TR-IT-0037

French Surface Form Generation in Transfer-Driven Machine Translation

Pierre-Francois Seri, Yasuhiro Sobashima
Osamu Furuse and Jun Kawai

January 1994

Abstract

This report describes French surface form transformations in Transfer-Driven Machine Translation (TDMT). It describes the generation component integrated to the TDMT prototype for translation from Japanese to French. The requirements for French generation are explained in detail with the techniques used to implement them.

Keywords

Transfer-Driven Machine Translation, Surface Form Generation.

Contents

List of Figures

Introduction

Machine translationv as all the research fields of natural language processing by computer is a very challenging subject. A lot has been achieved during the last two decades. Translation sytems are already available on the market and prototypes have been developed in research laboratories. The accomplishements are still tiny relatively to the remaining problems. The conventinal methods that have been developed twenty years ago and that are the basement of most of the studies completed in machine translation turned out to be insufficient. Thus, new methodologies have been proposed during this last decade in order to supplement the former ones. example-based translation, early advocated by professor Nagao[9], has now become one of the main translation techniques. Transfer-Driven Machine Translation (TDMT) developed at ATR is a new methodology that makes most of the example-based framework using transfer as the core of translation. It has shown good promise for translation in both directions between English and Japanese.

We describe in this report a generator component developed for the TDMT prototype for Japanese to French translation. The purpose of our work is to determine the requirements for French surface form generation and study the applicability of TDMT to French but also to languages with a rich and complex inflectional system. We only sudied the generation of the right correct syntactic and morphological form of the output French sentence.

In this contribution, we first give an outline of the TDMT and the current state of the prototypes developed at ATR. Then, we describe the main French surface transformation issues and the part of these problems we tackled. Chapters 3, 4 , and 5 give the methods and solutions we found for generating correct sentences. We explained the scope of our work and explain how we compete the syntactic and morphological stages in our study. The requirements and processes of surface form generation are detailed.

A generator component has been implemented and integrated to a TDMT prototype. The results of model conversation translation are satisfactory and encouraging. There are still problems to solve and we brifly outline the main ones that are to be tackled in futur studies.

1 Overview of TDMT

1.1 Outline

Many translation systems are now available on the market. Most of them are conventional sytems that achieve the translations through a very complex analysis of the input source language sentences. However, the grammar rules used in thoses systems turn out be inefficient for the analysis of spoken language. A lot of ungrammatical phenoma are part of the spoken language and cannot be tackled by most of the grammars used in conventional sytems. Thus, in order to achieve translations for dialogues in the field of conference registration, a TDMT system has been developped at ATR using the example-based methodology. The TDMT prototype is a complete transaltion system that makes most of the example-based framework and achieves very efficient translations. The prototype developped for translations in both direction between English and Japanese has shown a great promise and a real applicability of the example-based methodology [1].

1.2 Configuration of TDMT

The TDMT is a transfer centered system. The transfer is regarded as the main task during the translation process. Figure. 1 shows that the transfer module is the core of the system. The system attempts to achieve all translations using only the transfer rules. However, some difficult problems occuring in the source sentences require more information for their translations. To deal with these cases, the lexical processing and analysis modules add the missing information in revised versions of the input sentences. The revised versions are then processed by the transfer module. The generation module is the last stage of the translation. It produces the correct surface forms for the target language sentences. The generation process is the only one that cannot work autonomously. It has to be completed at the end of the transfer. More details will be given about the functions of generation in the next chapters.

1.3 Translation Techniques

1.3.1 Distance Calculation

The distance calculation is the main tool used in the TDMT in order to achieve translations using the example-based methodology. The distance is based on a thesaurus of the source language[10]. The distance between words is the distance between their semantic attributes in the thesaurus. The distance between semnatic attributes is determined accordingly to their positions in the hierrarchy of the thesaurus. Figure. 2 gives an example of the distance caluclation between two words. The distance calculation widens the scope of the example-based methodology because it involves a similarity criteria between words that may be totally unrelated. [1]

1.3.2 Example-Based Transfer

The transfer is achieved using a transfer knowledge that maps source language structures onto their equivalent target language structures [2] [3]. Thus, the transfer knowledge consists of transfer rules whose general scheme is the following :

$$SE \Longrightarrow \begin{array}{l} \mathrm{TE}_1\ Example - set_1(E_{11} \cdots E_{1p}) \\ \vdots \\ \mathrm{TE}_n\ Example - set_n(E_{n1} \cdots E_{nm}) \end{array}$$

The scheme above means that an input expression matching SE can be translated as TE_i in the context $Exampmle - set_i$. The distance calculation between the input expression and the different examples determines the most probable context for the transfer of that input. The transfer rule chosen will be the one with the closest example. Actually, the choice of the most probable mapping does not occur at the level of the transfer rules. The disatnces calculated for the transfer rules used during the translation of the sentence are added and the result is the score of the translation. The candidate with the lowest score is regarded as the best one. Thus, all the possible combinations of the transfer rules that can be applied to the input expression are compared using the distance calculation metric.

[1] For example, an input word W will be regarded as an occurence of the word Wp from the set of example words S (W1, W2,...,Wn) if the distance d(W,Wp) is the minimuffm of the distances between W and the words in the set S. Thus, no real relationship is required between W and Wp.

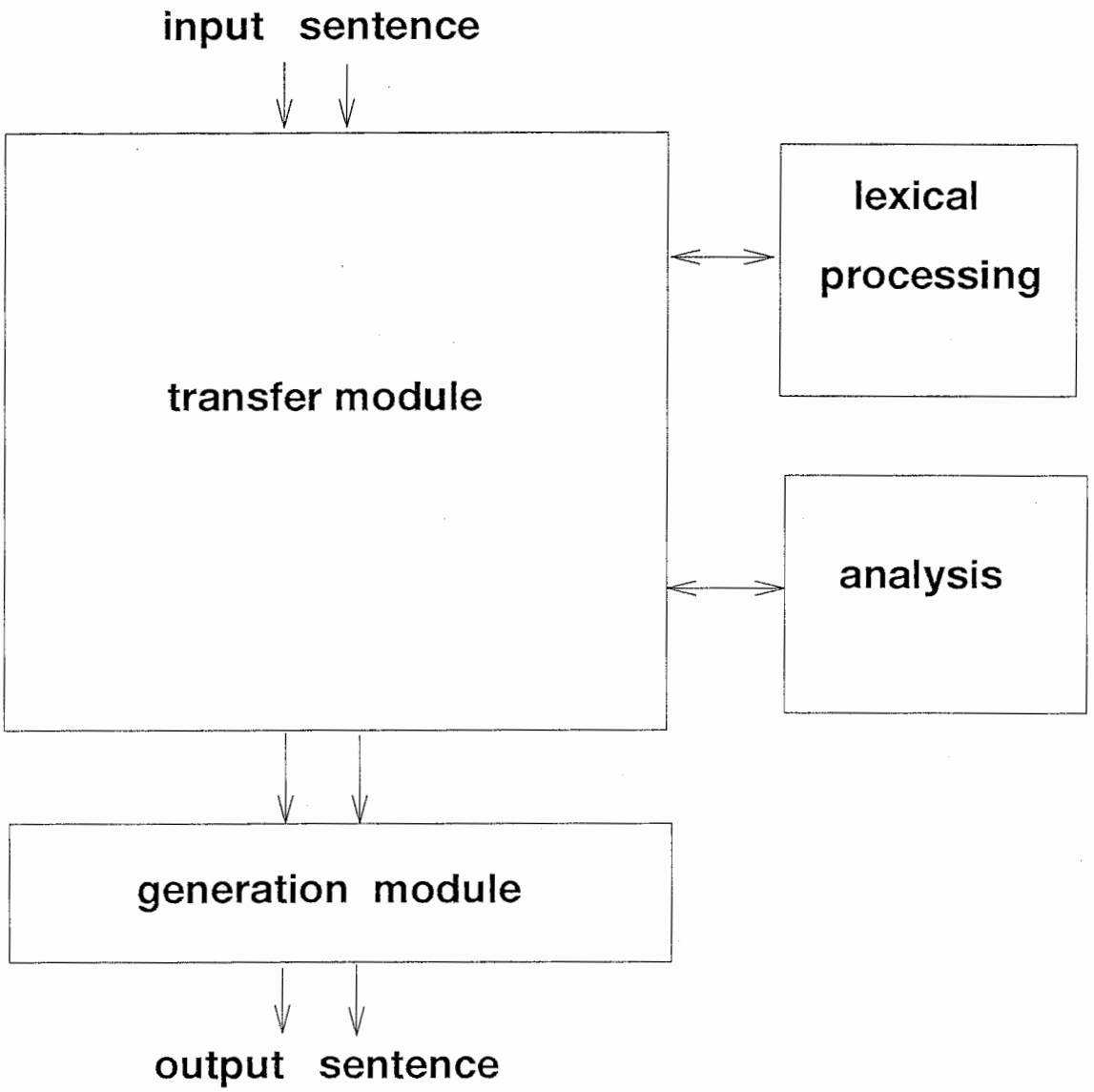

Figure 1: Configuration of the TDMT system.

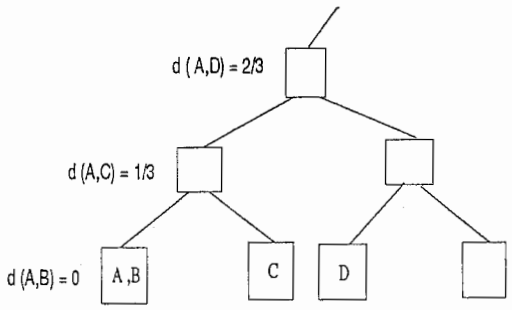

Figure 2: Distance between words in the thesaurus.

There are three different types of transfer rules used in the TDMT:

- string-level transfer knowledge:

The string-level transfer knowledge is especially used to solve the problems of a multiple interpretations in the target language of a single source language word. For example :

$$sochira \Longrightarrow \begin{array}{l} \text{this ((desu \{ be \}) } \cdots) \\ \text{you ((okuru \{ send \} } \cdots) \\ \text{it ((miru \{see \} } \cdots) \end{array}$$

Applying the previous rule to the sentence "sochira ni tsutaeru", the translation of sochira is "you" because "tsutaeru" is semantically closer to "okuru" than to the other examples.

- Grammatical-level transfer knowledge

This transfer knowledge is expressed in term of grammatical categories. The required grammatical information for the grammatical transfer rules are provided by the lexical processing module. The information are not provided by a complex and deep analysis of the input sentence. For example, the following transfer knowledge involves a set of three common nouns [2]:

$$CN_1\, CN_2\, CN_3 \Longrightarrow CN_3'\, of\, CN_1'((kaigi\, kaisai\, kikan)\cdots)$$

That rules allows the translation of "kaigi kaisai kikan" as "the time of the conference". The grammatical-level transfer knowledge is most of the time the mapping of structures defined by the parts of speech of the words they contain onto their equivalent target structures.

- Pattern-level transfer knowledge

The pattern-level knowledge is the main transfer knowledge. It deals with more general mapping rules. Basically, the transfer pattern consists of variables which represent parts of the input expression or structure and a matching part which defines the pattern. For example :

$$?X\ desu \Longrightarrow \begin{array}{l} \text{it is !X (kaigi, kaisha } \cdots) \\ \text{my name is !X (Brown, Nakamura, } \cdots) \end{array}$$

In the translation of "?X desu", the exact translation is determined by calculating the distance between the part of the input expression represented by ?X and the set of examples. There are more complex pattern whose matching part is not a string but a grammatical marker. These markers are provided either by the lexical processing module or by the analysis module. For

example, the following pattern rule is determined by the *Adnominal-mark* marker which is provided by the analysis module for signaling an adnominal expression [3]:

$$?X\ adnominal-mark\ ?Y \Longrightarrow \begin{array}{l} !Y \text{ that } !X \text{ ((iku \{go\}, basu \{bus\}) } \cdots) \\ !Y \text{ when } !X \text{ ((deru \{attend\}, hi \{day\}) } \cdots) \\ \vdots \end{array}$$

The previous rules, when applied to the sentence "Kyoto eki e iku abdominal-mark bus", output "The bus that goes to Kyoto station".[2]

1.3.3 The TDMT System for Japanese to French Translations

A Japanese-to-French TDMT protoype is being developed at ATR. The basic idea was to check the applicability of the example-based methodology to a language with a very rich inflectional system. The syntax of French is not very different from that of English but the required information for agreements and inflexions in French are more difficult to obtain during the transfer stage. Thus, the idea was to tackle the problem of correct surface forms generation in order to determine the required processes during the transfer. The transfer, analysis and lexical knowledge have already been developed for sentences from the model corpus. The results obtained for these sentences show a great promise for the applicability of the method for translations from Japanese to French. Moreover, the results are expected to be better for a language closer to French like English. The generator implemented has been developed to solve the problems of translations from both English and Japanese.

[2]It is obvious that the sentence is not translated by applying only this pattern. But themain part of the sentence, that is to say the adnominal expression is given by the rule.

2 Generation Issues

2.1 Why a French surface Form Generator

The generator described in this report is the last component of the TDMT system we developed for translation from Japanese to French. The purpose of our study of the generation issues for French was to determine the requirements for the generation of French correct surface forms during the translation process. Thus , the generator has been the first implemented component of the Japanese to French TDMT system. The backward approach we adopted allowed us to deal with general issues about French generation instead of issues specific to the TDMT system. Therefore, the experimental results presented in chapter 7. really emphasize the translation capabilities of the TDMT. The results are those obtained during the translations of the model corpus sentences by the prototype developed to test the generator. Actually, the generator has been implemented to deal with generation of output from both sytems tranlating Japanese and English into French. The results are expected to be better for translations from languages closer to French like English. Finally, we can say that Transfer-Driven methodology can be applied to languages with a very rich inflectional system.

2.2 Problems to be Solved

The domain of language in the scope of the TDMT prototypes is the field of *telephone registration for a conference.* The sentences in the model corpus are part of dailogues between a researcher willing to register for the conference and the conference office. In that context, the expected sentences are very polite common French sentences. The unusual phenomena occuring in sentences from domain such as poetry or journalism are not in the scope of our work. Most of the problems tackled in other surface form generators are processed in the TDMT system's generation component :

- word order in the sentence.
- Conjugation of the finite verb in the present, futur, perfect, plus-past, past-perfect, conditional and subjonctive.
- Analysis of the agreements.
- Inflexions of the verbs, nouns, adjectives, articles and the past-participles.
- Elisions including character deletions and word concatenations.

- Generation of relative clauses.

After the study of the model conversation translations, we have decided to divide all the French sentences into two classes that have respective syntactic rules. The subdivision is only based on syntactic criteria. The morphological processes are exactly the same for both classes.

