each receives its own morphological analysis and syntactic role. In (Middle) Polish, examples of such multiword tokens include jeszcześ (jeszcze + ś), kiedym (kiedy + m), and mogłaby (mogła + by). Conversely, several orthographic tokens may be combined into one syntactic word in well-motivated, language-specific cases.

2. **Morphology.** Each syntactic word is associated with a `LEMMA`, a universal part-of-speech tag (hereafter part of speech tag=`POS`; universal part of speech tag=`UPOS`) from a fixed 17-tag set, and a bundle of `FEATS` (morphological features). The UPOS tags cover open-class words (adjectives `ADJ`, adverbs `ADV`, interjections `INTJ`, nouns `NOUN`, proper nouns `PROPN`, verbs `VERB`), closed-class words (adpositions `ADP`, auxiliary verbs `AUX`, coordinating conjunctions `CCONJ`, determiners `DET`, numerals `NUM`, pronouns `PRON`, particles `PART`, subordinating conjunctions `SCONJ`), and other categories (punctuation `PUNCT`, symbols `SYM`, other `X`). UD v2 standardized features and values across languages and clarified tag boundaries, e.g. extending auxiliary verbs to copulas and tense–aspect–mood particles while narrowing particles.

3. **Syntax.** The syntactic layer is a single-rooted tree with possible 37 universal dependency relations organized according to functional and structural categories. Relations include:

   - core arguments (nominal subject `nsubj`, direct object `obj`, indirect object `iobj`, and clausal complement `ccomp`),
   - non-core dependents (object `obl`, dislocated element `dislocated`, adverbial clause modifier `advcl`, adverbial modifier `advmod`, discourse element `discourse`, auxiliary `aux`, and copula `cop`),
   - nominal dependents (nominal modifier `nmod`, numeral modifier `nummod`, adjectival modifier `amod`, determiner `det`, and case marker `case`),
   - coordination (conjunct `conj`, coordinating conjunction `cc`),
   - multiword expressions (fixed `fixed`, flat `flat`),
   - special relations (list element `list`, parataxis `parataxis`, orphan `orphan`, punct `punct`, root `root`, other dependent `dep`).

[1] Universal Dependencies, `https://universaldependencies.org`, accessed 2025-10-10.

The framework also allows language-specific subtypes (e.g., `nsubj:pass` for passive subjects, `det:poss` for possessive determiners) and defines semi-mandatory subtypes that should be used when the relevant phenomenon exists in the language. A full list of relations and subtypes, along with their descriptions, is available in the UD webpage.[2]

In addition to the *basic* representation, UD also defines an *enhanced* graph that adds extra arcs (and occasionally null nodes) to capture phenomena such as shared dependents in coordination, control and raising, relativization, and ellipsis.

Format: For practical implementation and data sharing, UD annotations must be encoded in a standardized format. UD uses the CoNLL-U format, a ten-column tabular specification with the fields:

- `ID` - a token index (or range for multiword tokens);
- `FORM` - the surface form;
- `LEMMA` - the dictionary form;
- `UPOS` - the universal POS tag;
- `XPOS` - a language-specific POS tag;
- `FEATS` - a pipe (|) separated list of morphological features;
- `HEAD` - the index of the head token (or 0 for the root);
- `DEPREL` - the dependency relation to the head;
- `DEPS` - for enhanced dependencies;
- `MISC` - for miscellaneous annotations.

Here is an example CoNLL-U snippet:

```
# sent_id = test-sentence
# text = Chłopiec siedzi na łóżku i czyta.
1   Chłopiec   chłopiec  NOUN   subst   Gender=Masc|Number=Sing|Case=Nom                    2   nsubj   _         _
2   siedzi     siedzieć   VERB   fin     Aspect=Imp|Mood=Ind|Tense=Pres|Person=3|Number=Sing  0   root    _         _
3   na         na         ADP    prep    AdpType=Prep|Case=Loc                              4   case    _         _
4   łóżku      łóżko      NOUN   subst   Gender=Neut|Number=Sing|Case=Loc                    2   obl     _         _
5   i          i          CCONJ  conj    _                                                  2   cc      _         _
6   czyta      czytać     VERB   fin     Aspect=Imp|Mood=Ind|Tense=Pres|Person=3|Number=Sing  2   conj    1:nsubj   _
7   .          .          PUNCT  interp  PunctType=Peri                                     2   punct   _         _
```

[2]Universal Dependencies relations list: `https://universaldependencies.org/u/dep/index.html`

2.3. Middle Polish Linguistic Resources

2.3.1. KorBa

KorBa (Gruszczyński et al. 2022) – from Polish *Korpus Barokowy*, "Baroque Corpus" – is a 13.5-million-token corpus of Polish texts from 1601–1772, compiled from over seven hundred sources and annotated morphosyntactically (lemmas, POS, features). It is searchable via MTAS (Multi Tier Annotation Search) (Brouwer et al. 2017), and provides parallel transliteration/transcription layers, structural and language markup, and rich metadata (period, region, text type, genre) that enable stratified analyses.

