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Abstract. In the domain of language acquisition, PILÉFACE is a system that has been initially designed to take into account the pragmatic aspects of language, i.e. to provide the learner not only with a linguistic competence, but also with a communicative competence. That communicative competence implies that the language learner master certain pragmatic usage rules, which are mastered by the native speaker, but unspoken and unwritten, and therefore implicit. In that context, PILÉFACE is readily equipped to take into account many socio-cultural aspects of communication exchanges. In this paper, starting with culture-aware pedagogical dialogues, we show which types of cultural aspects may occur in such dialogues, how these cultural aspects are actually implemented in the data organization and system architecture of PILÉFACE, and how they could be extended using the same architecture.

Keywords. Intelligent tutoring systems, language learning, pragmatics, communicative situation, communication intention, linguistic realization, cultural factors, architecture, system design.

Introduction

In language learning, the learner is expected not only to acquire a *linguistic competence*, i.e. to assimilate lexical and grammatical knowledge and correctly use that knowledge, but also to acquire a *communicative competence*, i.e. to adequately express her communicative goal in a given communicative setting (for a change, we use the feminine as our generic gender). To do so, she must be aware of the relevant parameters describing a given situation and to choose accordingly which linguistic production to use in order to express her goal. This can be done by using certain *pragmatic usage rules*. Indeed, the pragmatic aspect of language is defined as "those linguistic investigations that make necessary reference to aspects of the context, where the term *context* is understood to cover the identities of participants, the temporal and spatial parameters of the speech event, and [...] the beliefs, knowledge and intentions of the participants in that speech event, and no doubt much besides" [20, p. 5]. Pragmatics thus refers widely to *implicit knowledge*. And making implicit knowledge explicit is a difficult and challenging problem of artificial intelligence, in particular in conjunction with common sense representation and reasoning [9, p. 13].

Most pragmatic usage rules used in everyday communication are mastered by the native speaker, but unspoken and unwritten, and therefore implicit. Because of the importance of

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these usage rules in the communicative approach [8], we were interested in a computer program that could take them into account in foreign language teaching, in our case French as a second language [18]. This endeavor to define implicit and explicit knowledge progressively led us to more fundamental research questions [7]. Since pragmatic knowledge is widely implicit and encompasses socio-cultural aspects, PILÉFACE is readily equipped to take into account many socio-cultural aspects of communication exchanges. The paper [15] describes what making something explicit means; here, we concentrate mainly on the cultural and pragmatics aspects of the PILÉFACE system.

First, section 1 recalls the initial objectives and motivations of PILÉFACE, and present similar more recent systems. Then section 2, using pedagogical examples, shows how cultural aspects come into play. Section 3 describes more formally which types of cultural aspects may occur in PILÉFACE, and section 4 shows how the capabilities to deal with them are implemented. Finally, section 5 shows how it could be possible to extend these culture-aware capabilities to account for other languages and cultures.

1. PILÉFACE rationale and similar systems

The PILÉFACE system (for "Programme Intelligent pour les Langues Étrangères Favorisant l'Approche Communicative de l'Enseignement", i.e. Intelligent Program for Foreign Languages Fostering the Communicative Approach to Teaching) is primarily meant to establish and implement the relationships between, on the one hand, a *situation or context description* and a *communication intention* and, on the other hand, the *linguistic production(s)* adequately expressing that intention in that context.

1.1 Goals of PILÉFACE

PILÉFACE was designed with three goals in mind, more completely presented in [18]:

- *a short term linguistic goal*, which conceptually meets the initial needs: to have the computer program process the *language pragmatic aspects*; as a result, the student will use the keyboard and screen, and other artifacts, only to simulate linguistic realizations that are verbal exchanges (utterances); that is the problem-solving aspect or goal;
- *a medium term ergonomic goal* : the study of the *system interface* "*intelligence"*;
- *a longer term tutoring goal*, which every intelligent CALL system should tackle: an adequate *user-learner modeling*, and thus a strong adaptation of the system to the user.

As it turns out, the development of PILÉFACE has dealt essentially with its problem-solving and tutoring abilities, less with its interface capabilities or intelligence. In this paper, our discussion is also focused on the linguistic and tutoring goals of PILÉFACE, namely taking into account the pragmatic aspects of speech acts, and to their cultural implications and consequences, and how these aspects interact with user modeling.

