# Truth Value formalization and Groups Theory

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## Abstract

This study deals with natural language processing framework and has to do with the semantics which is a real challenge for current computational research. This formalization is based on language resources [Ibrahim, S. .2003] [Attiq,A. 1985], philosophical [ Ayer, A. J ; 1939] using Mathematical logic [Alliot,J.,M. & all, 1993] as Mathematical tools. Indeed, the work on the rhetoric of the Arabic language and particularly to the truth value of a natural language statement was proposed by the Arabic Grammatical Tradition (TGA) [Belkredim FZ, 2015]. In the same way, logical-philosophical work on the concept of truth of a statement (Declarative Sentence, Mathematical or others ) has been shown to solve philosophical problems related to metaphysics. All the concepts are taken from linguistics, philosophy and logic. This study is at his first stage and will be completed in the future works;

We considered language as communicative objet between a speaker and an interlocutor. Our proposal is to associate a statement (proposition in the logical sense) to the values of truth (Truth and False) of the speaker and the interlocutor noted P (v1, V2) such that $V_1$ is the speaker truth value and $V_2$ is the interlocutor truth value rather than a unique truth value (Truth or False) to a statement. The idea is to have a dynamic computational data base that can incorporate new statements, classify data and resolve conflicts as possible.

Key words: Arabic Rhetoric , Arabic Language, Natural Language Processing, Truth Value, Logic, Philosophy.

## 1. Work of Arabic Grammatical Tradition (AGT) that deals with linguistics.

Indeed, in the rhetoric, it was posed the problem of truth value of a Phrase Informative [Belkredim FZ,2015]. A consensus was established that there are declarative sentences which are true or false (admitted) and declarative sentences whose truth value is subject to Speakers (S) and Interlocutor (I).

Thus, we consider a statement (P) with two truth values ($V_1$, $v_2$); $V_1$ is given by the Speaker (S) and $v_2$ Interlocutor (I).

## 2. Truth in Philosophy and Logic

Declarative Sentences are statements to the Propositional Logic syntax ( definition of the truth is not the same). The semantic could be regarded as an extension of Propositional Logic semantic. For a statement P, it is associated a valuation V = ($V_{1i}$, $V_{2J}$) as $V_{1i}$ is truth value assigned by an individual (S) and $V_{2J}$ is the truth value given by an individual (I). Thus P is associated with two values of truth and at the same time $V_{1i}$ and $V_{2j}$. If $V_{1i}$ =$V_{2J}$, it noted T(True) or □(□□□□).

## 3. Formalization

In propositional logic, it assigned truth values (T true, F false) to a proposition and connectors of negation ($\neg$P), disjunction (($P_1 \vee P_2$) conjunction ($P_1 \wedge P_2$) and implication ($P_1 \rightarrow P_2$) is given by the truth tables.
For this formalization: to a statement P, it is associated both truth values P ($v_{1i}$, $v_{2j}$); $v_{1i}$ and $v_{2j}$ belong to {true (T), false (F)}. Then, L is considered as the set of Declarative sentences.

$$L \rightarrow \{T, F\} \times \{T, F\}$$
$$P \rightarrow (v_{1i}, v_{2j})$$

As in propositional Logic, all these formula with this semantics are equivalent:
$P_1 \rightarrow P_2$ is equivalent to $\neg P_1 \vee \neg P$

$P_1 \leftrightarrow P_2$ is equivalent $P_1 \rightarrow P_2 \wedge P_2 \rightarrow P_1$

Demonstration of connectors Truth is based on connectors Truth of Propositional Logic. We give the semantics of connectors by truth tables.

| P | ¬P |
|---|---|
| (T,T) | (F,F) |
| (T,F) | (F,T) |
| (F,T) | (T,F) |
| (F,F) | (T,T) |

Negation Truth table

| | | $P_2$ | | | |
|---|---|---|---|---|---|
| | ∨ | (T,T) | (T,F) | (F,T) | (F,F) |
| $P_1$ | (T,T) | (T,T) | (T,T) | (T,T) | (T,T) |
| | (T,F) | (T,T) | (T,F) | (T,T) | (V,F) |
| | (F,T) | (T,T) | (T,T) | (F,T) | (F,T) |
| | (F,F) | (T,T) | (T,F) | (F,T) | (F,F) |

