Świgra: An Implementation of a Large Grammar of Polish

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Świdziński's grammar

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Gramatyka formalna języka polskiego, Wydawnictwa Uniwersytetu Warszawskiego, 1992.

- a grammar written by a linguist
- not intended for an implementation
- probably the most extensive and most detailed formal grammar of Polish
- so-called surface syntax (no semantics)
- expressed as a metamorphosis grammar
- 460 rules

The parser *Świgra*

Świgra is a parser written in Prolog implementing Świdziński's formal grammar.

The aim:

- to examine what the exact set of sentences accepted by the grammar is and what structures are assigned to them
- to remain close to the original grammar
- to verify Świdziński's description

The formalism

Metamorphosis grammars — a Prolog based formalism developed by Colmerauer:

Alain Colmerauer

Metamorphosis grammars
In: L. Bolc (ed.), Natural Language Communication with Computers. *Lecture Notes in Computer Science 63*. Springer-Verlag 1978, pp. 133–189.

Now more commonly known in the **Definite Clause Grammar (DCG)** variant proposed by Pereira and Warren (1980).

Morphological analysis

The parser does not work with raw tokens of the input text but with results of a morphological analysis.

Each token is equipped with morphological interpretations consisting of an identifier of the lexeme and values of relevant grammatical categories.

Morphological analyzer *Morfeusz*

- the program developed by Marcin Woliński
- linguistic data provided by prof. Zygmunt Saloni
- uses the IPI PAN tagset
- built using finite-state techniques

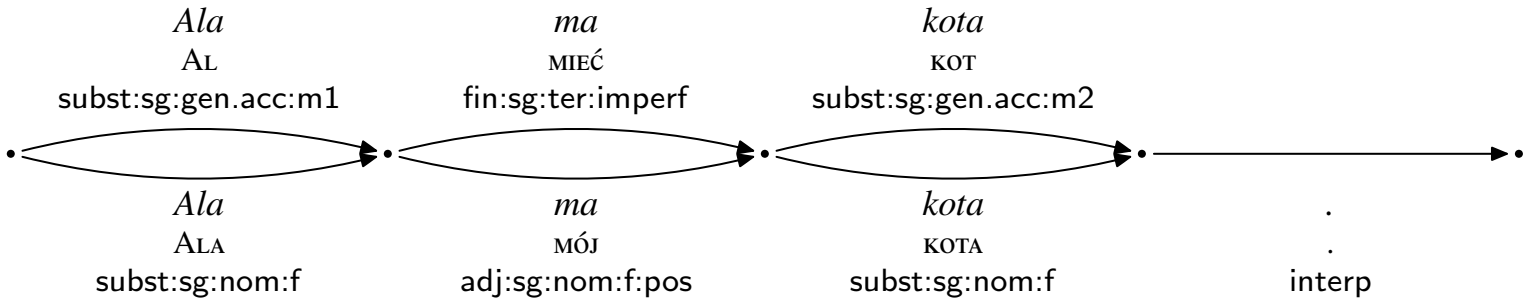
Morfeusz assigns to each token all possible morphological interpretations without checking context (it is not a tagger).

The tagset is based on the notion of a flexeme (proposed by Janusz Bień) — a set of wordforms which is uniform with respect to inflection.

