Netgraph – a Tool for Searching in the Prague Dependency Treebank 2.0

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The Starting Point

Three sides existed whose connection needed to be solved:

- The Prague Dependency Treebank
- Netgraph 1.0
- Users without programming skills

The Work

The doctoral thesis consists of these main parts:

- Analysis of the Requirements
- Designing the Query Language
- Usage of the Query Language
- Comparison to Other Search Systems
- Implementation in Netgraph

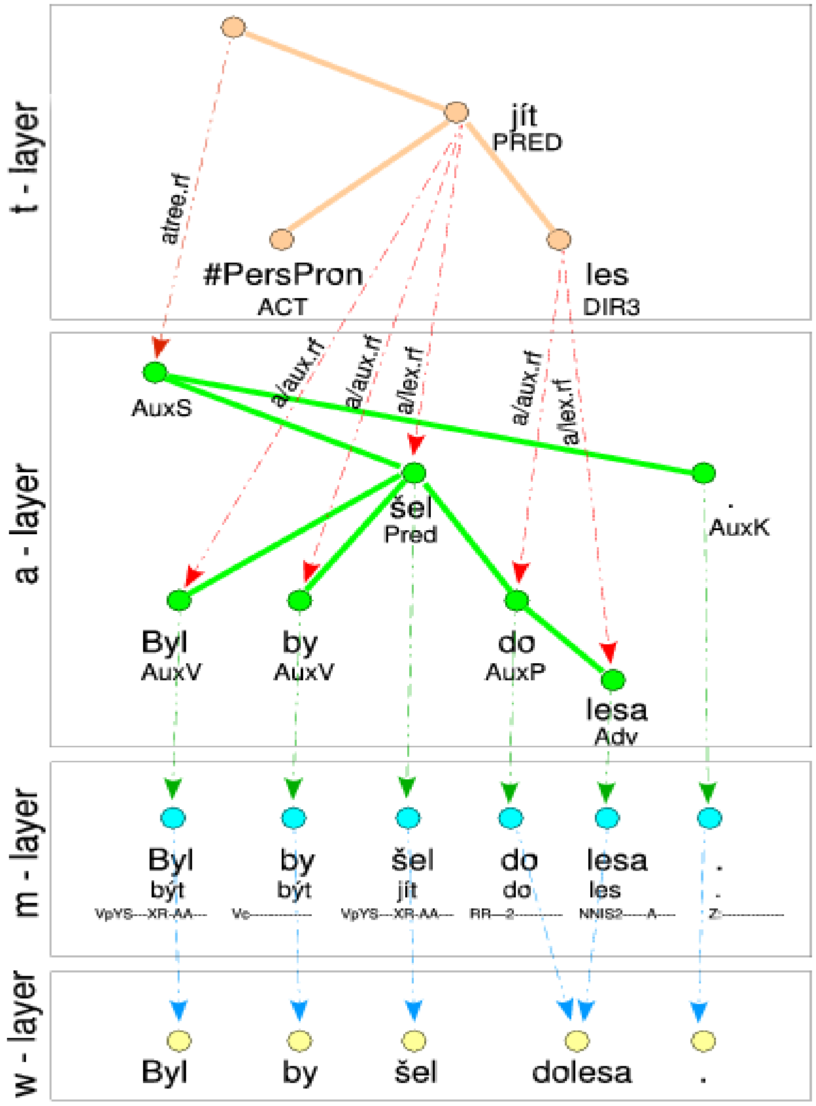
The Work

In this presentation, I will focus on these parts:

- Analysis of the Requirements
- Designing the Query Language
- Usage of the Query Language
- Comparison to Other Search Systems
- Implementation in Netgraph

Prague Dependency Treebank 2.0

Layers in PDT 2.0



Linguistic Requirements
Valency

To study valency, the query language should be able to:

- control a presence of a particular type of son
- control a non-presence of a son
- control number of sons

Linguistic Requirements
Coordination etc.

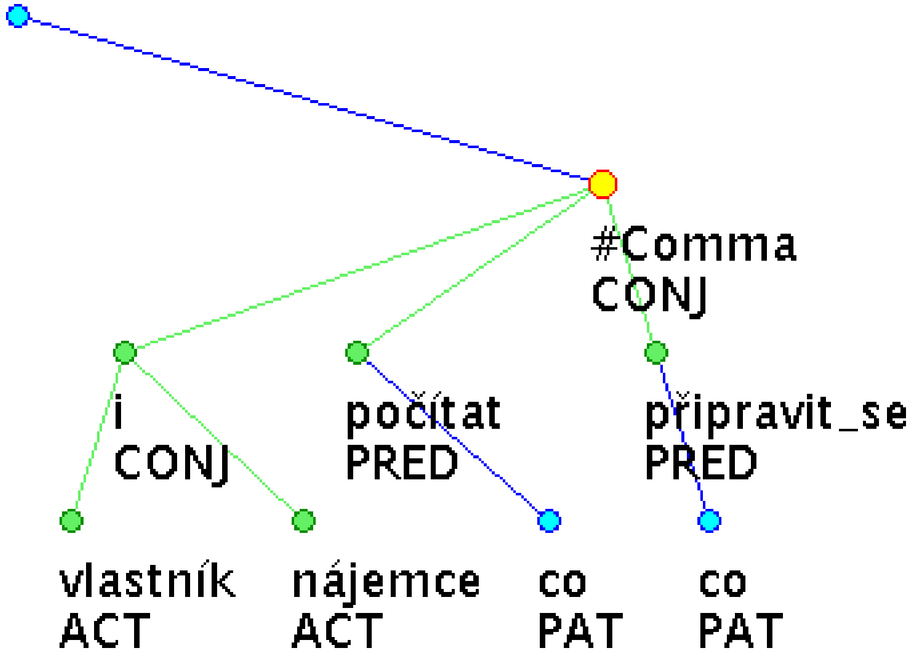
Tree dependency is not always linguistic dependency. We need:

➡ to skip a node (etc. coordination, apposition)

Linguistic Requirements
Complex Example of Coordination

Czech: S čím mohou vlastníci i nájemci počítat, na co by se měli připravit?

English (lit.): What can owners and tenants expect, what they should get ready for?



Linguistic Requirements
Coordination etc.

Tree dependency is not always linguistic dependency. We need:

