Lambda calculus in the context of formal semantis

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Formal semantics of natural language

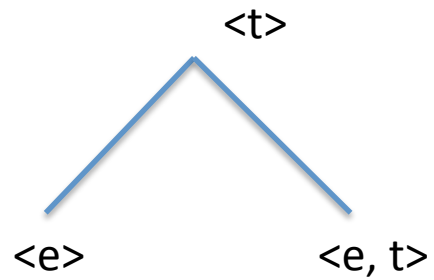
- What is it?
  - A mechanism, theory, or a collection of ideas that assigns meanings to sentences in a natural language in well-defined formal terms
  - E.g., john runs => run'(john')
    - run' = the meaning of run
    - john' = the meaning of john
    - S + V = Pred(Subj)
- What's fun?

Semantic object

- Assigning is easy
  - Just put “ ’ ”!
- Explaining is hard
  - Synonymy
    - John runs =/= Mary runs
  - (Logical) relations
    - John runs slowly => John runs
    - John has run => John is not running
- Needs semantics

Montague's proposals

- Syntax
  - Category grammar



- Semantics
  - (typed) lambda calculus – paradox free
  - Model theory
- Semantics naturally follows syntax
  - "English as a formal language"

But

- Pragmatics
  - Interpretations of sentences as uttered by a speaker in various circumstances
    - Indexicals: I, here, now
    - Speech acts: = non-declarative sentences
    - Implicature: non-literal meanings
- Even in semantics
  - Ominiscience
  - Reality
- Even in syntax
  - Nominalizations: john runs, running is fun, …

A Japanese fragment

- Verbs : hasiru, nuku
- NPs: ken, shin, otokonoko
- PostNominals: ga, o
- Sentences:
  1. Ken ga hasiru
  2. Ken ga shin o nuku
  3. Shin o ken ga nuku
  4. Ken ga nuku

Phrase structure grammar

- Avoid category grammar in favor of typelessness
- Rules:
  - S -> V
  - S -> NP VP
  - VP -> PN S
- Meanings:
  - Ken => ken', etc
  - Ga => lambda P lambda Q lambda e exists x (Agent(x,e) ^ P(e) ^ Q(x)]
  - O => lambda P lambda Q lambda e exists x (Object(x,e) ^ P(e) ^ Q(x)]
  - Compositionality = application
  - (events as objects)
- Apply -> beta-conversion -> meaning of the sentence
- Show the synonimity of 2 and 3

Proposed solutions

- Indexical semantics at large
  - Indexed by time, place, perspectives etc
  - Problems remain with “I”, etc
- Situation semantics(ca. 1981 --)
  - Partiality: not the world but part of the world
    - Solution to omniscience issue
  - Relational theory of meaning
    - Meaning as relations between types of situations
    - Information as invariance
  - To situation theory, and almost forgotten