Disjunction Truth table

| $P_1$ | | | | | |
|---|---|---|---|---|---|
| | (T,T) | (T,T) | (T,F) | (F,V) | (F,F) |
| | (T,F) | (T,F) | (T,F) | (F,F) | (F,F) |
| | (F,T) | (F,T) | (F,F) | (F,T) | (F,F) |
| | (F,F) | (F,F) | (F,F) | (F,F) | (F,F) |

Conjunction Truth table

| $P_1$ | $P_2$ | | | | |
|---|---|---|---|---|---|
| | → | (T,T) | (V,F) | (F,V) | (F,F) |
| | (T,T) | (T,T) | (T,F) | (F,T) | (F,F) |
| | (T,F) | (T,F) | (T,T) | (F,T) | (F,T) |
| | (F,T) | (T,T) | (T,F) | (F,T) | (F,T) |
| | (F,F) | (T,T) | (T,T) | (T,T) | (T,T) |

Implication Truth table

| $P_1$ | $P_2$ | | | | |
|---|---|---|---|---|---|
| | ↔ | (T,T) | (T,F) | (F,T) | (F,F) |
| | (T,T) | (T,T) | (T,F) | (F,V) | (F,F) |
| | (T,F) | (T,F) | (T,T) | (F,F) | (F,T) |
| | (F,T) | (F,T) | (F,F) | (F,T) | (T,F) |
| | (F,F) | (F,F) | (F,T) | (T,F) | (T,T) |

Equivalence Truth table

## 4. Relation with the theory of groups.

A group (G, *) with two elements has a single representation that is isomorphic to (Z / 2Z , +)

| $P_1$ | $P_2$ | | |
|---|---|---|---|
| | ↔ | v | F |
| | v | v | F |
| | F | F | v |

(G, *) Truth Table

| + | 0 | 1 |
|---|---|---|
| 0 | 1 | 1 |
| 1 | 1 | 0 |

(Z / 2Z , +) table

T is associated to $0^1$ F is associated to 1

A group (G, *) of four elements has two representations isomorphic to (Z/4Z, +) or (Z/2Z X Z/2Z, +). The interpretations of equivalence is isomorphic to the group (Z/2Z X Z/2Z ) ={ (0,0) , (0,1) (1,0) (1,1) }.

(0,0) is associated to (T,T)=T ; (1,0) is associated to (F,T) ;

(1,1) is associated to (F,F) =F ; (0,1) is associated to (T,F)

[1] It appear that Truth T is the neutral element corresponding to 0.

## 5. Application

This formalization will be used in information retrieval or extraction of information to classify statements of dynamic data base. It seems also to be used in others research as questions answering, Research of Plagiary, … ECT.

We start with a set of propositions annotated by P( T,?) or P(F,?) of a text. With this formalization, We look for P (T, T), P (T,F), P(F,F) and P(F,T) in a large corpus. The classification or ( class of equivalence) is:

P (T, T) = { P (Vi, Vj) / P (Vi, Vj) ↔P(T,T) }

P(T, F ) = { P (Vi, Vj) / P (Vi, Vj) ↔P(T,F) }

P (F, F) = { P (Vi, Vj) / P (Vi, Vj) ↔ P(F,F) }

P (F, T) = { P (Vi, Vj) / P (Vi, Vj) ↔ P(F,T) }

## 6. Conclusion

This formalisation will be used in different fields of computational linguistics. It is based on simple tools and extend Mathematical logic. The power of the theory of groups give strength to the reasoning. At the first, this formalisation will be used in Information extraction. This research is linked to research of theme [Loukam, M. & all. 2015 ] and will introduced be implemented in the extraction system .

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