1.2 The three operating modes of PILÉFACE

The system is to operate under one of three modes. In *generation mode*, the system is to produce *utterances* consistent with the proposed communication situation and the proposed

communication intention, as a student would do. In *analysis mode*, the system is to determine whether, how and why an utterance, proposed by a student for instance, is or is not consistent with the predefined communication situation and intention. In *tutoring mode*, the system is to exhibit the capabilities of the above two, but also some additional dialogue and feedback capabilities. Note that, although the implementation details of the third mode are outside the scope of this paper, its design is best suited to give examples of cultural aspects that PILÉFACE is equipped to account for.

1.3 Other culture-aware systems

Certainly pragmatics had been tackled in computational linguistics long before our research started [1], but not (to our knowledge) its incorporation into a program aimed at second language acquisition. However, since then (and fortunately), some other systems have been developed or are being developed, much more sophisticated!

For example, the *Croquelandia project* is an "online immersive environment designed to help students develop more sophisticated language skills" [21], in various Spanish-speaking cultures. The project leader is Julie Sykes, a Ph.D. candidate in Spanish and Portuguese studies. Croquelandia was built using *Croquet*, an open source software development environment that makes possible the creation of multi-user virtual worlds. More details can be found in the paper by Andrew Cohen [5], one of Sykes's supervisors.

Another major project dealing with pragmatics and therefore with culture is the *Tactical Language Training System (TLTS)*, led by Lewis Johnson and his colleagues [11] using educational animated agents. The Tactical Language Training System helps learners acquire communicative competence in spoken Arabic and other languages. An intelligent agent coaches learners, assessing their mastery and providing tailored assistance. Learners then perform missions in an interactive story environment, where they communicate with autonomous, animated characters. The team's fundamental hypotheses are that such a learning environment will be more engaging and motivating than alternative approaches, and will lead to more rapid skill acquisition.

A project using TLTS is *Tactical Iraqi* [10], an educational game using video-game-like visuals and also speech recognition rather than written responses. In that application, "Each language training package is designed to give people enough knowledge of language and culture to carry out specific tasks in a foreign country, such as introducing yourself, obtaining directions, and arranging meetings with local officials." (p. 291). However, the TLTS team considers *Tactical Iraqi* as more than a game [13], and even describes TLTS as "a serious game for learning foreign language and culture", since "The language courses delivered using TLTS have a strong task-based focus" (p. 307).

2. Examples of culture-aware pedagogical dialogues

In a type of exercise that the system deals with, the student is placed in a communication situation, i.e. the computer plays the role of the person whom the student is talking to (the student's addressee), and presents her with the situation parameters and the communication intention. Unlike to Croquelandia, the student's reply is open. An example of such an exercise is the following (text presented by PILÉFACE, in the learner's native language):

I am one of your professors, French, stand-offish and severe. You are a first year student, somewhat timid. You pass by me in a hallway of the Computer Science building of the University, in September, in the afternoon of a recess day. You are with friends of yours, whom you would like to impress. I am the professor whom you would like to greet to show your friends that you already know me well and that I already know you. How do you greet me?

We now present what could be three typical exchanges between the student and the intended PILÉFACE system following the above exercise statement. These exchanges have been set up by Diane Huot, a colleague specialized in language acquisition, based on her practice. They illustrate not only the typical adaptation of the teacher's pedagogical practice to the learner's reactions or behaviors, but also the variety of cultural aspects that may come up in the student's answers. The student's input is preceded by "**", and our comments are right-indented with respect to the computer-student dialogue.

2.1 First example

In this example, the learner is supposed to be known as analytically minded, and is therefore invited by PILÉFACE to some reflection about his or her own interventions.

** *Bonjour, Monsieur.*

Very good!

But will your friends have the impression that you know me more than they do?

This PILÉFACE intervention starts a reflection about the student's production. The learner will eventually give a good answer because she will have become aware of the need to add something to or subtract something from that production.

** *Yes.*

Oh, not at all! Unless you want to hide the fact that you know me... Try again.

PILÉFACE continues the meta-linguistic reflection discussing the initial "Bonjour, Monsieur".

** *Bonjour, Monsieur. Comment allez-vous?*

Well done, bravo!

