Prooftheoretic methods in NLP

Mid-course test

January 30, 2001

Abstract

This quiz tests your understanding of the technical material covered in the first part of the course. You can use the course notes to answer the questions.

1 Basics

1.1

Below you find a Montague-style type assignment for the verb ‘needs’:

\[(np\langle s\rangle)/(s\langle np\rangle\langle s\rangle)\]

1. Give the formula decomposition tree, for input \((\cdot)^*\) polarity.
2. Establish an acyclic axiom link within this formula decomposition tree.
3. Give the formula decomposition tree for \((np\langle s\rangle\langle np\rangle)^*\).
4. Construct a (planar) proof net over these two formula decomposition trees.

1.2

Which of the following type transitions is valid in the Lambek calculus? Construct a proof net for it. Show which correctness criterion is violated in the case of the Lambek invalid type transition.

\[a. \quad (a/b)/c \Rightarrow a/(b \bullet c) \quad b. \quad (a/b)/c \Rightarrow a/(c \bullet b)\]
2 Proof nets and lambda terms

In this exercise we consider the following sequent:

\[
\text{Everybody needs somebody} \quad \xi/(\eta/s) \quad (\eta/s)/(\eta/\xi) \quad (\eta/\xi) \quad \Rightarrow \ \xi
\]

The sentence in question is three-ways ambiguous. You are asked to construct three proof nets for it, and compute the lambda terms that go with them, using the different formats we have discussed in class.

2.1

Build a proof net for a first reading, using the labeling method of §2.2.1. You can proceed as follows:

1. Make the formula decomposition trees for the formulas in the sequent above.
2. Label the input nodes (\forall, need, \exists for the terminal inputs, variables \(x, y, z, \ldots\) for hypothetical inputs); propagate the labeling using the rules of §2.2.1.
3. Present your axiom links in terms of the instantiations for the unknowns at the output literals.
4. Compute the label for the goal \(\xi\).

2.2

Compute a second reading using the dynamic graph method of §2.2.3. Number the axioms links in the order of traversal, and present the stepwise construction of the lambda term for this traversal.

2.3

Compute a third reading, this time displaying the dynamic graph in tree format, as in Exercise 6.

3 Proof nets for structured resources

In this exercise you are asked to build a proof net for the noun phrase below, using the algebra of structural labeling of §2.3.

\[
\text{ship which Zaphod stole} \quad n/(n/n)/(\eta/\xi) \quad \eta/(\eta/\xi) \quad \Rightarrow \ n
\]
3.1

The logic which recognizes the relative clause in question has the structural postulate below:

\[(P) \quad (A \bullet B) \bullet \Diamond C \rightarrow A \bullet (B \bullet \Diamond C)\]

Give the rewriting rule in the labeling algebra that corresponds to \((P)\).

3.2

Construct the labeled proof net following the method of Exercises 7 and 8, and show that the structural label for the goal \(n\) rewrites to the normal label

\[\text{ship} \circ (\text{which} \circ (Zaphod \circ \text{stole}))\]

\textbf{Sucess!}