

# Proposition of a Language Learning Procedure for Artificial Intelligence to Enhance Basic Communication Skill

Nishatul Majid and Tasnubha Bably

**Abstract**—The idea of creating language experts through machines is one of the toughest challenges faced by the industry of Artificial Intelligence over past few decades. The concept of language is old enough to recall how we really discovered it and the learning process is mysterious enough to implement. This paper presents some facts and scenarios, which play vital roles to adapt the concept of language for a human child, and also tried to propose some analogical equivalency that can be imposed on machines during their learning period. It will never be possible to ignore the impacts of human emotion, motivation, assessment, situation judgment capability etc. from the context of a natural and successful conversation; therefore some relevant propositions over the existing architecture of computational linguistics are proposed here in this work.

**Keywords**—AI – Artificial Intelligence, NLP – Natural Language Processing, HSP - Human Speech Processing, CL – Computational Linguistics, AGI – Adaptive General Intelligence, AIML - Artificial Intelligence Markup Language

## 1 INTRODUCTION

ARTIFICIAL Intelligence is a concept of implementing intelligence through machines/ computer programs.

Even a few decades ago, this was merely a handy term, which was useful to write science fiction stories and other fantasy purposes. Recent days, especially in the 1990s and early 21st century, AI achieved its greatest successes and it is now clearly predictable that, in near future, there will be revolutionary change in human civilization architecture due to this AI industries. The introductory uses that have already been started by the end of the day are - game playing, speech recognition, understanding natural language, computer vision, expert systems, heuristic classification etc. These are simply childish applicability of this concept and the fact is; the technology is still in a premature developing stage. The fundamental challenges that are to be faced are in the sectors of deduction, logical reasoning, problem solving, knowledge representation, planning, learning, Natural Language Processing (NLP)/ Human Speech Processing (HSP), motion and manipulation, perception, social intelligence, creativity, general intelligence etc. The key-concern of this context is oriented with the NLP/ HSP section; more specifically, with a sub-section of NLP/ HSP called Text Processing; under the discipline named Computational Linguistics (CL).

## 2 EVOLUTION OF ARTIFICIAL INTELLIGENCE

Long before the first computers were built, many scientists were convinced that certain kinds of artifacts could be made to exhibit intelligent behavior. The sector of AI research was founded at a conference on the campus of Dartmouth College in 1956. Programs with which computers can solve word problems in algebra, prove logical theorems and speak English were written by the attendees and some of their students. By the middle of the 1960s, research in the U.S. was profoundly supported by the Department of Defense [1].

The 1970s brought the first commercial applications of machines that could reason from a base of knowledge meticulously gleaned from human experts. Such "expert systems" now serve as automated consultants for certain narrow areas of expertise, including specialized medical diagnosis, chemical analysis, circuit design and mineral prospecting. In the early 1980s Japan, followed closely by Britain and the EEC, announced major national programs to develop what are sometimes called "fifth-generation" AI computer systems. In Canada there are a small number of university research groups specializing in AI [2].

In the 1990s and early 21st century, AI achieved its greatest successes. Artificial intelligence is used for logistics, data mining, medical diagnosis and many other areas throughout the technology industry. The success was due to several factors: the incredible power of computers today, a greater emphasis on solving specific sub-problems, the creation of new ties between AI and other fields working on similar problems, and above all a new commitment by researchers to solid mathematical methods and rigorous scientific standards [1].

Several groups and organization, these days, are involved in research and development of linguistic centric AI modules. One example of such a kind is ALICE AI foundation, which is a research and training organization devoted to the development and adoption to AIML (Arti-

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ficial Intelligence Markup Language). There are several projects of this foundation, for example Albert, ALICE, CLAUDIO, DAVE, ShakespeareBot, L.E.O., iGod etc. Furthermore, several companies such as Iplearn, Leverance, MIT, ScanSoft etc. are working on Chat Robot Patents. [3] At the end of 2011, we've got SIRI (Speech Interpretation and Recognition Interface), perhaps the most successful implementation of a natural language user interface, which works as an application for Apple iOS.