The student's production (utterance) is in conformity with the parameters of the reference context. Here again, we could imagine another reflexive intervention, summarizing the elements contributing to the appropriateness of this answer.

2.2. Second example

In this example, the learner has been recognized as "global" in the learner model.

** *Bonjour, Monsieur.*

The student's production is the same as above.

Very good!

But your friends will not know that you know me better than they do. Try again!

This software intervention shows the learner, directly and without telling why, that her reply is not totally adequate.

** *Bonjour, Monsieur le Professeur [+ gesture: slap on the back]*

The system should have the capability to allow at any time the learner to give non verbal indications on what she would like to do: gestures, voice tone or intensity,

wink, smile, etc. This capability could be implemented simply, e.g. by pointing on the screen (e.g. via a light pen or mouse, or even directly with the finger) one of the pictograms displayed for that specific purpose by the system at the dialog start, or in a more sophisticated way, e.g. by using animated agents [4 papers].

Oh no! Inappropriate, that slap on the back! Try something different!

Here again, the system emits a verdict.

*** Bonjour, Monsieur. [It is impossible to show my friends that I know you well.]*

OK. We'll come back to this again later.

Using the hints she received, the learner could not do better. The system considers that situation as still not mastered, and will return to it later, not to discourage or exasperate the learner by insisting further or by giving too numerous explanations

2.3. Third example

Here the tutor's pedagogical behavior is of a mixed type. This example also illustrates the influence of geographic and cultural parameters on the student's production.

*** Salut, Monsieur!*

"Monsieur", is fine, but "Salut" is too familiar. Try again.

*** Salut, Monsieur le Professeur.*

Oh no! You insist in being impolite?

*** No*

Then try again.

*** Bonjour Ruddy!*

Can you really call a teacher by his first name, when you barely know him?

*** In Quebec, yes.*

Then it is OK, I accept your argument.

But I am French, and, besides, standoffish and severe. Thus try again.

*** Bonjour, Monsieur.*

Yes! But if you want to give your friends the impression that you know me more than they do, then add "Comment allez-vous?". Thus you'll say: "Bonjour Monsieur! comment allez-vous?" (but not "Salut", by all means!)

The student has tried four times to answer the exercise. Rather than returning to it later, the computer-tutor chooses to complete the student's answer immediately.

3. Which types of cultural aspects may occur?

The above examples show at least two cultural aspects appearing into this type of exercise: a slap on the back, and more relaxed rules used in Quebec for adopting a familiar addressing style. More generally, what types of cultural aspects may pop up? We distinguish here extra-linguistic knowledge, or world knowledge, and linguistic knowledge.

3.1 World knowledge

Preston [22] counted *n* = 50 *input parameters* (pp. 34-35) influencing the language variation or *output parameter*, here the utterance expressed in a communicative situation. One approach to make these influences explicit would be to construct a correspondence table with 50 + 1 columns, but that would be unrealistic. Another approach consists in expressing the relationships between input parameters and the output parameter as *rules*, but without each rule enumerating in its conditions the relevant value(s) of *every* input parameter. In this approach, instead, each rule would take into account in its premises only *a small number of parameters* (2 or at most 3), and would provide in its conclusion, not the value of the output parameter (impossible since the latter depends on about 50 parameters, not 2 or 3), but the value of some *intermediate parameter* (to be defined), summarizing the premise parameters. The way to construct these rules and to chain them to one another is implicitly directed by a *structure* and possibly a *precedence order* on the input parameters as such. One of the main problems that PILÉFACE tries to tackle is precisely *making explicit such a structure*, which also constitutes one of its originalities.

Rather than simply stating such rules in a random fashion, we also attempted to categorize them in the process. We did so in a somewhat arbitrary way and following a terminology specific to PILÉFACE since this categorization is still exploratory and rapidly changing. However, through this categorization, we defined an *ontology of variables and rules describing a communicative situation and their inter-relationships*. For lack of space, I give only a summary here (specific examples are in [15]):

- *Typological rules* are the simplest, for the knowledge they carry is not reasoning knowledge. They express a simple categorization or reformulation of a state of fact.
- *Situational rules* are rules directly related to the type of situation in which the actors interact. They may further be subdivided into spatio-temporal rules, socio-cultural rules, and relational rules (note that, by default, socio-cultural rules most often have consequences of a relational nature, but that the converse does not hold in general).
- *Behavioral rules*, in contrast to situational rules, which describe a situation in a static way, express how someone may behave in this type of situation. We may further subdivide them into rules related to the situation itself (shared by everybody in a given culture) and rules related to the actors' personality (depending on the actor, any such rule may thus be arbitrarily replaced by another one stating the contrary).

