Overall goal

Montagovian semantics for Computer Scientists, or
Derivation calculators for Semanticists

Derivations and normalizations are boring, let the computer do it

Gains

- for NL researchers: a helpful tool
- for PL researchers: an interesting application to build tools for

Beginning of a beautiful friendship
(or, collaboration, or at least mutual comprehension)

`http://okmij.org/ftp/gengo/NASSLLI10/`

Grand goal

NL researchers will

- gain rational reconstruction of Montagovian tricks
- import developed CS ideas:
  side effects, continuations, regions, staging, dependent types

PL researchers will

- export developed CS ideas:
  side effects, continuations, regions, staging, dependent types
- build theories of programming language competence

All would benefit from connections with logic and probability theory

Plan

June 18

- Making (intuitive) sense of our metalanguage (Haskell)
- CFG: writing and (*re*-)interpreting derivations
  overall: how to embed (object) languages and represent (grammar/type) derivations

June 19 Denotations and truth conditions: LLF

- Propositional logic
- STLC (STT)
- Simplifying formulas:
  teaching computer simple logical inferences

June 20

- Simple language fragments and interpreters
- Quantifiers, in two ways
- Quesion: quantifiers and scope ambuguity

Plan, cont

June 21

- Pronouns. Donkey anaphora
- Dynamic semantics: sentence as an imperative program
- *Extending* previous language fragments, interpreters and STT to account for information “update”
- A compositional semantics of donkey anaphora

June 22

- Scope and inverse linking in continuation semantics

Main ideas

- *Calculemus:* yield*s*, denotation*s*
- *Many* fragments, languages, interpretations
- Growing fragments and languages
- Interactivity
- Montagovian tradition

The look of Haskell

- GHCi prompt
- Arithmetic, Logic, Strings
- Abstractions and applications
- Types, type annotations, type errors
- Definitions, parametrized definitions

Exercises 1

```
twice = \f → \x → f (f x)
```

- How else we can write this definition?
- Does this term reminds us something from lambda-calculus?
- How to quickly verify that?

Exercises 2

1. Write Church numeral for 0
2. Write increment incr. How to test it?
3. Write addition, multiplication, exponentiation, decrement

Further look at Haskell

Pairs (products)

introduction, elimination, pattern-matching in definitions

Sums (co-products)

introduction, elimination, defining by clauses

Why pairs are called products and why Either is called a sum or a co-product?

Polymorphic types

Exercises 3

Write functions of these types:

$$((), a) \to a$$
$$a \to ((), a)$$
$$\mathsf{Either}\ a\ b \to (a \to c) \to (b \to c) \to c$$
$$((a, b) \to c) \to (a \to b \to c)$$
$$(a \to b \to c) \to ((a,b) \to c)$$
$$a \to ((a \to f) \to f)$$
$$(((a \to f) \to f) \to f) \to (a \to f)$$
$$(\mathsf{Either}\ a\ b \to f) \to (a \to f,\ b \to f)$$
$$((a, b) \to f) \to (((\mathsf{Either}\ (a \to f)\ (b \to f)) \to f) \to f)$$

- what do these functions do?
- What do these types remind you of?
- What do the terms your wrote signify?

Exercises 4

1. How polymorphic types relate to universals?
2. Why existentials in Haskell look the way they do?

Exercises 5

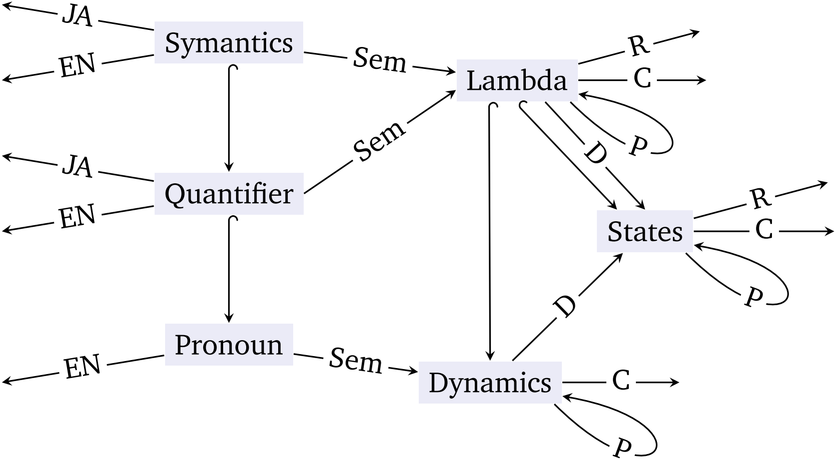
1. Define the data type of Pizzas
   The datatype describes which baked thing can be considered a pizza and which cannot.
2. Define a data type for burrito

Exercises 6

Think about representing the derivation of, and computing yield and truth values of two sample sentences from the Semantics boot camp:

- Rick Perry is conservative
- Rick Perry is in Texas

Map



JA
EN
Symantics
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Lambda
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C
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D
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Quantifier
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States
R
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EN
Pronoun
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Dynamics
C
P