Reference in Japanese-English Machine Translation

Francis Bond and Kentaro Ogura

Presented by: Manuel Medina González. Department of Artificial Intelligence
Professor Nomura's Laboratory of Natural Language Processing

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Outline

1. Introduction
   - Understanding the problem
   - NP reference
   - Referentiality in Natural Language Processing
2. Determination of Reference
   - Rules
3. Application to Translation
4. Evaluation
   - ALT-J/E
   - Result
   - Discussion

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The problem

- Determining the reference of NPs helps to generate correct articles and Noun's number when translating from Japanese to English

Example

私はりんごが好きです。

- I like apple.
- I like apples.
- I like the apple.
- I like the apples
- ...

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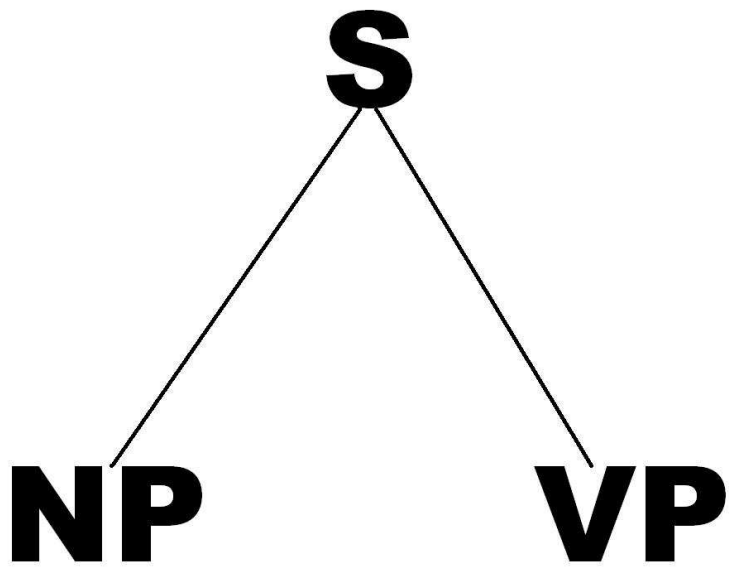
What is NP?

NP = Noun Phrase



- Noun is the main element.
  - Articles
  - Number (Singular/Plural)

What is NP reference?

Definition

To understand the way a noun is being used within a sentence.

The authors consider 3 types of reference:

- `Referential`
- `Generic`
- `Ascriptive`

Referential NPs

- Refers to some entity in the discourse world.
- Introduce a potential identity.
- Can be pronominalized.
- Can be modified by all determiners.
- Can be plural or singular.

Example

私はマンモスを探している。I'm looking for a mammoth

Default interpretation for all NPs.

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`Default interpretation for all NPs.`

Generic NPs

- Refers to kinds, not single members.
- Can't be modified by all determiners.
- Grammatical number is fixed.
- Take 3 forms in English:
  - Indefinite singular *"a"*
  - Definite singular *"the"*
  - Bare plural and generic ϕ

Example

a. A mammoth is a mammal.

b. The mammoth is a mammal.

c. Mammoths are mammals.

d. Furniture is expensive.

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Ascriptive NPs

- Ascribe an attribute to another NP.
- Complement of a *copular* verb.
- Agree with their target in number.

Example

a. A computer is a tool.

b. Computers are tools.

c. The students are a mob

Ascriptive NPs

Not all complements of copular verbs are ascriptive:

- Predicational

Example

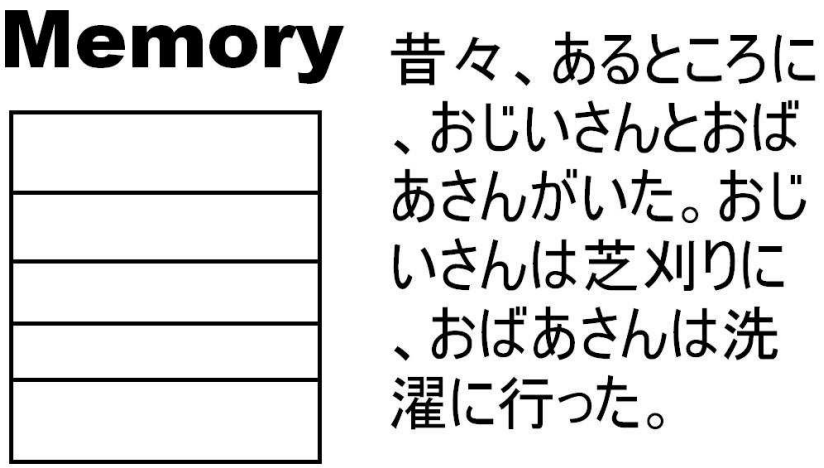
私の指導者はいい人です。

- Specificational

Example

私の指導者はXさんです。
Xさんは私の指導者です。

Why is referentiality necessary?



