Treebanks –
Formats, Tools and Usages

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First Treebank Course

in March 2004 sponsored by NorFa's Nordic Treebank Network

- Participants from
  - Danmark
  - Estonia
  - Finland
  - Iceland
  - Norway
  - Sweden

Course Overview

- The program / how to get credit points
- Goal: By the end of the course you should know
  - some important treebanks (and treebank projects)
  - some treebank representation formats
  - the reasons for building treebanks
  - some tools for building and searching treebanks
  - how to train and evaluate a parser on a treebank

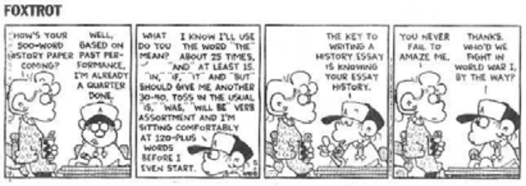
What is a Treebank?

- A Treebank is a corpus with linguistic annotation beyond the word level. The annotation is typically
  - a syntax tree and
  - manually checked and corrected.
- Not a treebank:
  - A corpus with manually checked PoS labels only.
  - An automatically parsed corpus.

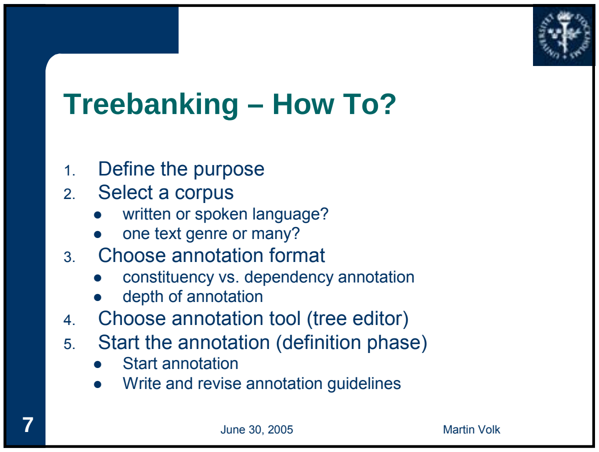
Why Treebanking?

- Providing training material for Machine Learning → NLP systems
- Building Gold Standards for the evaluation of NLP systems.
- Advocating linguistic empiricism against 'other' linguistic theories.
- Providing material for human grammar exploration and learning.

Linguistic empiricism

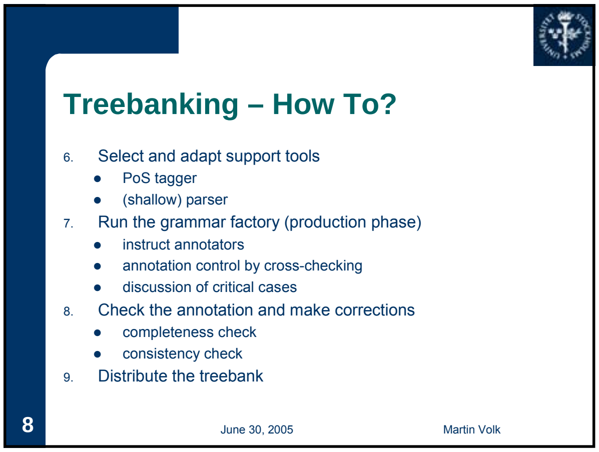

FOXTROT
HOW'S YOUR 500-WORD HISTORY PAPER COMING?
WELL, BASED ON PAST PERFORMANCE, I'M ALREADY A QUARTER DONE.
WHAT DO YOU MEAN?
I KNOW I'LL USE THE WORD "THE" ABOUT 25 TIMES. "AND" AT LEAST 15. "IN," "IF," "IT" AND "BUT" SHOULD GIVE ME ANOTHER 30-40. TOSS IN THE USUAL "IS," "WAS," "WILL BE" VERB ASSORTMENT AND I'M SITTING COMFORTABLY AT 120-PLUS WORDS BEFORE I EVEN START.
THE KEY TO WRITING A HISTORY ESSAY IS KNOWING YOUR ESSAY HISTORY.
YOU NEVER FAIL TO AMAZE ME.
THANKS. WHO'D WE FIGHT IN WORLD WAR I, BY THE WAY?