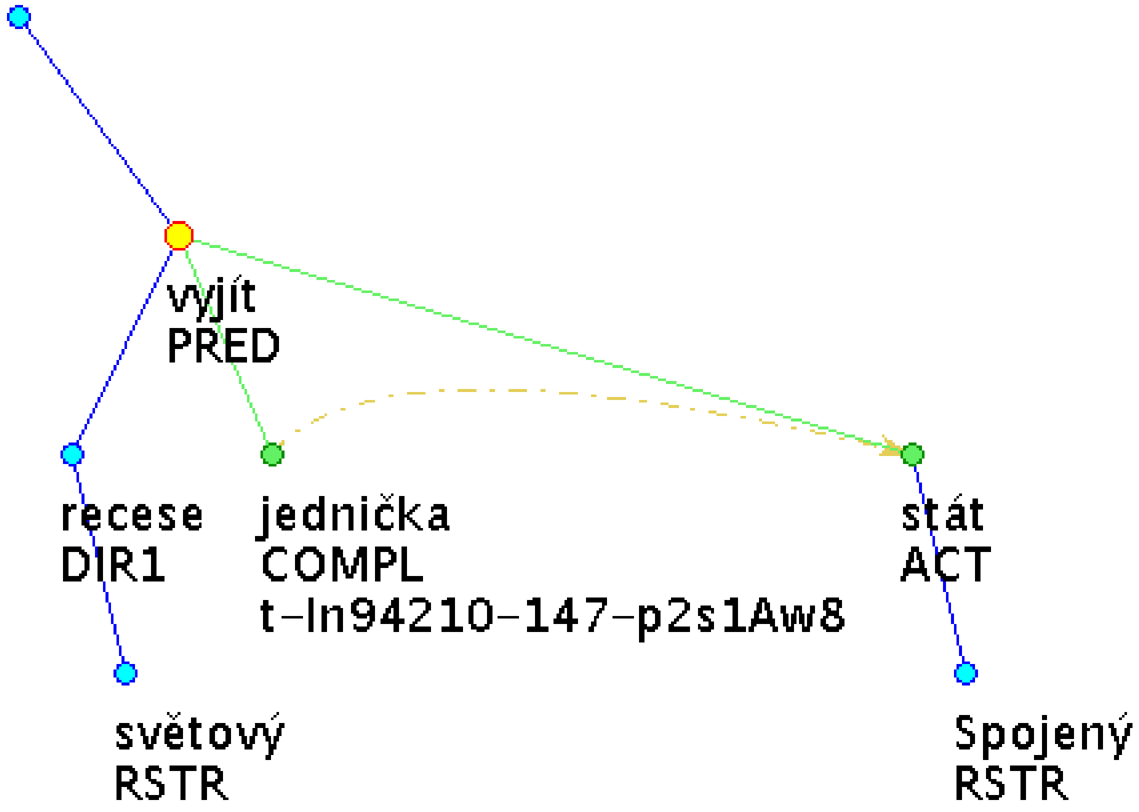
- to skip a node (etc. coordination, apposition)

- even better: to set a linguistic dependency

Linguistic Requirements
Predicative Complement

Czech: Ze světové recese vyšly jako jednička Spojené státy.

English: The United States emerged from the world recession as number one.



Linguistic Requirements
Predicative Complement

The dual dependency is represented by means of a **reference** to another node (attributes `compl.rf` and `id`). We need:

➡ to match values unknown at the time of creating the query

Linguistic Requirements *...other phenomena*

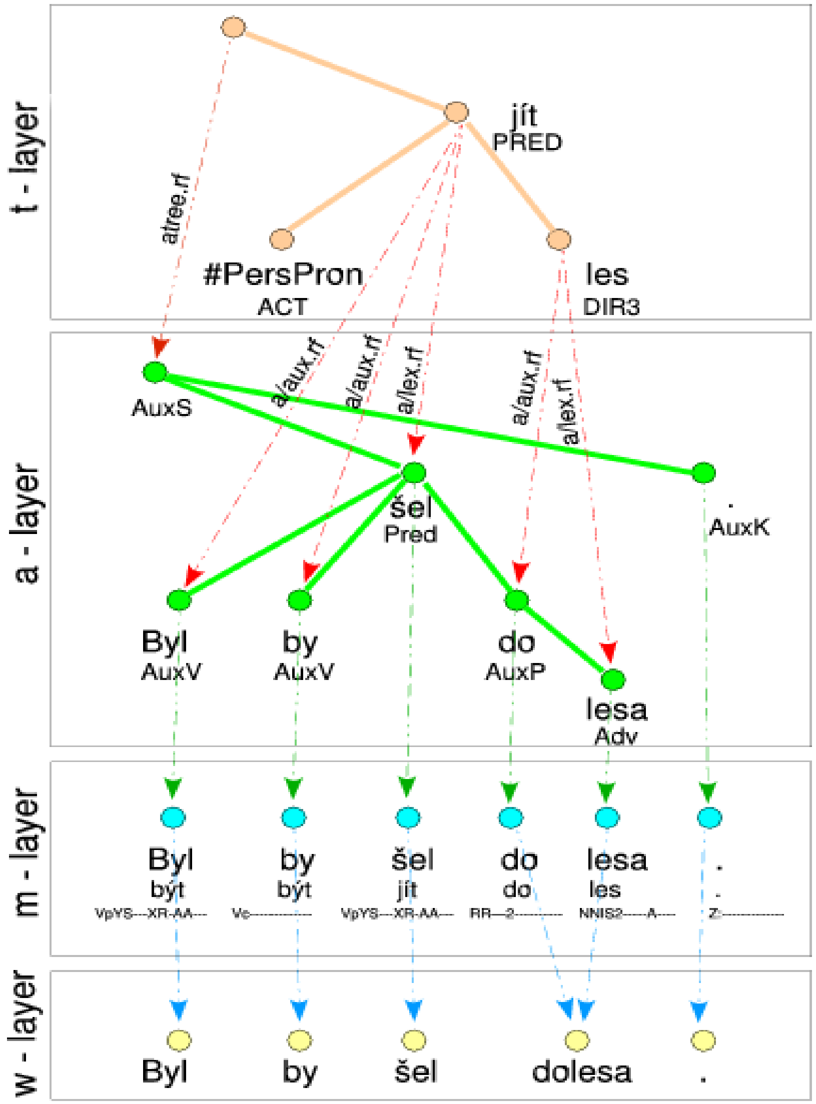
- *Topic – Focus, Focus proper* – combination of references, non-existence of a node and transitive closure of dependency; relation “<”
- *Rhematizers* – closest left son, closest left brother
- *(Non-)projectivity* – multiple-tree query to combine several one-tree queries representing different orientations of non-projective edges

Linguistic Requirements
...other phenomena

- *Idioms etc.* – searching in the linear form of the sentence (with regular expressions)
- *Agreement* – reference to only a part of a value of an attribute of another node (e.g. the fifth position of the morphological tag for case)
- *Word order* – measuring the horizontal distance between words

Linguistic Requirements

Layers in PDT 2.0



Linguistic Requirements
Accessing Lower Layers

Queries across the layers of annotation:

- A PATient expressed with a preposition k and a noun in the dative
- A PATient more dynamic than an ACTor but on the left side from it in the sentence

⇨ We need to have means of accessing the lower layers.

Linguistic Requirements
Summary

Evaluation of a node

- multiple attributes evaluation
- alternative values
- alternative nodes (alternative evaluation of the whole set of attributes)
- wild cards (regular expressions)
- negation, relations other than “equal to”

Linguistic Requirements
Summary

Dependencies between nodes
(vertical relations)

- direct, transitive (existence, non-existence)
- vertical distance (from root, from one another)
- number of sons (zero for leaves)