The corpus includes diverse text types ranging from literary works (epic poetry, drama, lyric poetry) to non-literary materials (scientific-didactic texts, persuasive writings, factual literature, official documents, press releases) and biblical texts. Geographically, texts span the Polish-Lithuanian Commonwealth, with approximately 27% of the corpus being of unknown origin. As shown in Figures 3 and 4, the corpus maintains careful balance across regions and text types to ensure representativeness of Middle Polish.

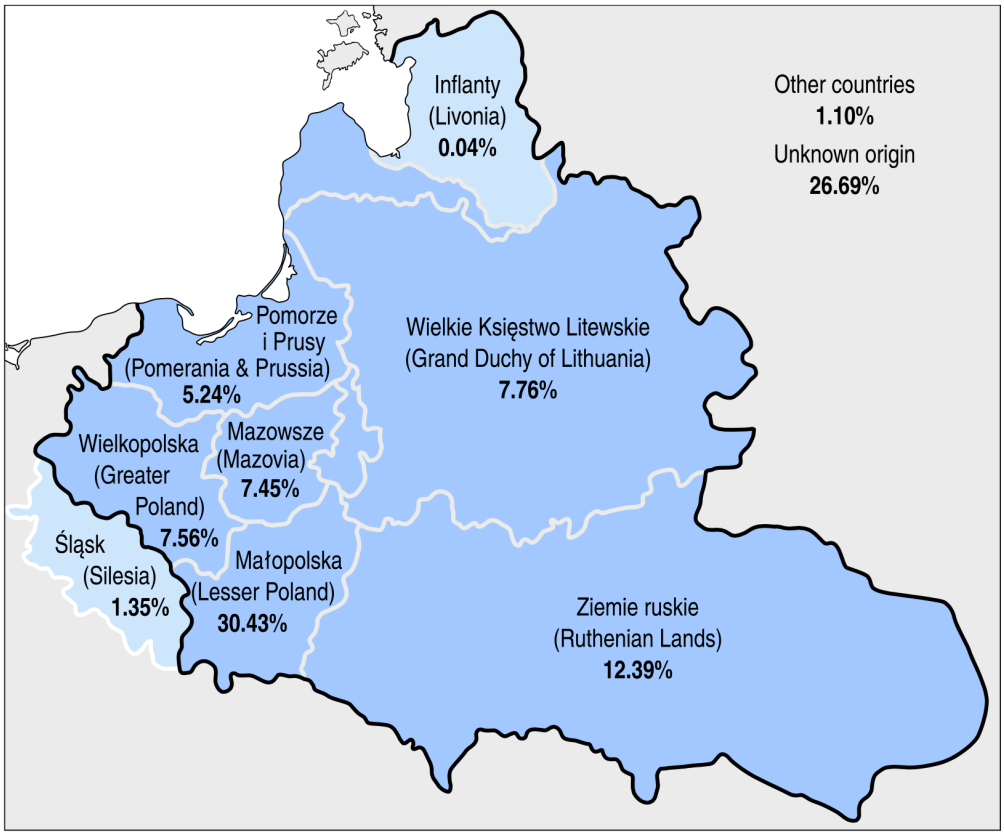

Figure 3: Geographical distribution of texts in the corpus displayed on the map of the Commonwealth after the Union of Lublin of 1569. Source: Gruszczyński et al. (2022), p. 315, CC BY 4.0.