[Cartoon found by Gerold Schneider, Zurich]



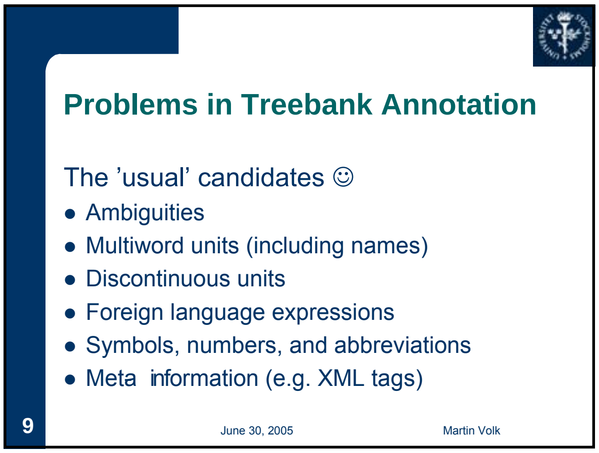
Treebanking – How To?

1. Define the purpose
2. Select a corpus
   - written or spoken language?
   - one text genre or many?
3. Choose annotation format
   - constituency vs. dependency annotation
   - depth of annotation
4. Choose annotation tool (tree editor)
5. Start the annotation (definition phase)
   - Start annotation
   - Write and revise annotation guidelines



Treebanking – How To?

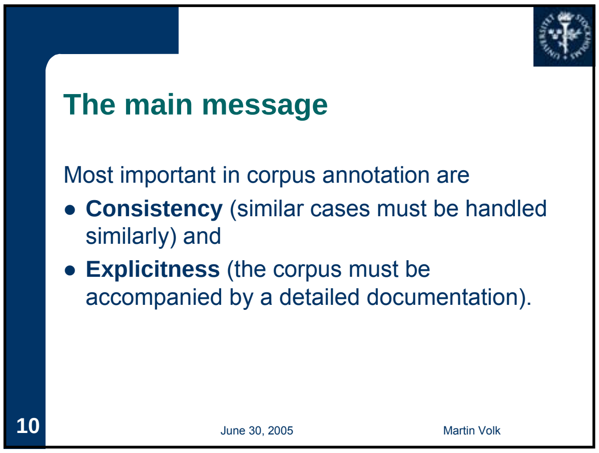
6. Select and adapt support tools
   - PoS tagger
   - (shallow) parser
7. Run the grammar factory (production phase)
   - instruct annotators
   - annotation control by cross-checking
   - discussion of critical cases
8. Check the annotation and make corrections
   - completeness check
   - consistency check
9. Distribute the treebank



Problems in Treebank Annotation

The ’usual’ candidates ☺

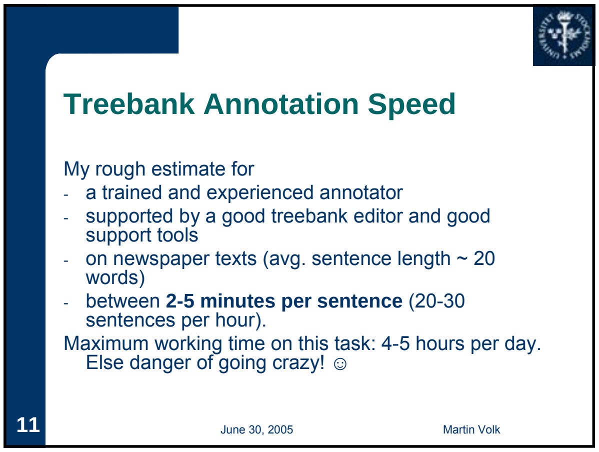
- Ambiguities
- Multiword units (including names)
- Discontinuous units
- Foreign language expressions
- Symbols, numbers, and abbreviations
- Meta information (e.g. XML tags)



The main message

Most important in corpus annotation are

- **Consistency** (similar cases must be handled similarly) and
- **Explicitness** (the corpus must be accompanied by a detailed documentation).