Linguistic Requirements
Summary

Horizontal relations

- precedence, immediate precedence
- negation of it
- horizontal distance

Secondary relations

- secondary dependencies, coreferences

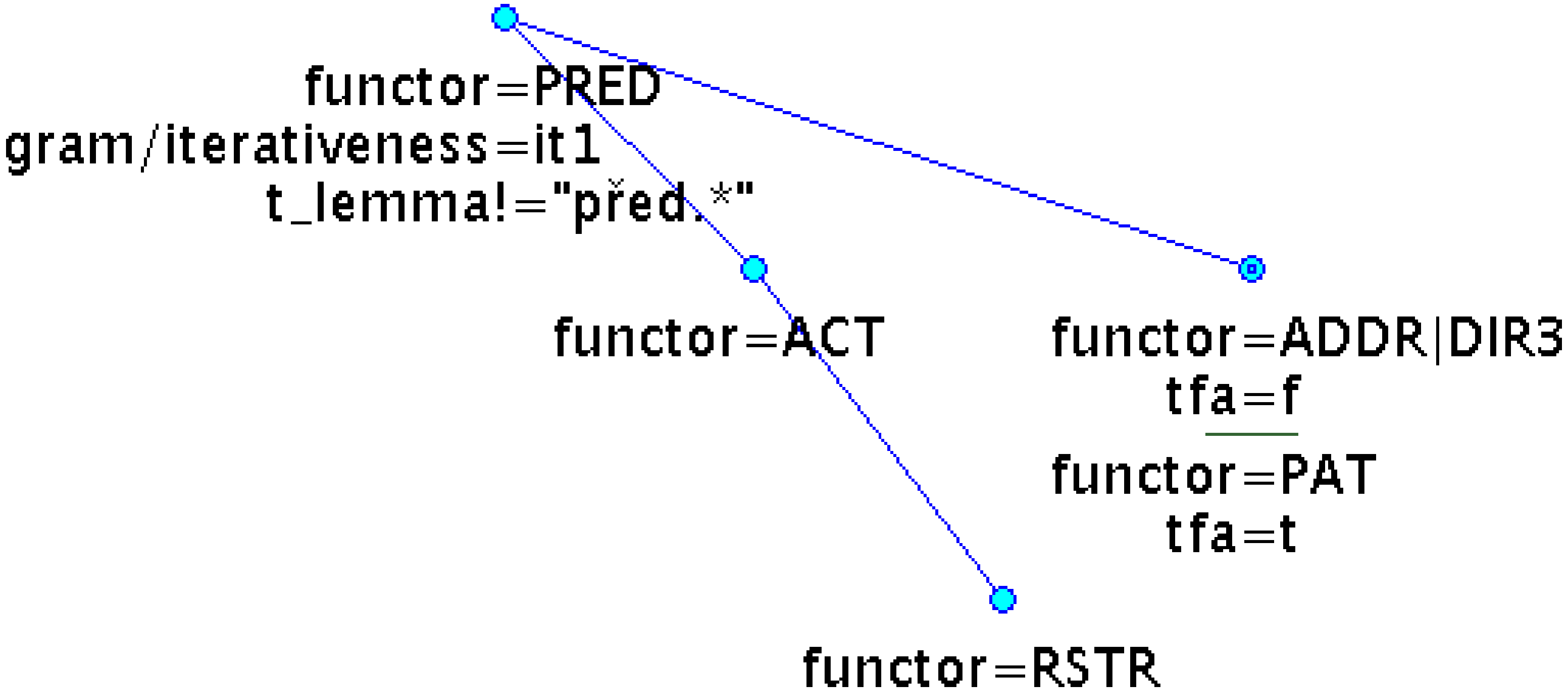
Linguistic Requirements
Summary

Other features

- multiple-tree queries
- accessing several layers of annotation at the same time
- searching in the linear form of the sentence

Netgraph Query Language

The Basics



functor=PRED
gram/iterativeness=it1
t_lemma!="před.*"

functor=ACT

functor=ADDR|DIR3
tfa=f

functor=PAT
tfa=t

functor=RSTR

Netgraph Query Language

Main additions to the query language of Netgraph 1.0:

- Meta-attributes
- References to attributes of other nodes
- Multi-tree queries
- Hidden nodes for a multilayer access

Netgraph Query Language
Meta-Attributes

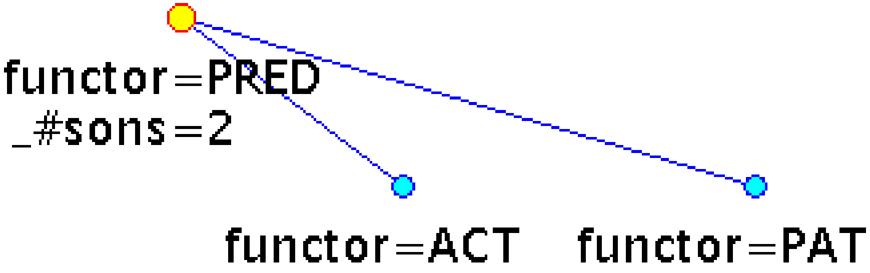
Attributes not present in the corpus,
treated like normal attributes:

- **_transitive** *(transitive edge)*
- **_optional** *(optional node(s))*
- **_#sons** *(number of sons)*
- **_#hsons** *(number of hidden sons)*
- **_#descendants** *(number of nodes in the subtree)*

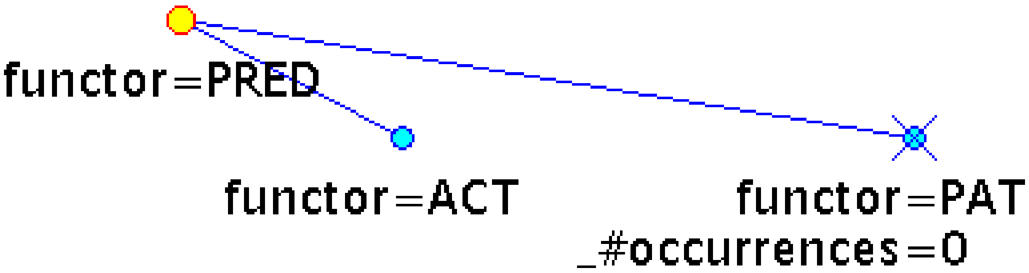
Netgraph Query Language
Meta-Attributes

- **_#lbrothers** *(number of left brothers)*
- **_#rbrothers** *(number of right brothers)*
- **_depth** *(distance from the root)*
- **_#occurrences** *(exact number of a particular type of sons/descendants)*
- ***_name*** *(label of a node for references)*
- ***_sentence*** *(linear form of the sentence)*