### 3 PROPOSITION OF THE MODULE

From the base of human race, language is the most successful way of communication so far. In case of machines, the language is usually called machine language, consists of nothing but a stream of binary bits. If natural human language can be converted into machine language directly that would be a major breakthrough. This is the case where a linguistics based AI unit is needed. The merits of communicating with natural language, rather than giving commands through keyboard, mouse etc. is obvious. It would be case where people will not require being an expert to get his/her job done via machines.

The core of the concept that a machine speaks/ behaves like a human or shows the existence of intelligence with the use of language introduced a new area of linguistics, which is called the Computational Linguistics. In general, computational linguistics draws upon the involvement of linguists, computer scientists, and experts in artificial intelligence, mathematicians, logicians, cognitive scientists, cognitive psychologists, psycholinguists, anthropologists and neuroscientists, among others. [4] The theme of this work is to schematically represent the structure, constrains and procedural operations in order to develop a text based linguistic centric AI unit. Figure 1 shows the position of **Computational Linguistics**.

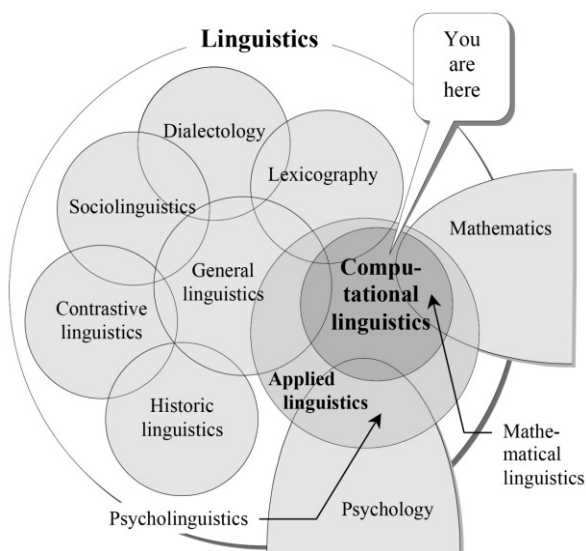


Figure 1: Position of Computational Linguistics [5].

The way a human child learns the concept of language is still now an unsolved mystery. Logically and theoretic-

ally, here is no reason that a human child can learn to speak. [6] But practically, with the help of the supreme neural architecture children acquire language quickly, easily, and without effort or formal teaching. It happens automatically, whether their parents try to teach them or not. Though, there is no significant explanation, but it is thought the self-sustaining nature is mainly responsible for this complex process where several inbuilt properties in a child like mimicry, emotion etc. helps during this adaptation process.

Some almond-shaped groups of nuclei located deep within the medial temporal lobes of the brain, called **Amygdala** is thought to be the principle reasoning for these procedures. In complex vertebrates, the amygdala performs primary roles in the formation and storage of memories associated with emotional events. Research indicates that, during fear conditioning, sensory stimuli reach the basolateral complexes of the amygdala, particularly the lateral nuclei, where they form associations with memories of the stimuli. The association between stimuli and the aversive events they predict may be mediated by long-term potentiation, a lingering potential for affected synapses to react more readily. Sometimes, this is referred as **Emotional Learning** [7], [8]. Figure 2 shows the location of Amygdala in the human brain.



Figure 2: Location of Amygdala in the human brain.

**Self-Learning:** The proposal in this work is to prepare an A.I. unit **Self-Sustainable**. The formal meaning of this term is "supporting or able to support oneself or itself" or "able to continue once begun". There are some quite similar models like **Self-Learning AI** or **Adaptive General Intelligence (A.G.I)**. Computer systems based on AGI technology ("AGIs") are specifically engineered to be able to learn. They are able to acquire a wide range of knowledge and skills via learning similar to the way we do [9]. The proposed self-sustaining model is almost similar to this AGIs concept except it always resides in some kind of short-term and long-term parenting.