Morphological analyzer *Morfeusz*

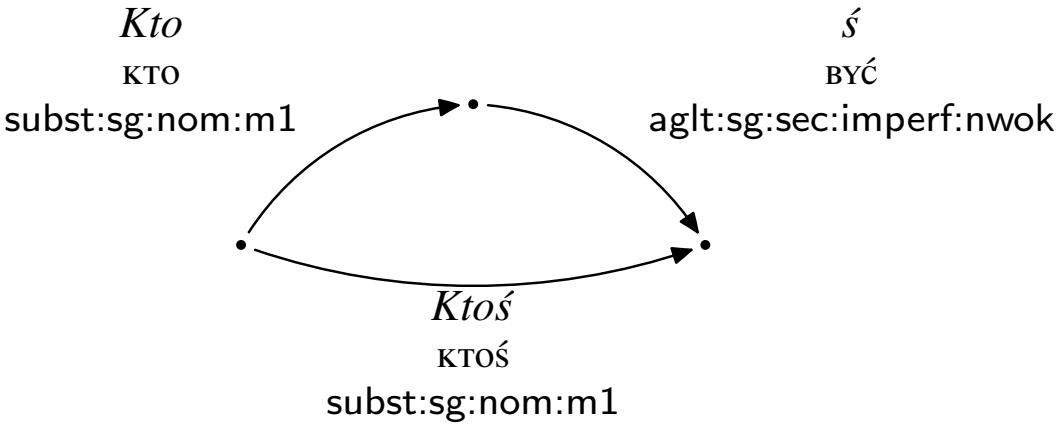
The analysed text is represented as a directed acyclic graph of interpretations:

- **nodes** — positions in the text (between tokens)
- **edges** labelled with possible token interpretations



In *Świgra* the DAG is stored in the form of Prolog clauses.

Word segmentation can be ambiguous



- Kto—ś ty?
  Who be.2PRS you

  ‘Who are you?’

- Ktoś przyszedł?
  Somebody came

  ‘Did anybody come?’

Morphological interpretations
for the sentence *'Ta poza nie wychodzi.'*

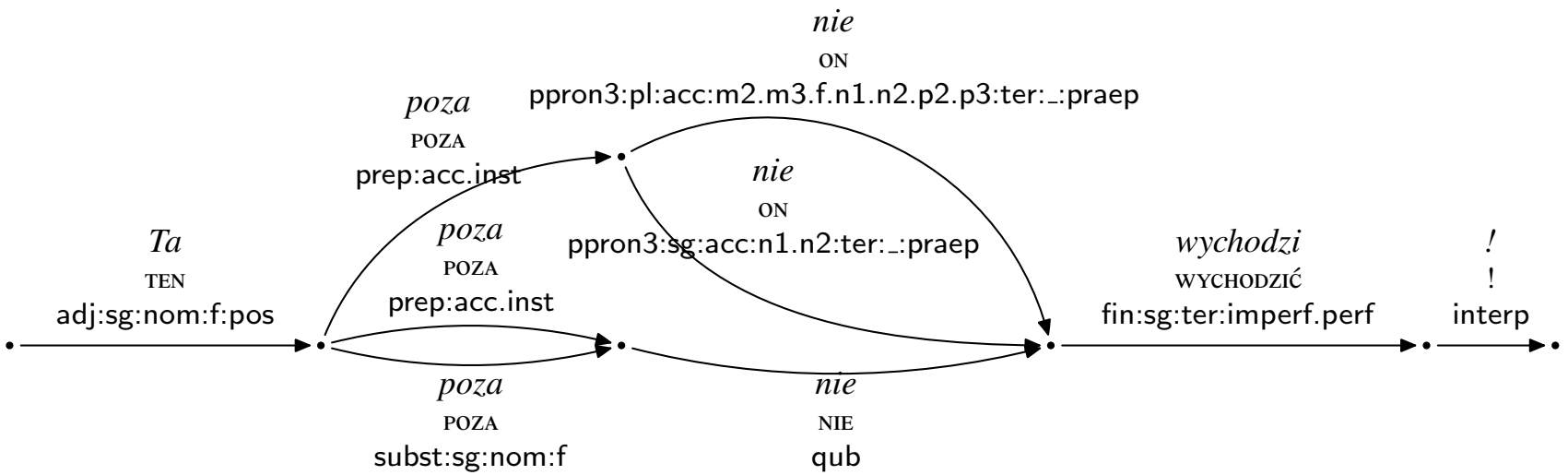
- Ta poza nie wychodzi!
  This pose not works

  'This pose doesn't work!'

- Ta poza nie wychodzi!
  This beyond them leaves

  'This goes beyond them!'