Such rules are at the core of the rule structuring and variables hierarchies of PILÉFACE, as part of the system modeling [17]. However, because of their number and fuzziness, not all of them have been implemented or tested (is such a task feasible?). This part of PILÉFACE is likely to remain an ongoing project (volunteers welcome!...).

3.2 Linguistic knowledge

Linguistic knowledge *or language rules* (here related to the French language) as such are usually better formalized and categorized, and we only briefly evoke them here, but giving in each case examples or culture-aware knowledge. Using the traditional separation between the four fields of linguistics, we can distinguish:

- *Language attitude rules* or *pragmatic rules*, such as the slap on the back (if non-verbal behaviors are implemented or simulated), the addressing rules, the formal vs. informal addressing rules (in French "tu" vs. "vous"), etc.;

- *Semantic rules*, like the appropriate use of affectionate terms of address (e.g. “honey” in English, or “chou” or “lapin” in French, are not immediately translatable into the other language);
- *Syntactic rules*, like the agreement consequences of using the formal or informal style, or the possibility to repeat the greeting formula in Quebec (e.g. “Bonjour bonjour!”);
- *Lexical rules*, like the use of “Adieu” to mean “Hello” in Switzerland, or the use of “Bonjour” to mean “Good bye” in Quebec.

All these linguistic rules are actually known and used in PILÉFACE.

4. Implementation of these cultural aspects in PILÉFACE

How is PILÉFACE equipped to deal with these various cultural aspects of communication exchanges? To answer that question, it is convenient first to remind the reader of the *data organization* and of the *system architecture* of PILÉFACE (see [14] for more details). Only then we show *how the various cultural aspects* examined in 3 fall into this architecture.

4.1 Data organization: problem specification

To construct the PILÉFACE system, we first had to organize and specify the problem data, i.e. completely describe the communication intention, the communication situation, and the corresponding linguistic production or form, here an utterance.

The *communication intention* or goal [2, 23, 24] is the simplest, since it is clearly specified. In fact, we had to restrict the expertise domain of our system [6] and, in order to abide by the communicative approach principles, we chose the communication intention as the criterion used to do so. In its first version, our system thus only deals with the intention of *greeting someone* in a face-to-face setting, since it is one of the first communication goals expressed by an individual. Other possible intentions to communicate are: excusing oneself, saying goodbye, or making a request.

The *communication situation* was the most complex problem data to formalize. To describe it, we developed a model [16] that meets several interesting criteria. The main one is that it separates the elements describing the situation, or *situation parameters*, from the social, cultural, affective, psychological, and economic elements, or general knowledge associated with them, which is independent from any particular situation and thus can be stored in permanent external knowledge bases. This knowledge is necessary to fully interpret the implications of the situation parameters and to make proper inferences from them. For the interested reader, [15] show in detail the groups of parameters we have identified so far, as well as the general external knowledge associated with each group.

The last component of the problem data is the linguistic form or *utterance* used to express the communication intention, here greeting someone. Utterances are described by a formal BNF-type grammar and by sets of rules of different kinds: *syntactic* (agreement rules for instance), *semantic* (only certain adjectives may be used to address the interlocutor), and naturally *pragmatic* (to make the utterance components appropriate to the situation). Our grammar specifies three main components for a greeting utterance: a *greeting formula* like “good morning”, “hello”, “hi”, etc. (only mandatory component), a *term of address* like “Sir”, “Professor”, a first name, “honey”, “you”, etc., and an *inquiry*

like “how are you?”, “OK?”, etc. This knowledge is also stored in an external problem-independent base. Finally, a dictionary (not detailed here) is used to describe and store the various terms that may appear in a target-language utterance (here a French utterance).