When a noun first appears, there's nothing in the memory.

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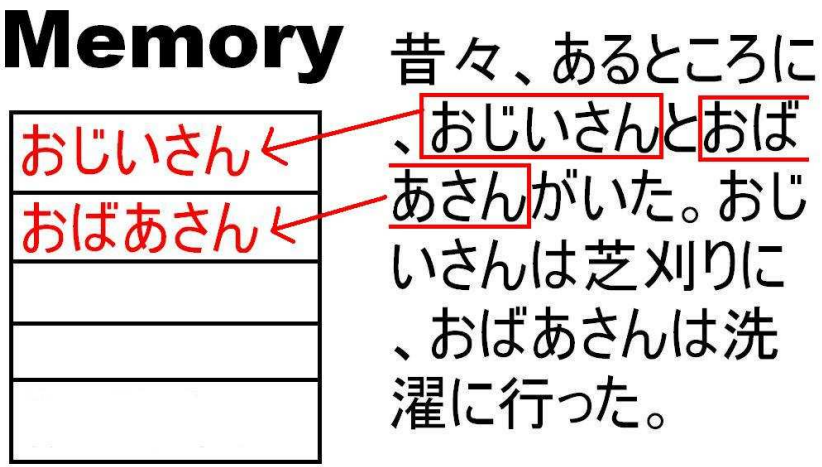

The noun is added and indefinite article is used.

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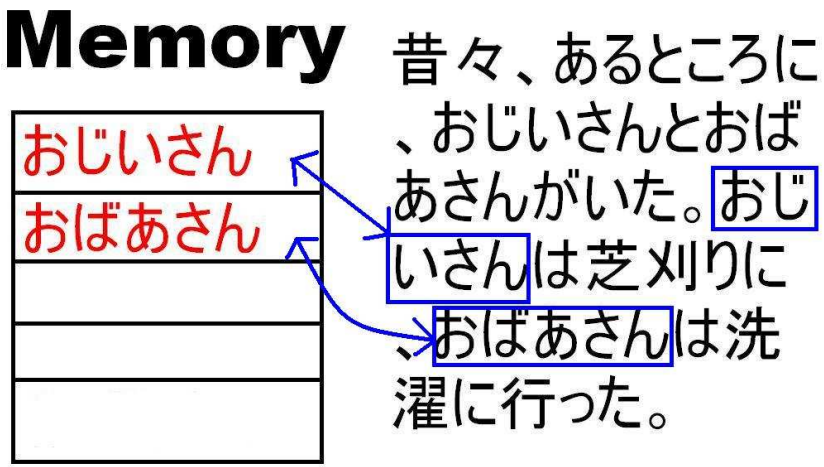

The second time a noun appears, it will be already in memory, thus, definite article is used.

1. Nouns that appeared before.

Using the rule applied in the previous slide:

Example

像は哺乳類であり、マンモスも哺乳類である。

Elephants are mammals and mammoths are also the mammals

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2. Concordance in number

Example

有名なシャーロックホームズ探偵の物語は大抵ロンドン地域を背景にしたものです。

The tales of famous detective Sherlock Holmes normally have the London area as a background

2. Concordance in number

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3. Determining the correct number

Example

この日は社員は来ません。

Employees do not come on this day

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この日は社員は来ません。

Employees do not come on this day

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Definition

Search for patterns within a sentence to determine:

- Structure
- Type

Example

If the subject is marked by one of the focus markers は or も, and the verb is past tense, then the sentence has a specificational reading.

子供はボールで遊んだ　　Search for patterns...