2.2.1 The Interrogative Sentences

The sentences in this class are real interrogative sentences. A real interrogative sentence as we defined it, is a sentence whose interrogative style is stressed by an interrogative syntactic structure. The false interrogative sentences that are considered interrogative because of the intonation of the speaker are not in this class. In order to avoid any confusion with the usual use of the word interrogative, the sentences in this class are called *YNQ* sentences.

1. Quel est votre nom ?
2. Avez vous une fiche ?
3. Que puis je faire pour vous ?
4. Je me demande si tu as une fiche.
5. une fiche ?

All the sentence above but the last two ones are *YNQ* sentences. The last sentence cannot be a transfer output because the TDMT system does not tackle any analysis of pragmatics.

2.2.2 The NORMAL Sentences

Any French expression or sentence that is not in the previous class is a *NORMAL* sentence. Moreover, any output of the transfer stage is regared as a *NORMAL* sentence unless it is in the *YNQ* class. However, some restrictions have been made concerning the French sentences covered by the generator. The only imperative sentences that are processed correctly are very polite imperative sentences begining with *"s'il vous plait, veuillez"*. For example, in the following set of imperative sentences,

1. Donnez moi votre adresse s'il vous plait;
2. Appelle le secretariat de la conference demain;
3. S'il vous plait, veuillez appeler le secretariat de la conference;

only the syntactic structure of the last one is covered by the ordering grammar developed for the generator. This restriction does not penalize the generator since the imperative sentences expected in the domain of translation should be very polite sentences.

The two classes described are not really sentences classes in the generator. Actually, the separation si made at the level of propositions. A sentence is therefore a sequence of either *NORMAL* or *YNQ* propositions. The definition of an interrogative proposition is very simple. For example, the sentence *"puis je vous demander ce qui est prevu pour les chercheurs ?"* is divided into two propositions separated by the relative pronoun *"qui"*:

- The first proposition is *"puis je te demander ce"*. It is a *YNQ* proposition.
- The second proposition is *"qui est prevu pour les chercheurs"*. It is a *NORMAL* proposition.

The relative pronoun is inserted into the proposition in order to define the sentence simply as a sequence of propositions. Furthermore, the division of sentences into propositions allows us to respect the criteria of unicity of each grammatical constituent in the structure to be generated [6]. Further details are given in the next chapters about the description of French sentences we chosed.

2.3 Architecture of the Generator

The generation task consists of two main tasks : the syntactic and morphological generations. The module for syntax and morphology are sequentially implemented. In fact, French syntax and morphology are sometimes deeply realted and cannot be achieved separately. We chose the sequential configuration because it is easier to analyze the morphological issues on a syntaxically correct struture. Moreover some aspects of French morphology depend on the syntactic structure of the sentence. In order to deal with the case in the corpus that required simultaneous syntactic and morphological processes, the syntactic module achieves a very simple morphological task. When a verb is to be conjugated in a composed tense, the first stage of the conjugation is completed during the syntactic processes. The verb is divided into an auxilliary that is to be conjugated in the corresponding simple tense and a past-participle. The two constituents of the verb group are then ordered. For example, in Figure. 3, the verb "transferer" whish is to be conjugated in the past perfect is divided into an auxilliary "avoir" conjugated in the perfect and a past-participle "transfere". The sequentiallity adopted for the configuration of the generator is efficient because the conjugations in composed tenses are the only issues that require a simultaneous syntactic and morphological processing. The syntactic module gives the right constituent order in the sentence while the second module completes agreements between

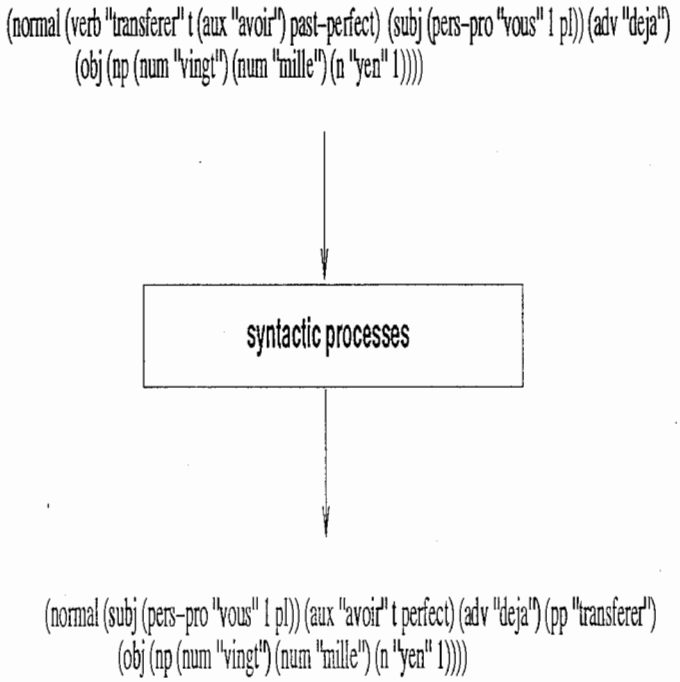

Figure 3: Interaction between morphology and syntax.

constituents, the inflexions and the elisions. The structuring module , inserted as the first module in 4, is actually a module added to the generator in order to handle the error cases. The structuring processes correct the wrong transfer otuputs. The transfer outputs that do not match the requirements of generation are revised. That module could have been added to the transfer stage, but it would then have been imposssible to obtain a standard transfer output for translations from Japanese to different languages; because some requirements of French generation are specific to French. The structuring processes are in fact very simple functions that achieve the following tasks :

- the defaults constituents are erased if they already exist in the sentence.
- the sentence is divided into proposition matching the required format. Constituents are gathered together in a proposition list when necessary.
- the transfer morphological informations are inserted in the constituents they qualify.

The structuring processes are explained more precisely in section 7. The most important part of our work while studying French surface forms generation was to find the information needed. All infornmation existing in the TDMT system for Japanese to French generation turned out to be useful to solve generation problems encountered in the model corpus.

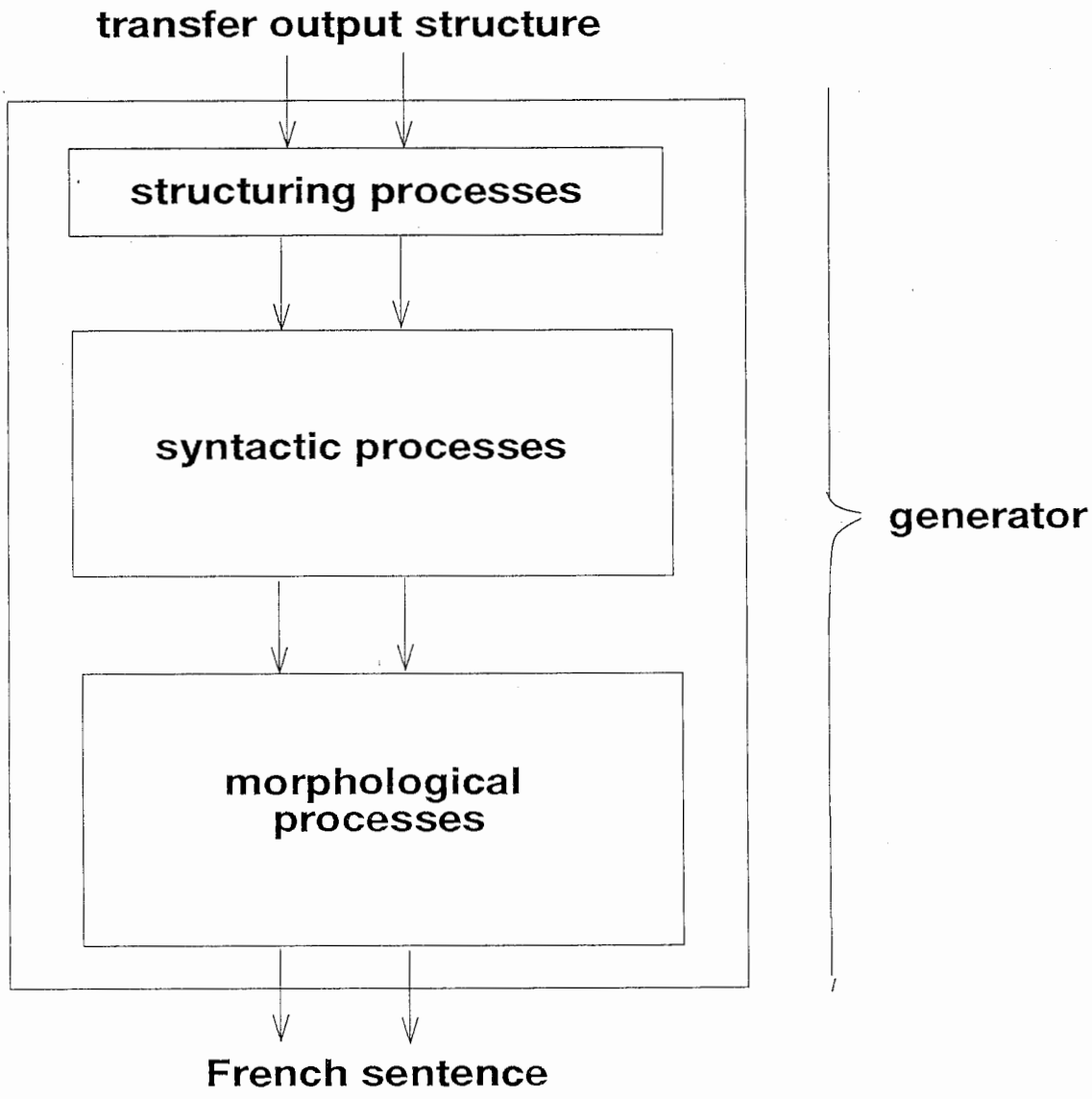

Figure 4: Architecture of the generator.

3 Required Information for Generation

3.1 Constituent Classes

The constituents classes in the TDMT system are mainly common grammatical constituents of French sentences. Some constituents have labels that are specific to the TDMT system but they are actually usual constituents whose labels have been changed in order to take benefit from the transfer capabilities of the TDMT system and facilitate the generation task.

3.1.1 The Proposition Classes

As already explained in section 2.2 , there are two proposition classes. The *YNQ* propositions and the *NORMAL* propositions. Each of the propoistion class requires specific syntactic rules. Thus, the separation into two different classes allows a specific processing of each class. The morphological processes are exactly the same for any sentences in the model corpus. The proposition class is never used during the morphological processes. Thus, the division into two groups is required by French syntax

3.1.2 The Verbs

There are three classes of verbs. These classes depend on the grammatical functions of the verbs in the proposition. All the verbs are in the *VERB* class. It is the generic verb class. If a verb is used in the proposition as a modal verb, it will then be labelled *MODAL-VERB*. An auxilliary verb is in the *AUX-VEB* class. The choice of specific labels depending on the grammaticla function of the constituents is achieved during the transfer process. For example, in the following sentences, *"pouvoir"* is respectively a *VERB* constituent in the first sentence and a *MODAL-VERB* constituent in the second sentence.

1. Je voudrais des renseignements s'il vous plait.

2. Je voudrais m'inscrire pour la prochaine conference.

3.1.3 The Adverbs

The *TOP-ADV* (respectively the *END-ADV*) are adverbs that are used as sentence introduction words (respectively as sentence concluding words). Actually, all the introduction expressions are in the *TOP-ADVERB* class. The concluding words are in the second class. The *ADV* class includes the usual adverbs whose position in a sentence cannot be determined easily. For

example, in the sentence *"A propos, puis je encore m'inscrire pour la conference ?"*, *"a propos"* is a *TOP-ADV* constituent while *"encore"* is a normal adverb.

3.1.4 The Prepositional Groups

There a different labels for the prepositional group. The labels depend on their expected position in the proposition. Basically, if the position of a prepositional group realtively to other prepositional groups is not relevent, it is labelled as a *PREP-GROUP* constituent. It is the generic class for prepositional groups. The other prepositional groups labels depend on the expected positions of the constituens in the proposition. For example, the preposiotional groups that hold the idea of time are labelled *TIME*. They are are most of the time the last prepositional groups. The following sentence illustrates the use of special labels for prepositional groups.

Il y a des bus pour les chercheurs a la gare de Tokyo a huit heures.

This sentence includes three prepositional groups. The first prepositional group is *"pour les chercheurs"* which is labelled *POUR* constituent by the transfer process. The second prepositional group is *" a la gare de Tokyo"*; it is labelled *PLACE* constituent which means that it holds the concept of location. The last prepositional group is a *TIME* prepositional group. In our study we realised that a *POUR* should precede both *TIME* and *PLACE*. Thus the labels enable us to order the prepositional groups.[3]

3.1.5 The Relative Pronouns and Conjunctions

The relative pronouns and the conjunctions are not separated in our grammar. They are *CONJ* constituents. The grouping of relative pronouns and conjunctions in the same class is due to the fact we order propositions instead of sentences. A relative clause is therefore processed as a proposition. Thus, the position of conjunctions in subordinate propositions is exactly that of relative pronouns in relative clauses.

3.1.6 The Interrogative Constituents

There are two classes for the interrogative pronouns. The usual *WH* class includes all the relative pronouns used in the model conversations except *"que"*, *"qui"*, and *"combien"*. These three

[3]The order within constituents that have the same grammatical function cannot be determined. Because, the grammar cannot make the difference between these constituents in a proposition.

are labelled *QUE-WH*. This difference in labels allows us to complete the syntactic processes of both interrogative sentence types described in section 4.1.2 .

The *WH-GROUP* is a noun phrase that contains an interrogative adjective labelled *WH-ADJ*. The most important thing here is that the interrogative constituent classes are most of the time the words part of speech. However, during the transfer stage a *WH-ADJ* may be transformed in a *QUE-WH* as illustrated by the transfer output on next page. The interrogative adjective *"quel"* is included in a *QUE-WH* list because it generates the same subject-verb inversion as the interrogative pronoun *"que"*.

```
SOURCE SENTENCE ==>

                    "ところで会議での公式言語は何ですか"

TRANSFER PROCESSES OUTPUT ===>

                   ((TOP-ADV "a propos,") YN-Q (QUE-WH (WH-ADJ "quel"))
                     (AUX-VERB "etre" I (AUX "avoir")) (SUBJ (N "langue officielle
                     (PREP-GROUP (PREP "a") (N  "conference" 0))))

GENERATION PROCESS ===>

                   ("a propos," "quelle" "est" "langue officielle" "a" "conference

TARGET SENTENCE ===>

                   ("a propos, quelle est langue officielle a conference" . 0.0)
```

Figure 5:Transfer analysis for an interrogative pronoun.