4.2 Reasoning mechanisms and system architecture of PILÉFACE

The reasoning mechanisms of the PILÉFACE system result from two fundamental decisions about the flow of knowledge from the communication situation and intention to the corresponding utterance(s) to be generated or analyzed. These decisions allow us to define the exchange style and the summarized context, which can then lead us to define the system architecture.

4.2.1 Exchange style

The first decision is *theoretic*. It consists of separating the linguistic aspects of the problem, characterizing the utterance, from the other aspects (sociological, cultural, geographical, and psychological) identified in 4.1, characterizing the situation. We thus defined an arbitrary border, the *exchange style*, as a compulsory intermediate step of the system cognitive process. Its definition is based on the following criterion: if we were interested in teaching English or Spanish rather than French as a target language, the rules *constructing* the exchange style from the given communication situation description would be left unchanged (in a given culture, see 4.3 and 5), whereas the rules *using* the exchange style to derive and generate or analyze possible utterances would have to be modified according to the selected target language. Incidentally, that separation led us to realize that some communicative situation parameters influence the exchange style, while some others (e.g. addressee’s name or time of day), used only in the utterance generation or analysis, do not.

4.2.2 Summarized context

The second decision has an *empirical* basis. It consists of extracting from the description of the communication situation (complete and possibly complex) some information that is perceived to be *necessary and sufficient* to derive the utterance(s), or the exchange style. Indeed, this complete description can be quite complex; for example, Preston [22], by studying and comparing the classifications of variables made by various authors, showed that about 50 factors may influence the linguistic form (in our case, the final utterance). The main reason underlying this decision is to circumvent the combinatorial explosion, by describing the current situation with a higher, more general abstraction level [19]. That extracted information constitutes the *summarized context.*

4.2.3 System architecture: three serial modules

Thus, on the reasoning chain going from the given situation description (and communication intention) to the linguistic form (or utterance) to be produced or analyzed, we defined at least two compulsory intermediate passage points, i.e. the summarized context and the exchange style, in that order. In a divide-and-conquer way, these two passage points led us to model the cognitive process of PILÉFACE as a serial set of three different *inference engines*, each one having its own permanent knowledge base:

- the *extractor*, which takes as input many situation parameters (in particular the behaviors, attitudes and roles of the actors) and produces the corresponding *summarized context*;
- the *formalizer*, which takes as input the summarized context and "converts" it into the *exchange style* that will characterize the final utterance;
- the *generator* and the *analyzer*, respectively in generation mode and in analysis mode (see section 1), which take as input the exchange style, the intended communicative intention, and a few other situation parameters, and produce either *one or several utterances* (generation mode), or a *diagnostic of the submitted utterance* as to its appropriateness to the situation (analysis mode).

At present, we have essentially implemented the formalizer, the generator, and the analyzer. A fundamental and extensive theoretic study in linguistics has been attempted (volunteers welcome!) to define and model the various situation parameters and their interrelationships, so that we could, starting with a (possibly very complex) situation description, (almost) automatically build the summarized context.

4.3 How the cultural aspects fall into the architecture of PILÉFACE

The correspondence between the general framework describing the types of cultural aspects to take into account (making the implicit explicit) and its instantiation in the PILÉFACE architecture is summarized in figure 1. As stated earlier, the extractor is only partly designed, and thus most of the situational and behavioral rules are not implemented. However, this is not by accident: these usage rules, which are probably the ones in greater number, are the most difficult to be made explicit, and that probably explains why making them explicit is still a fundamental research problem in linguistics. As a result, designing the extractor would be the most difficult part of the system, but also the most rewarding.

GENERAL FRAMEWORK			PILÉFACE IMPLEMENTATION
Parameters	Input parameters (communication situation)		Problem statement (or situation description parameters)
	Intermediate parameters		Summarized context Exchange style
	Output parameters (linguistic realization)		Generated utterance(s)
Rules	(Typological knowledge)	"Typological"	All knowledge bases
	Pragmatic (world) knowledge	"Situational" (all ?)	Extractor knowledge base
		"Behavioral" (most ?)	Formalizer knowledge base
	Semantic and syntactic knowledge	"Linguistic" (all)	Generator knowledge base Analyzer knowledge base

Figure 1. - General framework (cultural factors) and PILÉFACE architecture.