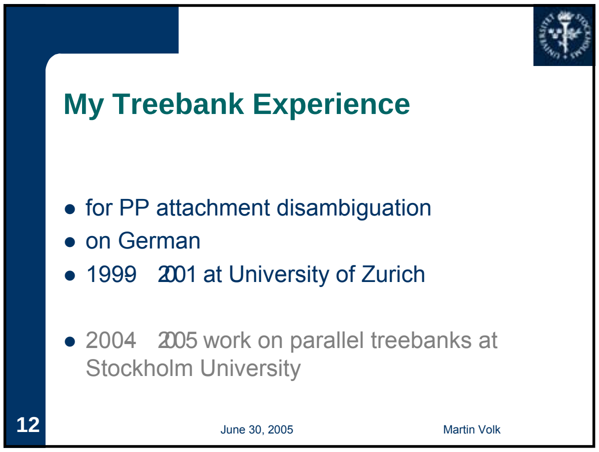


Treebank Annotation Speed

My rough estimate for

- a trained and experienced annotator
- supported by a good treebank editor and good support tools
- on newspaper texts (avg. sentence length ~ 20 words)
- between **2-5 minutes per sentence** (20-30 sentences per hour).

Maximum working time on this task: 4-5 hours per day. Else danger of going crazy! ☺

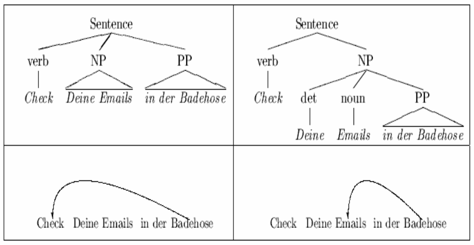


My Treebank Experience

- for PP attachment disambiguation
- on German
- 1999 2001 at University of Zurich

- 2004 2005 work on parallel treebanks at Stockholm University

PP Attachment Disambiguation



Example of Cooccurrence Measure

*For: **Check deine Emails in der Badehose***

freq(*Emails, in*) = 50

freq(*Emails*) = 10'000

→cooc(*Emails, in*) = 0.005

freq(*check, in*) = 15

freq(*check*) = 1'000

→cooc(*check, in*) = 0.015

Training Corpus

Annotate a 6 million words computer journal corpus (raw text) through

1. Proper name recognition
2. PoS-Tagging
3. Lemmatisation
4. NP/PP chunking
5. Clause boundary detection

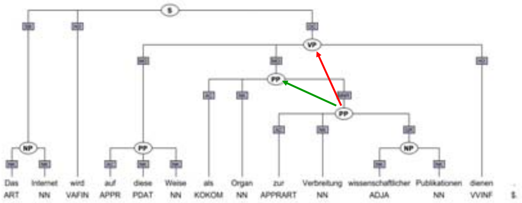
→ Learn cooc(noun,prep) and
cooc(verb,prep)

Evaluation Corpus

The CZ Treebank

- 3000 **manually** annotated German sentences with PPs in ambiguous positions
- from the 1996 ComputerZeitung (CZ)
- annotated at the University of Zurich in 1999
- following the NEGRA guidelines

Sentence with an 'ambiguous' PP

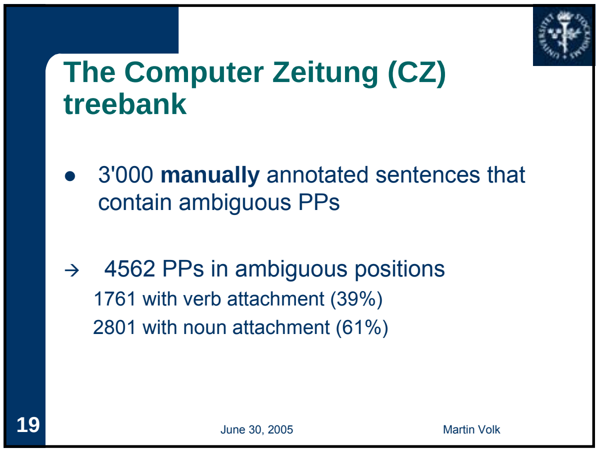


Extraction of 5-tuples from treebank sentences

Sentence:

… als (***Organ (zur Verbreitung (****wiss. Publikationen****))) dienen***

1.	Verb:	*dienen*
2.	Reference noun N1:	*Organ*
3.	Preposition:	*zur*
4.	PP noun N2:	*Verbreitung*
5.	Function:	noun attachment



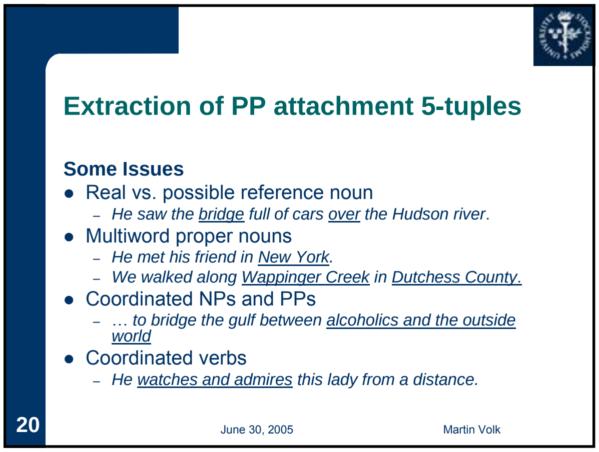
The Computer Zeitung (CZ) treebank

- 3'000 **manually** annotated sentences that contain ambiguous PPs

→ 4562 PPs in ambiguous positions

1761 with verb attachment (39%)

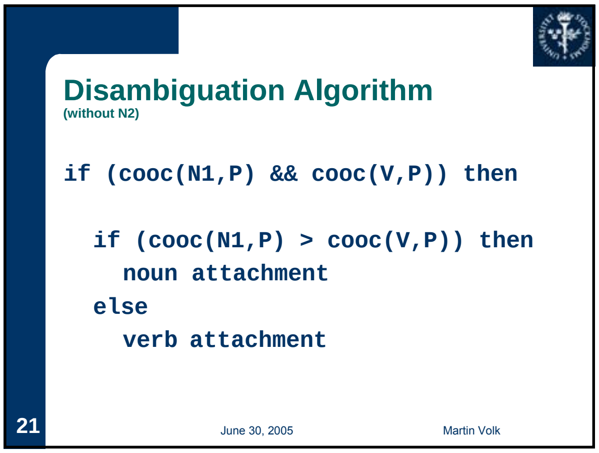
2801 with noun attachment (61%)



Extraction of PP attachment 5-tuples

Some Issues

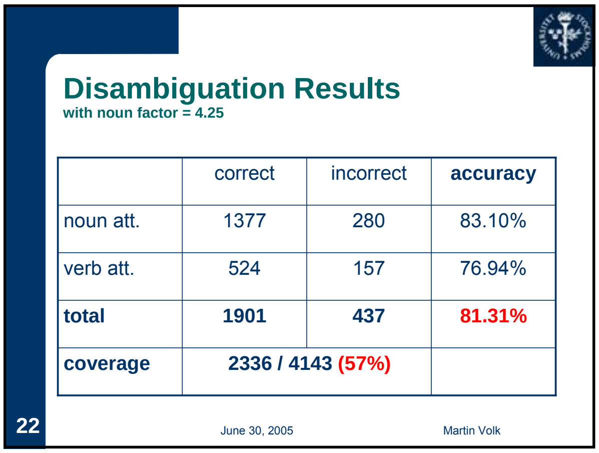
- Real vs. possible reference noun
  - *He saw the <u>bridge</u> full of cars <u>over</u> the Hudson river.*
- Multiword proper nouns
  - *He met his friend in <u>New York</u>.*
  - *We walked along <u>Wappinger Creek</u> in <u>Dutchess County</u>.*
- Coordinated NPs and PPs
  - *… to bridge the gulf between <u>alcoholics and the outside world</u>*
- Coordinated verbs
  - *He <u>watches and admires</u> this lady from a distance.*



Disambiguation Algorithm

(without N2)