Morphological interpretations
for the sentence *'Ta poza nie wychodzi.'*



Syntactic analysis

Świdziński's grammar is close to the metamorphosis grammars formalism but:

- an extension is used that allows for permuting phrases,
- conditions often refer to values which have not been computed yet,
- void recursion is present (cycles of nonterminal elements which can be rewritten to each other),
- rules of the lowest "preterminal" level are missing,
- rules describing an elementary sentence needed thorough clarification.

The parsing algorithm

- Świgra uses a bottom-up parsing strategy, which for Polish proved to be superior to the top-down strategy.
- The parser builds a shared parse forest, which is not only the result but also a means of avoiding unnecessary recomputation.
- The rules of the grammar are not interpreted at the runtime but they are compiled to Prolog clauses.

The parsing algorithm

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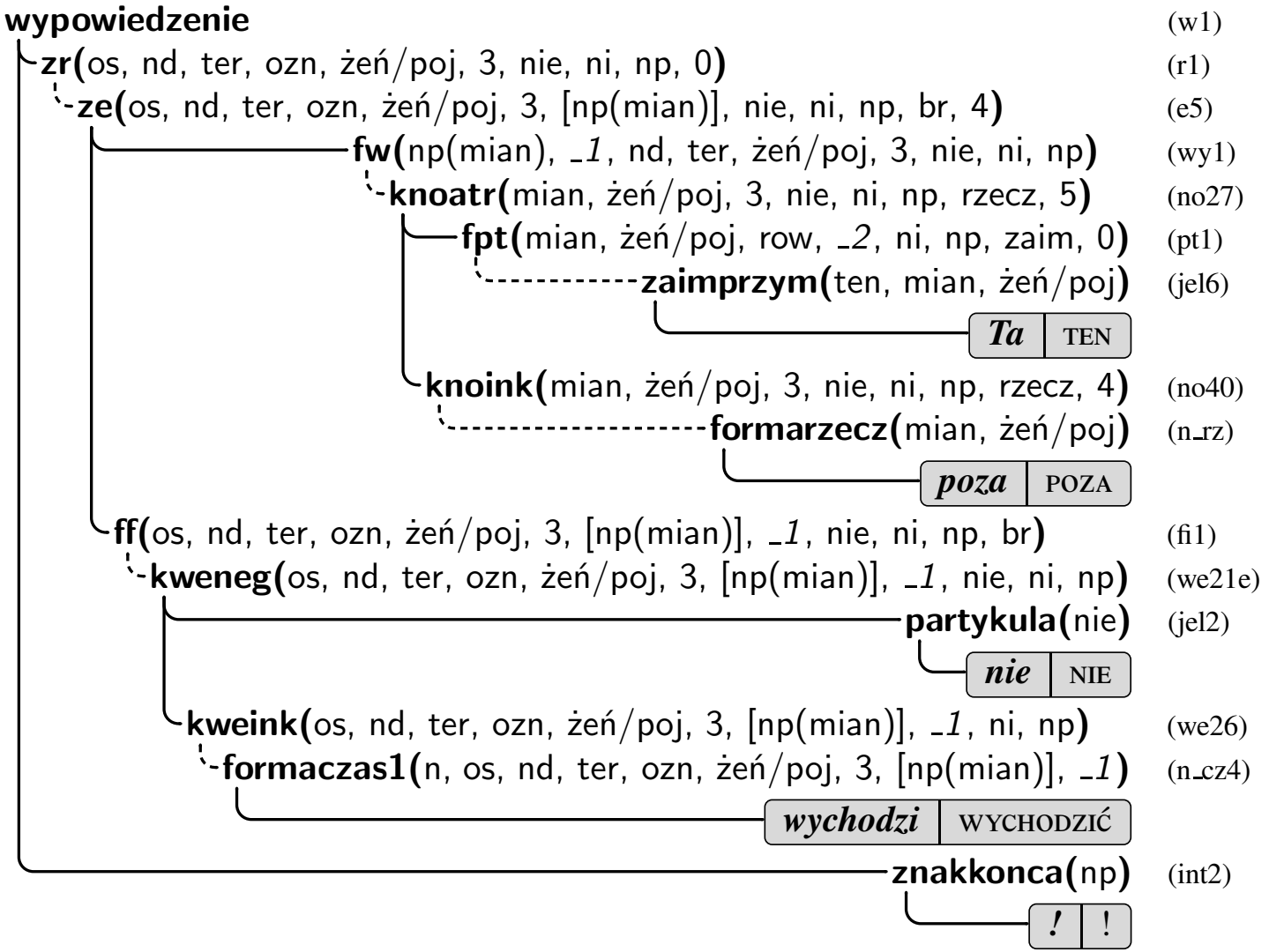
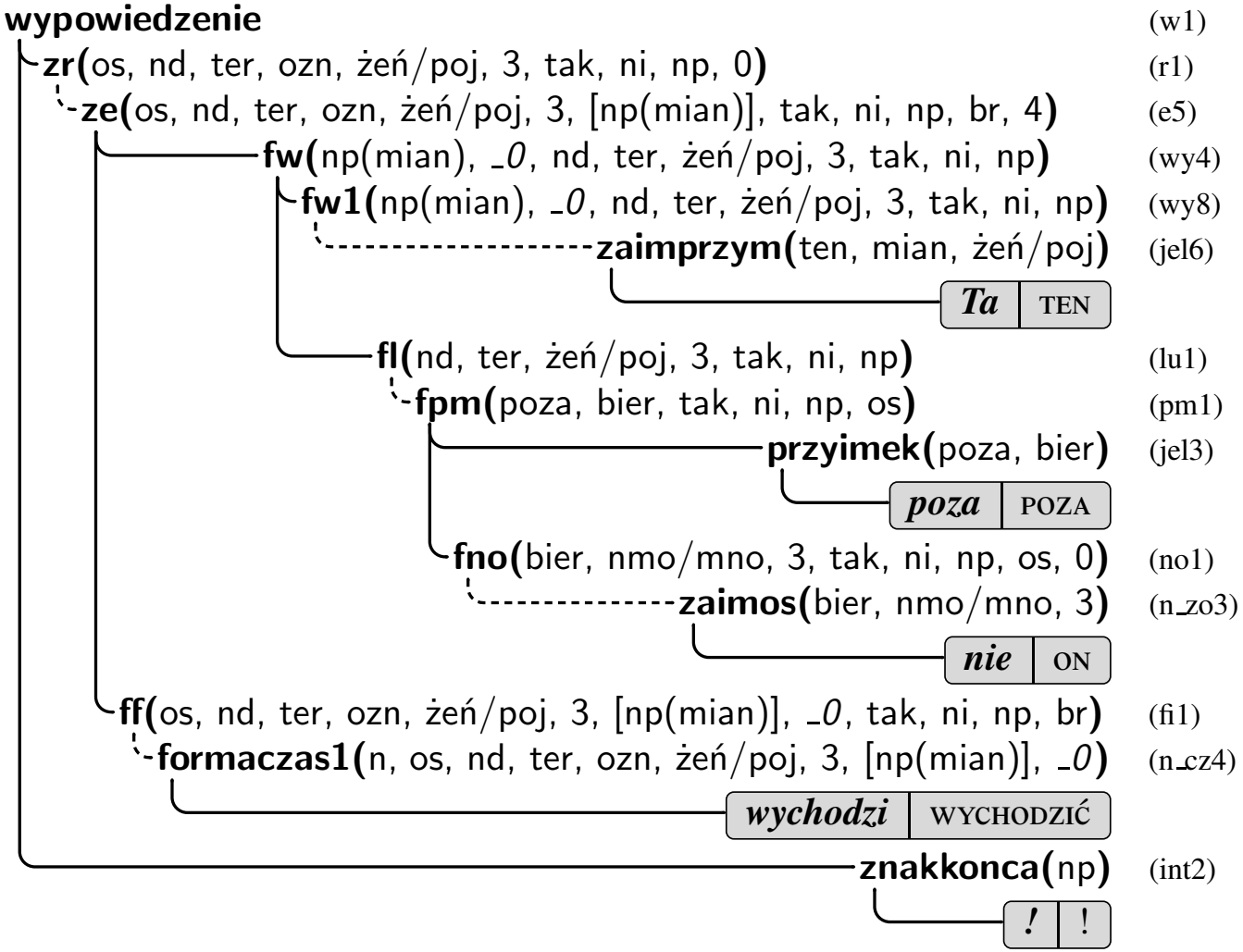
Our algorithm differs from chart parsing since no inactive edges are kept in the chart/forest. They are hidden in the recursion stack and reclaimed when no longer used, which provides for less memory requirements of the algorithm.

