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Analysis of Speech Acts for the Design of a Corpus of Phrases used in an Intelligent Learning Environment

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Abstract. Artificial intelligence is a fundamental part of our life today. An example is the simulators integrated by intelligent virtual characters that serve as instructors in interactive environments where no matter the place and time, people can take a class and even train in a video game. These virtual agents require a corpus of phrases to have a dialogue similar to that of a human being. This article describes an investigation of the types of speech acts immersed in an interactive dialogue. They describe the most relevant characteristics for an educational environment, such as the type of phrase, the function it performs, its meaning, etc., thus discarding those that do not belong to this environment. The main objective is to develop a specific corpus of phrases for an intelligent virtual agent belonging to a serious game for learning purposes used as an interactive learning environment.

Keywords: speech acts, intelligent learning environments, intelligent virtual agent, corpus, BDI architecture.

1 Introduction

Currently we can find very advanced technology based on artificial intelligence, which tries to emulate human behavior through machines, achieving satisfactory objectives in various fields, such as industrial, health, military, education, among others. In these fields, the so-called intelligent learning environments are developed, which are simulated environments with a problem to be solved, which are able to interact or communicate with various systems through the Internet. Technologies through the web give way to interact with other users and in the same way with instructors or agents, who assist and monitor learning.

Smart agents are a fundamental part of this technology, often serve to guide users within the system. Its application is increasing, since as time goes by, new improvements are made in its development and operation, getting closer and closer to its purpose, which is to achieve an entity as intelligent as possible. For this, it is necessary to improve the answers that the agent issues in his dialogue with the user, which leads us to analyze each phrase belonging to a corpus of available phrases to establish an interactive communication. This is where the theory of speech acts

intervenes, since they can be used to classify sentences and select the most appropriate to generate a coherent and natural response.

2 State of the Art

Below are some works related to the development of a corpus, the main theme of this article, which helped to prepare it, contributing ideas or comparing its development.

Úbeda [1] presents a collection of recordings to analyze and generate a corpus suitable to the objective that is, from an oral corpus, to describe the manifestation of the use of language in a situation, through its constant and frequent cognitive premises. Although the objective is different from that of this work, the idea that record a real dialogue in the study environment is retaken to analyze each phrase used.

In Casacuberta et al. [2] three different corpus are designed and constructed, the first with phonetically balanced sentences, the second with sentences corresponding to a task of consulting a geographic database and the third of speech produced in adverse conditions. For the research carried out in this work, the corresponding corpus classification would be the second, since it is intended to generate a specific corpus for an educational environment, which will help the selection of phrases.

The proposed methodology is based in the analysis of speech acts, similarly as it is developed in Torralvo [3] which focuses on finding the conversational, syntactic and pragmatic characteristics that are repeated in several dialogue recordings. With this, it is established a set of models that can serve as a guide in the construction of an automatic system capable of interacting with a human speaker.

3 Background

This section defines the following concepts: 1) Intelligent Learning Environment; 2) Virtual Agents; and 3) Theory of Speech Acts. Knowing these concepts will guide the reader through the understanding of the fundamental parts that indicates what type of agent is used, and why, in a dialogue inside a learning environment that be similar to that of a human being.

3.1 Virtual Agents in Intelligent Learning Environments

According to Hwang [4], Intelligent Learning Environments (ILE) are learning environments supported by technology. They make adaptations and provide adequate support with intelligent detection and recommendation technology in the right places at the right time. According to the individual needs of each student, the environments are determined through the analysis of their learning behaviors, their trajectory of performance and the online and real-world contexts, and composed by the resources that are provided or accessed, downloaded, read or elaborated.

According to Ros [5], ILE systems aim to help students learn even when doing other activities. They are the teacher friends, which look for opportunities to advise the student in their daily life taking into account their needs and preferences.

Within the ILE you can find instructors that serve as a guide to the student, which can be represented by virtual agents with a specific architecture and function (e.g. [6,7]).

An intelligent agent can be physical, like a robot, or virtual, like a computer program with which you can interact. The study in this article is related exclusively with intelligent virtual agents (IVA). This research specifically pursues the provision of an infrastructure to generate a coherent and natural interactive dialogue for intelligent virtual agents.