Using the Query Language
Valency

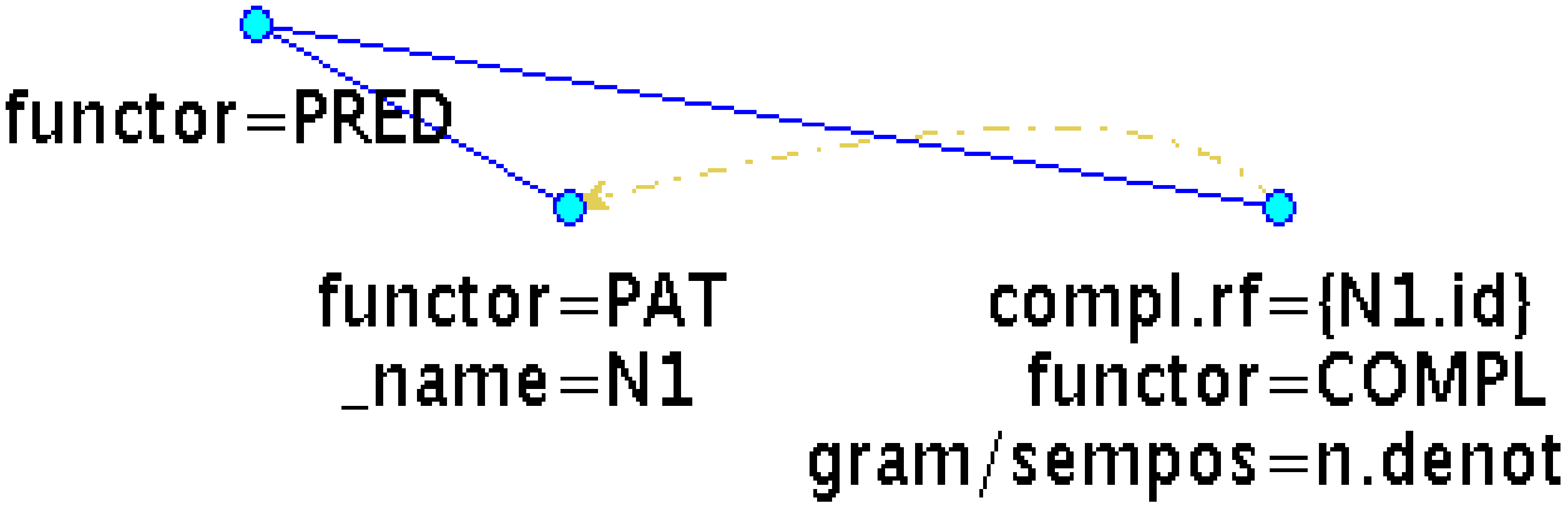


one ACTor, one PATient,
no other sons



at least one son (ACTor),
no PATient

Using the Query Language
Predicative Complement



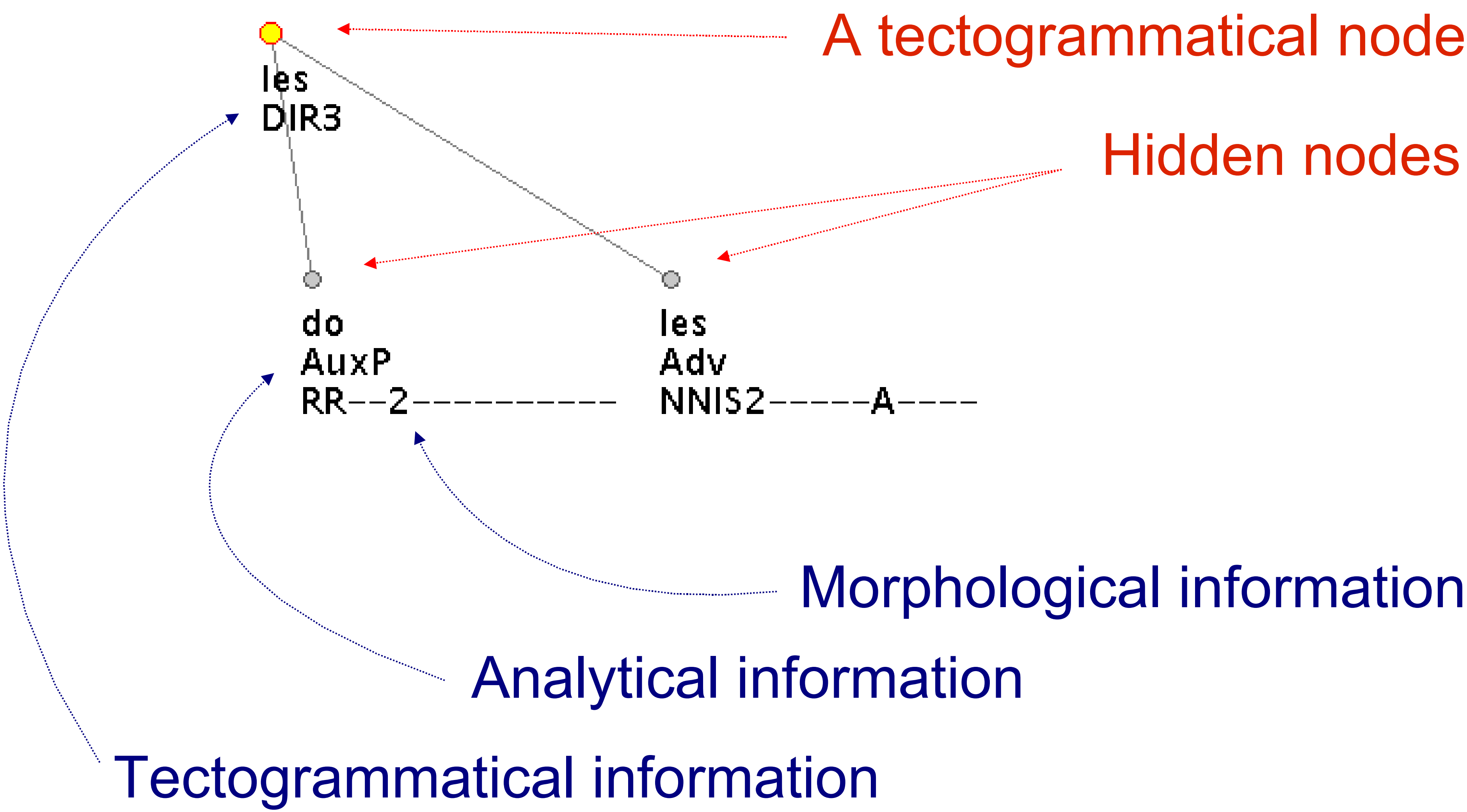
functor=PRED

functor=PAT
_name=N1

compl.rf={N1.id}
functor=COMPL
gram/sempos=n.denot

- a nominal predicative COMPLement with second dependency on a PATient

Netgraph Query Language
Hidden Nodes



A tectogrammatical node

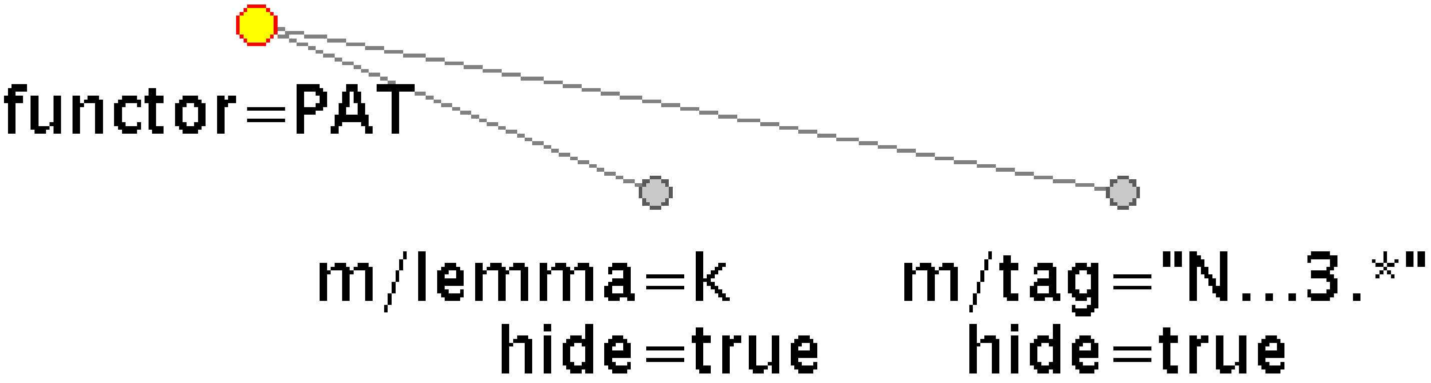
Hidden nodes

Morphological information

Analytical information

Tectogrammatical information

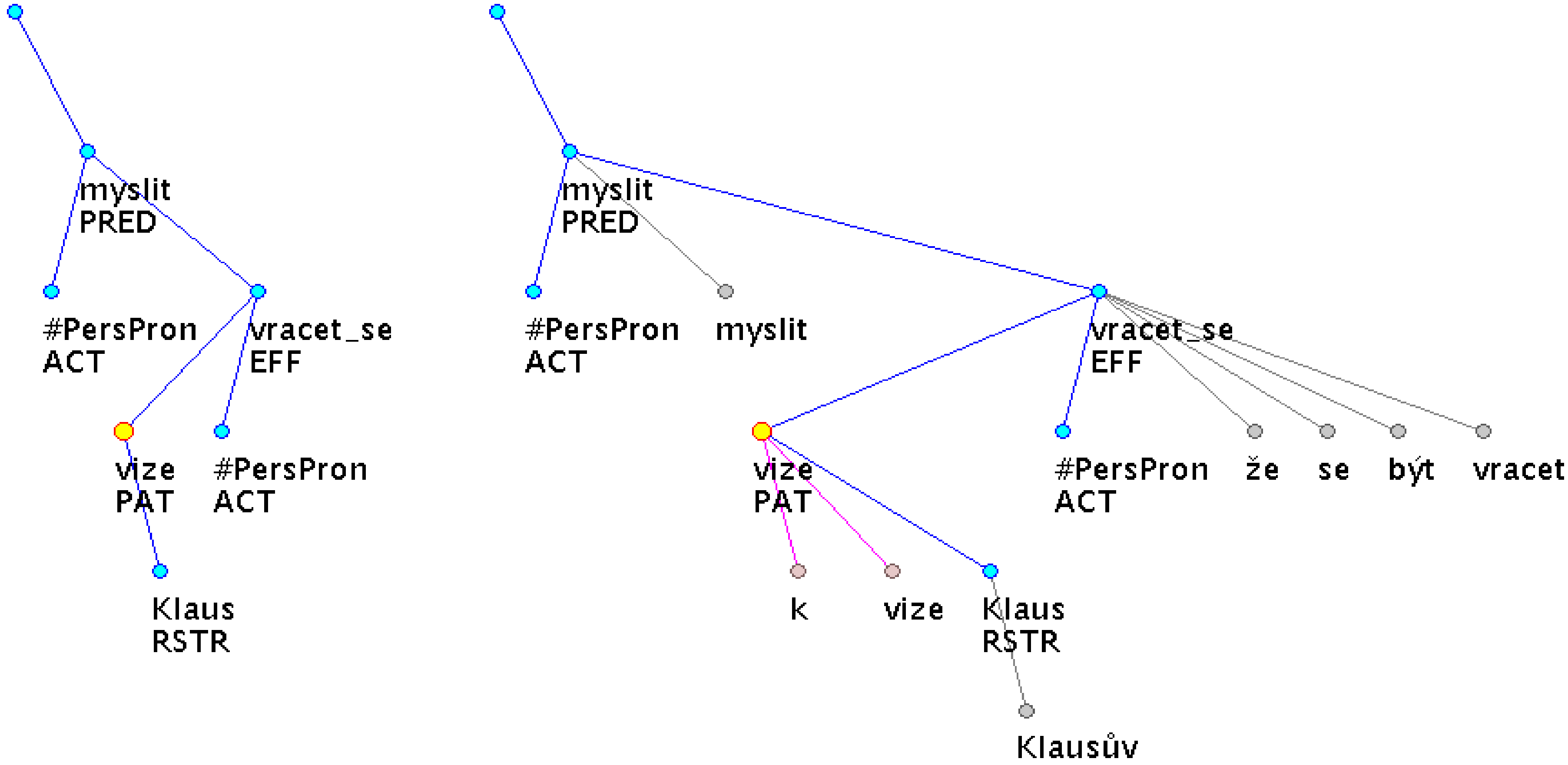
Using the Query Language
Hidden Nodes – A Query



