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Cis 5590

April 23rd, 2025

Narsese To English

I. Introduction

Non-Axiomatic Reasoning System (NARS) is a general purpose thinking machine meant to simulate logic using stored memory and statement controls (NAL 2nd ed., 2). This system employs a number of symbols and variables to represent and substitute for human thought in the form of Non-Axiomatic Logic (NAL). Statements combine substitution and logic manipulation to prove recursive statements meant to encapsulate rational human-like thought processes. NAL replaces English vocabulary into terms and copulas following the Narsese language model. Narsese is not easily interpreted like higher-level languages like Python, making little use of human vocabulary and relying on symbols instead. The language has a multitude of loose numbers and symbols not frequently seen in English readings, this makes it difficult to comprehend the intention of Narsese commands in simple english terms for both experienced programmers and new clients. The Narsese to English translation tool takes inputted Narsese language from NAL and prints standard English language for the purpose of user clarity and usability.

II. Narsese and NAL

Non-Axiomatic Logic is “Knowledge from which other conclusions are derived, the initial knowledge itself may be challenged by new evidence” (NAL 2nd ed., 8) in multiple layers that build upon each other from NAL-1 to NAL-9. With each subsequent layer, the capabilities and possibilities of NAL are expanded. Each layer introduces new logic that builds upon the pre-existing layers' logic recursively; the newly introduced logical expansions are independent from previous implementations while adding more options. Relevant NAL can be split up as a categorical statement defined by basic terms and various copulas. A copula reflects the relationship between terms; defining copulas for English language construction determines each term's relationships and affects their mapping.

The Narsese language model represents the internal-external pipeline communication of NARS represented in NAL; Narsese inputs update environmental system knowledge to create human-like representation of logic.

```
<(\,neutralization,_,base) --> acid>.
```

Example 1, (NAL-4, Wang)

The Narsese input in Example 1 is a logical sentence representing, “Something that can neutralize a base is an acid”. Narsese expresses logic in copulas and terms, the above terms acid, base, and neutralization, represent the basic words of the sentence to analyze. The copulas in Narsese sentences specify the transitivity of terms, this forms the structure of the sentence where the term, “neutralization”, acts on the base to create the product term, “acid”. This relational information affects English translations differently with each unique copula.

III. Project Outline

Task & Implementation

A working Narsese translation project has functional requirements for seamless integration user input and integration. The completed Narsese to English translation tool approaches deciphering Narsese with Python architecture equipped to translate uploaded NAL files and standalone sentences using a rules based approach. The user is presented with a menu allowing for both input to be typed or uploaded, seen in figure 1.

```
Options:
1. Translate a NAL file
2. Enter NAL sentence
3. Exit
```

Figure 1, Menu screen

The translation tool accepts terms and copulas from NAL 1-5. To ensure all coupla found within necessary NAL functions can be tested and implemented, all copula were mapped such that tests could be developed alongside integration, displayed in figure 2.

Symbol	Meaning	Translation
-->	Inheritance	"Is a type of"
<->	Similarity	"Is similar to"
{--	Instance	"Is an instance of"

-]	Property	"Is a property of"
{-]	Instance-property	"Is an instance with property"
~	Intensional Difference	"Is not"
-	Extensional Difference	"Not"
	Intensional Intersection	"And"
&	Extensional Intersection	"That are"
/	Extensional Image	"Or"
*	Product	"Product of"
=>	Implication	"Implies that"
<=>	Equivalence	"Is equivalent to"
\	Intensional Image	"The operation"
Sentence " "	New judgement	"It is possible that"
Sentence "?"	Question truth value	"Is it true that"

Figure 2

Once provided with Narsese formatted text, the translation tool will break down the text line by line into proper grammar rules and copulas and store them for later reconstruction. These sentence elements are compared against keys in a hashmap, to ascertain the composition of a given sentence. Once known, the sentence can be recreated in English by pulling the matching values from the hashmap and using a string builder to put them together to return.

```
Enter NAL sentence: <<robin --> bird> ==> <robin --> animal>>.
Translation: If <robin is a type of bird, then robin is a type of animal>.
```

Figure 3, Output Screen

A sentence parsed for Narsese symbols outputs strings of English translated outputs to the user through the terminal. The lines corresponding copulas affect their output position and meaning between terms. In the above figure the Narsese code is scanned for truth values, and copulas. This establishes the relationships between the nouns we will be reusing into the finished sentence. Now having matched the copulas, and their English equivalent form, we can begin to reconstruct the sentence. To do so we take in each element, rid it of NAL formatting and then concatenate it onto the growing string. While translations of Narsese sentences can never be perfect, the resultant output provides enough contextual details to provide an understanding of what the Narsese sentence conveys.

Limitations

As with any snapshot, our initial project demonstration and final results fall short of our desired scope. The final product of our Narsese to English translation tool is not compatible with all Non-axiomatic Language terms, specifically terms from NAL-6 and beyond are not accepted inputs for translation.

<(&/,<(*, \$x, key_101) --> hold>,+100) =/> <(*, \$x, room_101) --> enter>>.

Example 2, (NAL-7, Wang)

The above example from NAL 7 corresponds to, “If someone hold key #101, they will enter room #101 in 100 steps” in English. The example NAL utilizes the derived retrospective implication copula to describe multiple objects in reference to another term. The required judgement and introspective sentence evaluation involved with establishing sentence tenses were

beyond the resources and time allotted, but modular architecture allows for the addition of other NAL implementations in the future.

The Narsese translation tool is not equipped with a GUI for file upload and receiving translations. The tool ideally would come equipped with a developed frontend and backend that would allow the user to upload files/strings for translation from NARS output files. This would allow for increased usability and understanding of what is happening; neither are implemented functionalities.

IV. Conclusion

Narsese to English translator is far from a complete model, but it is our intention that the fruits of our efforts are furthered by somebody else in a future project using our framework and repository. The most immediate steps to improve would be the inclusion and implementation of the remaining NAL 6-9 terms and copulas; this change would allow for any file or user input to be translated from Narsese language instead of the limited selection. Furthermore, a direct pipeline from the NARS application to our translation tool and vice versa would aid in a smoother workflow, and increase the value of the produced translation due to its immediate usability. While a completed project could allow for direct upload of outputted Narsese files without the need to initialize the user interface, the Narsese to English translation tool provides the tools and capabilities for developing engineers to learn and utilize NARS in an environment with a lower barrier of entry.

References

The OpenNARS authors. (2020). OpenNARS (Version 3.0.4) [Computer software]. Github. <https://github.com/opennars/opennars>.

Wang, P. (2023). Non-Axiomatic Logic — A Model of Intelligent Reasoning (Second Edition). Draft made accessible as part of CIS 5590.004 Spring 2024, Temple University

Relevant Code

Narsese to English translation tool: <https://github.com/sh-jafri/Narese-to-Eng>