A parse tree


wypowiedzenie (w1)
zr(os, nd, ter, ozn, żeń/poj, 3, nie, ni, np, 0) (r1)
ze(os, nd, ter, ozn, żeń/poj, 3, [np(mian)], nie, ni, np, br, 4) (e5)
fw(np(mian), _1, nd, ter, żeń/poj, 3, nie, ni, np) (wy1)
knoatr(mian, żeń/poj, 3, nie, ni, np, rzecz, 5) (no27)
fpt(mian, żeń/poj, row, _2, ni, np, zaim, 0) (pt1)
zaimprzym(ten, mian, żeń/poj) (jel6)
Ta TEN
knoink(mian, żeń/poj, 3, nie, ni, np, rzecz, 4) (no40)
formarzecz(mian, żeń/poj) (n_rz)
poza POZA
ff(os, nd, ter, ozn, żeń/poj, 3, [np(mian)], _1, nie, ni, np, br) (fi1)
kweneg(os, nd, ter, ozn, żeń/poj, 3, [np(mian)], _1, nie, ni, np) (we21e)
partykula(nie) (jel2)
nie NIE
kweink(os, nd, ter, ozn, żeń/poj, 3, [np(mian)], _1, ni, np) (we26)
formaczas1(n, os, nd, ter, ozn, żeń/poj, 3, [np(mian)], _1) (n_cz4)
wychodzi WYCHODZIĆ
znakkonca(np) (int2)
! !