- a PATient expressed with a preposition k and a noun ("N...3.*") in the dative ("N...3.*")

Using the Query Language
Hidden Nodes – A Result Tree

Czech: Myslím, že ke Klausově vizi se budeme vracet.
English: I think that we will get back to Klaus's vision.



Comparison to Other Tools

A detailed comparison to the query languages of the three following search tools has been done:

- Netgraph > TGrep (Pito 1994)
- Netgraph ~ TGrep2 (Rohde 2005)
- Netgraph ~ TigerSearch (Brants et al. 2002)

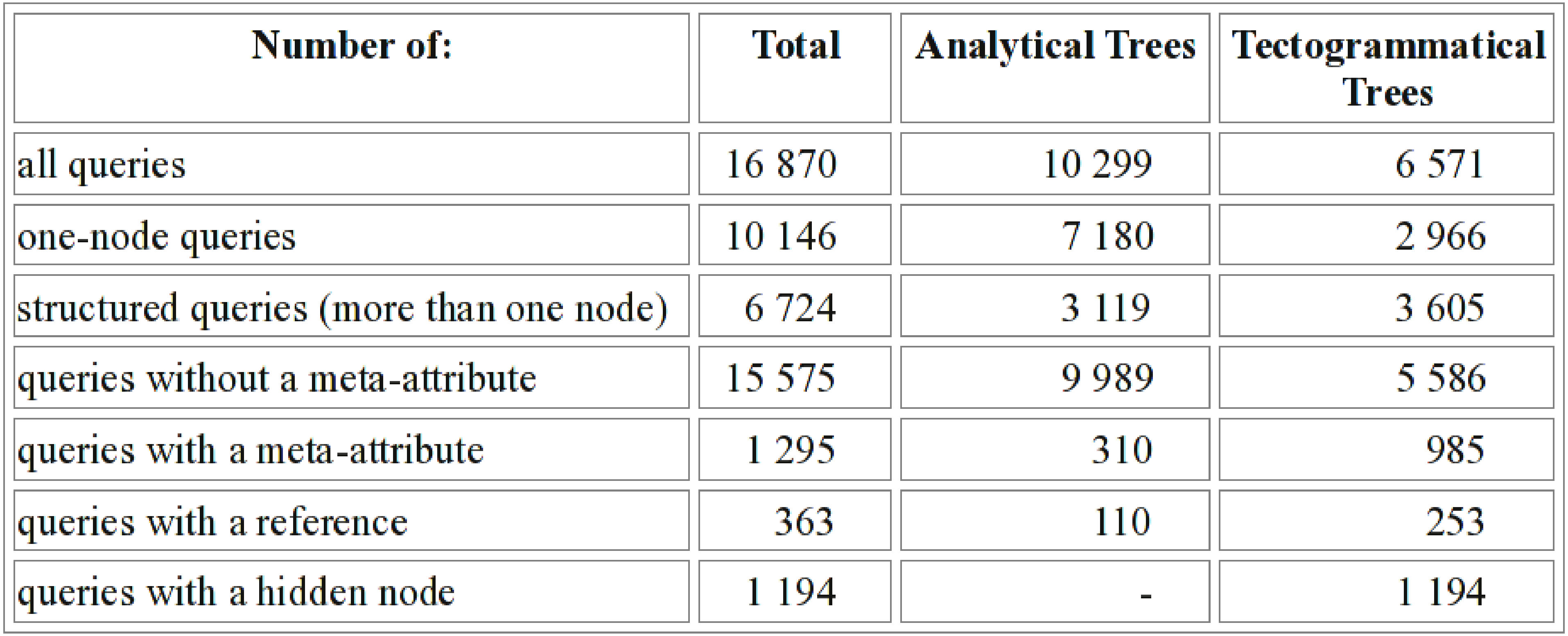
Netgraph As a Tool

Main extensions to the tool since version 1.0:

- Graphical creation of the query
- Chained queries
- Inverted matching
- Displaying context trees
- Removing trees from the result