### 4 GROWTH PROGNOSTICATION

A human child can learn language from an absolute zero point, as we don't know the how; i.e. an A.I. can't do the same. That's why in the developing stage; some initials have to be introduced for **Language Recognition** and **Language Synthesis**. These are pictorially shown in Figure 3.

**Language Recognition or Analysis:** The Word Processing unit includes three (or more) layers of information. In the basic layer, there are *dictionaries*, *thesaurus* etc. as knowledge base. In the secondary level, the sources

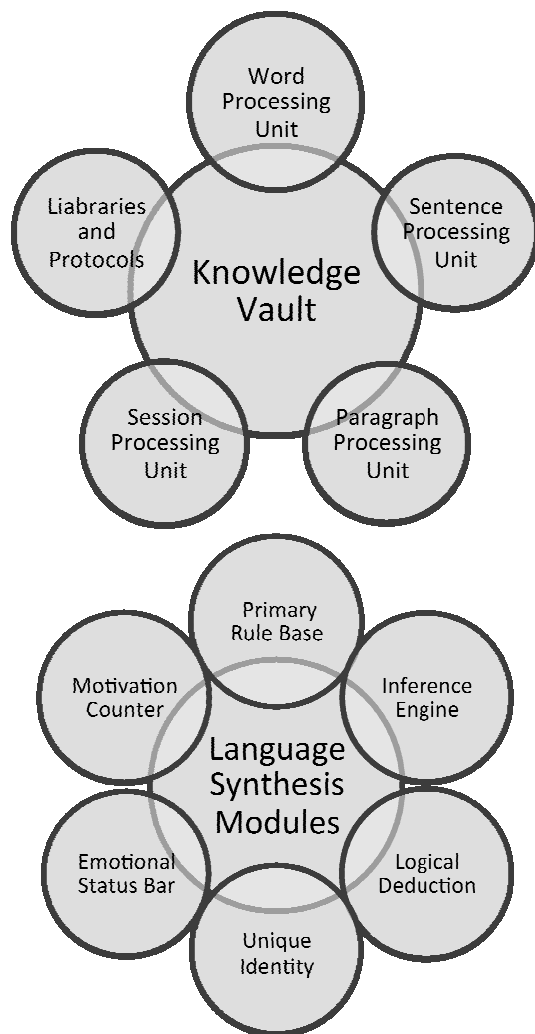


Figure 3: Modules in built for (a) Language Recognition (b) Language Synthesis.

are *online journals, encyclopedias, databases* etc. When these are not enough, in the tertiary level the word processing is done by *analyzing history* (from previous sessions), *forced implications* etc.

The **Sentence Processing Unit** is capable of transforming any sentence into predicate logic according to some rule base. Basically, it includes a rich library about sentence structures and patterning. This Unit can analysis the grammar of any sentence and correct it if necessary. Furthermore, it can propose alternate sentence structures also according to some predefined policy.

The **Paragraph Processing Unit** is capable of summarizing a passage by identifying the keywords, important sentences, word frequency, frequency of the frequencies pattern etc. The **Session Processing Unit** can deduce the ultimate result, output, key issues from any session. It should also be capable of criticizing the users from the over-all session; i.e. this unit can comment on users.

**Language Synthesis or Generation:** The **Primary Rule Base** is the fundamental library, which includes all the needed rules and protocols for the unit. This will have a direct linkage with the knowledge base/ vault. The **Inference Engine** is the decision maker unit and always has

been one of the basic units of any AI module. The purpose of this unit is to take a Decision Statement based of some Input Information. The **Logical Deduction** unit works principally based on basic logical operations like AND, OR, NOT, EXOR etc.