Another parse tree

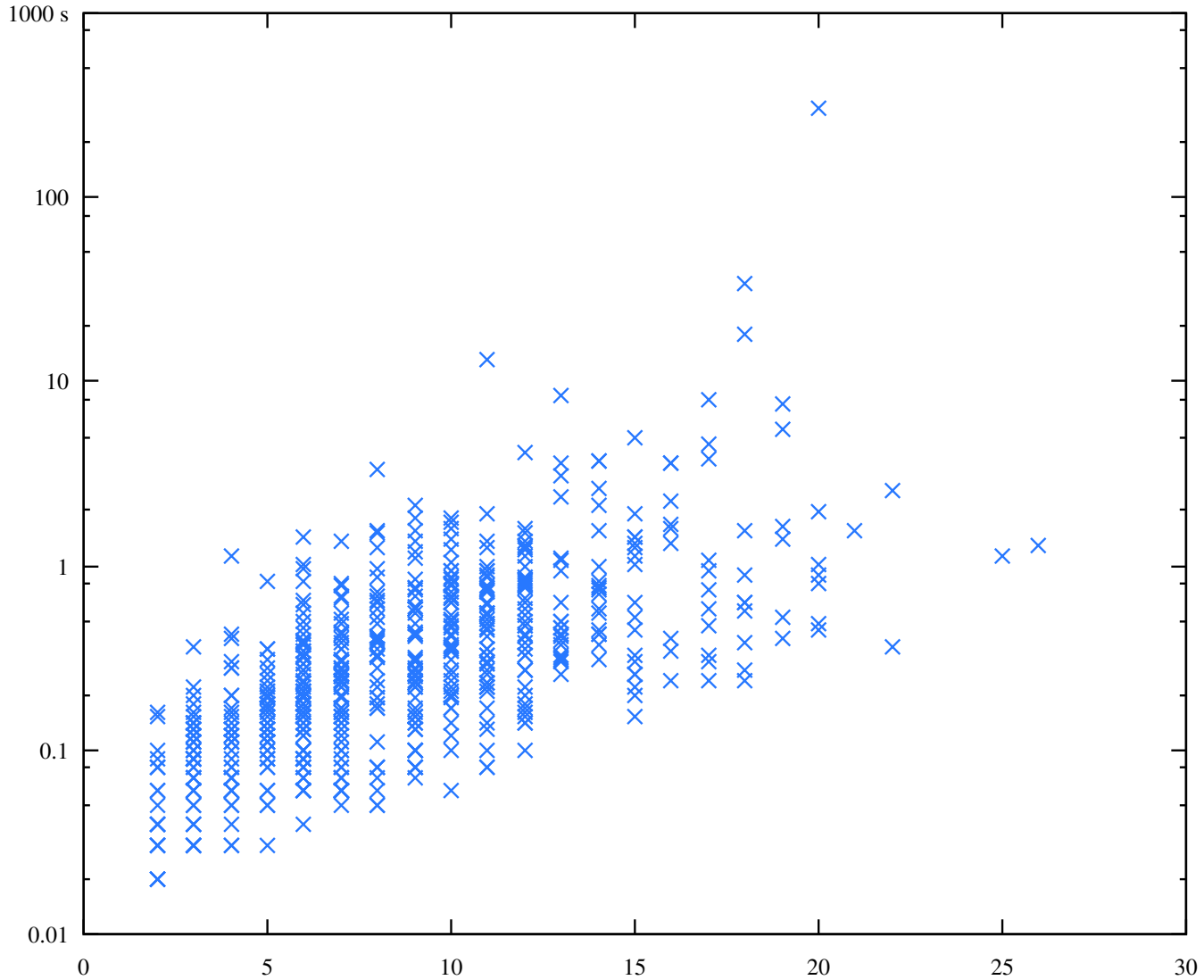


Preliminary results of evaluation

	correct		incorrect	
	acc.	nacc.	acc.	nacc.
sentences	515		145	
	469	46	34	111
	91%	9%	23%	77%
trees	10		14	
time (s)	0.26	0.36	0.20	0.15
inferences	267905	273601	201369	183400

Results of parsing 660 example sentences provided by Świdziński. Time measured on a 1.8 GHz Pentium running Linux.
The length of analysed sentences (including punctuation) varies between 3 and 27 (over a half of them in the range 7–16).

Parse time depending on sentence length



The extreme sentences

- *Mieliśmy czas, aż ani ja nie zostałem, ani on nie poszedł, ani ona nie przyszła.*
  1,029,654 trees, 18 seconds, 5861 edges in the forest
- *Gdybyśmy mieli czas, to ja nie zostanę, on nie pójdzie, ona nie przyjdzie ani dziecko nie uśnie.*
  302 seconds, 18,050 edges, 12,282 trees

Incorrect sentences accepted

One of the shortest "incorrect" sentences accepted by the grammar:

- Ona nie czytała książkę.
  She not read book.ACC

The correct form:

- Ona nie czytała książki.
  She not read book.GEN
  'She wasn't reading a book.'

Summary

- The grammar proved to be consistent enough to be a good starting point for improvements.
- Its limitations and deficiencies can clearly be seen.
- Extensions needed:
  - numeral phrases,
  - coordination within phrases (e.g., nominal, adjectival).
- Overgeneration of parse trees ("free phrases"!)

- *Świgra* is quite efficient.
- A parser implemented in Prolog provides for easy experiments with the grammar.
- *Świgra* is still experimental
  but already not a toy parser.