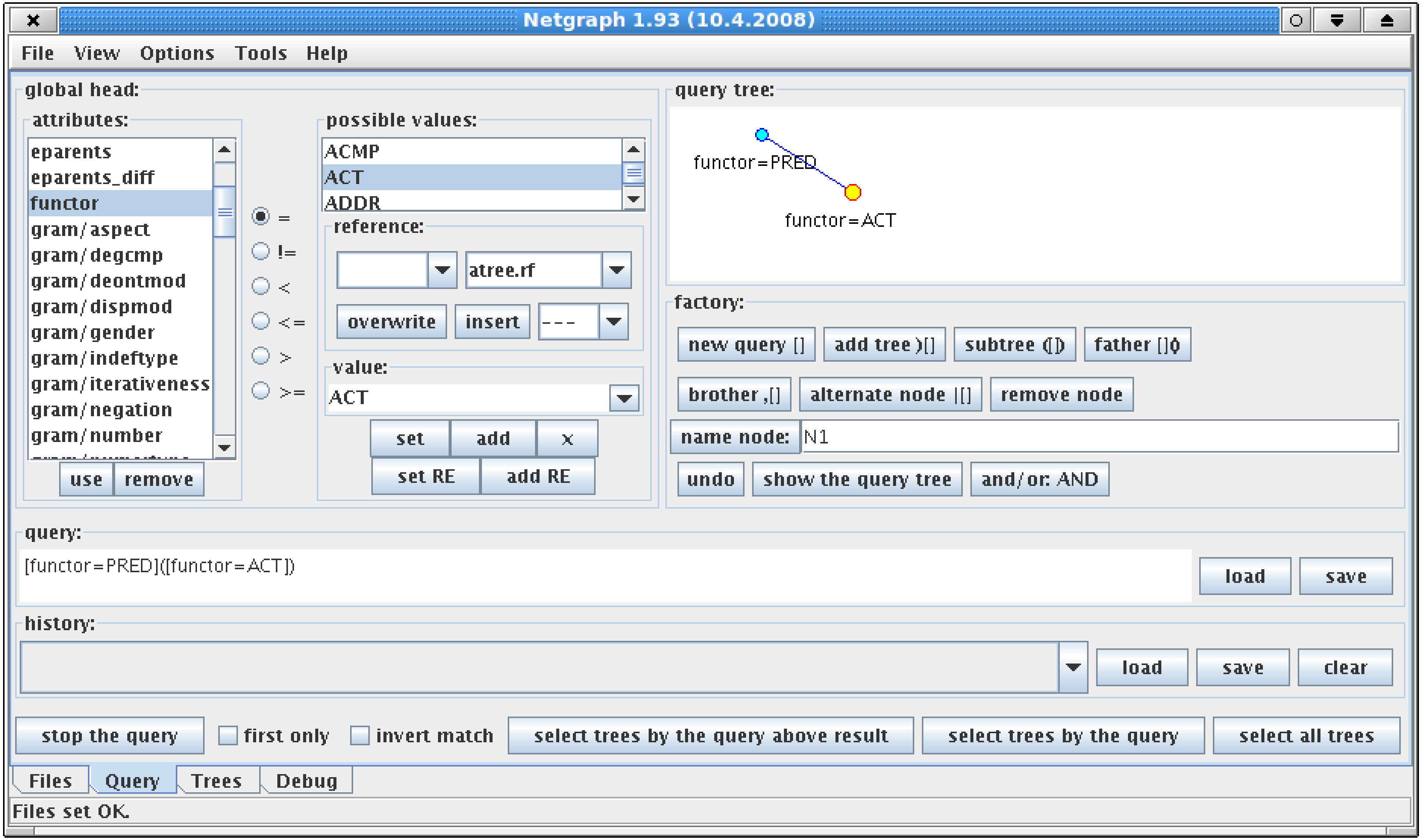
Usage of the Query Language

Analytical trees: October 2002 – March 2008
Tectogrammatical trees: February 2005 – March 2008



Number of:	Total	Analytical Trees	Tectogrammatical Trees
all queries	16 870	10 299	6 571
one-node queries	10 146	7 180	2 966
structured queries (more than one node)	6 724	3 119	3 605
queries without a meta-attribute	15 575	9 989	5 586
queries with a meta-attribute	1 295	310	985
queries with a reference	363	110	253
queries with a hidden node	1 194	-	1 194

Netgraph 1.93



Netgraph 1.93 (10.4.2008)

global head:

attributes: functor

possible values: ACT

● =

reference: atree.rf

value: ACT

query tree:

functor=PRED

functor=ACT

name node: N1

and/or: AND

query:

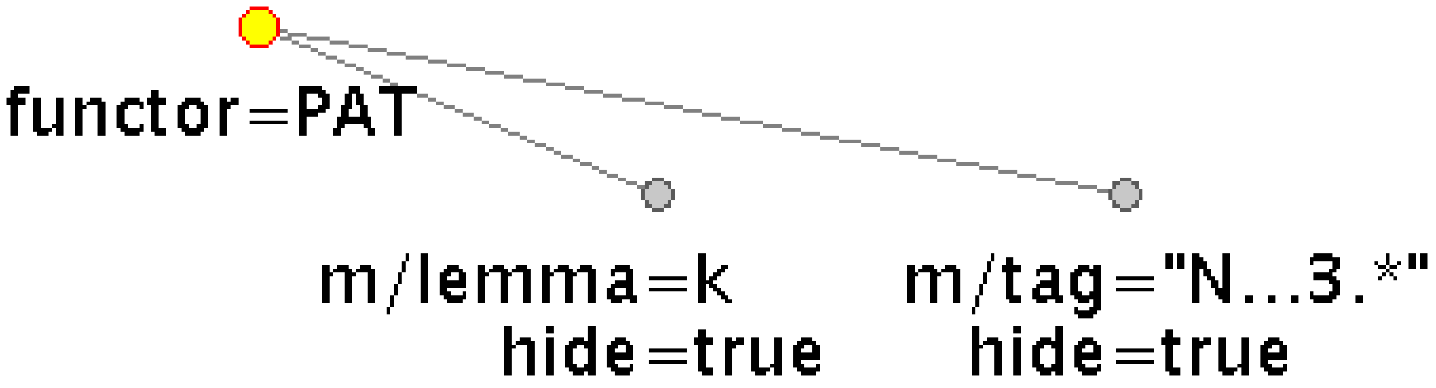
[functor=PRED]([functor=ACT])

history:

☐ first only ☐ invert match

Files set OK.