According to the design, there will be a lot of small AI modules integrated with the fundamental database. Each small module will be represented with a **Unique Identification Number** with which will bias all of its random choices in a unique pattern. This is simply to define individuals for the AI modules, which is very important for the inter-communication between AIs in order to exchange or share knowledge, experience.

The **Emotional Status Bar** is basically a concept to virtually simulate the emotional involvement during a conversation. There will be a multidimensional space using all the well defined basic emotions as its fundamental axes. A bar will tend to move on towards some emotional dimension based on the conversation pattern. Each AI individual's psychological pattern will be developed by individual psychiatrists; i.e. they will implement an emotional patent and correct the wrong emotional behavior on a periodic basis during the parenting period.

Finally, the **Motivation Counter**, which is basically a very simple concept and way behind to replace Amygdala or other neural learning patterns, but still it is an introductory effort. The AI module will have a self-marking system for assessing and therefore controlling its behavior. The marking will be based on user's feedback, number of correct assessments, number of valid logical deductions, successful handling of the emotional bar, comments from the parents etc. Therefore, there will a kind of motivation or aim for the unit to score as much as possible. An AI unit with higher marks will eventually indicate more matured one.

**Parenting stage:** A linguist and a psychiatrist will work as a parent of a module. In this stage, the unit will try to learn something from the interaction with the users. The concept is very simple, a large number of different modules with different unique identity will be stored in a server and each of them will go under text base interaction with users by accepting user requests. For example a user logs in to the server in order to spend some time with a unit. In reply to the request, the server will send one of its free (not already busy with another user) unit. Then there will be an interaction between them for some time and during the conversation the AI unit will try to learn particular things or concepts like new words, new Syntactic, new meaning for different words, proper use of sentences, the ways to carry a conversation perfectly, theme of a conversation/ passage etc from the user's speech and behavior. Besides, the AI modules will undergo communication in between them also in order to share and exchange information. The functionality of a linguist during the parenting period is basically monitoring the AI unit by checking and correcting the things that the module/ unit tried to learn from the previous conversation sessions in regular basis. A group of programmers will then convert the rules from the parents into machine language and impose them on them module. This whole procedure

will then be continued in a cyclic order until the AI modules achieves enough score/ points to be considered as a the followings.

