May 3, 2004
Lexical rules in action,
MRS, open Q&A
Overview

- How the LKB applies lexical rules
- MRS: representations
- MRS: composition
- Time for Q&A
How the LKB applies lexical rules (1/3)

- When we write them, we think in terms of building an inflected word from a stem.
- When we write the lexicon, we provide stem forms.
- When we go to parse something, we hand the LKB fully inflected forms.
- How to reconcile this?
How the LKB applies lexical rules (2/3)

- Tokenize sentence into words
- Attempt to apply each spelling change rule to each word REGARDLESS OF MORPHOSYNTAX to produce stem froms.
  - Use spelling-change subrules to create stems.
  - Look up stems in lexicon.
  - If successful, record which rule was used.
- Enter stem forms (as complete feature structures) in the chart.
• Attempt to build further edges using lexical rules with stem forms as daughters.

• If the rules used for stemming aren’t used in building the form back up, produce an error.
How the LKB applies lexical rules (3/3)

- What happens if the stem isn’t in the lexicon?
- What happens if the spelling change rule isn’t written right?
- What happens if there is a feature path error or a non-existent type used in the lexical rule instance?
- What happens if the stem’s feature structure doesn’t unify with the DTR of the lexical rule?
Semantics: Scope

- Quantifiers (predicate logic or natural language) take three arguments:
  - A variable to bind
  - A restriction
  - A body

- Every dog sleeps: $\forall x \text{dog}(x) \text{sleep}(x)$

- When one quantifier appears within the restriction or body of another, we say the first has wider scope.
**MRS: Goals**

- Adequate representation of natural language semantics
- Grammatical compatibility
- Computational tractability
- Underspecifiability
- → For our purposes today: represent scopal relations in a flat structure.
Working towards MRS (1/4)

- Every big white horse sleeps.
- \( \text{every } (x, \land \text{big}(x), \land (\text{white}(x), \text{horse}(x))), \text{sleep}(x) \)
Working towards MRS (2/4)

\[ \text{every}(x) \land \text{sleep}(x) \]

\[ \text{big}(x), \text{white}(x), \text{horse}(x) \]

\[ \text{every}(x) \land \text{sleep}(x) \]
Working towards MRS (3/4)

- \(h_0: \text{every}(x)\)

- \(h_1\):
  - big(x)
  - white(x)
  - horse(x)

- \(h_2: \text{sleep}(x)\)

And finally:

- \(h_0: \text{every}(x, h_1, h_2), h_1: \text{big}(x), h_1: \text{white}(x), h_1: \text{horse}(x), h_2: \text{sleep}(x)\)
This is a flat representation, which is a good start.

Next we need to underspecify quantifier scope, and it’s easier to see why with multiple quantifiers.

At the same time, we want to be able to partially specify it, since this is required for adequate representations of NL semantics.
Every dog chases some white cat.

```
some(y)  
  white(y), cat(y)  every(x)  
    dog(x)  chase(x, y)  
      every(x)  
        dog(x)  some(y)  
          white(y), cat(y)  chase(x, y)
```
Underspecified quantifier scope (2/2)

- $h1$: every($x, h3, h4$), $h3$: dog($x$), $h7$: white($y$), $h7$: cat($y$),
  $h5$: some($y, h7, h1$), $h4$: chase($x, y$)

- $h1$: every($x, h3, h5$), $h3$: dog($x$), $h7$: white($y$), $h7$: cat($y$),
  $h5$: some($y, h7, h4$), $h4$: chase($x, y$)

- $h1$: every($x, h3, hA$), $h3$: dog($x$), $h7$: white($y$), $h7$: cat($y$),
  $h5$: some($y, h7, hB$), $h4$: chase($x, y$)
Partially constrained quantifier scope (1/4)

- For the BODY of quantifiers, we have no particular constraints to add.

- In turns out that the RESTRICTION needs to have partially underconstrained scope:
  - Every nephew of some famous politician runs.
  - every($x$,some($y$,famous($y$) ∧ politician($y$),
nephew($x,y$)) run($x$))
  - some($y$,famous($y$) ∧ politician($y$), every($x$, 
    newphew($x,y$),run($x$)))
  - But not:
• every($x$,run($x$)),some($y$,famous($y$) $\land$ polician($y$), nephew($x,y$))

• ‘Everyone who runs is a nephew of a famous politician.’
Partially constrained quantifier scope (2/4)

top

...  ...  ...

run(x)

every(x)  some(y)

...  ...  ...

nephew(x,y)  famous(y),politician(y)
Partially constrained quantifier scope (3/4)

```
  top
   ...
    ...
     probably
      ...
       ...
        chase(x,y)

  every(x)
   ...
    ...
     dog(x)
      ...
       ...
        ...

  some(y)
   ...
    ...
     white(y), cat(y)
      ...
       ...
        ...
```
Partially constrained quantifier scope (4/4)

- \langle h_0, \{ h_2 : \text{every}(x, h_3, h_4), h_5 : \text{nephew}(x, y), h_6 : \text{some}(y, h_7, h_8), h_9 : \text{politician}(y), h_9 : \text{famous}(y), h_{10} : \text{run}(x) \}, \{ h_1 \equiv_q h_{10}, h_7 \equiv_q h_9, h_3 \equiv_q h_5 \} \rangle

- \langle h_0, \{ h_1 : \text{every}(x, h_2, h_3), h_4 : \text{dog}(x), h_5 : \text{probably}(h_6), h_7 : \text{chase}(x, y), h_8 : \text{some}(y, h_9, h_{10}), h_{11} : \text{white}(y), h_{11} : \text{cat}(y) \}, \{ h_0 \equiv_q h_5, h_4 =_q h_6 =_q h_7, h_9 =_q h_{11} \} \rangle
MRS in feature structures

- HOOK, HCONS, RELS
- ARGn
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