Using the Query Language
Hidden Nodes – A Query



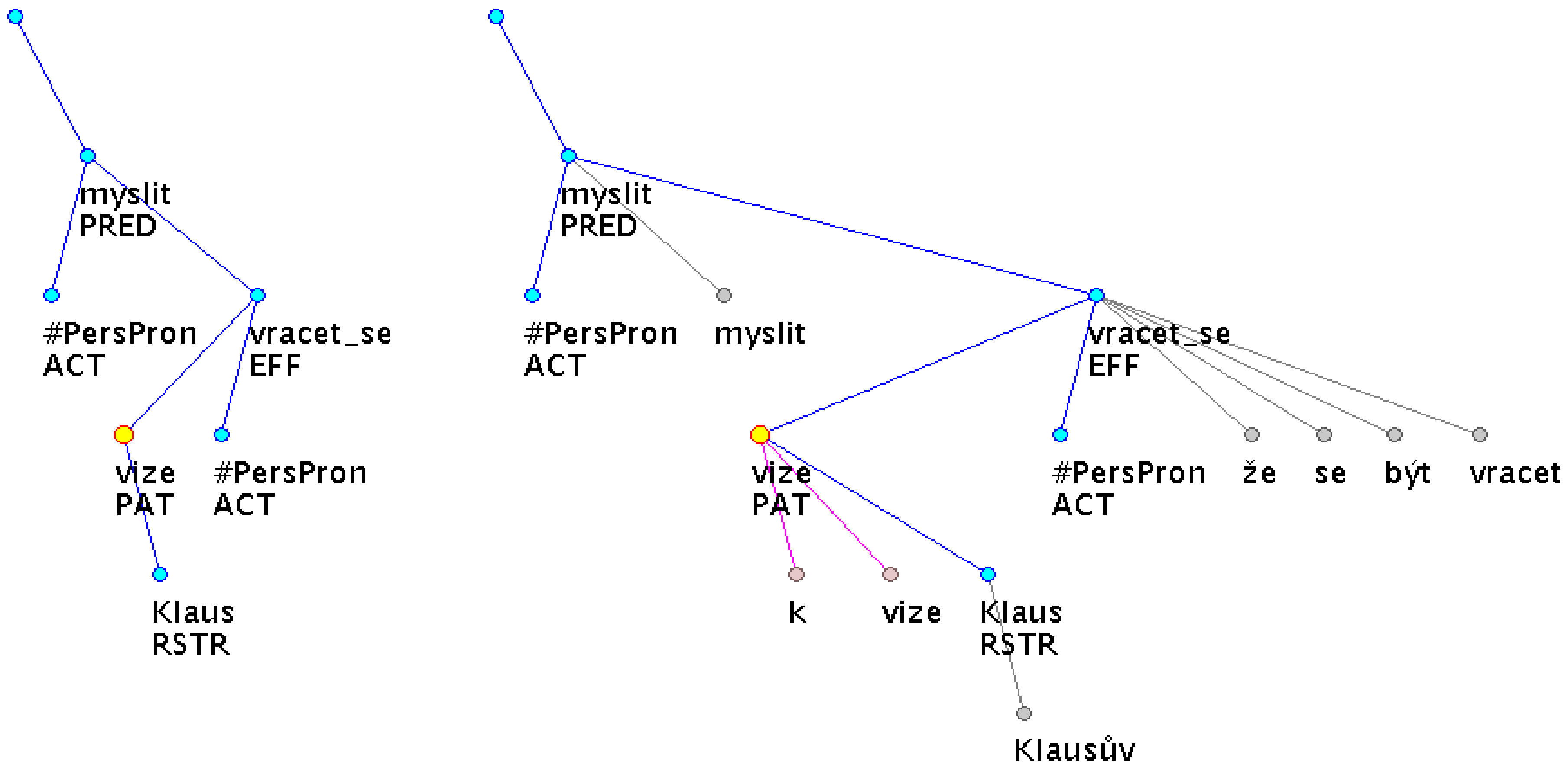
functor=PAT

m/lemma=k
hide=true

m/tag="N...3.*"
hide=true

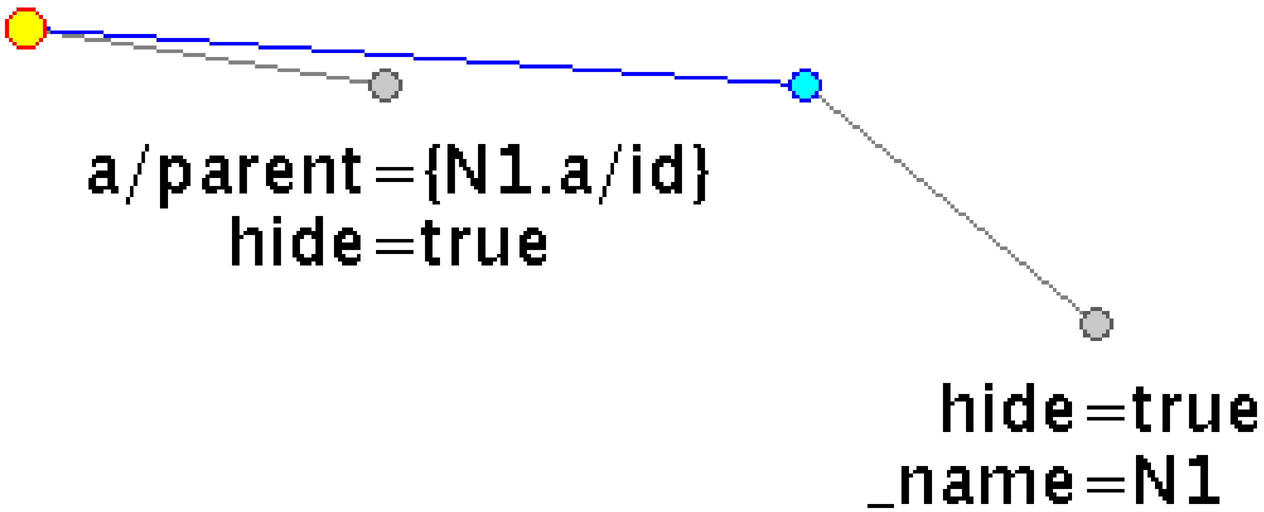
- a PATient expressed with a preposition k and a noun ("N...3.*") in the dative ("N...3.*")

