Dependence on Context
in case of English-Japanese Machine Translation I－12

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英和機械翻訳における文脈依存性 I－12

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Abstract

This is the twelfth of a series of articles on the context dependency analysis in case of English-Japanese machine translation system which we call "US system". In this issue we examine the examples taken from Lesson 12 of three English textbooks for the first year grade Japanese junior high school students.

The main subjects to be examined in this issue are the followings: (1) Is the verb transitive or intransitive (in case it is followed by a preposition and a numeral)? (2) Add a counting unit to a numeral (in case a numeral follows directly a verb) (3) Is the verb transitive or intransitive (the most general case)? (4) Negative answer to a question "Do (Does) XX live in YY?" (5) Add a counting unit to two numerals, and (6) A case where "you" is interpreted as singular in "What do you do?"

Key words: machine translation, context dependence, context inherited from the preceding sentences, US system.

1．Is the verb transitive or intransitive （in case it is followed by a preposition and a numeral）？

In the previous issue ［6］ of this series, we explained the choice rule for determining whether the given verb is used as a transitive or intransitive verb in case the verb is followed by a preposition. In this issue we explain the same case where the preposition in question is followed by a numeral. In such a particular case, the prepostion with a numeral often forms an adverbial phrase which expresses the time upon which the event of the verb occurred. In this case the verb is evidently intransitive. See the example sentences below.

> Our school *begins* at eight fifty. .... （1）
> 私達の学校は 8 時 50 分に*始まります*.
> Watashitachi no gakkou wa hachi ji go-juppun ni *hajimari-masu*.

The choice rule for the selection of the adequate Japanese translation for "begin" above is as follows.

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33; *j; 1; J1=7; DJ1<> によって; J2=15; T2=n; J-1=1; J-2=8; T-2=O; DJ0<>VR $; VZ<>?; X825;

Even in this case, if the verb "begin" is inherited from the previous English sentence, it sometimes happens that the object of the transitive verb already appeared in the previous sentence is omitted in the present sentence. This is the reason why the choice rule above verifies that the verb in question is different from the main verb of the previous sentence (DJ0<>VR$;). Further the rule checks that the verb in the previous sentence doesn't have attribute '?', the presence of which would imply that the verb appeared in an interrogative sentence. This verification is necessary because the object of the transitive verb is sometimes omitted in a response sentence to an interrogative sentence.

2. Add a counting unit to a numeral (in case a numeral follows directly a verb).

In the 8th article [3] of this series, we presented a generation rule which attaches the adequate counting unit to the numeral place after "have only". This time we show an analogous example in which a numeral follows directly the transitive verb "have".

> How many classes do you have in the afternoon?
> 午後あなたは何科目の授業がありますか？
> Gogo anata wa nan kamoku no jugyou ga ari-masu ka?
>
> We have *two*. .... (2)
> 私達は*2科目*あります.
> Watashitachi wa *ni kamoku* ari-masu.

The grammar rule for the generation of the Japanese translation of the English sentence (2) above is as follows.

5; 31; 3; 1; LT; T1=n; E1<>*; OZ=y; DJ0<>に; DJ0<>*/; T0<>Ejv; T1<>dtyzEK; DJ1<>で; J0#-格; J0#VR; T1#+OZ$; T1#KAZ1; J1#KAZ2; J1#-の:no; E850;

This rule connects "3(verb)ari-masu" and "1(noun)ni" after attaching the adequate counting unit "kamoku" to the numeral noun "ni". The command "T1#+OZ$" appends the attribute set (OZ$) of the object ('classes') of the preceding sentence to that of the first component of the phrase ('two'). The command "T1#KAZ1" picks up the counting unit 'kamoku' from the appended information, and the command "J1#KAZ2" attaches that 'kamoku' to the numeral "ni" and makes it into "ni kamoku".

3. Is the verb transitive or intransitive (the most general case)?

We examined the choice rules determining whether the given verb is used as a transitive or intransitive verb in our previous issues [1] and [6] as well as in section 1 of this issue. They all treated the cases where the verb in question is followed by a period or a preposition. In fact we have moreover a generation rule to treat much more general situation where there are no words in the rear which could form the object phrase of the verb. See the following example.

