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Natural Language Phrases in Lambda Calculus Converted into Generalized Constraint Language

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Introduction

- Natural Language Processing allows for extracting significant words from natural language expressions
- Computing with Words is useful for inferring words from natural languages, and applying their meaning to an application
- Joining these two fields will allow for more advanced application of natural language processing, as meaning and significance can be applied to what Natural Language Processing can extract

Hypothesis

A program can be written to convert a natural language expression stored as lambda calculus into Generalized Constraint Language.

Method

- Program was written in Java
- Used Strings to take in input
- Constructed initial relationship (ex. X is R)
- Evaluated words and relationships to determine modality
- Output was the GCL constructed from the lambda calculus expression

Explanation of Modalities Used in this Study

Modality	Meaning	Example
Blank	Shows direct relationship	Distance of robot *is* close
v	Shows truth probability	(Status of tank of gas *is* full) *isv* somewhat true
u	Shows usuality	(Taste of food *is* good) *isu* not usually
p	Shows likelihood	(Contents of groceries *is* milk) *isp* likely

Examples of Inputs and Outputs

Sentence	Lambda Calculus	GCL
The robot is close to the wall.	(λx.λy.distance(y, x))	Distance of robot *is* close
The tank of gas is full.	(λx.λy.status(y, x))(v.0.7)	(Status of tank of gas *is* full) *isv* somewhat true
The food tastes good.	(λx.λy.taste(y, x))(u.0.45)	(Taste of food *is* good) *isu* not usually
The groceries contain milk.	(λx.λy.contents(y, x))(p.0.8)	(Contents of groceries *is* milk) *isp* likely

GCL Overview

- Formatted as X *is* R
- Where X is a linguistic variable and R is the constraint on X
- Purpose is to show the meaning of significant words in a natural language expression
- Modality can also be applied, which is used to show the specific relationship between X and R

Conclusion

The program was successfully able to translate the lambda calculus expressions into GCL. The program also was able to correctly detect and output the modality of the original sentence.

Future Work

- Add the other modalities defined by Dr. Zadeh to the program's capabilities
- Add the functionality for the program learn from past translations for higher accuracy