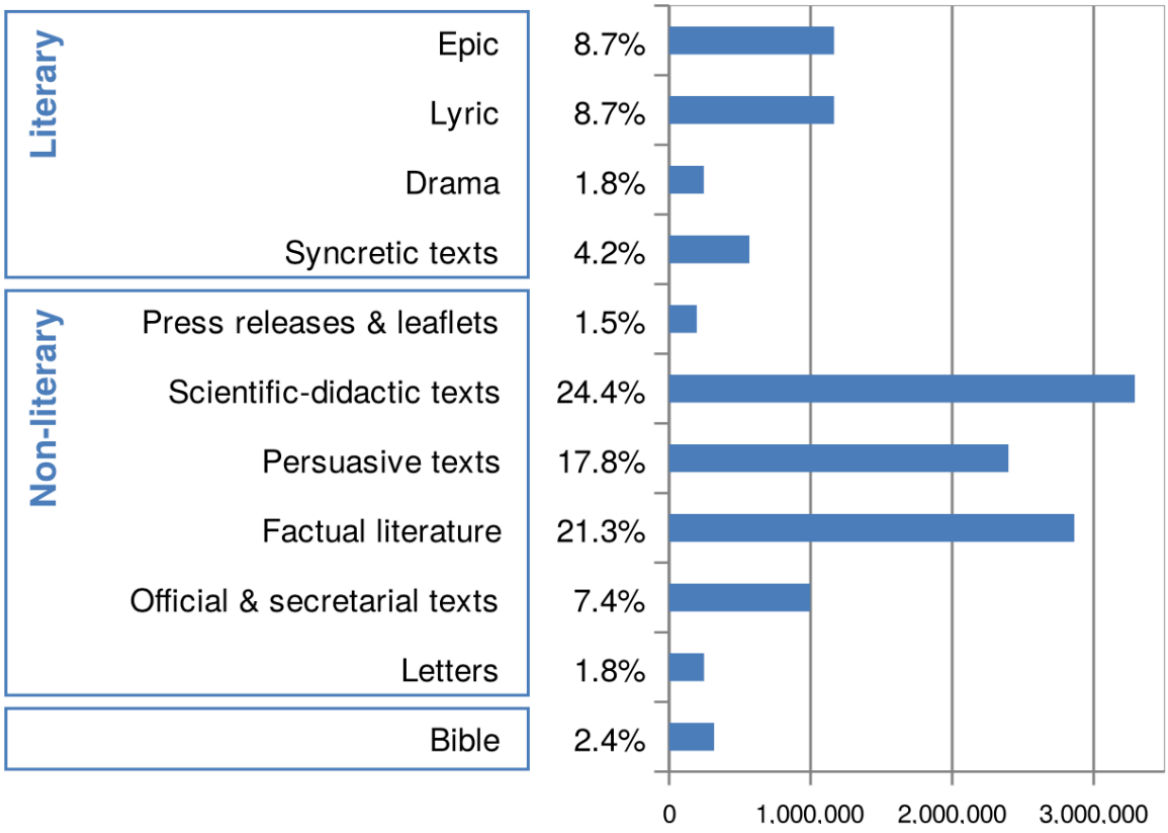

Figure 4: Types of texts in KorBa. Source: Gruszczyński et al. (2022), p. 316, CC BY 4.0.

2.3.2. MPDT

The Middle Polish Dependency Treebank (MPDT) is a manually curated, syntactically annotated subset of the KorBa corpus, capturing key syntactic phenomena of 17th–18th-century Polish texts. Sentences chosen for MPDT exclude poetry and Latin insertions. This ensures high-quality tokenization, lemmas, POS tags, and morphological features, while maintaining representativeness across period, region, and text type.

Annotation workflow:

1. **Automatic pre-annotation.** Two parsers trained on contemporary PDB data (MaltParser, COMBO) generate initial dependency analyses.

2. **Manual correction.** Two linguist annotators independently revise parser outputs, leveraging complementary error profiles.

3. **Adjudication.** Conflicting annotations are resolved by an adjudicator to produce a single gold-standard tree.

4. **Format and tooling.** Final annotations are encoded in CoNLL-U with KorBa's extended tagset (e.g., dual number `Dual`) and processed using MaltEvalAnnotator.

To accommodate Middle Polish morphology, which is described in detail in Chapter 3 (to add a chapter autoref here !!!), several POS and feature categories were added:

- `adjb`, `ppasb`, `ppraet` for short-forms and past participles
- Feature `Number=Dual` alongside `Sing` and `Plur` for the dual number.

Corpus statistics

- Total sentences: 2 018
- Total tokens: 47 273
- Distinct POS tags: 45
- Distinct dependency relations: 27
- Non-projective edges: 3 748 across 879 sentences
- Average sentence length: 23.43 tokens

Figure 5 presents the 20 most frequent MPDT POS tags, highlighting the prominence of nouns (`subst`: 11,374 occurrences), punctuation (`interp`: 7,971), adjectives (`adj`: 5,315), and prepositions (`prep`: 4,391).