> She gets the ball for Jim.
> 彼女はジムの為にボールを受けます.
> Kanojo wa Jimu no tame ni booru wo uke-masu.
>
> She *runs* very fast. .... (3)
> 彼女はとても速く*走ります*.
> Kanojo wa totemo hayaku *hashiri-masu.*

The verb "run" has two intransitive Japanese translations "hashiru (a human behavior)" and "nagareru (a river water movement)" as well as two transitive Japanese translations "wo ugokasu (move a machine)" and "wo keiei-shite-iru (manage an enterprise)" registered in the system dictionary. The following choice rule selects the intransitive ones for "run" used in example (3) above.

33; *j; 1; DJ0<>VR$; E-1<>to; J-1<>9#; J-2<>1; T1<>Gr; DJ1<>'; DJ1<>「; J2<>3; DJ2<>「; DJ-1<>」; TA<>qrv; JZ<>128; E1<>…; Y050;

This rule checks first of all the condition that there are no noun, pronoun and article in the rear (JZ<>128;). Taking account of the possibilities that might cause the inversion of the verb and its object,

the rule above further checks that the preceding English word is different from 'to' (E-1<>to;) which would make an infinitive clause and that there are no interrogatives, relatives nor 'be' verb) frontward. Again this rule also checks that the verb in question is different from the main verb of the previous sentence (DJ0<>VR$;).

4．Negative answer to a question "Do (Does) XX live in YY?"

Negative answers "No, I don't." or "No, she doesn't" etc. to interrogative sentences like "Do you ～ ?" or "Does she ～ ?" are translated into Japanese by our system using the Japanese translation of the main verb of the previous sentence registered in the variable vr. The system creates the negative form of the registered Japanese verb and inserts it into the translation of the answering sentence as follows.

(example 4)
Ken: Does she *play* volleyball, too?
健「彼女はバレーボールも*します*か？」
Ken "Kanojo wa baree-booru mo *shi-masu* ka?"

Mike: No, she *doesn't*. She doesn't like volleyball very much.
マイク「いいえ，*しません*．彼女はそれほどバレーボールが好きではありません．」
Maiku "Iie, *shi-masen*. Kanojo wa sorehodo baree-booru ga suki-de-wa ari-masen."

(example 5)
Kumi: Does Jane *have* a bicycle, too?
久美「ジェーンも自転車を*持っていますか*？」
Kumi "Jeen mo jitensha wo *motte-i-masu* ka?"

Ken: No, she *doesn't*.
ケン「いいえ，*持っていません*．」
Ken "Iie, *motte-i-masen*."

(example 6)
Nancy: Yes, she does. Does your mother *cook* one in Japan?
ナンシー「はい，料理します．あなたのお母さんは日本でそれを*料理します*か？」

Nanshii "Hai, ryouri-shi-masu. Anata no okaa-san wa Nihon de sore wo *ryouri-shi-masu* ka?"

Kenji: No, she *doesn't*.
健二「いいえ，*料理しません*．」
Kenji "Iie, *ryouri-shi-masen*."

But there are cases where such way of translation gives rise to a little bit unnatural Japanese sentences. See the following example.

(example 7)
Meiling: Does he *live* in London?
美玲「彼はロンドンに*住んでいますか*？」
Meirin "Kare wa Rondon ni *sunde-i-masu* ka?"

Kumi: No, he *doesn't*. He lives in Liverpool.
久美「いいえ，*住んでいません*．彼はリバプールに住んでいます．」
Kumi "Iie, *sunde-i-masen*. Kare wa Ribapuuru ni sunde-i-masu."

The point of the question doesn't concern whether he lives or not but whether he live in London or in another place. So the answer must deny the adverbial phrase instead of the main verb. Therefore the exact answer should be "IIe, Rondon ni-wa sunde-i-masen (No, he doesn't live in London)". But this translation seems to be too accurate compared with the English original. Considering all these aspects, our system actually produces the simplest answer "Chigai-masu (No)." in case the previous question is "に住んでいますか？ (live in ～ ?)". This process of Japanese translation is realized by the following generation rule.

3; 6024; X; 0; FT; LT; PJS=* に住んでいますか？; T0 =N; T3=N; OZ=g; OZ=?; J5=2; E6=live; T7=g; J2#Z; J 3#Z; J3#+ ちがいます : chigai-masu; 9945;

This grammar rule verifies that the preceding Japanese translation contains "に住んでいますか？ (live in YY?)", that the present English part to be translated consists in fact of more than one sentences, that "No, XX doesn't." is followed directly by a sentence whose main verb is "live", and that there is a word with attribute "g (= geography)".

In case all these conditions are satisfied, the rule creates the answer "ちがいます (No)" instead of the general case answer "住んでいません (doesn't live)". Consequently the real Japanese translations of the English sentences given in example 7 become as follows.

