Linguistics and Compilers

by Kenneth Miller

December 20th 2016

Upcoming FP Events

● Lambda Days	Feb 10	Krakow, Poland
● Kats Conf 2	Feb 18	Dublin, Ireland
● Bob Konf	Feb 24	Berlin, Germany
● Clojure D	Feb 25	Berlin, Germany
● Elixir Daze	Mar 2	St. Augustine, FL
● Destination Code	Mar 27	Powder Mtn, UT
● flatMap	May 2	Oslo, Norway
● Elm Europe	Jun 8	Paris, France

Linguistics and Compilers

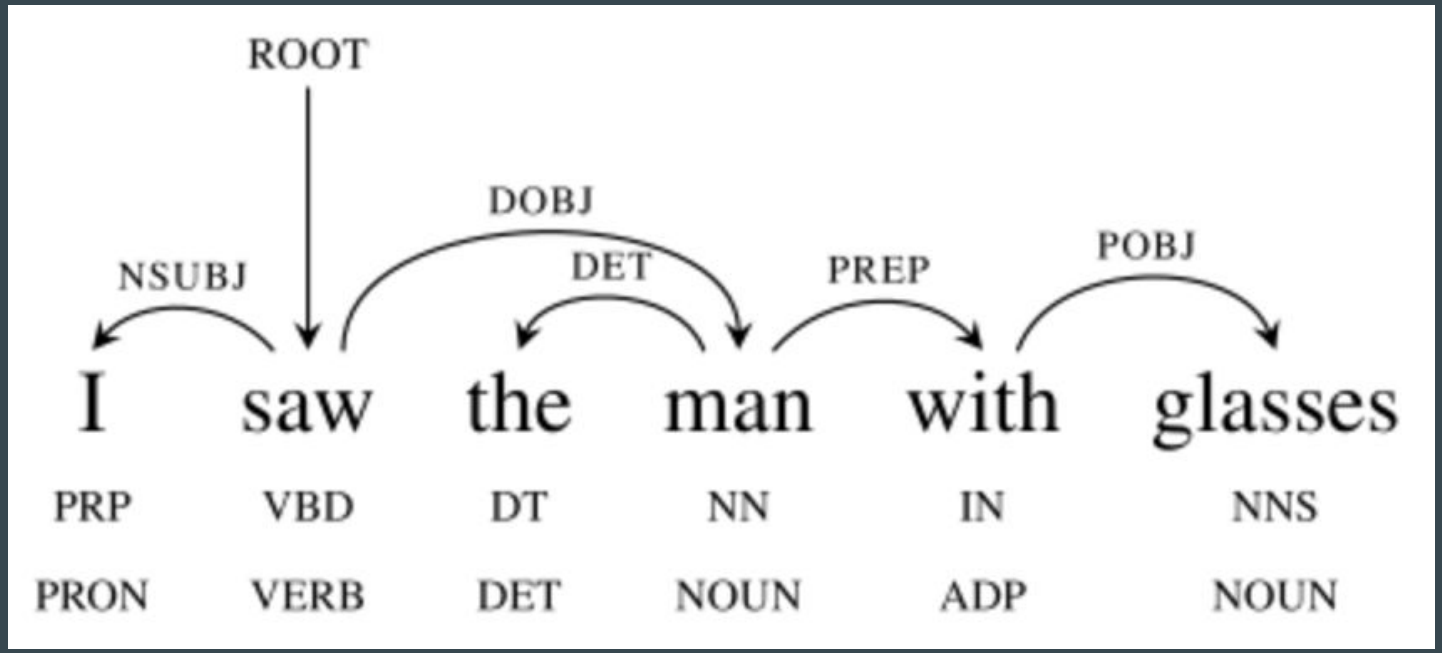
...

by Kenneth Miller

Phases of Compilation for Programming Languages

- Lexical & Syntactical Analysis
- Interpretation
- Type Checking & and Language Rules
- Machine code generation

Lexical & Syntactic Analysis



Interpretation

- Word < = > meaning sense
- Prepositional phrases
- Subject-noun-verb

$$\frac{}{\Gamma, x : \tau \vdash x : \tau}\,Var$$

$$\frac{\Gamma, x : \tau_p \vdash t : \tau_r}{\Gamma \vdash (\lambda x : \tau_p . t) : \tau_p \to \tau_r}\,Lam$$

$$\frac{\Gamma \vdash t_f : \tau_p \to \tau_r \qquad \Gamma \vdash t_p : \tau_p}{\Gamma \vdash t_f\ t_p : \tau_r}\,App$$