There are several types of intelligent virtual agents, classified mainly depending on their architecture, which is the internal structure that determines the mechanisms that an agent uses to react to stimuli.

According to Iglesias [8], the architectures of the agents can be classified into deliberative architectures and reactive architectures. The deliberative architectures follow the current of the symbolic artificial intelligent, which is based on the hypothesis of the physical-symbol systems enunciated by Newell y Simons [9], according to which a system of physical symbols capable of manipulating symbolic structures can exhibit intelligent behavior. In order to work at Newell's level of knowledge, our problem will be how to describe the objectives and means of satisfying them, and how to translate the level of knowledge to the symbolic level.

In this case we have selected an agent with BDI architecture (with Beliefs, Desires and Intentions) aka deliberative agents, that besides being very intelligent agents (mainly in their interaction with the user), they also contain variables for the selection of the dialogue that will help with the characterization of the sentences.

A BDI agent architecture must offer responses according to the program in function. To achieve this goal, the agent must be able to express itself through specific speech acts.

3.2 Theory of Speech Acts for the Generation of Interactive Dialogue

According to Lozano [10], the first theory of speech acts was proposed by J. L. Austin in 1962. This theory basically states that, in saying one thing, another was also done besides the simple act of saying it, such as asking or promising, among others. Later, in 1990, Searle deepened the subject by perfecting Austin's theory of speech acts, and made an extension of the analysis of it.

Austin [11] identified three different acts when making a sentence. Such acts are discussed as follows:

a. Locutionary act: the act of utterance a sentence with a certain meaning or reference.
b. Illocutionary act: the communicative force that accompanies a sentence, such as asking, questioning and promising, among others.
c. Perlocutionary act: the effect on the receiver, either on their feelings, thoughts or actions.

Also, speech acts can be divided into two types according to Austin [11]: direct acts, and indirect acts. The direct acts are those statements in which the sequence and illocutive aspect coincide, that is, the intention is expressed directly. The indirect acts

are those phrases in which the sequence and illocutive aspect do not coincide, therefore the purpose of the sentence is different from what is expressed directly.

Searle [12] proposes as classification of the illocutionary acts the assertions, directions, commissions, expressions, and declarations.

In the acts of assertion, the intention of the speaker is to express to the receiver how things are, the correspondence address is of words to the world; the condition of sincerity, that is, the one that expresses the psychological state of the speaker in carrying out the speech act, is to believe that the proposition is true.

In the acts of direction, the intention of the speaker is to make the receiver do something. The correspondence address is from the world to the words; the condition of sincerity is desire.

In the commission acts, the speaker's intention is to commit to a future act. The correspondence address is from the world to the words and the condition of sincerity is the intention.

In the acts of expression, the intention of the speaker is to express their feelings and attitudes. There is no correspondence address, since, when performing an act of this type, the speaker will try to make the correspondence address from the world to the words or vice versa.

In the declaration acts, the speaker's intention is to cause a change in the world through the statements that she/he utters. The correspondence address can be from the world to the words or the other way around, there is no condition of sincerity. For a better understanding of the classification provided by Searle, Table 1 presents examples of each type of illocutionary act that has been taken from Alanis [13].

Table 1. Types of illocutionary acts.

Type	Example
Assertive	statements, claims, hypothesis, descriptions, explanations, and reports
Commissive	promises, vows, oaths, offers, or threats
Directive	suggestions, challenges, requests, questions, orders, and mandates
Declarative	baptize, bids, blessings, name, inaugurate, and dismiss
Expressive	apologies, complaints, congratulations, thanks, deplores, and condolences

Based on the analysis of definitions of types of speech acts, it was identified that it is necessary to have a database or corpus of phrases, where the possible answers are stored, which is a fundamental part of this project for the good functioning of the system.

In the field of linguistics, according to Torruella [14], the word corpus is a somewhat ambiguous word, and it is currently used in a general sense to refer to any type of compilation of texts. Then the appropriate corpus will be made to classify according to the speech acts previously seen. The following section presents the proposed methodology that should be followed to accomplish such task.