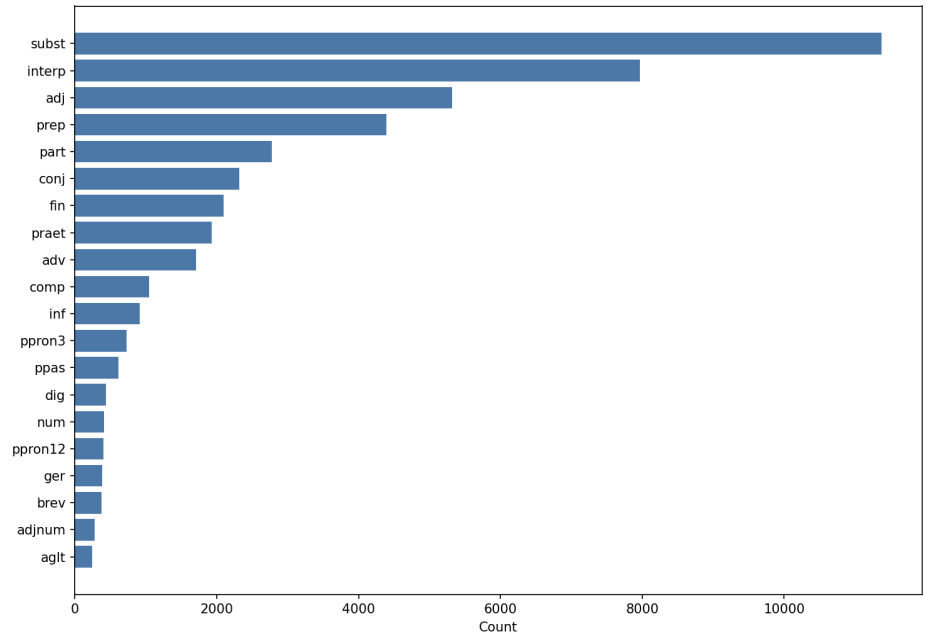

Figure 5: Top 20 MPDT POS tag frequencies

Figure 6 shows the distribution of the top 20 dependency relation bases. Adjuncts (`adjunct`: 13,276) and complements (`comp`: 8,539) are most common, followed by punctuation (`punct`: 6,896), coordination elements (`conjunct`: 6,071), and core arguments (`obj`: 3,423; `subj`: 2,286).

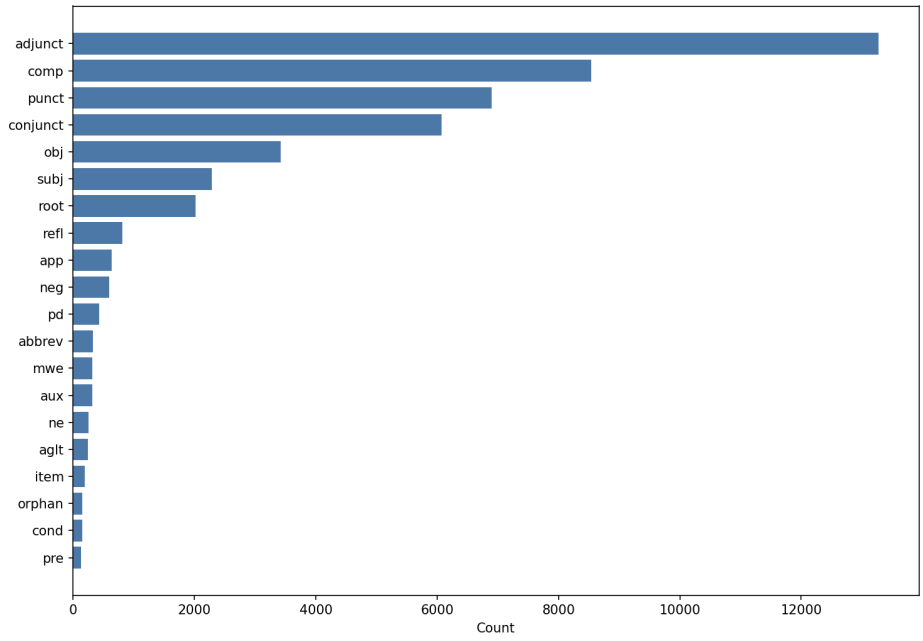

Figure 6: Top 20 MPDT dependency relation base frequencies

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