The previous example illustrates the fact the interrogative constituent classes are actually grammatical classe even if default classes are given in the bilingual dictionary. These default classes may be changed by the analysis proceses during transfer.

The remainining constituents used in the grammatical description of the senetnces are not described here because they are commom constituents that do not have special features in our work. For further details see the table of grammatical constituents in appendix A.

3.2 Structure of the Generator's Input

The input of the generator will be refered to as TO standing for transfer output. The TO described here is the required input for the real generation tasks. This TO is sometimes a revised TO output by the structuring module when necessary.

The first caracteristic of the TO is that it is a sequence of propositions. The propositions are defined as explained in section 2.2. The sentences that are to be generated are divided into propositions processed iteratively.

```
SOURCE SENTENCE :
"今回の会議は通訳電話に関連する広範な研究分野を含んでいます''

TRANSFER OUTPUT:

NORMAL [0.0 (!X)]
 |--!X [0.0 (!X)]
     |--!X [0.0 ((SUBJ !X) !Y)]
         |--!X [0.0 ((NP !X !Y))]
         |   |--!X [STRING (DET ce)]
         |   |
         |   |--!Y [STRING (N conference 0)]
         |
         |--!Y [0.16666999999999999 (!Y (OBJ !X))]
             |--!Y [STRING (VERB inclure T (AUX avoir))]
             |
             |--!X [0.16666999999999999 (!Y (REL-CLAUSE (CONJ qui) (*SUBJ !Y DEL) !X))]
                 |--!Y [0.16666999999999999 (!X !Y)]
                 |   |--!X [STRING (ADJ divers)]
                 |   |
                 |   |--!Y [STRING (N domaine de recherche 1 PL)]
                 |
                 |--!X [5.0E-6 (!Y (PREP-GROUP (PREP a) !X))]
                     |--!Y [STRING ((VERB etre I (AUX avoir)) (PP lier))]
                     |
                     |--!X [STRING (N Traducion telephonique 0)]

TARGET SENTENCE:

''cette conference inclut divers domaines de recherche qui sont lies a traduction
  telephonique''
```

The previous sentence consists of one proposition which is a *NORMAL* proposition.[4] As for sentences with several propositions the scheme of each of the proposition is the same as the previous one. The label of each proposition may be either *NORMAL* or *YNQ* depending on their nature. There are two types of information required in the TO.

3.2.1 The Lexical Information

The lexical information in the TO are taken from the bilingual dictionary that maps a japanese word onto its french translation. These information are then provided by the transfer. The first information is the part of speech of each word. The generation of French requires an accurate lexical retrievement of word parts of speech. For example, the word *"ce"* has a different inflectional mechanism depending on wether it is a personal pronoun or a determiner. Thus, in the example TO, the word *"technique"* which is an adjective is in a list begining with *ADJ*. The part of speech is required for all the words in the TO. Some specific information are necessary for special words.

- Information for the nouns and personal pronouns :

The gender of a noun is a required lexical information. We did not use a default gender because none of the feminin and masculin is more frequent than the other one. The gender of a feminin personal pronoun should be explicitly given in the lexical because the personal pronouns are considered masculin if there is no such information. For example, (n "conference" 0) means that *"conference"* is a feminin noun. The number of a noun is required in the dictionary when the noun is always plural. For example, *"gens"* which is always plural should be explicitly input as a plural noun in the dictionary.

- Information for the verbs :

The lexical information required for the verbs are more complex. The verb is defined in the transfer dictionary by its part of speech, its transitivity and the auxilliary used to conjugate it in composed tense. The verb *"transferer"* is therefore defined in the dictionary by the following list: (verb "transferer" t (auxilliary "avoir")). The transitivity of a verb is necessary for ordering its objects complements. The use of the transitivity is explained in details in the next sections.

[4]The numbers in the structure are the distance scores obtained during the transfer of the parts of the structure. They do not affect the generation process.

3.2.2 The Analysis Information

The analysis information are provided by the transfer module. These information include the class of the propositions, the grammatical relations between the proposition constituents and the morphological informations such as the tenses for the verbs, the number for the nouns and the agreement markers. For example, in the TO for the sentence *"cette conference inclut divers domaines de recherche qui sont lies a traduction automatique"*, the noun "domaine" is in the list (N"domaine" 1 PL). The *PL* in that list is not a lexical information because "domaine" may be singular. Thus, *PL* is a number marker inserted by the transfer process. The grammatical constituents such a *SUBJ, NP, OBJ, REL-CLAUSE*, etc ... are required informations for generation. The verb "lier" is inserted in a *PP* constituent because it is to be conjugated as a past-participle. In the example, the verb "inclure" holds no tense information. The present tense is used as a default tense. Thus when a verb is to be conjugated in the present tense, the tense information is sometimes omited.

The information in the TO are used to complete the real surface form generation tasks. Chapter 5 and 6 give more details about the use of each information during the geneartion process.

4 Syntactic Processes

4.1 Basic Facts about French Word Order

The input for the syntactic module is a list of propositions. The syntactic task is iteratively completed on each of the propositions in the list. Thus we will only describe the constituent order in a proposition. The first restriction we made is that we order only the constituents in the proposition. The words inside the constituents are supposed to be in the right order.[5] The second restriction is that the syntactic processes are completed on *finite* propositions. We define a *finite* proposition as a proposition containing a finite verb. The other propositions or input expressions are not processed syntactically; they are considered already correct syntactically after the transfer stage. The finite verb in a proposition is the verb conjugated in a simple tense.

1. Nous vous expedions une fiche immediatement.
2. Vous avez deja transfere vingt mille yens.
3. Je ne sais pas parler anglais.

The finite verbs of the above propositions [6] are respectively *"expedions"*, *"avez"* and *"sais"*. Thus, in proposition 2, the auxilliary verb *"avoir"* is the finite verb instead of the main verb *"transferer"*. If a verb is conjugated in a composed tense, the auxilliary is the finite verb. The finite verb determined using the previous criteria is used as a pivot in our grammar. The scheme of any French proposition is the following:

{ PRE } FINITE-VERB { POST }

The proposition is divided into three groups, the *PRE* which includes all the constituents that are before the finite verb in the proposition; the *POST* is the group of all the constituents that are after the finite verb in the proposition; and the *FINITE-VERB* is of course the finite verb itself. The previous description of the proposition is efficient because the main ordering problems we encountered in the corpus were the problems of determining the positions of constituents relatively to the finite verb. Constitiuents order in the *PRE* and *POST* does not

[5] The first level constituents in the grammatical tree of the sentence are ordered. The second level constituents are kept in the order they are in the constituents.

[6] The use of the word proposition when talking of sentences that contain only one proposition may seem strange. However, the propositions are the only parts of sentences that can have exactly the same structures as sentences. Processing them, requires the same functions as processing a sentence but reduces the scale of the tasks.

vary a lot. The use of the finite verb as the pivot in the ordering of sentence constituents is usually applied to German sentences [6] [7]. In german sentences, the position of the finite verb determines the sentence class and its syntactic structure. The difference in our work and the methods applied to german is that the finite verb is always at the center of the proposition. The other groups may be empty but logically they are supposed to exist on both sides of the finite verb.

4.1.1 Constituent Order in a *NORMAL* Proposition

- The adverbs :

An adverb position is easily found in a french proposition. An adverb is either at the begining of the proposition [7],at the end or just after the finite verb. The *TOP-ADV* and *END-ADV* are respectively at the begining and the end of the proposition. The *ADV* constituents are in the *POST* just after the finite verb.

1. Vous pouvez vous inscrire maintenant.
2. Nous ne pouvons vraiment pas faire de reduction cette fois.
3. A propos, quelle est le prix du resume des articles ?

The adverb *"maintenant"* is at the end of the proposition; *"vraiment"* is a normal adverb that is just after the finite verb and *"a propos"* is considered as a *TOP-ADV.* Actually, the adverbs can be at either of the positions described earlier. The position of the adverb is simply a stylistic matter. However, som adverbs like *"maintenant"* change the meaning of the proposition depending on their position. The sentence *"Vous pouvez maintenant vous inscrire."* means that the registration is now possible instead of the registration is possible now. Thus, the choice of labels for the adverbs should be done after an analysis of the style and pragmatics of the sentence.

The case of the negation adverbs is special because "ne" is always before the finite veb and "pas" always after the finite verb. The negative adverbs are labelled *NE* and *PAS.*

- The subject :

In a non-interrogative proposition, the subject group is always before the finite verb.[8] The subject is always in the *PRE.*

[7]These adverbs are sentence intorduction expressions or words.

[8]The place of the subject can change in very stylistic sentences that never occur during dialogues by telephone.

1. Je suis membre de la societe de traitement de l'information.

2. La conference a lieu a Tokyo le mois prochain.

- The constituents of the verb group :

All constituenst of the verb group except the finite verb are in the *POST*. For the verb group, there are two constituents that may be added by the generation module. As already explained, when a verb is to be conjugated in composed tense, it is divided into two constituents: an auxilliary that will be counjugated in the corresponding simple tense and the past-participle of the verb. The auxilliary is then a new constituent in the TO and is labelled *AUX*. It is the finite verb. The second constituent that may be added to the TO by the generation module is the *PART* constituent. This is in fact a constituent that represents the particule of ceratin verbs. For example, in the sentence *"J'ai besoin de renseignements"*, the verb "avoir besoin de" is defined in the dictionary by the list (verb "avoir" (part (n "besoin" 1) (prep "de")) (aux "avoir")). It means that the verb is the verb "avoir" which has a particule "besoin de". Therefore the particule is separated from the verb during the syntactic processes and is ordered in the proposition. The *PART* is always after the verb. It is in the *POST*.

- The direct and indirect object groups:

These are the challenging constituents for the syntactic process. The rule for these groups is the following: The object groups are after the finite verb if they are not personal pronouns. If they are personal pronouns, they are before any transitive verb they complete [9]and after the verb otherwise.

1. Je vous ai envoye une fiche.

2. Je vous les ai envoyees.

3. Je peux l'envoyer a votre secretariat.

4. Nous vous ferons faire un tour de la ville.

It is difficult to find which verb the object group qualify if the constituents are in a random order in the TO. The lexical information about the transitivity are used to find the most probable candidate. An intransitive verb is never completed by an object group. A modal verb is also never completed by an object group. In sentence 4, the verb "faire" has two different functions.

[9]The verb which they complete is the verb whose objects group they are.

It is a modal verb "ferons" and a verb "faire". In that case it is important to distinguish the two verbs because "faire" is transitive as a normal verb and intransitive as a modal verb.

All the remaining constituents that may appear in a *NORMAL* proposition are in the *POST*. The conjunctions and relative pronouns have a special place in the proposition. Normally, they separate the propositions. They are added in our work to the proposition they precede in the sentence. Thus, they are the first constituenst of the propositions or relative clauses they occur in.

4.1.2 Constituent Order in a *YNQ* Proposition

All the results given for the constituents in the *NORMAL* propositions are still valid except those concerning the position of the subject group. The new problems are to find the place of the subject group and interrogative constituents relatively to the finite verb.

1. Avez vous une fiche ?
2. La conference a-t-elle lieu a Kyoto ?
3. Quand la conference a-t-elle lieu ?
4. Que fait le secretariat pour les chercheurs ?
5. Quelle fiche dois je utiliser pour m'inscrire ?

The example set above illustrates the variations in the subject position relatively to the finite verb that we encountered in the model conversations. We divided the *YNQ* proposition into two groups:

- Propositions from the first group :

Sentences 1, 2 and 3 are in this group. The interrogative propositions in this group are propositions that do not contain a *QUE-WH* constituent. The following rule determines the subject group's position in these propositions :

> If the subject is a personal pronoun, it is in the *POST* just after the finite verb.
> Otherwise, it is in the *PRE* and its pronominalised form is added to the *POST*.

The pronominalised form is a new constituent that is to be generated morphologically. It is labelled *PRONOMINALIZE*. Thus, in sentence 2 and 3, the personal pronoun "elle" is the pronominalised form of the subject "la conference". The *PRONOMINALIZE* is the first constituent after the finite verb. It is therefore in the *POST*.

- Propositions from the second group :

The proposition in this group contain a *QUE-WH* constituent. It is the case for sentences 4 and 5. In these propositions, the subject is always in the *POST*. The subject is after the last element of the verb group unless it is a personal pronoun. It may only precedes the prepositional groups and complements as in sentence 4 where "la conference" precedes "pour les chercheurs". If the subject is a personal pronoun, it is just after the finite verb like "je" in sentence 5.

One may have noticed that "quelle" is not a *QUE-WH* constituent but an interrogative adjective. Actually, the grammatical structure output by the transfer process for sentence 5 is the following :

```
YNQ [0.0 (!X)]
 |--!X [0.0 (!X)]
     |--!X [0.0 ((SUBJ !X) !Y)]
         |--!X [STRING (PERS-PRO  je)]
         |
         |
         |
         |
         |--!Y [0.16666999999999999 (!Y (QUE-WH !X))]
             |--!Y [0.3333 (!Y (POUR (PREP pour) !X))]
             |   |--!Y [0.0 (!X !Y)]
             |   |   |--!X [STRING (MODAL-VERB devoir I (AUX avoir))]
             |   |   |
             |   |   |--!Y [STRING (VERB utiliser T (AUX avoir))]
             |   |
             |   |--!X [STRING (VERB inscrire P (AUX *etre))]
             |
             |--!X {5.0e-6 (WH-GROUP !X !Y)]
                 |--!X [STRING (WH-ADJ quel)]
                 |
                 |--!Y [STRING (N fiche 0)]
```

The *WH-GROUP* "quelle fiche" is inserted in a *QUE-WH* during the transfer processes. The interrogative constituenst are all in the *PRE* that is to say before the finite verb. They are at the begining of the proposition just after the sentence introduction constituents.

Two aspects of our work must be precised at this sage of the report. First, during the description of the word order in the sentence, we only mentionned sentence constituents. Basically, we only tackled the problem of constituent order because during transfer process the TDMT system is able to complete most of the word ordering into the constituents. Thus, we only tackled the issues that are not solved by the pattern rules. The second point is that we only divided the proposition into three parts and we did not really described the order in the *PRE* and the *POST*. The reason we did not mention those processes is that only linear precedence rules are necessary to complete them finally. Thus these linear rules are listed in the grammar in appendix B. and do not require more explanations.

4.2 The Grammar Formalism

The formalism described deals only with the sentence syntax. The agreements and inflexions are completed separately. The formalism used is adapted fron the GSP formalism described by H. Uszkoreit in his study of the Germman word order [8] The difference is that' in our work the finite verb is always in the middle of the proposition; while it can be either at the begining, the middle or the end of the german proposition. WE use two kinds of rules : the first rules are called *distribution rules* and the second ones are usual linear precedence rules.