（example 7'）

Meiling: Does he *live* in London?

美玲「彼はロンドンに*住んでいますか*？」

Meirin "Kare wa Rondon ni *sunde-i-masu* ka?"

Kumi: No, he *doesn't*. He lives in Liverpool. .
....(7')

久美「いいえ，*ちがいます*．彼はリバプールに住んでいます．」

Kumi "Iie, *chigai-masu*. Kare wa Ribapuuru ni sunde-i-masu."

5．Add a counting unit to two numerals

In our 8th article ［3］ and in section 2 of this issue, we explained about the generation rule for the Japanese translation of a numeral which is an object of "have" verb. By the commands of the rule, the system adds the attribute set of the object of the preceding sentence to that of the numeral in question, picks up an adequate counting unit from the extended attribute set of the numeral and attaches it to the numeral.

In this section we present an analogous example with two numerals connected by a conjunction.

Mike: How many *classes* do you have on Monday, Ken?

マイク「月曜日にあなたは何科目の*授業*がありますか，健？」

Maiku "Getsuyou-bi ni anata wa nan kamoku no *jugyou* ga ari-masu ka, Ken?"

Ken: I have four in the morning and *two* in the afternoon. .... (8)

健「私は午前中*4科目*と午後*2科目*があります．」

Ken "Watashi wa gozen-chuu *yon kamoku* to gogo *ni kamoku* ga ari-masu."

The Japanese translation of the answering sentence above is generated by the following grammar rule.

4; 16916; 1; 0; DJ2=と; T0=n; T3=n; T0<>y; T3<>y; T0#+OZ$; T3#+OZ$; T0#KAZ1; T3#KAZ1; J0#KAZ2; J0#-の: no; J3#KAZ2; J3#-の: no; J0<->J1; J3<->J4; D385;

The generation rule above supposes, in case there are two numerals connected by a conjunction, both modified by a respective adverbial phrase, that both of the numerals correspond to the same noun in the previous sentence. The rule then picks up an adequate counting unit from the attribute set of the object noun of the previous sentence and attaches it to the both numerals.

6．A case where "you" is interpreted as singular in "What do you do?"

In our 6th issue ［2］, we showed the following example sentences;

T: Yes, there are. Ellen, Roy, and I belong to the International Club.
B: What do <u>you</u> do in the International Club?

where the Japanese translation of "you" in the second sentence above is decided to be "anata-tachi" ("you" plural) in view of the fact that the previous sentence contains ", and I" and that the attribute set of the subject noun of the previous sentence contains "F" (a noun phrase containing an "and/or" conjunction). The choice rule adapted in this situation supposes that "you" in the second sentence corrsponds to "XX, and I" in the first sentence and selects the plural interpretation of "you".

And in the 9th article ［4］ of this series, we presented the following sentences;

Tom: Ken, look. We don't eat lunch in the classroom.
Ken: Where do *you* eat lunch then?

,where "you" in the second sentence above is again translated as "anata-tachi" ("you" plural) in view of the fact, this time, that the previous sentence contains "We don't" (a negation with a plural subject) and that the present sentence to be translated has "then" at the end. The choice rule

adapted in this situation supposes that "you" in the second sentence corresponds to "we" in the first sentence.

Further we exhibited in the 10th issue ［5］ the following example sentences.

What do *you* do on Sundays?
My family enjoys Sundays.

, where "you" in the first sentence corresponds to "My family" in the second sentence, and therefore it should be translated as "anata-tachi" ("you" plural) in Japanese.

This time we exhibit an example in which "you" should be interpreted as "anata" ("you" singular) in view of the context information concerning the previous sentence.

Ken: *I have* four in the morning and two in the afternoon.
健「*私は*午前中４科目と午後２科目*があります.*」
Ken "*Watashi wa* gozen-chuu yon kamoku to gogo ni kamoku *ga ari-masu.*"

Mike: What do you do after school?　................（9）
マイク「放課後*あなたは*何をしますか？」
Maiku "Houkago *anata wa* nani wo shi-masu ka"

In fact these English sentences are the continual part of the sentences cited in the previous section.
The choice rule adapted in this situation is the following.

XX; あなた達は ;2;E0=what do you do;J-1=|;BS=*: I have ; x775;

This choice rule verifies that the English clause "what do you do" in question is preceded by the quotation mark（J-1=|;）, and the preceding English

sentence contains ": I have ". With these proofs verified, the rule rejects "あなた達は"（"you" plural）.

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