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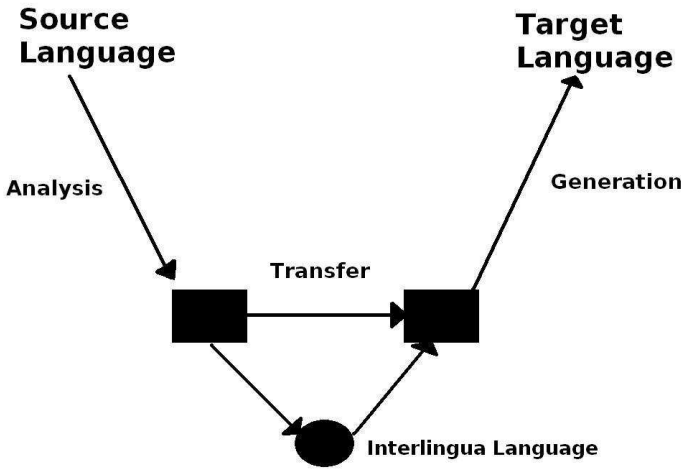
If the subject is marked by one of the focus markers は or も, and the verb is past tense, then the sentence has a specificational reading.

子供はボールで遊んだ **Specificational**

Creation

Rules are created to be applied to the original text in the transfer phase.



3 levels of rules:

1. Clause Level
2. Case-element Level
3. Modification of and within the NP

All proper nouns and pronouns are assigned the value referential

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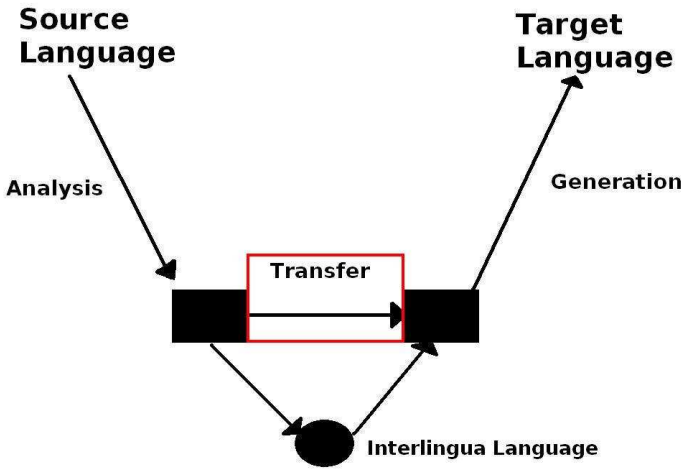

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Example

— The subject of a **specificational** sentence is referential (and definite).
問題は困難であった。 The problem was difficult.
— The complement of the copula in a **predicational** sentence is ascriptive.
マンモスは動物である。 Mammoths are animals.
— The complement of として is ascriptive:
それをマンモスとして扱って。 Treat it as a mammoth.
— Locative NPs are **referential**.
空港に行った。 I went to the airport.
— An NP whose head is modified by a relative clause is **referential**.
店で買ったプレゼント。 The gift I bought at the store.
...

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Countability of Nouns

Based on countability, nouns are divided in:

- Fully countable: **knife**
- Both countable
  - Strongly countable: **cake**
  - Weakly countable: **beer**
- Uncountable: **furniture**
- Pluralia tantum: **scissors**

Generic NPs

GT	FC	BC	U	PT
a	a mammoth	a cake	*a furniture	*a scissors
the	the mammoth	#the cake	#the furniture	#the scissors
ϕ	mammoths	cake/cakes	furniture	scissors

GT: **Generic Type**
FC: **Fully Countable**
BC: **Both Countable**
U: **Uncountable**
PT: **Pluralia Tantum**

- # = Cannot have *generic* reference.
- * = Ungrammatical

Referential NPs

Special rules are used to determine Referential NPs:

Example

— Determine according to verb:
話題がつきた。 I ran out of topics.
— Determine according to adjunct:
全国の学校。 Schools all over the country.
— Specific function words that mark plurality:
達 = plural and countable

Trigger Nouns

Definition

Nouns that have been manually identified and marked in the lexicon

- Basically refers to NPs that in English use a possessive pronoun but in Japanese is often omitted.

Example

財布を落した。 I lost my wallet

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Selecting determiners for referential NPs

Example

— `place nouns` heading locative NPs are **definite**

空港に行った。 I went to the airport

— NPs whose head is modified by a `relative clause` is **definite**

昨日来た男。 the man who came yesterday

— An NP whose head is modified by one of certain modifiers is **indefinite**

ある男。 a certain man

Ascriptive NPs

As heuristic, all ascriptive NPs are indefinite = articles will be generated in the same way as for `indefinite referential NPs`:

- Countable singular NPs will take the **indefinite article**.
- Countable plural and uncountable NPs will take ϕ.

