## Towards Logical Syntactic Structures as Graphs

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- 1. Logical grammar reduces grammaticality to provability in a categorial logic.
- 2. Consequently, a) Parsing is deduction; and b) Syntactic structures/parse structures are proofs.

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3. But what is a proof?

4. E.g. sequent proofs are not enough:

$$\frac{N, (N \setminus S)/N, N \Rightarrow S}{(N \setminus S)/N, N \Rightarrow N \setminus S} \setminus R$$

$$\frac{(N \setminus S)/N, N \Rightarrow N \setminus S}{S} \xrightarrow{R} /L$$

$$\frac{CN \Rightarrow CN}{(S/(N \setminus S))/CN, CN, (N \setminus S)/N, N \Rightarrow S} /L$$

$$\frac{CN \Rightarrow CN \qquad S/(N\backslash S), N\backslash S \Rightarrow S}{(S/(N\backslash S))/CN, CN, N\backslash S \Rightarrow S}/L$$

$$\frac{N \Rightarrow N \qquad (S/(N\backslash S))/CN, CN, (N\backslash S) \Rightarrow S}{(S/(N\backslash S))/CN, CN, (N\backslash S)/N, N \Rightarrow S}$$

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5. Girard's proof nets are a good answer.



6. These are graphs which must satisfy certain global and local properties to be correct as proofs (proof nets).

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7. But in many cases we don't know how to define proof nets, e.g. our current categorial logic contains 62 connectives.

8. An intermediate answer is Andreoli's focalisation.

- In focalisation situated (•/°) connectives are classified as of negative (asynchronous) or positive (synchronous) *polarity* according as their rule is reversible or not.
- 10. There are alternating phases of don't-care nondeterministic negative rule application, and positive rule application locking on to focalised formulas.

- 11. Focalisation does not provide the complete answer to the question "What is a proof/syntactic structure?", but it does facilitate efficient parsing/theorem-proving.
- 12. We are developing the categorial logic parser/theorem-prover CatLog using focalisation.

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