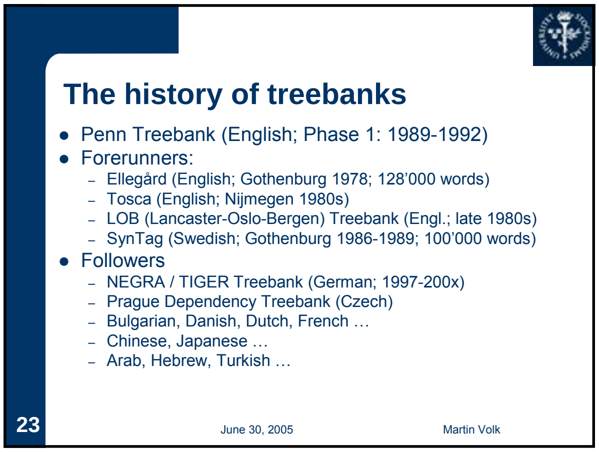
```
if (cooc(N1,P) && cooc(V,P)) then

  if (cooc(N1,P) > cooc(V,P)) then
    noun attachment
  else
    verb attachment
```



Disambiguation Results

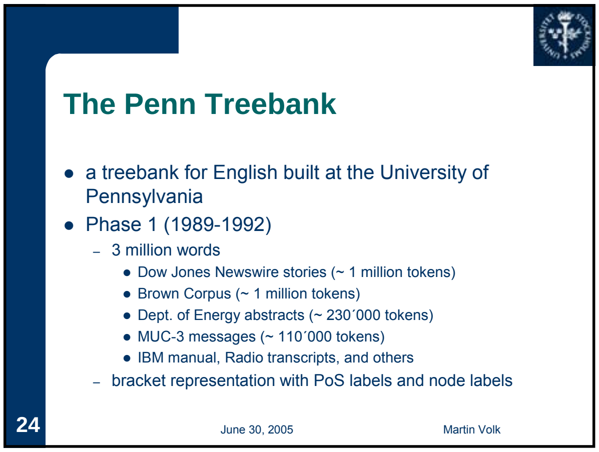
with noun factor = 4.25

	correct	incorrect	**accuracy**
noun att.	1377	280	83.10%
verb att.	524	157	76.94%
total	**1901**	**437**	**81.31%**
coverage	**2336 / 4143 (57%)**		



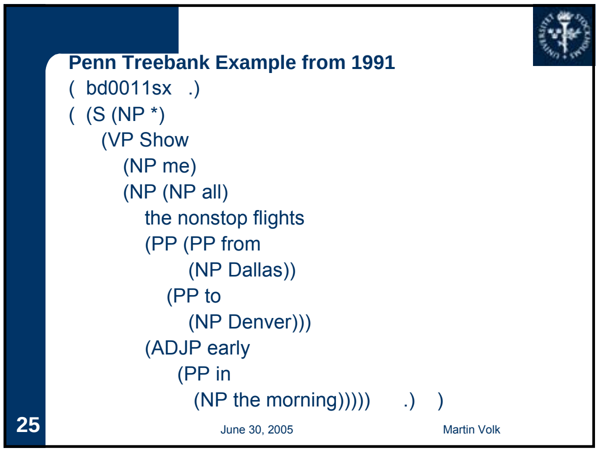
The history of treebanks

- Penn Treebank (English; Phase 1: 1989-1992)
- Forerunners:
  - Ellegård (English; Gothenburg 1978; 128'000 words)
  - Tosca (English; Nijmegen 1980s)
  - LOB (Lancaster-Oslo-Bergen) Treebank (Engl.; late 1980s)
  - SynTag (Swedish; Gothenburg 1986-1989; 100'000 words)
- Followers
  - NEGRA / TIGER Treebank (German; 1997-200x)
  - Prague Dependency Treebank (Czech)
  - Bulgarian, Danish, Dutch, French …
  - Chinese, Japanese …
  - Arab, Hebrew, Turkish …