4.2.1 Distribution Rules

The distribution rules are the rules that allows to find the place of a constituent relatively to the finite-verb. The format of a distribution rule is the following:

$$< YNQ; CONDITION(X_1 \cdots X_n) \Longrightarrow PRE(X_p) >$$

The previous structure means that : in a *YNQ* proposition, if a condition involving the set of n constituents is true then the constituent X_p is in the *PRE*. Most of the time the condition involves the constituent to be placed and the finite verb. For example, a distridution rule used for the subject group in an interrogative proposition is the following:

$$< YNQ\,; \begin{array}{l}\text{SUBJ not personal pronoun} \\ \text{QUE-WH none}\end{array} \Longrightarrow PRE(SUBJ) >$$

That rule means that: in an interrogative proposition containing no *QUE-WH* constituent, the subject is before the finite verb if it is not a personal pronoun. The sentence si divided into three parts thanks to these rules. The next stage is to process these parts.

4.2.2 Linear Precedence Rules

The linear precedence rules are usual precedence rules as defined in grammars such as GSP or TAG grammars. The linear precedence rules involve only two constituents that are in the same side of the finite verb. The scheme of a linear precedence rule is the following :

$$< PRE\,;\, CONDITION(X_1, X_2) \Longrightarrow X_1\, is\, before\, X_2 >$$

The rule means that in the *PRE*, the constituent X_1 precedes the constituent X_2 if the condition on the constituents is true. The conditions are constraints made on the nature of the constituents. The difference between the conditions in the linear precedence rules and those used in distribution rules is that the former are conditions only on the constituents that are compared. There are no external constituents. For example, the followig rules involve the verb and a subject in an interrogative proposition containing a *QUE-WH* constituent :

- distributing rule

$$< YNQ\,;QUE-WH\, exists \Longrightarrow POST(SUBJ) >$$

- linear precedence rules

$$< POST\,;\, SUBJ = personalpronoun \Longrightarrow SUBJ\, is\, before\, VERB >$$

$$< POST\,;\, SUBJ \neq personalpronoun \Longrightarrow SUBJ\, is\, after\, VERB >$$

These rules are describe the position of the subjects relatively to the non-finite verb in the sentences 1 and 2 of section 2.2.1.

The syntactic rules used in our work are listed in the appendix B. The lisp format used to implement them is explained in chapter 6. of this report. The agreement rules are separated form the synatcic processing of the sentence. They are analyzed in the morphological module.

5 The Morphological Processes

5.1 Agreements

Agreements are much more complex in French than English. A lot of agreement rules are needed to complete the correct inflexion of a French word. These rules sometimes involve very distant constituents in the tree structure of the sentence. therefore, we decided to separate morphological processes from syntax and to use syntactically correct structures to achieve them. The main agreement are listed in the following parts of this section.

5.1.1 Determiners and Nouns Agreements

The determiners agree with the noun they define in gender and number. For example, one should say *"la maison"* instead of *"le maison"* because "maison" is a feminin word. The agreement in gender and number with the noun holds for all the determiners.

5.1.2 Adjective-noun Agreements

An adjective agrees in gender and number with the noun it qualifies. This agreement occurs in a noun phrase when the adjective is an epithet. For examle, in sentence *"Les rapports techniques sont ecrits en francais"*,(the technical reports are written in English.) "technique" agrees with the noun "rapport". In fact the agreements of the adjectives are wider than just agreements with the noun. An attributive adjective used with auxilliary verbs such as "etre" agrees with the subject of that verb. For example in the following sentence : *Les traductions sont simulatanees en anglais et japonais."*,(The translations in English and japanese are simultaneous.) the adjective "simultanee" agrees with the subject group "Les traductions".

5.1.3 Subject-verb Agreements

These are the basic agreements of French morphology. The verb inflectional system is very rich in French. The rule is that the verb agrees in number and person with its subject. The cojugation of the verb "etre" (To be) illustrates this agreement:

Je suis
Tu es
Il est
Nous sommes
Vous etes
Ils sont

Each number-person pair generates a new form of the verb. This a general case in French and is not restricted to a few verbs as in English.

5.1.4 Past-participle Agreements

The past-participle agrements are the most difficult agreements in French. Let us give a set of example sentences to illustrate this assertion.

1. Les fiches expediees apres le 24 avril ne sont pas acceptees.
2. Les chercheurs sont alles a Tokyo ce matin.
3. Vous avez transfere trente mille yens le mois dernier.
4. Les rapports que vous avez ecrits l'annee derniere sont disponibles.
5. Les chercheurs se sont empares des locaux.
6. Les chercheurs se sont inscrit a la conference.

The main rule for the agreement of past-participle is divided into three sub-rules:

```
-- if the past-participle is used without an auxilliary or with the auxilliary
   ''etre''', it has the same agreement rules as the adjectives;
-- if the auxilliary is ''avoir'' (have), the past-participle agrees in gender
   and number with the direct object complement of the verb if the latter precedes
   it;
-- in other cases, it is invariant.
```

The pronominal verb past-participles are special cases. They are all conjugated with the auxilliary "etre". But the real pronominal verb past-participles that is to say verbs that can not be used in non-pronominal forms agree in number and gender with the subject of the verb; The other pronominal verb past-participles agree with the direct object complement as if the auxilliary was "avoir". For example, in sentence 5., "empares" agrees with "les chercheurs" because the verb is "s'emparer" (to seize) which is a real pronominal verb. In sentence 6., "inscrit" does not agree with "les chercheurs" because "inscrire" (to note) is a normal verb whose pronominalised form is "s,inscrire" (to register).There are other particular cases that are explained in details in [4] but are not implemented yet for the prototype.

The agreements are the variables that define the inflectional forms that are to be generated for each of the words in the sentence.

5.2 Inflexions

5.2.1 The Morphological Transformation Dictionary

The morphological transformation dictionary used in the generation module is exactly the opposite of the morphological dictionary used during the transfer stage. The morphological transformation dictionary maps the canonical forms of the words onto the inflected forms. The morphological transformation dictionary used in the generation module has been developed in order to automate most of the inflexion processes. For example a verb is given in the dictionary with its root and its inflectional class. The inflectional class of a verb is the representative class of verbs that have the same inflectional paradigms. For example , "rendre" and "prendre" are in the seme class and the list that defines "prendre" in the dictionary is ("prendre" (verb "ren" rendre)). It means that "prendre" is to be conjugated like "rendre" with the stem "pren". Each class has its inflexion paradigms stored in an inflexion bank. The same method is used for nouns and adjevctives and past-participles. The determiners are input in the morphological transformation dictionary with all their inflected forms. The morphological transformation dictionary is therefore not a one-entry one-lexical unit dictionary.

5.2.2 The Verb Inflexion

The generator conjugates the verbs in the present, futur, perfect, plus-past, past-perfect, conditional, subjonctive and imperative tenses. The generation rules for each verb class are stored in the inflectional bank. The classes chosen for the verbs are based on the inflectional paradigms used when they are conjugated. In the curent state of our work, the conjugation of a verb requires both the root and the class in the morphological dictionary. The list defining the morphological transformations of a verb is longer when the verb is a pronominal verb : ("inscrire" (verb "inscr" ecrire)) defines "s'inscrire". The conjugation is completed in the tense given by the transfer processes. Only the finite verb is conjugated and the default tense is the present tense. In the TO,complete verb structure is for example: (verb "transferer" t (aux "avoir") past-perfect) that will be generated as (aux "avais") and (pp "transfere") .

5.2.3 The Determiner Inflexion

The determiners are always given by their canonical form in the TO. The determiners are inflected in their feminin or plural forms when they agree with a feminin or plural noun. The inflectional mechanismes for determiners are all in the morphological dictionary.

5.2.4 The Adjective and Past-participle Inflexions

The adjectives and the past-participles are inflected in the same way. The agreements rules are first analyzed and the results are used to produce the required inflexion form. The past-participle are inflected in two satges, First, the right past-participle is produced by the conjugation function and then the past-participle is inflected. There are no past-participles in the morphological dictionary because their inflexion function does not require lexicalised information.

5.2.5 The Noun Inflexion

The noun inflexions are the only inflexions that do not require information from the other constituents. In the TO, the noun constituents hold all information about gender and number. In fact, we considered in our work that any information about gender and number is provided by the nouns. For example, the sentence *"elle est une bonne eleve."* cannot be output by the generator because the word "eleve" is in the transfer dictionary as a masculin word. Thus, the output of the generator would be *"elle est un bon eleve."*. The informations about gender and number are given by the nouns. The priority is given to the nouns. The inflexion of nouns is done automatically using inflectional class when the word is not special. In case, the inflexions are special, the inflexion forms are stored in the morphological transformation dictionary.

5.3 Elisions

Two types of elisions occur in the corpus : the deletion of the final character of words and the concatenation of words. They are very frequent phenomena in french. They are achieved sequentially during the elision process.

5.3.1 Deletion of Word Ending Vowels

This kind of elision allows an easier pronounciation of some sequence of words. It is completed on relative pronouns, conjunctions, prepositions and determiners. When one word of these classes which ends with a vowel is followed in the sentence by a word begining with a vowel, its last vowel is erased and replaced by an apostrophy. The two words are then concatenated. For example, one says *'' Le secretariat de la conference"* (the conference office) and *"l'office de la conference"* (the conference bureau). In the second exemple the determiner "le" becomes "l"'.

5.3.2 Concatenation of Prepositions and Determiners

This second kind of elision occurs when a preposion is followed by a determiner. These are conventional elisions. For example, instead of saying *"Je suis membre de le groupe de traitement de l'information"*, one should say in correct French *"je suis membre du groupe de traitement de l'information"* (I am member of the information processing group.). In that exemple, the preposition "de" is concatenated to the article "le" to produce "du". The concatenation phenomena could have been processed as inflexions of the preposition itself. But, we described them as elisions because the resulting string depends on both the preposition string and the following article string.

The morphological processes are the last processes of the generation. They require information from both the TO and the morphological transformation dictionary. They turned out to be easier to complete on a syntactically correct structure.

SOURCE SENTENCE :

"今回の会議は通訳電話に関連する広範な研究分野を含んでいます"

TRANSFER OUTPUT:

```
NORMAL [0.0 (!X)]
 |--!X [0.0 (!X)]
     |--!X [0.0 ((SUBJ !X) !Y)]
         |--!X [0.0 ((NP !X !Y))]
         |    |--!X [STRING (DET ce)]
         |    |
         |    |--!Y [STRING (N conference 0)]
         |
         |--!Y [0.16666999999999999 (!Y (OBJ !X))]
             |--!Y [STRING (VERB inclure T (AUX avoir))]
             |
             |--!X [0.16666999999999999 (!Y (REL-CLAUSE (CONJ qui) (*SUBJ !Y DEL)
                 |--!Y [0.16666999999999999 (!X !Y)]
                 |    |--!X [STRING (ADJ divers)]
                 |    |
                 |    |--!Y [STRING (N domaine de recherche 1 PL)]
                 |
                 |--!X [5.0E-6 (!Y (PREP-GROUP (PREP a) !X))]
                     |--!Y [STRING ((VERB etre I (AUX avoir)) (PP lier))]
                     |
                     |--!X [STRING (N Traducion telephonique 0)]


GENERATION OUTPUT:

("cette" "conference" "inclut" "divers" "domaines de recherche" "qui" "sont"
   "lies" "a" "Traducion telephonique")
```

Figure 6: Translation processes for the TDMT system.

6 Implementation

The generator is implemented in COMMON LISP on a symbolic MAC IVORY machine. It is integrated to the mainframe of the TDMT system. The lisp formalism turned out to match the demands of our algorithms. For example, the syntactic trees could easily be representated by lists.

6.1 Stored Data

Two kinds of data are used for the generation. There are data that are provided by the procedures used in the processes and data that are fixed data and can be stored when the TDMT system is loaded. These laters data have been stored using two different LISP tools.

6.1.1 The Dictionaries

There are two dictionaries used during the generation of French. The first one is the bilingual dictionary and the second one is the morphological transformation dictionary. Both are stored in hash-tables. The acces to the data is more efficient in hash-tables. Thus, each lexical unit is a hash key and the associated information is the variable accessed through this key.

```
("９月" (n "Septembre" 1))
("ありがとうございました" (top-adv "merci beaucoup"))
("ありません" (adv "rien"))
("ある" (verb "etre" i (aux "avoir")))
("いいえ" (num "i-i-e"))
("いいです" (top-adv "c'est bien"))
("いつ" (wh "quand"))
("お願いします" (top-adv "cela me convient"))
("お待ちする" ((verb "esperer" t (aux "avoir")) (verb "voir" t (aux "avoir"))
                                                  (*obj (pers-pro "vous"))))
("さようなら" (top-adv "au revoir"))
("そうです" (top-adv "c'est exact"))
("そうですか" (top-adv "je vois"))
("できません" (top-adv "ce n'est pas possible"))
("どういう内容の" ((wh-adj "quel") (n "genre" 1) (det "de")))
("どういたしまして" (top-adv "pas du tout"))
```

```
("どうもありがとうございました" (top-adv "merci beaucoup"))
("どうやって" (wh "comment"))
("どこか" (n "quelque part"))
("どのような" ((wh-adj "quel") (n "genre" 1) (det "de")))
("どのように" (wh "comment"))
("はい" (top-adv "oui"))
("もしもし" (top-adv "allo"))
("よろしくお願いします" (top-adv "merci beaucoup pour votre cooperation"))
("アダムスミス" (n "Adam Smith" 1))
("アル" (verb "etre" i (aux "avoir")))
("ケンブラウン" (n "Ken Brown" 1))
("ジムワイベル" (n "Jim Waibel" 1))
```

Excerpt from the bilingual dictionary.

6.1.2 Inflexions

Counter to the dictionary, inflexions are all stored in the property list of the variable *INFLEXION-TREE*. We used only one variable for all inflexions, even verb conjugations. Thus, there is a standard acces function for all the inflection paradigms. The same method could have been done using an hash-table. However, the size of the inflexion bank which is small does not penalize the speed of the programm.

```
( setf (get 'inflexion-tree 'first-group) '(present ("e"
                                                     "es"
                                                     "e"
                                                     "ons"
                                                     "ez"
                                                     "ent")
                                            imp      ("ez")
                                      conditional    ("erais"
                                                     "erais"
                                                     "erait"
                                                     "erions"
                                                     "eriez"
                                                     "eraient")
```

```
                perfect ("ais"
                         "ais"
                         "ait"
                         "ions"
                         "iez"
                         "aient")
                  futur ("erai"
                         "eras"
                         "era"
                         "erons"
                         "erez"
                         "eront")
              subjonctive ("e"
                           "es"
                           "e"
                           "ions"
                           "iez"
                           "ent")
                     pp ("e")))
```

Inflexion data for the conjugation of first group verbs.