Example

- 癌は病気だ。 Cancer is a sickness.
- 子供は天使だ。The children are angels.

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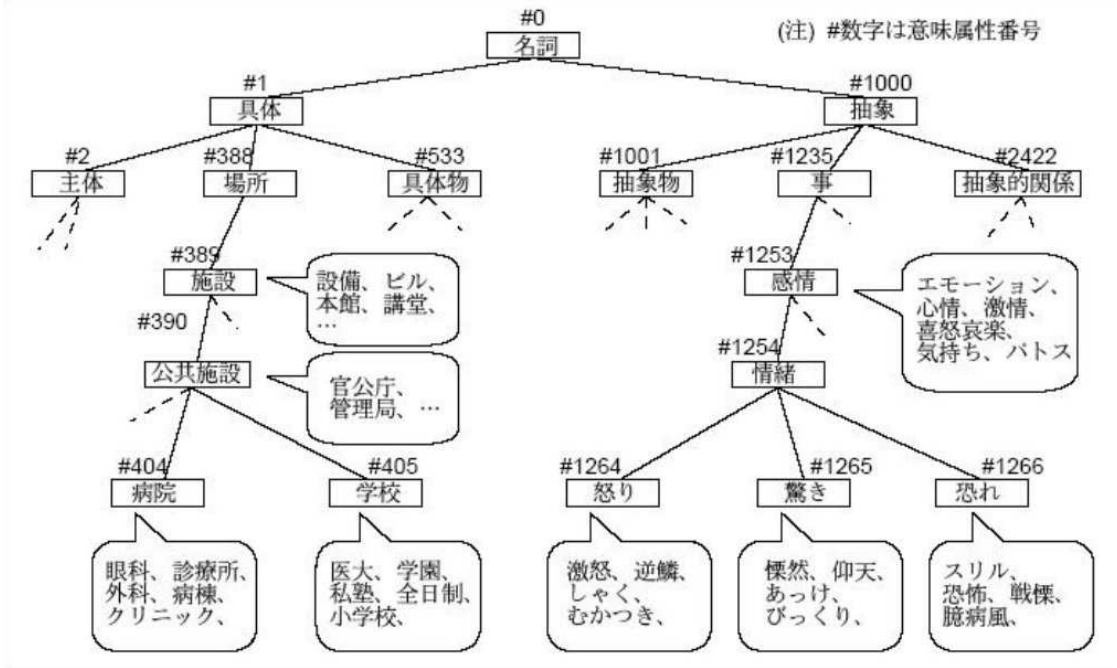
Description

All the process described has been implemented in ALT-J/E Machine Translation System.

- Developed by NTT Labs between 1982 and 1986
- Very robust
- Uses a 2,715 semantic hierarchy for common nouns



Procedure

- The algorithm was evaluated on a collection of newspaper articles from the `Nikkei-Sangyo` newspaper by an English native speaker not connected with the development of the algorithm.
- The results were compared against and old version of ALT-J/E.

Algorithm	NPs(717)	Sentences(102)
New	85%	36%
Old	65%	5%

Evaluation values

Each NP was given one of the following values:

best:	The most appropriate article and number.
analysis:	Problem with the parse.
NP structure:	Problem with NP structure or choice of translation.
dictionary:	Problem with the dictionary.
article:	Inappropriate article
number:	Inappropriate number.
possesive:	Inappropriate use of possessive determiner.
countability:	problem with countability.
reference:	problem with reference property.

- For a sentence to be judged as correct all the NPs must be correct.

Correct example

Example

会員は 37,000 円、非会員は 47,000 円の参加費が必要。

New: Members need 37,000 yen as the registration fee and non-members need 47,000 yen.

Old: A member needs 37,000 yen as the registration fee and a non-member needs 47,000 yen.

Errors

Problem	Frequency
Analysis	7%
Dictionary	7%
NP structure	18%
Reference	13%
Number	25%
Articles	26%
Possessive	5%

Unrecognized example

Example

NTT は新会社 NTT テレコムエンジニアリング東京を 8 日付で設立する。

- NTT will establish a new company. NTT Telecom Engineering Tokyo, on the 8th.

Example

新会社の資本金は 800 万円。

- The capital of a/the new company is 8 million yen.

Summary

- Referentiality is an important concept necessary in order to get high-quality translations.
- Some rules used to determine NP referentiality in Japanese-English Machine Translation were presented.
- Although the method has been proven to be efficient, several problems remain to be explored.