The Penn Treebank

- a treebank for English built at the University of Pennsylvania
- Phase 1 (1989-1992)
  - 3 million words
    - Dow Jones Newswire stories (~ 1 million tokens)
    - Brown Corpus (~ 1 million tokens)
    - Dept. of Energy abstracts (~ 230´000 tokens)
    - MUC-3 messages (~ 110´000 tokens)
    - IBM manual, Radio transcripts, and others
  - bracket representation with PoS labels and node labels



Penn Treebank Example from 1991

```
( bd0011sx   .)
( (S (NP *)
     (VP Show
        (NP me)
        (NP (NP all)
           the nonstop flights
           (PP (PP from
                 (NP Dallas))
              (PP to
                 (NP Denver)))
           (ADJP early
              (PP in
                 (NP the morning)))))     .)   )
```

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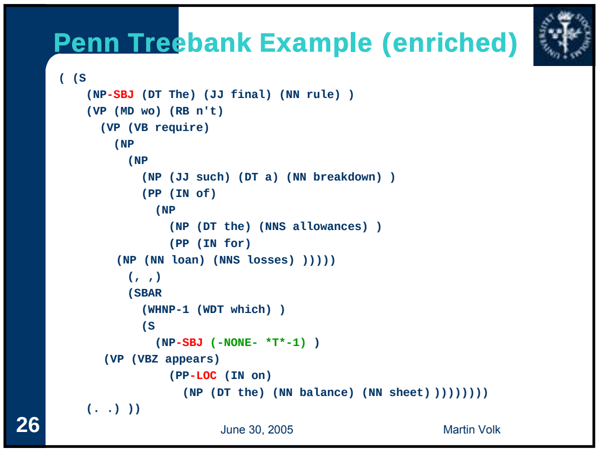

Penn Treebank Example (enriched)

```
( (S
    (NP-SBJ (DT The) (JJ final) (NN rule) )
    (VP (MD wo) (RB n't)
      (VP (VB require)
        (NP
          (NP
            (NP (JJ such) (DT a) (NN breakdown) )
            (PP (IN of)
              (NP
                (NP (DT the) (NNS allowances) )
                (PP (IN for)
       (NP (NN loan) (NNS losses) )))))
          (, ,)
          (SBAR
            (WHNP-1 (WDT which) )
            (S
              (NP-SBJ (-NONE- *T*-1) )
     (VP (VBZ appears)
                (PP-LOC (IN on)
                  (NP (DT the) (NN balance) (NN sheet) ))))))))
    (. .) ))
```

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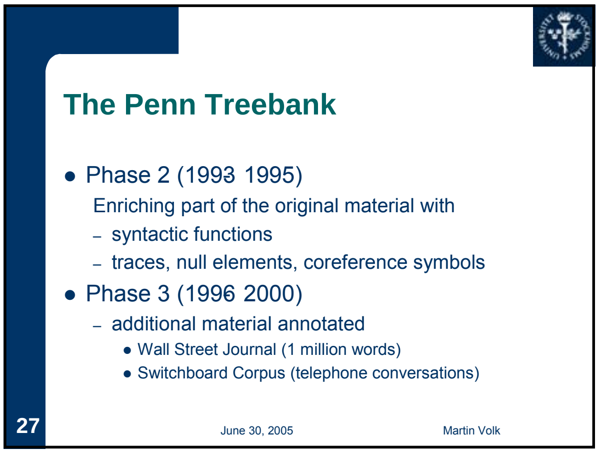

The Penn Treebank

- Phase 2 (1993 1995)

  Enriching part of the original material with
  - syntactic functions
  - traces, null elements, coreference symbols
- Phase 3 (1996 2000)
  - additional material annotated
    - Wall Street Journal (1 million words)
    - Switchboard Corpus (telephone conversations)