Using the Query Language
Hidden Nodes – A Result Tree



Using the Query Language

Hidden Nodes – A Query



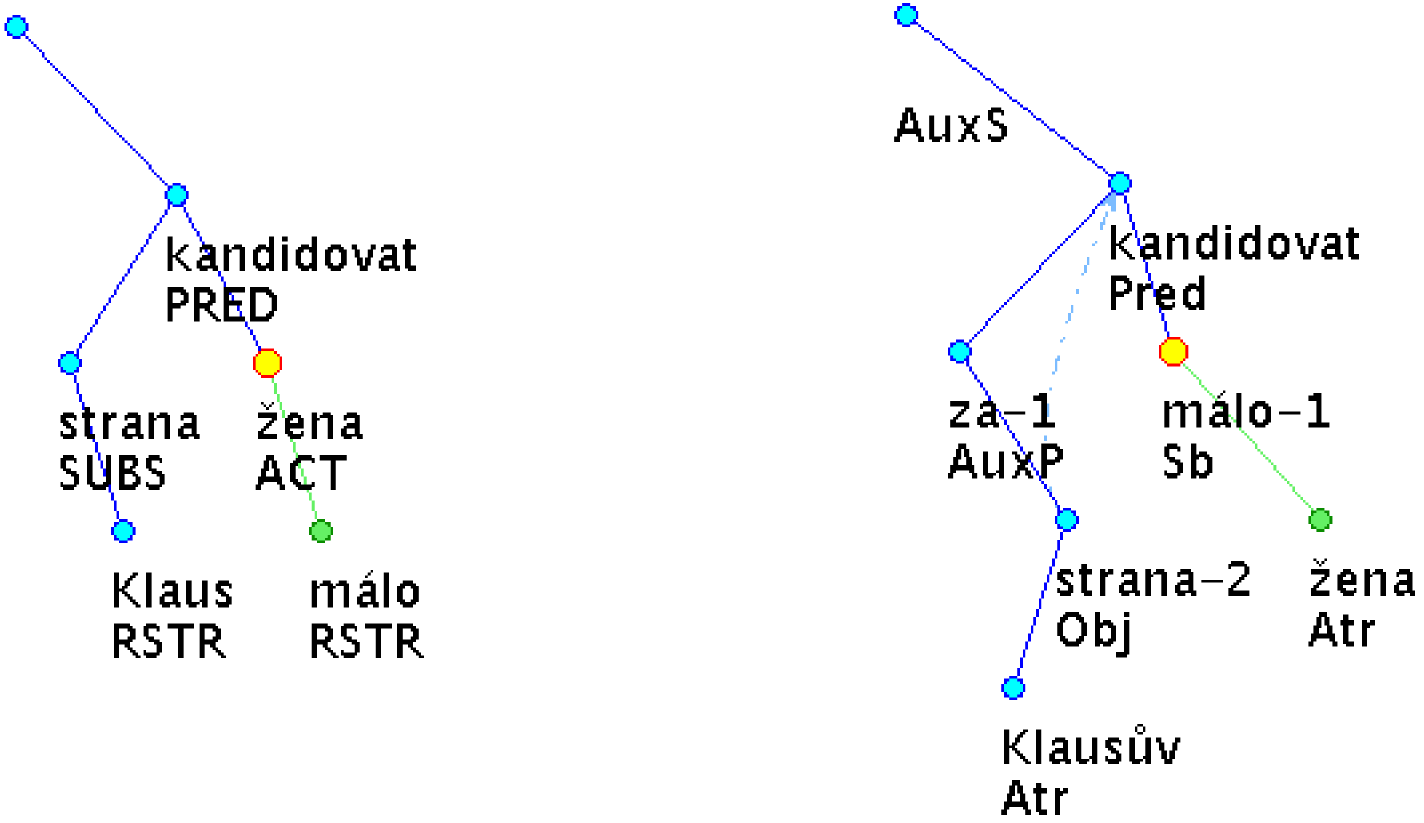
a/parent={N1.a/id}
hide=true

hide=true
_name=N1

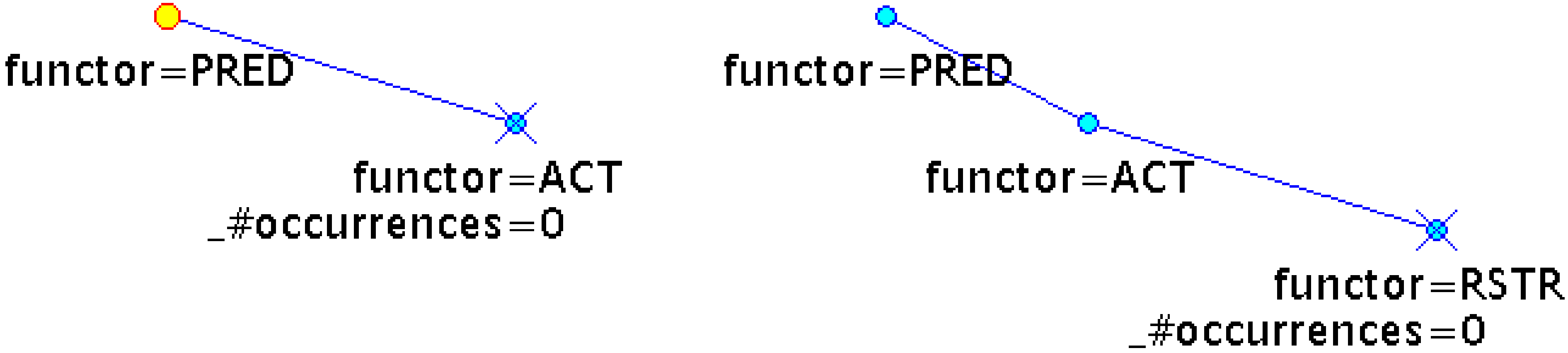
- an opposite dependency on the different layers

Using the Query Language

Hidden Nodes – A Result Tree

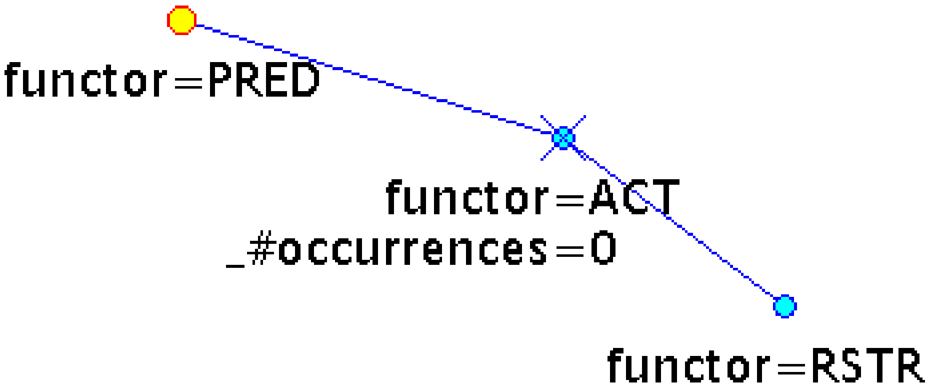


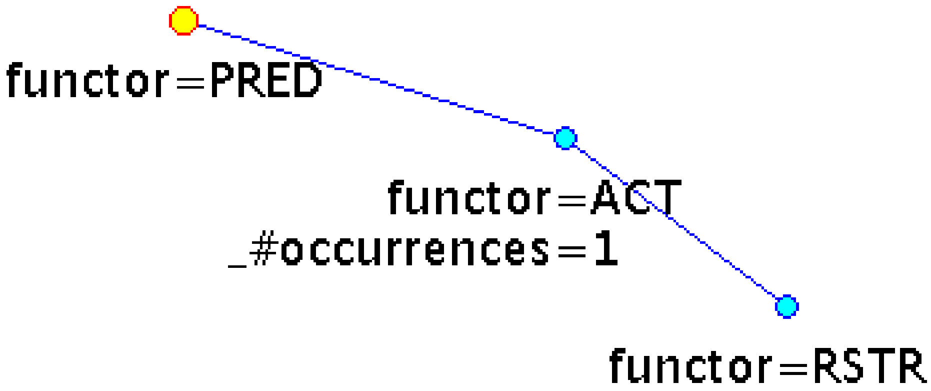
Improvements to the Query Language
Structured Negation Today



- a PREDicate that does not govern
an ACTor that governs a RSTR
(a multi-tree query with relation AND)

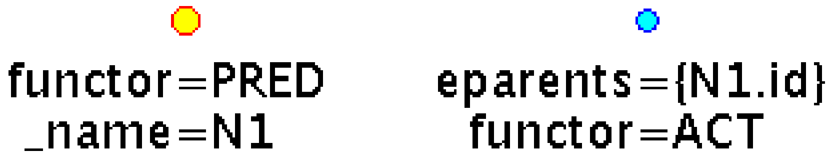
Improvements to the Query Language
Structured Negation – a Possible Future





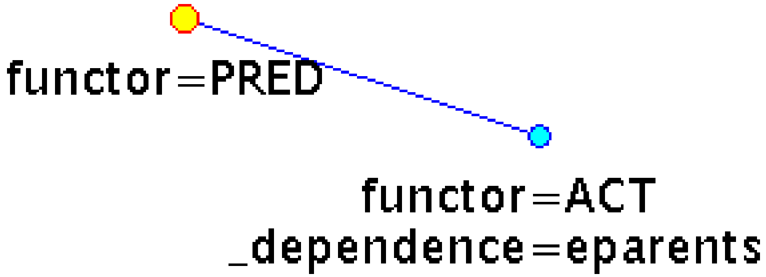
- unclear meaning of the second query

Improvements to the Query Language
Changing the Meaning of the Dependency



functor=PRED
_name=N1

eparents={N1.id}
functor=ACT

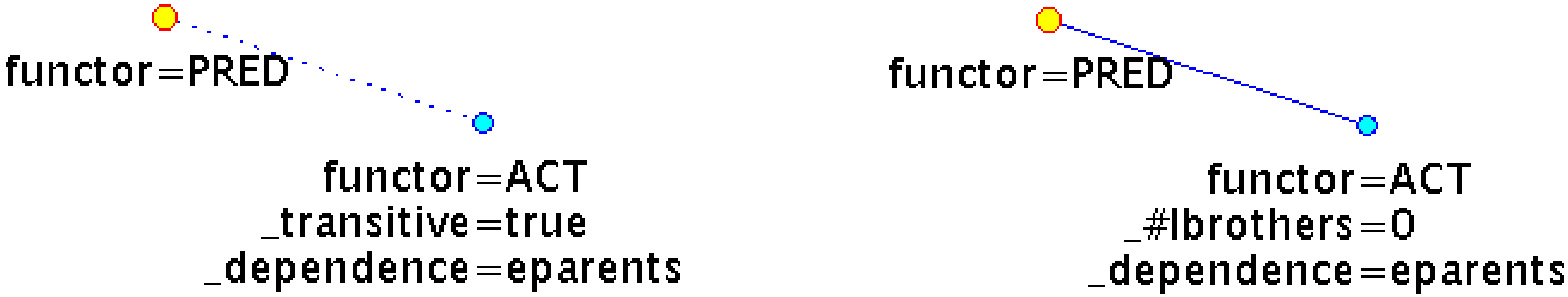


functor=PRED

functor=ACT
_dependence=eparents

- a new meta-attribute _dependence might change the meaning of the dependency

Improvements to the Query Language
Changing the Meaning of the Dependency



- combinations of meta-attributes have to be carefully thought over