The grammar rules are also stored in property lists. But, the rules in this lists do not include the conditions and are applied on special constituent labels.

6.2 Syntactic Function

The syntactic function is based on the grammar formalism described in section 4.2. In the current state of our work, all the conditions used in the distributing rules and linear precedence rules are conditions that are disjunctions and conjuctions of local contraints made on a single constituent. For example, the following rules :

- distributing rule

$$< YNQ\,; QUE - WH\, exists \Longrightarrow POST(SUBJ) >$$

- linear precedence rules

$$< POST\,;\, SUBJ = personalpronoun \Longrightarrow SUBJ\, is\, before\, VERB >$$

$$< POST\,;\, SUBJ \neq personalpronoun \Longrightarrow SUBJ\, is\, after\, VERB >$$

are processed in the following way. If there is a *QUE-WH* constituent in the proposition that is to be process syntactically, the *SUBJ* constituent is labelled *POST-SUB*. It means that the subject is after the finite verb. If the subject is also a personal-pronoun, it is labelled *POST-PRO-SUB* which means a personal pronoun subject that is after the finite verb. Thus, the second rule can be written as :

POST-PRO-SUB is before VERB

Therefore, the grammar rules stored in the system are only linear precedence rules between constituenst whose labels have been changed depending on the constraints used in the formalism

```
(make-constituent-structure 'pro-ind-obj
                            ((normal (pre (top-adv
                                           subj
                                           ne
                                           conj)))
                             (ynq (pre (top-adv
                                        wh
                                        wh-group
                                        que-wh
                                        subj
                                        ne
                                        conj)))))
```

The above structure represents the precedence rules for an indirect-object group that is a personal pronoun. The rule means that: in a *NORMAL* proposition, The *TOP-ADV, SUBJ, NE* and *CONJ* are to be placed before the former complement group. The representation is tha same for *YNQ* propositions. The linear precedence rules are given in appendix B.

6.3 Morphological Functions

6.3.1 Inflexions

The inflexions in French are numerous and there are many special cases. However, we generate the inflexions in a procedural way for words that can be grouped in inflectional classes. The special cases are input in the morphological transformation dictionary. The real particularity of our work is that number and gender are hold only by the nouns and personal pronouns. The other words are supposed neutral. this can sometimes lead to a wrong translation of the sentence because in the source language, the gender or number may be hold by another constituent than the noun. But this problem does not occur in translations from Japanese and English because the gender and number are rarely marked in the sentences.

6.3.2 Elisions

Completing the elision does not require the syntactic structure of the sentence. Therefore, the elision procedure is completed on a sequence of the sentence words. The words are of course in the right order and they are just given with their parts of speeches. In fact the words are stored in the property lists of variables whose names are the position number of the word. For example, for the proposition *"L'office est ferme."* whose syntactic structure is (NORMAL (SUBJ (NP (DET "le") (N "office"1))) (AUX-VERB "etre" i (AUX "avoir)) (PP "fermer")), we use the memory map of the proposition shown on next page.

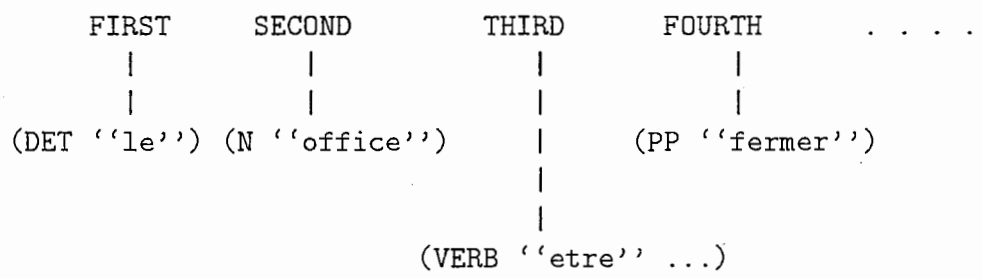

Figure 7: Memory map for elision.

By storing this structure in memory, it is easy to handle the positions of words. In fact, this structure is useful for local agreement such as determiner-noun agreement. For example, it is easy to complete the agreement between "le" and "office" in the proposition. The information stored in that kind of property list is much more complex and cannot be described in details without explaining the algorithm of the inflexion functions.

6.4 Processing the Relative Clauses

The relative clauses are not first level constituents of the propositions. They occur in object, subject an complement groups. However, the relative clauses have the same structure as the propositions and they may contain exactly the same constituents as any proposition. In our work, a relative proposition is not different from a proposition because we grouped the conjunctions and the relative pronouns in the same word class. Therefore, it was important to achieve the generation processes on the relative clauses. The generation is achieved recursively in case there is a relative clause in the proposition. The relative clause is first processed and replaced in the proposition by a constituent labelled **REL-CLAUSE*. That constituent contains correct surface forms and is inserted in the proposition at the place of the relative clause. The following generation history illustrates the generation of proposition containing relative clauses:

```
TRANSLATE:
----------
(translate "今回の会議は通訳電話に関連する広範な研究分野を含んでいます")

GENERATION:
----------
1 Enter F-GENERATION::GENERATION ((SUBJ (NP # #)) (VERB "inclure" T (AUX "avoir"))
                                  (OBJ (ADJ "divers") (N "domaine de recherche" 1 PL)
                                  (REL-CLAUSE # # # # #)))

Generation of the relative clause:
        ---------------------------------

| 2 Enter F-GENERATION::GENERATION ((NORMAL (CONJ "qui") (*SUBJ # # :DEL)
                                    (VERB "etre" I #) (PP "lier") (PREP-GROUP # #)))

        Output of the relative clause generation:
        -----------------------------------------
| 2 Exit F-GENERATION::GENERATION ("qui" "sont" "lies" "a" "Traducion telephonique")

        Output of the generation:
        -------------------------
1 Exit F-GENERATION::GENERATION
("cette" "conference" "inclut" "divers"  "domaines de recherche" "qui" "sont"
 "lies" "a" "Traducion telephonique")

OUTPUT SENTENCE:
---------------

''cette conference inclut divers domaines de recherche qui sont lies a
 traduction telephonique''
```

Figure 8: Recursive generation of relative clauses.

6.5 Structuring Processes Algorithm

The structuring process output the required structure for generation. These processes as explained earlier are very simple. They are divided into three parts:

6.5.1 Deletion of Defaults Constituents

The transfer stage of the TDMT prototype sometimes adds defaults constituents to the proposition. Actually, the defaults constituents are used to solve the problem of missing information in spoken Japanese. Basically, the subject of a sentence is not used unless it is necessary for ambiguity reasons. The most frequent case is that the speaker does not use the personal pronoun *"Watashi"* ("I") when it is the subject of the verb. Thus, in those cases, because the subject is required in French, a default subject is given by the transfer stage. The default constituent is therefore to be erased if the constituent effectively exists in the proposition.

6.5.2 Dispatching of the Information

The TO contains some morphological information such as the tenses of the verbs and the number the nouns. During the transfer stage these information are not dispatched to the respective constituents they qualify. In order to put the correct piece of information in the right constituent, we used the following algorithm:

> If there is a tense marker, it is a piece of information for the first verb found in the TO after it; if the marker is a number marker it qualifies the first noun found after it. If there is no verb or noun after the marker, the marker is useless.

6.5.3 Separation of the Propositions

During the transfer stage, it is sometimes impossible to give the exact limits of a proposition in the sentence to be generated. In those cases, the constituents are listed in the TO without their proposition list. The structuring processes separate the constituent in their respective proposition.The following example illustrates the dispatching of information and the separation of the propositions for generation of the sentence *"Je voudrais que vous me disiez comment je pourrai aller au hall de la conference."*:

```
 TRANSFER OUTPUT:
 ---------------

*first proposition constutuents and morphological markers :
    ((subj (pers-pro "je")) conditional* (modal-verb "vouloir" i (aux "avoir"))

*second proposition:
   (normal (conj "que") (obj (pers-pro "me")) (subj (pers-pro "Vous" 1 pl)) subjonctive*
         (verb "dire" t (aux "avoir")))

*third proposition constituents and morphological markers :
 (conj "comment") conditional (modal-verb "pouvoir" i (aux "avoir"))
 (prep-group (prep "a") (n "hall de la  conference" 1 ) (verb "aller")))


 STRUCTURING PROCESSES OUTPUT:
 ----------------------------

((NORMAL (SUBJ (PERS-PRO "je")) (MODAL-VERB "vouloir" I (AUX "avoir") CONDITIONAL))
 (NORMAL (CONJ "que") (OBJ (PERS-PRO "me")) (SUBJ (PERS-PRO "Vous" 1 PL))
         (VERB "dire" T (AUX "avoir")))
 (NORMAL (CONJ "comment") (MODAL-VERB "pouvoir" I (AUX "avoir"))
         (PREP-GROUP (PREP "a") (N "hall de la  conference" 1)) (VERB "aller")))
```

Figure 9: Structuring processes on an incomplete TO.

7 Sample of Results

The results described in this section are the results obtained for translations of 225 sentences form the model converstaion corpus. The success rate for the generator was 99.55%. This result show the real applicability of thetransfer driven methodology to translations into languages with a very rich inflectional sytem. The results are especially interesting, because the required output for our generator is a complex and precised grammatical structure of the French sentence to be generated. Thus, TDMT is able to give a sharp analysis of the target language sentence. Some target structures are presented in the following parts of this chapter. All the results for translations of the model conversation sentences are given in apendix D. Only some special results are enumerated here.

7.1 Transfer Translations

The translations that are achieved directly by the transfer module are trasnlations of expressions or idioms. These idioms or expressions are stored in the dictionary as lexical units.

```
****
もしもし ==> ("allo" . 0)

****
はい ==> ("oui" . 0)

****
そうです ==> ("c'est exact" . 0)

****
いいえ ==> ("non" . 0)

****
まだです ==> ("pas encore" . 0.0)

****
分かりました ==> ("je vois" . 0)

****
よろしくお願いします ==> ("merci beaucoup pour votre cooperation" . 0)
```

```
****
どうもありがとうございました ==> ("merci beaucoup" . 0)
```

7.2 syntactic Function Results

The examples given above are the cases that illustrate the most difficult syntactic processes. The first structure is the input structure (it is sometimes a revised TO.); the second structure is the corresponding correct structure.

7.2.1 NORMAL Propositions Results

```
(translate "登録用紙を至急送らせて頂きます")

| 2 Enter F-GENERATION::SYNTACTIC-FUNCTION

(NORMAL (*SUBJ (PERS-PRO "nous" *1 PL))
        (VERB "expedier" T (AUX "avoir") FUTUR*)
        (OBJ (N "fiche d'inscription" 0))
        (*IND-OBJ (PERS-PRO "vous"))
        (ADV (ADV "immediatement")))

| 2 Exit F-GENERATION::SYNTACTIC-FUNCTION

(NORMAL (*SUBJ (PERS-PRO "nous" *1 PL))
        (*IND-OBJ (PERS-PRO "vous"))
        (VERB "expedier" T (AUX "avoir") FUTUR*)
        (ADV (ADV "immediatement"))
        (OBJ (N "fiche d'inscription" 0))
)

|TARGET SENTENCE

(("nous vous expedierons immediatement fiche d'inscription" . 0.0))
```

Position of the direct and indirect object groups.

```
(translate "それは別に問題ありません")

| 2 Enter F-GENERATION::SYNTACTIC-FUNCTION
(NORMAL  (NE "ne")
         (PAS "pas")
         (SUBJ (pers-pro "cela"))
         (VERB "avoir" (OBJ (PREP-GROUP (PREP "de") (DET "le") (N "importance" 0)
         (END-ADV (END-ADV (PREP "en  particulier")))
)

| 2 Exit F-GENERATION::SYNTACTIC-FUNCTION

(NORMAL (SUBJ (PERS-PRO "je"))
        (NE "ne")
        (F-GENERATION::FINITE-VERB "avoir" I (AUX "avoir"))
        (PAS "pas")
        (OBJ OBJ (PREP-GROUP (PREP "de") (DET "le") (N "importance" 0)))
        (END-ADV (END-ADV (PREP "en  particulier")))
)

|TARGET SENTENCE

(("cela n'a pas de l'importance en particulier". 0.0))
```

Ordering of the negation adverbs and the verb particule.

The previous example is interesting because it illustrates how the verbs that are to be conjugated with particules are processed by the generator. The particule is put in the verb lexical unit in the dictionary. It is put with its grammatical function and is considered to represent the transitivity of the verb. The transitivity of verbs with particule is not necessary because they are always intransitive verbs.

7.2.2 The Interrogative Sentence Generations

```
(translate "ところで会議での公式言語は何ですか")

| 2 Enter F-GENERATION::SYNTACTIC-FUNCTION

(YNQ (TOP-ADV "a propos,")
     (PREP-GROUP (PREP "a") (N "conference" 0))
     (AUX-VERB "etre" I  (AUX "avoir"))
     (SUBJ (N "langue" 0) (ADJ "officiel"))
     (QUE-WH (WH-ADJ"quel"))
)

|2 Exit F-GENERATION::SYNTACTIC-FUNCTION

(YNQ (TOP-ADV "a propos,")
     (QUE-WH (WH-ADJ "quel"))
     (AUX-VERB "etre" I  (AUX "avoir"))
     (SUBJ (N "langue" 0) (ADJ "officiel"))
     (PREP-GROUP (PREP "a") (N "conference" 0))
)

|TARGET SENTENCE

(("a propos, quelle est la langue officielle a conference". 0.0))
```

Syntactic structure of a proposition containing a *QUE-WH* constituent.

```
(translate "では誰かが私の代わりに参加することはできますか")

| 2 Enter F-GENERATION::SYNTACTIC-FUNCTION

(YNQ (TOP-ADV "dans ce cas,")
     (MODAL-VERB "pouvoir" I (AUX "avoir"))
     (SUBJ (N "quelqu'un" 1))
     (VERB "assister" T (AUX "avoir"))
     (*IND-OBJ (PERS-PRO "y"))
     (NE (ADV "d'autre"))
)

| 2 Exit F-GENERATION::SYNTACTIC-FUNCTION

(YNQ (TOP-ADV "dans ce cas,")
     (SUBJ (N "quelqu'un" 1))
     (NE (ADV "d'autre"))
     (MODAL-VERB "pouvoir" I (AUX "avoir"))
     (PRONOMINALIZE (N "quelqu'un" 1))
     (*IND-OBJ (PERS-PRO "y"))
     (VERB "assister" T (AUX "avoir"))
)

|TARGET SENTENCE

(("dans ce cas, quelqu'un d' autre peut il y assister" . 0.16666666666666666))
```

Syntactic processing of an interrogative proposition without a *QUE-WH*.