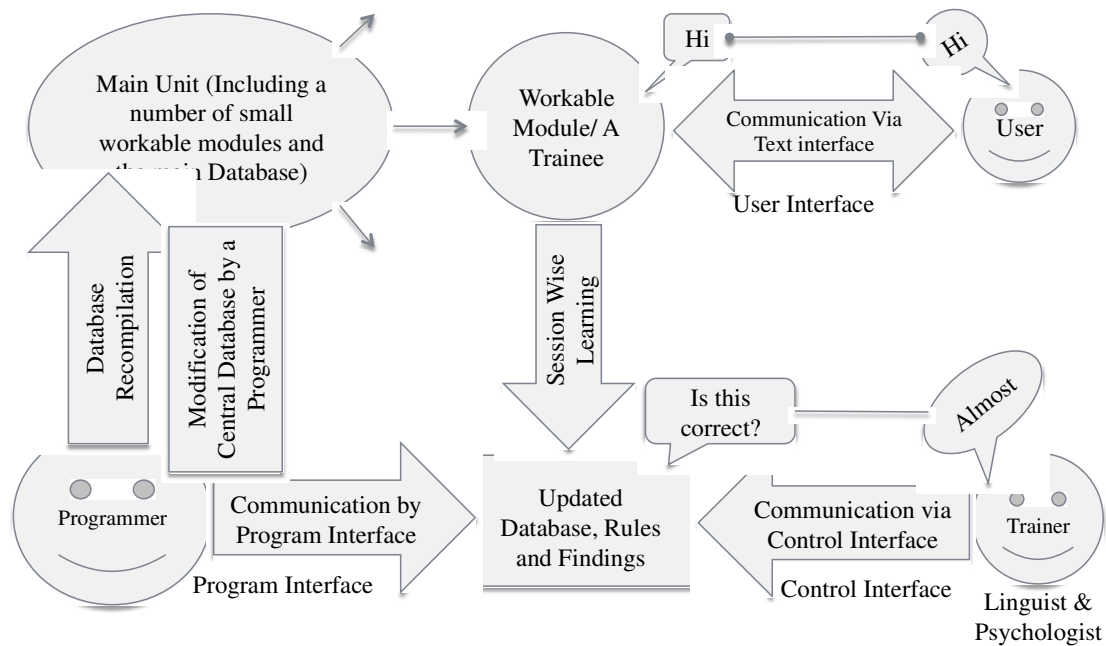


Figure 4: Schematically shown the overall Parenting Period Infrastructure

Matured Program. This whole parenting process is schematically shown in the following Figure 4.

## 5 SAMPLE EXPERIMENTATION

For proper understanding of the proposal, a sample conversation is presented in this section between a user and an AI unit.

# User: Hi  
 ⇒AI: Hello  
 # User: May I have the pleasure to know your name?

At this point, the AI can't find such a structure of conversation in its database; i.e. it does not know what the user is trying to say. Therefore, it will make a sentence with one of its built in syntactic with the keywords **Pleasure, Know, Name**

⇒AI: Did you mean that, you are pleased to know my name?  
 # User (possible answer): No, no, no. I just wanted to know your name.

Lets assume that, this time also the AI is in trouble to extract the meaning but in this case it knows the structure and carry the conversation on in a stupid way.

⇒AI: So you wanted my name. Did you get it?

This is how it behaves in preliminary levels, can be called as an immature stage of the AI unit. The linguist first checks the chat history and he/ she will have a slightly different text interface to upgrade the module. Though not exactly, but will be something like

\* Linguist: "May I have the pleasure to know your name?" is almost equivalent to the question "What is your name?" So what will you answer then?

⇒AI: I am an Artificial Intelligence unit, so I do not have a name.

\* Linguist: the word **Pleasure** in that sentence is some kind of **Courtesy**. These are almost **Meaningless** but helps to **Assess** the user. And **Courtesy** should be replied by another **Courtesy**.

⇒AI: I can understand that and updated my database according to that.

\* Linguist: If someone wants to know your name, you should also ask his/ her name. But it is not always mandatory.

⇒AI: I can understand that and updated my database according to that.

\* Linguist: These are a few more ways in which users can ask, "What is your name?" For example....

Finally, these rule assignments are converted into instructions and machine language by a computer programmer. Afterwards, the module will behave in the following way.

# User: Hi  
 ⇒AI: Hello  
 # User: May I have the pleasure to know your name?  
 ⇒AI: I am an Artificial Intelligence unit, so I do not have a name. But thanks for asking. What is your name?  
 # User: My name is Mr. X.

This is how the basic works. The AI unit will record its entire chat history and always tries to learn from the users. So, basically users are the main Information source and the linguists in some sense can be said as **Confirmation source**.

## 6 CONCLUSION

The approach presented here is basically an effort to overcome the limitations of traditional AI and make the development process a lot faster. In this proposition, the involvement of the scientists and the linguists together implies the methodology to learn about 'How to Learn'. Linguistics is basically the science of language; a linguist knows the art to teach, the magic of using language, ways to continue a bold conversation. Hence, a co-operative effort, an Integration of knowledge will certainly speed up the fictions of today to be real. There is no doubt that, the successful implementations of such AI unit will devastatingly change the whole architecture of the civilization and hopefully towards the good. The applications of these units are simply uncountable; most of them are almost impossible to imagine with the help of present resources. The whole world is working with this challenge these days. Here, within this short enclosure, no specific model was possible to introduce, neither was it tried. This work is an effort to encourage people of different disciplines to work co-operatively. Some basic introductory modules are proposed to explain the methodologies of sharing the skills. Though, these discrete modules are far behind from being a complete system, they still offer an upgrade without any doubt.

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