4 Methodology

The methodology proposed for the creation of a corpus consists of four stages: 1) Obtaining the dialogue; 2) Obtaining the sentences; 3) Analysis and classification of sentences; and, 4) Generation of the specific corpus.

In stage 1, a dialogue was collected as an example of a real conversation in an educational environment, for its use in the analysis. At this point, Google's ListNote application [15] was used to record the phrases of the conversation, from a questionnaire given by a teacher to his student.

In stage 2, with the written dialogue, we proceeded to pass it to a file where each of the sentences was broken down, eliminating errors when recording and completing some words, which many times, due to the low tone of voice, the application does not reach to distinguish.

In stage 3, once the necessary sentences were collected, each one was analyzed and classified through speech acts previously investigated, and with this, selecting the most appropriate for an intelligent virtual agent to serve as an instructor in the educational environment.

In stage 4, the selected phrases are finally collected for the creation of the corpus, which will serve as the speech acts of a conversational virtual agent in an ILE.

5 Results

In this section,we present results obtained for the application of a methodology for the creation of a specific corpus, proposed in this work.

The first stage was the obtaining of dialogue, in this case, so that the dialogue was real, some mentioned phrases were recorded in an educational environment, where the instructor is a teacher and the user is a student of the basic math material. The dialogue consists of 29 sentences with 435 words. Below is a part of the dialogue obtained:

> *"Hello, good afternoon. How can I serve you seriously extra? Good afternoon? I have the doubt in this problem, you are in love, and you do not pay attention to the class. Hehe, not the teacher as I believe I want to know what it is What operation is the one that I will solve first to be able to continue passions is a equation ma of fractions with multiplication of fractions with square roots okay To begin what is your first doubt for the next thing you need law of order you know what is the law of order roots multiplication with exponents and root then here I am going to draw what is the root of 9 and under the same the whole problem and now where do I have the root I put in what is the 3 What is the square root 9 "*

The second stage proposed in the methodology was obtaining the sentences, where the sentences of the dialogue are separated to give them order and clarity, so that we can work with each one of them. The dialogue is not very clear in some sections, or the words appear incomplete, since the application cannot clearly understand them when the dialogue is performed with low voice.

Once the sentences were separated, it proceeds with the identification of the actor involved with each of them; the results from such task are shown in Table 2. There, the actors identified were the student and the Professor involve in the dialogue derived from the case of study.

The main idea under the case of study is to represent through an IVA, the speech act of instructor in an educational environment. The IVA must act as a teacher in such a way that it incorporates a direct, serious and firm character in its speech such that it maintains the order within a class room. To achieve this purpose, the third stage of the methodology analyze each sentence shown in Table 2 in order to describe and classify it according to the revised speech acts theory.

Table 2. Dialog phrases.

Actor	Phrases
Professor	Hello good afternoon, How can I serve you?
Student	Good afternoon, I have a doubt in a problem
Professor	Surely you are in love, and do not pay attention in class.
Student	Hehe, not master as he believes
Professor	What kind of operation do you want to solve?
Student	It is an equation of fractions with multiplication of fractions and square roots
Professor	Okay To begin what is your first doubt
Student	Where to start if the problem is 5 (1/4) + (2/3) -√9
Professor	For the following you need law of order, do you know what the law of order is?
Student	Yes, first the roots and exponent are solved, then multiplication and divisions and at the end, addition and subtraction. So here I'm going to take root first of 9?

Table 3 summarizes the results obtained from this step. In column 2 are shown the sentences from the dialog that corresponds to its locutionary act. Column 3 shows the description obtained from analyzing the intentions in the locutionary act, which were obtained by interpreting the real intentions of the subject of study (i.e. the teacher). Column 4 shows the description obtained from analyzing the real effect of the locutionary act, which was obtained through the examination of the sequences of statements and the impact among the interlocutors. Columns 5 and 6 presents the classification according to the type of speech acts (TSA) and the type of illocutionary act (TIA); this classification is derived from the comparison among the concordance among the illocutionary, and perlocutionary acts.

Let us point out that those that do not comply with the overall purpose of the dialogue and the context are highlighted in bold.