The two previous examples illustrate the syntactic processing of interrogative sentences. In the second example the constituent *PRONOMINALIZE* is involved in the structure of the proposition as the pronominalization of the subject which is to be before the finite verb.

7.2.3 Sentences with Multiple Propositions

Sentences with multiple propositions are processed very easily by the generator because the input structure is a sequence of propositions. Thus, the syntactic process is completed only at the level of the proposition.

```
(translate "今会議に申し込めば参加料はいくらですか")

| 1 Enter F-GENERATION::SYNTACTIC-FUNCTION

(NORMAL (CONJ "si")
        (VERB "inscrire" I #)
        (*SUBJ #)
        (POUR # #) (TIME #)
)

| 1 Exit F-GENERATION::SYNTACTIC-FUNCTION

(NORMAL (CONJ "si")
        (*SUBJ #)
        (F-GENERATION::FINITE-VERB "inscrire" I #)
        (POUR # #) (TIME #)
)
| 2 Enter F-GENERATION::SYNTACTIC-FUNCTION

(YNQ (CONJ ",")
     (QUE-WH "combien")
     (SUBJ #)
     (F-GENERATION::FINITE-VERB "etre" I #)
)

| 2 Exit F-GENERATION::SYNTACTIC-FUNCTION

(YNQ (CONJ ",")
     (QUE-WH "combien")
     (F-GENERATION::FINITE-VERB "etre" I #)
     (SUBJ #)
)
|TARGET SENTENCE

(("si je m'inscris pour conference maintenant , combien sont droits de participation" .
 0.16667166666666666))
```

Syntactic processing of mulptiple proposition sentence.

The examples given in this section illustrate briefly the syntactic processes that are completed on the propositions. The generation of relative clause syntactic structutres are not explained here because they are exactly the same processes as those described fo non-interrogative propositions. The results are described only for the syntactic function because they are not easy to analyze through the translation outputs. The morphological processes tackled by the generator are obvious when reading the translations in appendix D. because all the french words are in their canonical forms in the dictionaries. Thus, all the morphological transformations such as conjugations, inflexions and elisions that are in the ouput sentences are completed by the generator.

7.2.4 Wrong Outputs

From the 225 sentences translated by the French TDMT prototype, only one sentence is not correctly generated. The following sentence is wrong:

```
|TRANSLATE

申し訳ありませんがこちらでは専門的な質問にお答えできません

|GENERATION RESULT
("excusez moi, mais nous ne pouvons pas repondre question technique" .
                                                    1.3666666666666667)

|EXPECTED SENTENCE

("excusez moi, mais nous ne pouvons pas repondre a  question technique" .
                                                      1.3666666666666667)
```

Wrong generation of non-finite intransitive verbs

The generation component implemented cannot tackle the problem of intransitive verbs that are not finite verb. In fact, the only verbs that are processed in our work are finite verb and pronominal verbs. Thus the verb "repondre" which is an intransitive verb and shoul be used with the preposition "a" is used without the "a" beause the verb is not processed. The same error would occur for any intransitive verb that is use in a sentence as a non finite verb. Thus

sentences like *"Je veux assister la conference."* would be generated instead of *"je veux assister a la conference."*. There is only one occurence of this issue in the corpus but it is a frequent French phenoma an is included in the future improvement of our generator.

Conclusion

The results of the experiment on the model corpus show the efficiency and the real applicability of TDMT to languages with a rich inflectional system like French. The generation of correct surface forms using the output of the transfer satge of the TDMT turned out to be a simple task that requires only sequential and iterative processes. We used a special grammatical formalism that is simpler than most of the formalismes usually used for generation. The simplicity of our work is another evidence of the transfer capabilities of TDMT. Some aspects of French are to be studied in order to widen the scope of the generation :

Deletion of repeated constituent in the sentence Generation of other classes of sentences Insertion of missing constituents

The French prototype is being developed and the requirements for these problems are our further research themes.

Acknowledgements

First and foremost, We must thank ATR Interpreting Telephony Laboratories for enabling us to achieve this work, and especially Dr. Yamasaki, the president of ATR ITL laboratories and Mr. Iida, the Head of department 3, for welcoming us in these laboratories. We must express particular gratitude to Dr. Lepage whose help and explanations into French of the system gave us a remarkable illustration of language importance. We also thank all our colleagues at ATR for their encouragement and help.

A Constituent Classes

The constituents are given with their labels in the TDMT prototype. The constituents with several labels are the constituents for which special ordering rules are required in the grammar.

```
SUBJECT ===> SUBJ

VERB ==> VERB

AUXILLIARY VERB ==> AUX-VERB

MODAL VERB ==> MODAL VERB

AUXILLIARY ==> AUX

CIRCONSTANTIAL COMPLEMENTS ==> COMP


                          PREP-GROUP
                          TIME
PREPOSITTIONAL GROUPS ==> PLACE
                          POUR
                          A-PROPOS-DE
            NE
            TOP-ADV
ADVERBS ==> ADV
            END-ADV
            PAS

                                QUE-WH
INTERROGATIVE CONSTITUENTS ==> WH
                                WH-GROUP

ADJECTIVE  ==> ADJ

OBJECT GROUP ==> OBJ
```

```
INDIRECT OBJECT GROUP ==> IND-OBJ
```

These are the first-level constituents that may occur in the input structures. Tfhe other constituents of the sentences are ususal grammatical units or simply words whose part of speech is in the dictionary.

B Excerpt of the grammar rules

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;GRAMMAR RULES;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                          ;;;;;;;;;;;;;;

(in-package :f-generation)

(defun grammar ()


;;;;;;;;;;;;;;;;;;;;;;;;RULES FOR THE SUBJECT GROUP;;;;;;;;;;;;;;;;;;;;;;;;;;;;


              (make-constituent-structure 'subj
                                          '((normal (pre (top-adv
                                                          conj)))
                                            (ynq (pre (top-adv
                                                       wh
                                                       wh-group
                                                       que-wh
                                                       conj)))))

              (make-constituent-structure 'post-pro-sub
                                          '((ynq (post (
                                                        pronominalize
                                                        )))))

               (make-constituent-structure 'post-sub
                                           '((ynq (post (pas
                                                         adv
                                                         modal-verb
                                                         pp
                                                         verb
                                                         post-pro-ind-obj
                                                         post-pro-obj
                                                         conj)))))
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;RULES FOR THE INDIRECT-OBJECT GROUP;;;;;;;;;;;;;;;;;;;;;

(make-constituent-structure 'pro-ind-obj
                            '((normal (pre (top-adv
                                            subj
                                            ne
                                            conj)))
                              (ynq (pre (top-adv
                                         wh
                                         wh-group
                                         que-wh
                                         subj
                                         ne
                                        conj)))))
(make-constituent-structure 'post-pro-obj
                            '((normal (post (adv
                                             pas
                                             modal-verb
                                             pp
                                             post-pro-ind-obj
                                             conj)))
                              (ynq (post (adv
                                          pas
                                          modal-verb
                                          pp
                                          post-pro-sub
                                          pronominalize
                                          post-pro-ind-obj
                                          )))))

(make-constituent-structure 'ind-obj
                            '((normal (post (adv
                                             pas
                                             modal-verb
                                             verb
```

```
                pp
                obj
               conj)))
(ynq (post (pronominalize
            adv
            post-pro-sub
            modal-verb
            verb
            pp
            obj
            conj)))))
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;RULES FOR THE OBJECT GROUP;;;;;;;;;;;;;;;;;;;;

(make-constituent-structure 'pro-obj
                            '((normal (pre (top-adv
                                            subj
                                            ne
                                            pro-ind-obj
                                            conj)))
                              (ynq (pre (top-adv
                                         wh-group
                                         wh
                                         que-wh
                                         subj
                                         ne
                                         pro-ind-obj
                                        conj)))))

(make-constituent-structure 'post-pro-obj
                            '((normal (post (adv
                                             pas
                                             modal-verb
                                             pp
                                             post-pro-ind-obj
                                             conj)))
                              (ynq (post (adv
                                          pas
                                          modal-verb
                                          pp
                                          post-pro-sub
                                          pronominalize
                                          post-pro-ind-obj
                                          )))))

 (make-constituent-structure 'obj
                             '((normal (post (adv
```

```
                    pas
                    modal-verb
                    verb
                    pp
                   conj)))
    (ynq (post (adv
                pas
                pronominalize
                post-pro-sub
                modal-verb
                verb
                pp
                conj)))))
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;RULES FOR  THE NON FINITE VERB;;;;;;;;;;;;;;;

                (make-constituent-structure 'verb
                                            '((normal (post (adv
                                                             pas
                                                             modal-verb
                                                             pp
                                                             post-pro-ind-obj
                                                             post-pro-obj
                                                            conj)))
                                              (ynq (post (pronominalize
                                                           adv
                                                           post-pro-sub
                                                           modal-verb
                                                           pas
                                                           pp
                                                           post-pro-ind-obj
                                                           post-pro-obj
                                                           conj)))))

                                            nil))
```

C Inflectional Paradigms

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;INFLEXION PARADIGMS;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                           ;;;;;;;;;;;;;;;;;;;

;;;;Noun class list

(setq noun-group-list '("conference" 0))

;;;;Adjective class list

(setq adj-group-list '("ne" 0 "sale" 0))

;;;;Verb class list

(setq group-list '(first-group second-group avoir etre payer appeler venir
                   savoir voir valoir rendre craindre connaitre conclure ecrire
                   dire lire faire vouloir pouvoir devoir aller reduire courir mettre))

;;;;;;;;;;;;;;;;;;;;;;;;;;;;CONJUGATION RULES;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defun inflexion-tree ()

::Verbs of the first group
---------------------------

( setf (get 'inflexion-tree 'first-group) '(present ("e"
                                                      "es"
                                                      "e"
                                                      "ons"
                                                      "ez"
                                                      "ent")
                                                 imp ("ez")
                                         conditional ("erais"
                                                      "erais"
                                                      "erait"
```

```
                                                    "erions"
                                                    "eriez"
                                                    "eraient")
                                            perfect ("ais"
                                                    "ais"
                                                    "ait"
                                                    "ions"
                                                    "iez"
                                                    "aient")
                                              futur ("erai"
                                                    "eras"
                                                    "era"
                                                    "erons"
                                                    "erez"
                                                    "eront")
                                         subjonctive ("e"
                                                    "es"
                                                    "e"
                                                    "ions"
                                                    "iez"
                                                    "ent")
                                                 pp ("e")))
                                              pp ("i")))

::Verb avoir
------------

( setf (get 'inflexion-tree 'avoir) '(present ("ai"
                                               "as"
                                               "a"
                                               "avons"
                                               "avez"
                                               "ont")
                                      futur ("aurai"
                                               "auras"
                                               "aura"
```

```
                                        "aurons"
                                        "aurez"
                                        "auront")
                                  imp ("ayez")
                              perfect ("avais"
                                        "avais"
                                        "avait"
                                        "avions"
                                        "aviez"
                                        "avaient")
                          conditional ("aurais"
                                        "aurais"
                                        "aurait"
                                        "aurions"
                                        "auriez"
                                        "auraient")
                          subjonctive ("aie"
                                        "aies"
                                        "ait"
                                        "ayons"
                                        "ayez"
                                        "aient")
                                   pp ("eu")))

::Verb devoir
-------------

(setf (get 'inflexion-tree 'devoir) '(present ("dois"
                                               "dois"
                                               "doit"
                                               "devons"
                                               "devez"
                                               "doivent")
                                      futur ("devrai"
                                             "devras"
                                             "devra"
```

```
                                        "devrons"
                                        "devrez"
                                        "devront")
                                perfect ("devais"
                                        "devais"
                                        "devait"
                                        "devions"
                                        "deviez"
                                        "devaient")
                            conditional ("devrais"
                                        "devrais"
                                        "devrait"
                                        "devrions"
                                        "devriez"
                                        "devraient")
                            subjonctive ("doive"
                                        "doives"
                                        "doive"
                                        "devions"
                                        "deviez"
                                        "doivent")
                                    imp ("")
                                     pp ("du")))


::Verb ecrire
-------------

(setf (get 'inflexion-tree 'ecrire) '(present ("is"
                                        "is"
                                        "it"
                                        "ivons"
                                        "ivez"
                                        "ivent")
```

```
                                futur ("irai"
                                       "iras"
"ira"
                                       "irons"
                                       "irez"
                                       "iront")
                            perfect ("ivais"
                                     "ivais"
                                     "ivait"
                                     "ivions"
                                     "iviez"
                                     "ivaient")
                        conditional ("irais"
                                     "irais"
                                     "irais"
                                     "irions"
                                     "iriez"
                                     "iraient")
                        subjonctive ("ive"
                                     "ives"
                                     "ive"
                                     "ivions"
                                     "iviez"
                                     "ivent")
                                imp ("ivez")
                                 pp ("it")))
```

.
.
.
.
.