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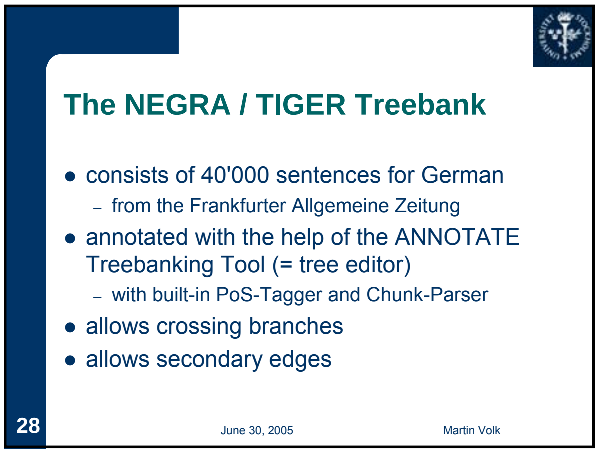

The NEGRA / TIGER Treebank

- consists of 40'000 sentences for German
  - from the Frankfurter Allgemeine Zeitung
- annotated with the help of the ANNOTATE Treebanking Tool (= tree editor)
  - with built-in PoS-Tagger and Chunk-Parser
- allows crossing branches
- allows secondary edges

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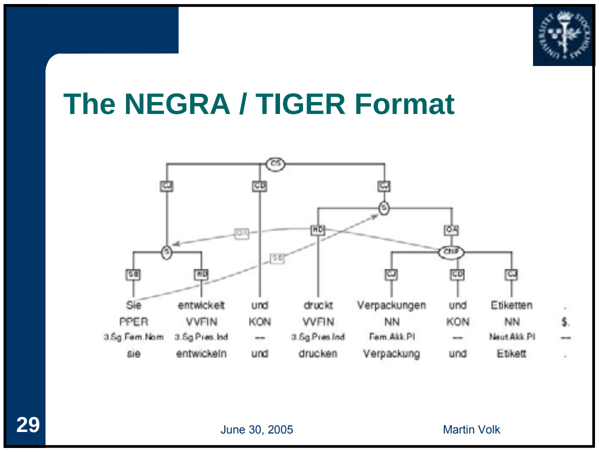

The NEGRA / TIGER Format

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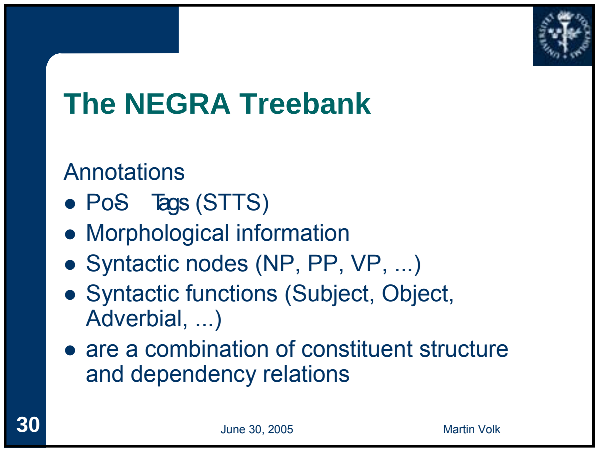

The NEGRA Treebank

Annotations

- PoS-Tags (STTS)
- Morphological information
- Syntactic nodes (NP, PP, VP, ...)
- Syntactic functions (Subject, Object, Adverbial, ...)
- are a combination of constituent structure and dependency relations

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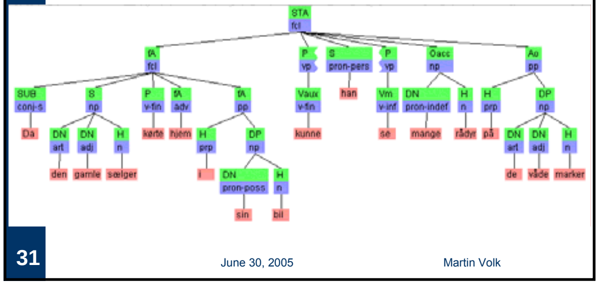
Constituent trees for Danish

from Eckhard Bick



Why Treebanking?

Treebanks are at the heart of the Machine Learning paradigm.

My believe: NLP will only make progress

1. if we can combine rule-based systems with machine learning, and
2. if we have standards for evaluation.

Summary

- Central to treebank building
  - Clear annotation guidelines
  - Good treebank editor and support tools
- The Penn Treebank has been the most influential in our field.
- Treebanks have been built for many languages in various formats.