Finally, in the stage four it is generated the specific corpus. After having classified the sentences, it was determined that the speech acts need the direct type, since the direct phrases are very clear and do not hide another meaning in the sentence, so the agent would be understood easily which is one of the purposes. Also, an agent must use the directive illocutionary act type, since, like any instructor, the user must be questioned, guided and given instructions.

In the case of the study the other interlocutor besides the instructor is a student; this situation obligates an instructor to be firm and consistent in his/her dialogue in order that the student achieve his/her goals.

The phrases that were eliminated are of the indirect type. They do not comply with the formal behavior of an instructor. In order that an IVA succeed it cannot be assumed on its design that there is trust from the students at the beginning, or that the agent has prior knowledge of their life, without that information an indirect speech act is impossible.

Once the sentences that do not correspond have been eliminated, the final corpus will have the selected phrases shown in Table 4. It should be mentioned, as in the previous examples, that only a small part of the entire dialogue is being integrated.

Let us observe it is desirable to organize the phrases on the corpus according to an expected characterization that are suitable for the specific application of an IVA in a ILE. This way it is possible to progress in the automation of the dialogue generation used in interactions with human beings.

Table 3. Analysis of sentences.

#	Locutionary	Illocutionary	Perlocutionary	TSA	TIA
1	Hello good afternoon, How can I serve you?	Say hello and ask what you can do	He is greeted and receives service	Direct	Directive
2	Good afternoon, I have a doubt in a problem	Say hello and declare a doubt a problem	Corresponding greeting and declares the doubt	Direct	Directive
3	**Surely you are in love, and do not pay attention in class.**	**It means that he is distracted and does not pay attention**	**He's joking to break the ice**	**Indirect**	**Declarative**
4	**Hehe, not master as he believes**	**Laughs to be nice and denies being distracted**	**The joke corresponds**	**Indirect**	**Expressive**
5	What kind of operation do you want to solve?	Ask about the type of operation	Ask about the type of operation	Direct	Directive
6	It is an equation of fractions with multiplication of fractions and square roots	Describe the type of equation	Describe the type of equation	Direct	Directive
7	Okay To begin what is your first doubt	Ask for the first doubt	Ask for the first doubt	Direct	Directive
8	Where to start if the problem is 5 (1/4) + (2/3) -√9	Do not know where to start and declare the problem	Do not know where to start and declare the problem	Direct	Directive
9	For the following you need law of order, do you know what the law of order is?	Explain what you need and ask if you know	Explain what you need and want to know if you know	Direct	Directive
10	Yes, first the roots and exponent are solved, then multiplication and divisions and at the end, addition and subtraction. So here I'm going to take root first of 9?	Explain the law of order and ask if it's okay as it starts	Explain to check what you know and ask if it's okay	Direct	Directive

Table 4. Corpus of selected phrases used by professors or students in ILE.

Actor	Corpus of phrases
Professor	Hello good afternoon, How can I serve you?
Professor	What kind of operation do you want to solve?
Professor	Okay To begin what is your first doubt
Professor	For the following you need law of order, do you know what the law of order is?
Student	Good afternoon, I have a doubt in a problem
Student	It is an equation of fractions with multiplication of fractions and square roots
Student	Where to start if the problem is 5 (1/4) + (2/3) -√9
Student	Yes, first the roots and exponent are solved, then multiplication and divisions and at the end, addition and subtraction. So here I'm going to take root first of 9?

6 Conclusion and Future Works

This research work proposes a speech acts approach to analyze the dialogue from a specific context to generate corpus of phrases. For the elaboration of the specific

corpus, a methodological application was made to analyze sentences of a real dialogue, through speech acts, which led to classifying the sentences and selecting only those that fulfilled the function of a teacher and a student. The case of study to test the proposed methodology was a learning environment.

Specific phrases were selected for an intelligent learning environment, focused on education, through the analysis of speech acts, creating a guide for the conformation of a specific corpus. The results shown that it is possible to eliminate redundant or unnecessary phrases from a dialogue in a specific context. Also, it was possible to characterize the sentences involved in the dialogue according to speech act theory.

From here a broader study can be made with more dialogues to analyze and shape the corpus suitable for the instructor agent. It also leaves a previous work for the characterization of the phrases using the BDI architecture, with this the agent will be able to select the best answer for the user.

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