# Inference and Execution of Semantic Structures

## Note on vectorization of Semantic Signature

Recall, the rules for forming semantic signature of compound particle are:

Signature of a thought particle is a matrix where

Rule for calculation of the semantic signature of a compound thought particle

which is also matrix

The last line can be written with the following syntax using radicals:

Obviously, the signature of every compound thought particle is matrix.

Every connecting particle signature encodes the operation which will be applied to the object particle on the left and the operation which will be applied to the object article on the right. Those operations and will preserve the original information contained in the signature of object particle which is being operated on with an additional information pertaining to the link particle.

## Note on Semantic distance between thoughts

Let us have the thought and represented by their particle sequence and their semantic trees:

and T2 = [Vk+1 Ak+1 Vk+2 Ak+2 … Vk+l Ak+l]

\_\_Vh\_ \_\_ Vq\_\_

/ \ / | \

Va Vg Vm Vp \_Vr\_

/ \ \ / \ / | \

Vb Vf Vk Vn Vl Vs Vt Vk+l

We say that T1 and T2 are equivalent if and only if all of the following is true:

1. dist(Vh, Vq) is small enough and cos(vect(Vh), vect(Vq)) is close to one and positive

## Comparing thought sequences and paradox analysis

Let us denote by a sequence composed of thoughts from a set of contexts on the same context path. Let us denote with the thoughts in , .

Let us denote by another sequence composed of thoughts from a set of contexts on the same context path. Let us denote with the thoughts in .

Let us assume that there are two thoughts and for which the semantic distance is negative.

## General Form for the Rules of inference for a sequence of thoughts

Let us denote by a thought sequence composed of thoughts from a set of contexts on the same context path. Let us denote with the thoughts in . Let us denote by a set of -particles which are entirely contained in the thought sequence such that each of the thoughts in contains at least one -particle from . The set will be the *inference trigger* which if present will kick start the synthesis of a new sequence of thoughts which will be the result of the inference. The new ordered sequence of thoughts will be denoted with . The mapping from to will represent inference operation which will be triggered by the presence of .

Let us consider the following set of examples:

*Example 1a: I do not know John.*

*Example 1b: I probably do not know John. “Probably” means I am not certain.*

*Inference a: I am not certain that I do know John. -or-*

*b: I am not certain that I do not know John.*

*Example 1c: He probably does not know John. “Probably” means I am not certain.*

*Inference: a: He is not certain that he knows John. -or-*

*b: He is not certain that he does not know John*

## Types of Inference Processes

We recognize three types of inference processes – Inductive, Deductive and Abductive inference (Peirce, 1878).

### Inductive Inference

### Deductive Inference

### Abductive Inference

Multi step process for building and refining a hypothesis

Hypothesis is synthesized and refined in a set of iterations. After it matches the input and output the hypothesis will be used for making an inference, ranked and stored for a future use.

## Learning Model for Inference Processes

Hypothesis Synthesis of new thoughts Hypothesis

## Execution of thoughts

The Execution of a sequence of thoughts implies validation analysis for the consequences of assuming these thoughts were true and linking them to other thoughts in the context path.

### Facts

*Definition of Fact*:

Executed thought becomes a fact.

### Generative-Adversarial model for thought execution

A new sequence of thoughts is formed by parsing of new statements and by recursive application of inference to the pool of thoughts within the current context path.

Simulated execution is performed resulting in the creation of Execution Plan. Alternative thoughts are formulated through alternative hypothesis formulation. Adversarial circuit parses each proposed execution plan and attempts to find a weakness in it. For this purpose the adversarial circuit compiles a ranking of facts which should not be altered/undone as there is a firm belief that these facts are correct.

Phases of the execution of sequence of thoughts

1. Parses a sequence of new statements
2. Applies Inference recursively which results into the generation of new sequence of thoughts
3. In case there is a missing link it makes a hypothesis and based on it generates new sequence of thoughts.

Execution of a thought sequence occurs when all of the following conditions are met:

1. has been inferred or parsed from a source

# Bibliography

Fischer, H. R. (2001). Abductive Reasoning as a Way of Worldmaking. *Foundations of Science, special issue on "The Impact of Radical Constructivism on Science", edited by A. Riegler, 2001, vol. 6, no.4*, 361-383.

Ian J. Goodfellow, J. P.-A.-F. (December 2014). Generative Adversarial Nets. *NIPS'14: Proceedings of the 27th International Conference on Neural Information Processing Systems - Volume 2*, (pp. 2672–2680).

Kloesel, N. H. (1992). *The Essential Peirce, Selected Philosophical Writings, Vol 1 (1867-1893).* Bloomington, IN, USA: Indiana University Press, 601 North Morton Str, Bloomington, IN 47404-3797 USA.

Peirce, C. S. (1878, August). Deduction, Induction, and Hypothesis. *Popular Science Monthly, Vol 12*, pp. 470-482.

Wang-Zhou Dai, Q. X.-H. (2019). Bridging Machine Learning and Logical Reasoning by Abductive Learning. *33rd Conference on Neural Information Processing Systems (NeurIPS 2019).* Vancouver, Canada.