Homework Assignment 5

October 16, 2013

1 Implement the syntax and semantics of $L_0$ in Haskell

Consider the $L_0$ logical system introduced in ch. 2 of Dowty et al. (1981) (Intro to Montague Semantics). Implement the syntax and semantics of this logical system in Haskell.

In particular, implement the following slightly modified definition of $L_0$ syntax:

(1) $L_0$ syntax:
   a. Basic expressions:
      i. Names: Dick, Noam, John, Muhammad
      ii. One-place predicates: HasMustache, IsBald
      iii. Two-place predicates: Knows, Loves
   b. Formulas:
      i. If $\delta$ is a one-place predicate and $\alpha$ is a name, then $\delta \alpha$ is a formula. Make sure that you
display such a formula as $\delta(\alpha)$ by appropriately defining show.
      ii. If $\gamma$ is a two-place predicate and $\alpha$ and $\beta$ are names, then $\gamma \beta \alpha$ is a formula. Make sure
that you display such a formula as $\gamma(\alpha, \beta)$ by appropriately defining show.
      iii. If $\phi$ is a formula, then $\neg \phi$ (the negation of $\phi$) is a formula.
      iv. If $\phi$ and $\psi$ are formulas, then $\phi \land \psi$ (the conjunction of $\phi$ and $\psi$) is a formula.
      v. If $\phi$ and $\psi$ are formulas, then $\phi \lor \psi$ (the disjunction of $\phi$ and $\psi$) is a formula.

Also, implement a more general version of the semantics of $L_0$ as follows:

• assume that all models have 4 entities Nixon, Chomsky, Mitchell and Ali, i.e., the domain of entities
  is $\{Nixon, Chomsky, Mitchell, Ali\}$

• assume that the semantic values of the four names Dick, Noam, John, Muhammad are fixed in the
  obvious way: Dick denotes (Richard) Nixon, Noam denotes Chomsky, John denotes Mitchell and
  Muhammad denotes Ali

• generate all possible models that satisfy the above two constraints, i.e., generate all possible (com-
binations of) appropriate denotations for the one-place and two-place predicates listed above;

• in particular, one-place predicates should denote subsets of the domain of entities $\{Nixon, Chomsky,$
  Mitchell, Ali$\}$ and two-place predicates should denote sets of pairs of entities, i.e., subsets of $\{(x,$
  $y) \mid x \leftarrow \{Nixon, Chomsky, Mitchell, Ali\}, y \leftarrow \{Nixon, Chomsky, Mitchell, Ali\}\}$

• given all these models, define tautologies, satisfiability, contradictions, entailment and Context
  Set updates just as we did in the lecture notes on propositional logic