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;OTHER INFLEXIONS;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

::Adjectives like "simulatne"
----------------------------

(setf (get 'inflexion-tree 'ne) '("s"
                                  "e"
                                  "es"))

::Adjectives like "technique"
-----------------------------

(setf (get 'inflexion-tree 'sale) '("s"
                                    ""
                                    "s"))
::Noun that take an "s" in theri plural form
--------------------------------------------

(setf (get 'inflexion-tree 'conference) '("s"))
```

D Translation Results

```
*J-MODEL-CONVERSATION-1*

もしもし
("allo" . 0)

そちらは会議事務局ですか
("est ce secretariat de la conference" . 1.5000000000000002E-5)

はい
("oui" . 0)

そうです
("c'est exact" . 0)

どのようなご用件でしょうか
("que puis je faire pour vous" . 1.0)

会議に申し込みたいのですが
("je voudrais m'inscrire pour conference" . 0.0)

どのような手続をすればよろしいのでしょうか
("comment pourrais je proceder" . 1.0)

登録用紙で手続きをして下さい
("s'il vous plait veuillez proceder avec fiche d'inscription" . 1.0E-5)

登録用紙は既にお持ちでしょうか
("avez vous deja fiche d'inscription" . 1.0)

いいえ
("non" . 0)

まだです
("pas encore" . 0.0)
```

分かりました
("je vois" . 0)

それでは登録用紙をお送り致します
("dans ce cas, nous vous expedierons fiche d'inscription" . 1.0)

ご住所とお名前をお願いします
("s'il vous plait veuillez me donner adresse et nom" . 2.0)
("s'il vous plait veuillez me donner nom a adresse" . 2.6666666666666665)

住所は大阪市北区茶屋町二十三です
("adresse est 23 Chaya-machi Kita-ku Osaka-shi" . 0.33335166666666666)

名前は鈴木真弓です
("nom est Suzuki Mayumi" . 1.0E-5)

分かりました
("je vois" . 0)

登録用紙を至急送らせて頂きます
("nous vous expedierons immediatement fiche d'inscription" . 0.0)

よろしくお願いします
("merci beaucoup pour votre cooperation" . 0)

それでは失礼します
("dans ce cas, au revoir" . 0.0)

J-MODEL-CONVERSATION-2

はい
("oui" . 0)

こちらは会議事務局です

("c'est secretariat de la conference" . 0.7404869761904762)

会議の参加料について教えて頂きたいのですが
("je voudrais que vous me disiez au sujet de droits de participation de conferen
ce" . 1.5000000000000002E-5)

今会議に申し込めば参加料はいくらですか
("si je m'inscris pour conference maintenant , combien sont droits de participat
ion" . 0.16667166666666666)

はい
("oui" . 0)

参加料は現在お一人三万五千円です
("droits de participation sont 30 cinq mille yen par personne maintenant" . 0.59
72422222222222)

来月お申込みになりますと四万円です
("si vous vous inscrivez mois prochain , cela coute 40 mille yen" . 1.50002)

参加料には予稿集代と歓迎会費が含まれています
("prix du resume des articles et droits d'inscription sont inclus dans droits de

participation" . 0.30001199999999995)

わたしは情報処理学会の会員なのですが
("je suis membre de societe de traitement de l'information" . 5.0E-6)

参加料の割引はないのですか
("n'y a il pas droits de participation reduction" . 0.0)

今回は割引を行なっておりません
("nous ne faisons pas une reduction cette fois" . 0.25)

そうですか
("je vois" . 0)

参加料はどのようにお支払いしたらよいのですか
("comment pourrais je payer droits de participation" . 1.0)

参加料は銀行振り込みです
("payez droits de participation par transfert bancaire" . 0.0)

案内書に記載されている口座番号に振り込んで下さい
("s'il vous plait veuillez transferer a numero de compte qui est decrit dans fai
re
   part" . 0.0)
("s'il vous plait veuillez transferer a faire part a numero de compte qui est de
crit" . 0.3888938888888889)

また期限は今年いっぱいです
("et date limite est jusqu'a la fin de cette annee" . 0.3333333333333333)

分かりました
("je vois" . 0)

どうもありがとうございました
("merci beaucoup" . 0)

どういたしまして
("je vous en prie" . 0)

分からない点がございましたらいつでもお聞き下さい
("si vous avez question , s 'il vous plait veuillez nous demander a n'importe

  quel moment" . 1.000005)

失礼致します
("au revoir" . 0)

J-MODEL-CONVERSATION-3

はい
("oui" . 0)

こちらは会議事務局です
("c'est secretariat de la conference" . 0.7404869761904762)

会議に論文を発表したいと思っているのですが
("je voudrais presenter article a conference" . 0.6666666666666666)
("je voudrais presenter article pour conference" . 0.8333353333333333)
("je voudrais presenter article pour conference" . 1.0555575555555557)

会議の内容について教えて下さい
("s'il vous plait veuillez me dire au sujet de contenu de conference" . 0.0)

今回の会議は通訳電話に関連する広範な研究分野を含んでいます
("cette conference inclut divers domaines de recherche qui sont lies a Traducion

telephonique" . 0.500015)
("cette conference inclut divers domaines de recherche qui sont lies dans Traduc
ion
telephonique" . 0.8333433333333333)
("inclut divers domaines de recherche qui cette conference est liee a Traducion
telephonique" . 0.8333483333333333)

言語学や心理学を専攻する方にも参加して頂く予定です
("ceux qui se specialisent en linguistique et psychologie y assisteront" . 0.833
3333333333334)
("ceux qui se specialisent y assisteront en linguistique et psychologie" . 1.166
6666666666668)
("vous ceux qui se specialisent en linguistique et psychologie assisterez" . 1.2
222222222222224)
("vous ceux qui se specialisent en linguistique et psychologie assisterez" . 1.2
857142857142858)
("vous ceux qui se specialisent assisterez en linguistique et psychologie" . 1.5
555555555555556)
("vous ceux qui se specialisent assisterez en linguistique et psychologie" . 1.6

19047619047619)
("vous ceux qui se specialisent assisterez linguistique et psychologie" . 1.6388
93888888889)

分かりました
("je vois" . 0)

ところで会議での公式言語は何ですか
("a propos, quelle est langue officielle a conference" . 0.0)
("a propos, langue officielle a conference est elle quelle" . 0.0)

英語と日本語です
("anglais et japonais" . 1.0E-5)
("japonais anglais" . 0.500005)

わたしは日本語が全然分からないのですが
("je ne comprends pas du tout japonais" . 5.0E-6)

発表が日本語で行なわれる場合英語への同時通訳はあるのですか
("si presentation est tenue dans japonais , y a il traduction simultanee en angl
ais" . 0.5416816666666666)

はい
("oui" . 0)

英語への同時通訳を用意しております
("nous sommes en train de preparer traduction simultanee en anglais" . 0.0)

分かりました
("je vois" . 0)

どうもありがとうございました
("merci beaucoup" . 0)

さようなら
("au revoir" . 0)

J-MODEL-CONVERSATION-4

こちらは会議事務局です
("c'est secretariat de la conference" . 0.7404869761904762)

会議について詳しいことを教えて下さい
("s'il vous plait veuillez me dire details au sujet de conference" . 5.0E-6)

会議の案内書はお持ちですか
("avez vous faire part au sujet de conference" . 1.3333333333333335)

いいえ
("non" . 0)

持っていません
("je ne l'ai pas" . 0.0)

そうですか
("je vois" . 0)

会議は８月２２日から２５日まで京都国際会議場で開催されます
("conference est tenue a hall de la conference internationale de kyoto d'aout 22 a 25" . 0.5555763888888888)
("conference 25 est tenue d'aout 22 a hall de la conference internationale de kyoto" . 1.4000244999999998)

参加料は四万円です
("droits de participation sont 40 mille yen" . 0.16668666666666665)

発表を希望されるのでしたら３月２０日までに要約を提出して下さい
("si vous voulez presenter article , s'il vous plait veuillez soumettre resume avant mars 20" . 0.6500045)

会議の案内書をお送り致しますのでそれをご覧下さい

("nous vous expedierons faire part au sujet de conference , s 'il vous plait don c veuillez
 parcourir cela" . 2.3333333333333335)

失礼ですがお名前とご住所をお願い致します
("s'il vous plait excusez moi, mais veuillez me donner nom et adresse" . 2.5)
("s'il vous plait excusez moi, mais veuillez me donner nom" . 2.6527777777777777
)

アダムスミスです
("je m'appelle Adam Smith" . 1.0E-5)

住所は大阪市東区玉造２丁目２７の７です
("adresse est 2 chome 2 7 7 Tamatsukuri Higashi-ku Osaka-shi" . 0.33337166666666
66)

分かりました
("je vois" . 0)

電話番号もお聞きしたいのですが
("je voudrais demander numero de telephone" . 1.1666666666666668)

はい
("oui" . 0)

３７２の８０１８です
("3 7 2 8 0 1 8" . 0.12699888888888888)

３７２の８０１８でございますね
("3 7 2 8 0 1 8 , exact" . 0.12699888888888888)
("il est 3 7 2 8 0 1 8" . 0.6825477777777778)

はい
("oui" . 0)

そうです
("c'est exact" . 0)

それではよろしくお願いします
("dans ce cas, merci beaucoup pour votre cooperation" . 1.0)

失礼します
("au revoir" . 0)

J-MODEL-CONVERSATION-5

はい
("oui" . 0)

こちらは会議事務局でございます
("c'est secretariat de la conference" . 0.7738213095238096)

ちょっとお願いがあるのですが
("pourrais je vous demander faveur" . 1.0)

私は会議に申込みをした者です
("je me suis inscrit pour conference" . 5.0E-6)
("je me suis inscrit pour conference" . 1.0E-5)
("je me suis inscrit conference" . 0.5)
("je me suis inscrit conference" . 0.5)
("je me suis inscrit a conference" . 0.5)
("je me suis inscrit pour conference" . 0.5)
("je me suis inscrit dans conference" . 0.5)
("je me suis inscrit a conference" . 0.5)

参加を取り消したいのですが
("je voudrais annuler inscription" . 0.16666666666666666)

お名前をお伺いできますでしょうか
("peux je demander nom" . 2.16667)

はい

("oui" . 0)

ベル研のジムワイベルです
("je m'appelle Jim Waibel de laboratoires Bells" . 1.5000000000000002E-5)

既に登録料の八万五千円を振り込まれておられますね
("vous avez deja transfere quatre-vingt cinq mille yen pour droits d'inscription " . 0.500025)

はい
("oui" . 0)

そうです
("c'est exact" . 0)

登録料を払い戻して頂けますか
("rembourserez vous droits d'inscription" . 5.0E-6)
("pouvez vous rembourser droits d'inscription" . 1.000005)

お気の毒ですができません
("je suis desole, mais ce n'est pas possible" . 0.0)

案内書にも書いていますが
("il est ecrit dans faire part" . 0.33333666666666667)

９月２７日以後の取り消しに対する払い戻しはできません
("nous ne pouvons pas rembourser pour annulation apres septembre 27" . 0.9222465555555556)
("nous ne pouvons pas apres septembre 27 rembourser pour annulation" . 1.200026)
("nous ne pouvons pas rembourser pour annulation d'apres septembre 27" . 1.200026)

後日プログラムと予稿集をお送り致します
("nous vous expedierons programme et resume des articles plus tard" . 1.805558888888889)
("nous vous expedierons resume des articles de programme plus tard" . 1.8769874603174604)

では誰かが私の代わりに参加することはできますか
("dans ce cas, quelqu'un d' autre peut il y assister" . 0.16666666666666666)

それは別に問題ありません
("cela n'a pas de l'importance en particulier" . 0.0)
("cela est cela ne pas avoir en particulier" . 0.083335)
("cela est cela ne pas avoir en particulier" . 0.083335)

代理人が参加する場合はあらかじめこちらまでお知らせ下さい
("si remplacant y assiste , s'il vous plait veuillez nous informer auparavant" .
2.0238138095238094)

分かりました
("je vois" . 0)

代理人が決まりましたらお知らせ致します
("quand remplacant est decide , nous vous informerons" . 1.7916758333333332)

では失礼します
("dans ce cas, au revoir" . 0.0)

>>> *J-MODEL-CONVERSATION-6*

はい
("oui" . 0)

こちらは会議事務局ですが
("c'est secretariat de la conference" . 0.023828809523809527)

会議の間に市内観光があるそうですが
("j'ai entendu dire qu'il y a tour de la ville pendant conference" . 0.0)

まだ参加できますか

("peux j'encore y assister" . 0.0)

はい
("oui" . 0)

まだ参加可能です
("vous pouvez encore y assister" . 0.5555555555555556)

８月５日の午後に清水寺金閣寺龍安寺などを見学します
("nous verrons Kiyomizu-dera Kinkaku-ji et Ryoan-ji aout 5 apres-midi" . 0.40001
699999999996)

参加なさいますか
("y assisterez vous" . 0.0)

参加料はいくらですか
("combien sont droits de participation" . 0.16667166666666666)

八千円です
("cela coute huit mille yen" . 2.0E-5)

参加料には夕食代も含まれています
("le cout de diner est aussi inclu dans droits de participation" . 0.30000699999
999997)

講演者も参加されるのですか
("orateur y assistera il aussi" . 0.75)

講演者の何人かは参加する予定になっています
("quelque orateur y assistera" . 0.3055588888888889)
("j'y assisterai le quelque orateur" . 0.75)

そうですか
("je vois" . 0)

それでは参加したいと思います
("dans ce cas, je voudrais y assister" . 0.0)

ではお名前と人数をお願い致します
("s'il vous plait dans ce cas, veuillez me donner nom et nombre de personnes" . 1.5)
("s'il vous plait dans ce cas, veuillez me donner nom" . 1.6527777777777777)

ケンブラウンと申します
("je suis Ken Brown" . 5.0E-6)
("je Ken Brown et etre" . 0.8333333333333334)

家内と参加します
("j'y assisterai avec ma femme" . 0.0)
("je ma femme et assister y" . 0.6666666666666666)

集合場所は会議場の受付の前になっております
("lieu de regroupement est en face de bureau d'inscription a hall de la conferen ce" . 0.0)
("lieu de regroupement est en face de bureau d'inscription hall de la conference " . 0.26666866666666667)
("lieu de regroupement est en face de bureau d'inscription a hall de la conferen ce" . 0.8666666666666667)
("lieu de regroupement est en face de bureau d'inscription hall de la conference " . 1.1333353333333334)

参加料は当日集合場所でお支払い下さい
("s 'il vous plait veuillez payer droits de participation a lieu de regroupement au jour meme" . 1.0)

分かりました
("je vois" . 0)

ありがとうございました
("merci beaucoup" . 0)

ではお待ちしております
("dans ce cas, nous esperons vous voir" . 0.0)

J-MODEL-CONVERSATION-7

はい
("oui" . 0)

こちらは会議事務局です
("c'est secretariat de la conference" . 0.7404869761904762)

会議で扱う話題に関して質問したいんですが
("je voudrais vous poser questions a propos de sujet qui sera traite a conferenc
e" . 0.6726240476190477)
("je voudrais vous poser questions a propos de sujet qui sera traite a conferenc