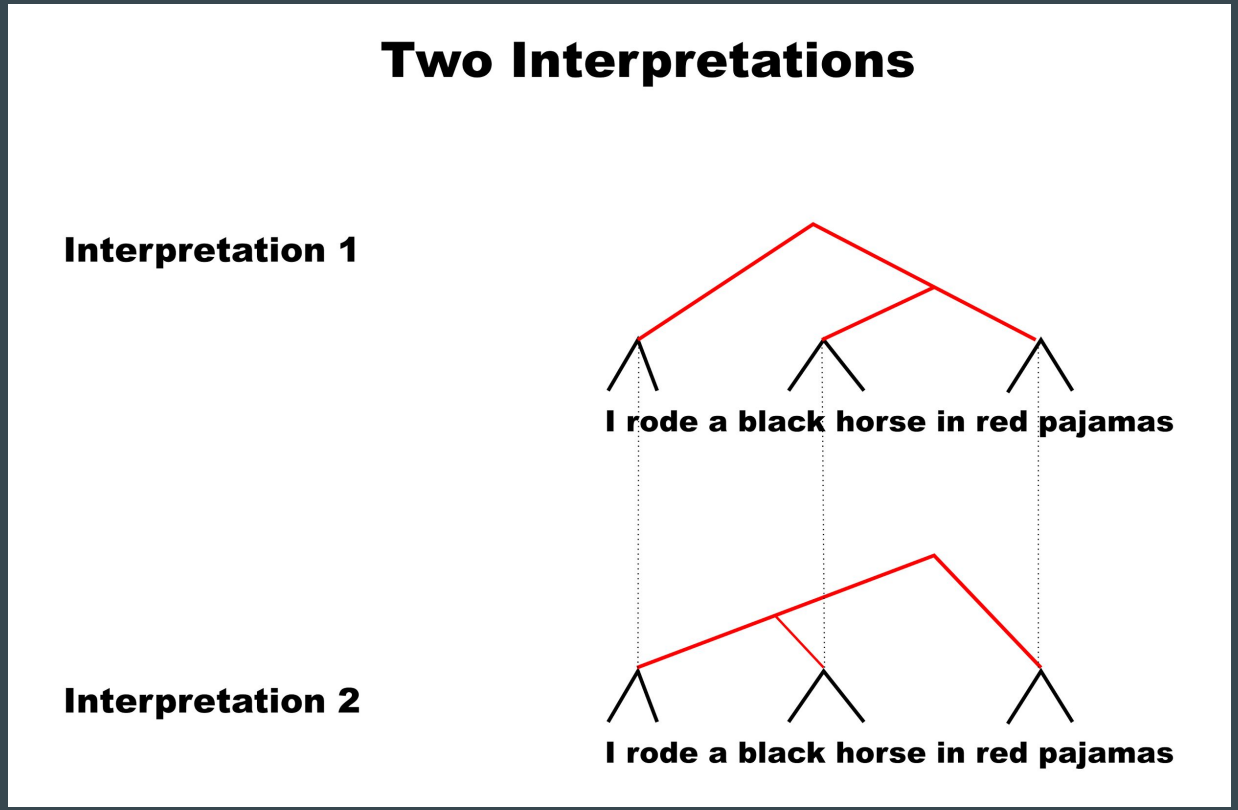
Example: Admitting Divergence

Multiple interpretations limited by syntax, context and semantics

I rode a *black horse* in red pajamas

I rode a black horse in red pajamas

Example: Admitting Divergence



Technique: Interpretation Retention

- Keep both interpretations

- Context of evaluation to disambiguate interpretation...
  - Or else raise an evaluation to spurn this to occur

A Class of Bijections with Natural Languages

Opcode selection	Term matching against expressions
Type & Variable Context	Implicit local environment
Type inference	Semiotic structure recognition
Interpretation & Evaluation	Expression matching against terms
Free/bound Variables	Articles within context of discussion
Type Introduction	New term/entity identified

Deferred Evaluation for Dual Interpretation

- Evaluation != Interpretation

- Build meta-data for each parse tree fragment
  - Type implications
  - Meaning sense interpretation
  - Variable context influence & requirements
  - ect

Type Checking & Language Rules

- Identify possible meaning-sense interpretations for each word.

- Contrast meaning-sense interpretation with context.

Example: Type Checking Natural Language

“I rode a horse in red pajamas.”

- “Pajama” and “horse” are each nouns with interpretation restrictions
  - Type of “I” is defined for “in red pajamas”
  - Type of “horse” is not defined for “in red pajamas”

Type Checking Natural Languages

- Rule out illegal meaning sense combinations with metadata about each word.

- This assists other phases, since we can relax their constraints.

Probabilistic Type Structure Recovery

- How do we acquire type information about each term?

- Quite a bit of information on restraints.

Conversation Algebra for Linguistic Analysis

- Consider two bodies of text, one original and the other an edited version...

- Would an algebra between knowledge representations of the two exist?
  - Reasoning patterns programmable by operating over this algebra?

Lazy Kindedness for Ontological Semiotics

- Kindedness is a form of higher order type information

1. Infer Kindedness
2. Evaluate from the top down to identify incompatibilities

Kenneth Q & A

kennethadammiller@gmail.com

Thanks!