5. Extensibility of the culture-aware capabilities of PILÉFACE

The PILÉFACE system has been designed and built to take into account the pragmatic aspects of French. To apprehend really what its culture-aware capabilities are, it is

necessary to examine what should be done to extend its capabilities to take into account the pragmatic aspects of another target language. The answers to that question depend on the considered target language, but even more on the culture in which that language is inserted. We distinguish two cases, depending on whether we stay in a Western culture, or if we move to a culture other than Occidental.

5.1 In a Western culture

In all Western cultures, the knowledge contained in the knowledge bases of the Extractor and the Formalizer (world knowledge) is essentially the same (but not identical), with a few linguistic variations. For example, Brown and Levinson [3] have identified some "politeness universals in language use", which have then been exploited by Johnson et al. [12] as tactics for their pedagogical agents: as regards German and US English "Politeness ratings are remarkably similar between the two languages and cultures." (p. 304). More specifically, all Western languages have a formal way and an informal way to address a person ("tu" vs. "vous" in French, "tu" vs. "Lei" in Italian, "tu" or "vos" vs. "Usted" in Spanish, etc.), if we except English (which has "you" as unique addressing pronoun). The distinctions between these addressing styles are roughly the same in all these languages, except for regional variations (e.g. the one mentioned in the example 2.3).

As for implementation, it is mainly the proper linguistic knowledge, i.e. the one encompassed in the Generator or Analyzer, which must be changed according to the target language (and that linguistic knowledge is to account for the regional variations).

5.2 In a non-Occidental culture

However, the variations are much more important between a Western culture and a non-Occidental one, as well as between non-Occidental cultures. Examples of such cultures are African, Islamic, or Asian cultures (and each of these adjectives encompasses several cultures). Indeed these variations encompass behaviors and attitudes in addition to oral expressions. For example, in Thailand (a country that I, a Western professor, visited for several successive months), the social hierarchy goes from Buddha at the top, down to the King, to monks, to parents and teachers, in that order; teachers are thus relatively high in that hierarchy, to such an extent that there exists a "teachers day" in all schools and universities. For example, still in Thailand, dressing for work or for school is very important and can be perceived as constraining to a Westerner: on the one hand, I had been surprised, during my first extended visit to Australia, to see a colleague give his class dressed in his shorts (which we certainly would not do in France or in Canada!); on the other hand, building on that experience and erroneously transposing it to Thailand, I thought that I could at least go to the university in my shorts on a particularly hot day when I was not teaching, but one of my students, accidentally seeing me, made me understand (not directly, because of the deference due to teachers; see above) that my dressing was not appropriate, even if not teaching, because I was a professor. As a third and last example, the "family" plays a more important role in all African cultures and in Islamic cultures than in the Western ones, by its size and also by its social and spiritual roles.

Such diverse cultural factors are widely independent from the language, and are "above" the language. If the corresponding knowledge were to be encoded in a

PILÉFACE-like system, it would be mainly enclosed in the Extractor and possibly (to a lesser extent) in the Formalizer knowledge bases, where roles, attitudes and behaviors are accounted for. Of course, in addition, and assuming that the PILÉFACE architecture can still remain (which may be debated), the language-specific factors would have also to be coded, in the Generator and in the Analyzer knowledge bases, like for Western languages.

Conclusion

Starting with culture-aware pedagogical language-teaching dialogues, we have shown which types of cultural aspects may occur in such dialogues, how these cultural aspects are actually implemented in the data organization and system architecture of PILÉFACE, and how they could be extended using that architecture. Thus, PILÉFACE is readily equipped to take into account many socio-cultural aspects in the communicative situations it handles. This is not surprising since cultural factors are addressed when dealing with pragmatics, and dealing with pragmatics (as part of the communicative approach to language acquisition) is the main purpose of PILÉFACE, and the initial reason for its development.

However, these cultural aspects are but a part of the cultural factors to be taken into account in an educative system, especially (but not only) on the Internet, where teaching methodologies and instructional design cannot always be universally applied. Indeed, through their underlying preconceptions, their impact can greatly vary from one culture to another, and the Internet addresses simultaneously all possible cultures. More generally, such a wide cultural awareness should be incorporated in any system that aims to be efficient from the communication standpoint: teaching and learning are such domains, but also marketing, advertisement, politics, government, etc. The difficulty here is to be clear and transparent while respecting all cultures.

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