e" . 0.8392857142857143)

はい
("oui" . 0)

何でしょうか
("lequel est ce" . 1.0E-5)

機械翻訳という話題が案内書に載っていますが

具体的にこれはどういう内容のものなんですか
("quel sujet est ce precisement" . 0.0)

;;WRONG GENERATION;;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

申し訳ありませんがこちらでは専門的な質問にお答えできません
("excusez moi, mais nous ne pouvons pas repondre technique question" . 1.3666666
666666667)

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;WRONG GENERATION DUE TO WRONG TRANSFER;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

第二版の案内書に会議で発表される論文の題目が載っております

("titre d'article qui sera presente article a conference est ecrit dans seconde
version de faire part" . 0.6083353333333333)
("titre d'article qui sera presente article dans seconde version de faire part a
conference est ecrit" . 0.8583353333333333)
("titre d'article qui sera presente article est ecrit dans seconde version de fa
ire part a conference" . 0.8861131111111111)

そちらを見て頂けないでしょうか
("pouvez vous le voir" . 0.0)
("me le verrais vous" . 0.5555555555555556)

いいですよ
("c'est bien" . 0)

それでは早急にその案内書を送って下さい
("s'il vous plait dans ce cas, veuillez m'expedier le faire part immediatement"
. 0.9444477777777777)

送り先は大阪市東区城見２の１の６１渡辺明です
("je m'appelle adresse etre 2 1 6 1 Shiromi Higashi-ku Osaka-shi Akira Watanabe"
. 0.27781)
("je m'appelle adresse etre 2 1 6 1 Akira Watanabe Shiromi Higashi-ku Osaka-shi"
. 0.7222511111111111)

大阪市東区城見２の１の６１渡辺明様ですね
("2 1 6 1 Shiromi Higashi-ku Osaka-shi Mr. Akira Watanabe , exact" . 0.277805)
("2 1 6 1 Mr. Akira Watanabe Shiromi Higashi-ku Osaka-shi , exact" . 0.638912777
7777778)

はい
("oui" . 0)

早速送らせて頂きます
("nous vous l'expedierons immediatement" . 0.0)

他に何かございますか
("y a il quelque chose d'autre" . 0.0)

("il y a quelque chose d'autre" . 0.3333333333333333)

いいえ
("non" . 0)

ありません
("rien" . 0)

ありがとうございました
("merci beaucoup" . 0)

失礼します
("au revoir" . 0)

J-MODEL-CONVERSATION-8

はい
("oui" . 0)

会議事務局です
("secretariat de la conference" . 0.46667066666666674)

ちょっとお聞きしたいことがあるんですが
("j'ai quelque chose a demander" . 1.000015)
("j'ai quelque chose a demander" . 1.2592775925925928)

私は今度の会議に発表したいと思っているんですが
("je voudrais presenter article a prochaine conference" . 0.6666716666666667)
("je voudrais presenter article pour prochaine conference" . 0.8333403333333334)
("je voudrais presenter article a prochaine conference" . 1.0)

どのような手続きをすればよろしいでしょうか
("comment pourrais je proceder" . 1.0)

先ず二百字の要約を３月２０日までにこちらまでお送り下さい
("s'il vous plait d'abord, veuillez nous envoyer resume de deux cent mots
avant mars 20" . 1.5666786666666668)

こちらで審査を行ない５月２０日までに結果をお送りします
("apres que nous ayons juge , je vous expedierai resultat avant mai 20" . 1.5666
736666666668)

投稿が受理された場合原稿用紙を同封致します
("si inscription est acceptee , nous joindrons manuscrit article" . 0.0)

６月３０日までに原稿の送付をお願いします
("s'il vous plait veuillez m'envoyer manuscrit aux environs de juin 30" . 0.7333
453333333333)

分かりました
("je vois" . 0)

要約はどのような書式で書けばいいんですか
("pourrais j'ecrire resume dans quel formulaire" . 1.16667)

所定の申込み用紙がありますのでそれに記入して下さい
("il y a requise fiche d'inscription , s'il vous plait donc veuillez ecrire dans
cela" . 5.0E-6)

それでは申込み用紙を送りますので送り先をお願いします
("dans ce cas, je vous expedierai fiche d'inscription , s'il vous plait donc
veuillez me donner adresse" . 0.5)
("dans ce cas, je vous expedierai fiche d'inscription , s'il vous plait donc veu
illez me donner adresse" . 1.5)

分かりました
("je vois" . 0)

人工知能研究所のジョージオハラです
("je m'appelle George Ohara de AI Labs" . 2.0E-5)

住所は東京都豊島区東池袋３丁目２番５号です
("adresse est 3 chome 2 ban 5 gou Higashi Ikebukuro Toshima-ku Tokyo-to" . 2.166
6666666666667E-5)

人工知能研究所のジョージオハラ様ですね
("Mr. George Ohara de AI Labs , exact" . 0.3333333333333333)

ご住所は東京都豊島区東池袋３丁目２番５号でよろしいですね
("adresse est 3 chome 2 ban 5 gou Higashi Ikebukuro Toshima-ku Tokyo-to , n'est
ce pas " . 1.0000216666666666)
("c'est cela etre d'accord dans 3 chome 2 ban 5 gou Higashi Ikebukuro Toshima-ku
Tokyo-to en adresse , n'est ce pas" . 1.5000316666666667)
("c'est adresse etre d'accord dans 3 chome 2 ban 5 gou Higashi Ikebukuro Toshima
-ku Tokyo-to , n'est ce pas" . 1.5000316666666667)

はい
("oui" . 0)

そうです
("c'est exact" . 0)

それでは申込み用紙の送付をよろしくお願いします
("s'il vous plait dans ce cas, veuillez m'envoyer fiche d'inscription" . 1.00000
5)

はい
("oui" . 0)

分かりました
("je vois" . 0)

では早速お送り致します
("dans ce cas, nous vous l'expedierons immediatement" . 1.0)

失礼致します
("au revoir" . 0)

J-MODEL-CONVERSATION-9

そちら会議事務局ですか
("est ce secretariat de la conference" . 0.023828809523809523)

はい
("oui" . 0)

会議事務局です
("secretariat de la conference" . 0.46667066666666674)

何のご用件でしょうか
("que peux je faire" . 1.0)

会議場へどうやって行ったらいいか教えて欲しいんですが
("je voudrais que vous me disiez comment je pourrais aller a hall de la
conference" . 1.2666686666666667)
("je voudrais que vous me disiez comment je pourrais aller dans hall de
la conference" . 1.7037037037037038)
("je voudrais comment que vous me disiez je pourrais aller dans hall de la confe
rence" . 1.7037037037037038)
("je voudrais comment que vous me disiez je pourrais aller dans hall de la confe
rence" . 1.7037037037037038)

今京都駅にいるんです
("je suis a gare de Kyoto maintenant" . 0.26667166666666664)

地下鉄で北大路駅まで行って下さい
("s'il vous plait veuillez aller en metro a Kitaoji station" . 1.0E-5)

そこから国際会議場へ行くバスが利用できます
("vous pouvez utiliser bus qui va de la-bas a hall de la conference
internationale" . 5.0E-6)
("vous pouvez utiliser bus qui va a hall de la conference internationale de la-b
as" . 0.30000499999999997)

("vous pouvez utiliser bus qui va de la-bas a hall de la conference internationa
le" . 0.6666716666666666)

北大路駅ではタクシーも利用できます
("vous pouvez aussi utiliser taxi a Kitaoji station" . 5.0E-6)

京都駅からタクシーで会議場まで行くにはいくらぐらいかかりますか
("combien coute il pour aller a hall de la conference en taxi de gare de Kyoto"
. 0.26190619047619046)
("combien coute il de gare de Kyoto pour aller a hall de la conference en taxi"
. 0.26191119047619044)
("combien coute il de gare de Kyoto en taxi pour aller a hall de la conference"
. 0.26191119047619044)
("combien coute il de gare de Kyoto en taxi a hall de la conference pour aller"
. 0.26667366666666664)

京都駅からですとおよそ六千円かかります
("il coutera aux environs de six mille yen de gare de Kyoto" . 2.5E-5)

では北大路駅からですといくらぐらいかかりますか
("dans ce cas, combien coute il de Kitaoji station" . 5.0E-6)

北大路駅からですとおよそ九百円です
("cela coute de Kitaoji station aux environs de neuf cent yen" . 2.5E-5)

分かりました
("je vois" . 0)

どうもありがとうございました
("merci beaucoup" . 0)

いいえ
("non" . 0)

どういたしまして
("je vous en prie" . 0)

J-MODEL-CONVERSATION-10

もしもし
("allo" . 0)

はい
("oui" . 0)

会議事務局でございます
("c'est secretariat de la conference" . 0.500005)

会議の宿泊施設についてお尋ねしたいのですが
("je voudrais vous demander au sujet de location des chambres d'hotel pour confe
rence" . 1.4444477777777778)

そちらでどこか紹介して頂けますか
("me recommanderiez vous quelque part" . 0.16666916666666667)
("me recommanderais vous vous ou" . 0.5)
("me recommanderais vous ou a vous" . 0.5)
("pouvez vous recommander quelque part" . 1.1666691666666667)
("pouvez vous recommander vous ou" . 1.5)
("pouvez vous recommander ou a vous" . 1.5)

はい
("oui" . 0)

私どもでご紹介できるホテルは京都ホテルと京都プリンスホテルです
("hotel que nous pouvons vous recommander est Kyoto Hotel et
  Hotel Prince a Kyoto" . 1.0000300000000002)
("hotel que peut recommander est vous Kyoto Hotel et Hotel Prince a Kyoto" . 1.3
333633333333335)
("hotel que peut recommander est Kyoto Hotel et Hotel Prince a Kyoto" . 1.333363
3333333335)
("hotel que nous pouvons vous recommander est Hotel Prince a Kyoto Kyoto Hotel"

. 1.5000250000000002)
("hotel que nous pouvons vous recommander est Hotel Prince a Kyoto Kyoto Hotel"
. 1.5000250000000002)
("hotel que peut recommander est vous Hotel Prince a Kyoto Kyoto Hotel" . 1.8333
583333333335)
("hotel que peut recommander est vous Hotel Prince a Kyoto Kyoto Hotel" . 1.8333
583333333335)
("hotel que peut recommander est Hotel Prince a Kyoto Kyoto Hotel" . 1.833358333
3333335)
("hotel que peut recommander est Hotel Prince a Kyoto Kyoto Hotel" . 1.833358333
3333335)

一人部屋の値段は一晩七千円から一万円です
("prix de chambre a un lit est de sept mille yen par nuit a dix mille yen" . 0.0
5559388888888889)

二人部屋の値段は九千五百円から六万円です
("prix de chambre a deux lits est de neuf mille cinq cent yen a soixante mille
yen" . 4.0E-5)

そうですか
("je vois" . 0)

どちらのホテルが会議場に近いですか
("quel hotel est il plus pres de hall de la conference" . 0.6952429523809525)

京都プリンスホテルが会議場には近いんですが
("Hotel Prince a Kyoto est plus pres a hall de la conference" . 0.72222722222222
22)

それでは京都プリンスホテルを予約したいのですが
("dans ce cas, je voudrais reserver Hotel Prince a Kyoto" . 0.3333383333333333)

ホテルの手配もして頂けるのですか
("ferez vous aussi demarches pour chambres d'hotel" . 5.0E-6)
("pouvez vous aussi faire demarches pour chambres d'hotel" . 0.7333383333333333)

はい
("oui" . 0)

京都ホテルと京都プリンスホテルは予約できます
("Kyoto Hotel et Hotel Prince a Kyoto sont disponibles" . 1.5000000000000002E-5)
("Hotel Prince a Kyoto est Kyoto Hotel disponible" . 0.4629729629629629)

そうですか
("je vois" . 0)

では京都プリンスホテルの七千円の一人部屋をお願いします
("dans ce cas, je voudrais chambre a un lit a sept mille yen a Hotel Prince a Kyoto" . 0.20835833333333334)
("dans ce cas, je voudrais chambre a un lit a sept mille yen de Hotel Prince a Kyoto" . 0.4861361111111111)

はい
("oui" . 0)

京都プリンスホテルの七千円の一人部屋ですね
("chambre a un lit a sept mille yen a Hotel Prince a Kyoto , exact" . 2.5E-5)
("chambre a un lit a sept mille yen de Hotel Prince a Kyoto , exact" . 0.2778027777777778)

はい
("oui" . 0)

そうです
("c'est exact" . 0)

いつからお泊まりになりますか
("a partir de quand viendrez vous" . 1.0)
("a partir de quand viendrez vous" . 2.0)
("vous a partir de quand venir" . 2.0)

8月4日の夜からです
("a partir de soir aout 4" . 1.0666736666666666)

８日の朝までお願いします
("jusque a matin de 8 , s'il vous plait" . 2.5E-6)

分かりました
("je vois" . 0)

少々お待ち下さい
("s'il vous plait veuillez attendre un instant" . 1.0)

お部屋が取れるかどうか調べます
("je verifie si je peux reserver chambre" . 2.025925925925926)
("je verifie si je peux reserver chambre" . 2.4217592592592596)

お部屋をお取りできます
("nous pouvons reserver chambre" . 2.0)

ではお名前とご住所をお願いします
("s'il vous plait dans ce cas, veuillez me donner nom et adresse" . 2.5)
("s'il vous plait dans ce cas, veuillez me donner nom" . 2.6527777777777777)

中村一雄です
("je m'appelle Kazuo Nakamura" . 1.0E-5)

住所は東京都港区新橋１丁目１番３号です
("adresse est 1 chome 1 ban 3 gou Shimbashi Minato-ku Tokyo-to" . 0.074093518518
51852)

電話番号もお願いします
("s'il vous plait veuillez me donner numero de telephone" . 0.0)

電話番号は３３１の２５２１です
("numero de telephone est 3 3 1 2 5 2 1" . 0.08731111111111112)

分かりました
("je vois" . 0)

京都プリンスホテルに８月４日から８日まで一人部屋をお取りしました
("j'ai reserve chambre a un lit a Hotel Prince a Kyoto d'aout 4 a 8" . 2.3184800
375180377)
("j'ai reserve chambre a un lit d'aout 4 a Hotel Prince a Kyoto jusque a 8" . 2.
4883221168831167)

どうもありがとうございました
("merci beaucoup" . 0)

失礼します
("au revoir" . 0)

References

[1] Y. Sobashima, O. Furuse, S. Akamine, J. Kawai and H. Iida, *A bidirectional, Transfer Driven Machine Translation sytsem for spoken dialogues*, submitted to COLING 94.

[2] O. Furuse and H. Iida, *Transfer Driven Machine Translation*, PROC. of FGNLP (1992).

[3] O. Furuse and H. Iida, *Cooperation between Tranfer and Analysis in Example-Based framework*, PROC. of COLING (1992).

[4] R.L. Wagner et J. Pichon, *GRAMMAIRE DU FRANCAIS classique et moderne*, HACHETTE UNIVERSITE (1963).

[5] L. Danlos,*A French and English syntactic component for generation*, NATO ASI SERIES : Applied Sciences - No. 135 (1987), 192–218.

[6] S. Buseman, *Surface Transformations during the generation of written german sentences*, SYMBOLIC COMPUTATION: Natural Langauge Generation Systems (1988), 98–165.

[7] H. Uszkoreit, *Word Order and Constituent Structure in German*, CSLI Lecture Notes, 8, (1987).

[8] Y. Sobashima, *local context analysis of dialogues using bilingual corpus*, PROC. of ISSD (1993), 61–64.

[9] Nagao, M : A framework of a mechanical translation between Japanese and English by analogy principle, in Artificial and Human Intelligence, ed. Elithorn, A. and Banerji, R., North-Holland, pp.173–180, (1984).

[10] Sumita, E. and Iida, H. : Example-Based Transfer of Japanese Abdominal Particles into English, IEICE TRANS. INF. & SYT., Vol.E75-D, No.4, pp.585–594, (1992).