

Implementing location in English to Finnish Machine Translation

Arvi Hurskainen
Department of World Cultures, Box 59
FIN-00014 University of Helsinki, Finland
arvi.hurskainen@helsinki.fi

Abstract

The paper discusses the problems of translating locative structures from English to Finnish. The special problem is that while English uses only a few means for expressing locatives, Finnish has a much larger array of distinctions to handle. The paper suggests solutions for handling the problems, although the solutions are not claimed to be exhaustive or final.

Key Words: *machine translation, locatives.*

1 Introduction

The three basic distinctions in location are (1) *movement to*, (2) *no movement* (static), and (3) *movement from*. In addition to these three basic distinctions, also the degree of specificity is often expressed. The expression may refer to a defined place or to a place, which is only vaguely defined. Languages differ radically in how these distinctions are expressed. For example, English does not mark linguistically the distinction between defined and undefined place. Also, the distinction between *movement to* and *no movement* is often missing. For example, in examples 'He came here' and 'He is here' the adverb *here* encodes *movement to* and *no movement*. In addition, the adverb *here* does not indicate in any way whether it refers to a defined or undefined place. Although English has no linguistic means for making these distinctions, they are implied and should become clear on the basis of the context.

This is only one example of cases, where English leaves unmarked such distinctions, which must be linguistically marked in many other languages. For machine translation this is a problem, because the question is not only of translation of constituents, but also of creating something new out of nothing.

Below we will see various types of expressing location, and how they can be handled in English to Finnish translation.

2 Translating locative adverbs *here* and *there*

The locative adverbs *here* and *there* have several equivalences in Finnish. These adverbs are derivatives of the demonstrative pronouns *this* and *that*. Note that English does not have a corresponding locative adverb for *it*, although Finnish has it. Therefore, the adverb *there* has eight equivalences in Finnish. In (1) are explained the adverbs *here* and *there* and their Finnish equivalences.

(1)

here - tässä (defined place close, no movement)
tähän (defined place close, movement to)
täällä (undefined place close, no movement)
tänne (undefined place close, movement to)

from here - tästä (defined place close, movement from)
täältä (undefined place close, movement from)

there - tuossa (defined place far, no movement)
tuohon (defined place far, movement to)
tuolla (undefined place far, no movement)
tuonne (undefined place far, movement to)
siinä (defined place very far, no movement)
siihen (defined place very far, movement to)
siellä (undefined place very far, no movement)
sinne (undefined place very far, movement to)

from there - tuosta (defined place far, movement from)
tuolta (defined place far, movement from)
siitä (defined place very far, movement from)
sieltä (undefined place very far, movement from)

Already on the basis of these two locative adverbs, *here* and *there*, one can understand how huge the translation problems are, when a language leaves unmarked important distinctions.

As we stated above, English has two locative adverbs, *here* and *there*. These are highly ambiguous, and also in English they need some specification. Construtions such as *in here* and *over there* are used for giving the expression more specificity. Here we will discuss the translation of the basic adverbs.

Consider the sentences in (2).

(2)

- a. The boy sits here.
- b. The boy lives here.

It is obvious that sentence (a) refers to a defined place, and sentence (b) to an undefined place. The correct translation can be achieved on the basis of the argument structure of the verb (3).

(3)

sit { istua V52 O-INE };
live { elää V53 FRONT O-ADE , asua V52 O-ADE };

The undisambiguated translation of the sentences in (4) are here.

(4)

```
"<boy>"
  "boy" { poika N10-D } HUM %SUBJ DEF N NOM SG
  "boy" { pikkupoika N10-D } HUM %SUBJ DEF N NOM SG
"<sits>"
  "sit" { istua V52 O-INE } %+FMAINV V PRES SG3
"<here>"
  "here" { tässä } LOC %ADVL ADV
  "here" { täällä :2 } LOC %ADVL ADV
  "here" { tänne :3 } LOC %ADVL ADV
  "here" { tähän :4 } LOC %ADVL ADV
  "here" { NOGLOSS } LOC %ADVL ADV
"<.>"
  "." { . }
"<boy>"
  "boy" { poika N10-D } HUM %SUBJ DEF N NOM SG
  "boy" { pikkupoika N10-D } HUM %SUBJ DEF N NOM SG
"<lives>"
  "live" { elää V53 FRONT O-ADE } %+FMAINV V PRES SG3
  "live" { asua V52 O-ADE } %+FMAINV V PRES SG3
"<here>"
  "here" { tässä } LOC %ADVL ADV
  "here" { täällä :2 } LOC %ADVL ADV
  "here" { tänne :3 } LOC %ADVL ADV
  "here" { tähän :4 } LOC %ADVL ADV
  "here" { NOGLOSS } LOC %ADVL ADV
```

We see that the verb *sit* has the tag O-INE indicating that the non-object argument should be in inessive case. The adverb *tässä* corresponds to the case requirement, and it is chosen. In the second sentence the verb *live* has a tag O-ADE, meaning that the non-object argument should be in adessive case. The adverb *täällä* meets the requirement, and it is chosen. The result is in (5).

(5)

```
"<boy>"
  "boy" { poika N10-D } %SUBJ HUM DEF N NOM SG SG @NOM
"<sits>"
  "sit" { istua V52 } %+FMAINV O-INE V PRES SG3 SG
"<here>"
  "here" { tässä } %ADVL LOC ADV
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<boy>"
  "boy" { poika N10-D } %SUBJ HUM DEF N NOM SG SG @NOM
"<lives>"
  "live" { elää V53 FRONT } %+FMAINV O-ADE V PRES SG3 SG
"<here>"
  "here" { täällä } %ADVL LOC ADV
```

When we have the undefined locative adverb in the sentence, we get the following undisambiguated translation (6).

```
(6)
"<boy>"
  "boy" { poika N10-D } HUM %SUBJ DEF N NOM SG
  "boy" { pikkupoika N10-D } HUM %SUBJ DEF N NOM SG
"<sits>"
  "sit" { istua V52 O-INE } %+FMAINV V PRES SG3
"<there>"
  "there" { siinä } LOC %ADVL ADV
  "there" { siellä } LOC %ADVL ADV
  "there" { siihen } LOC %ADVL ADV
  "there" { sinne } LOC %ADVL ADV
  "there" { NOGLOSS } LOC %ADVL ADV
  "there" { tuossa } LOC %ADVL ADV
  "there" { tuohon } LOC %ADVL ADV
  "there" { tuonne } LOC %ADVL ADV
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<boy>"
  "boy" { poika N10-D } HUM %SUBJ DEF N NOM SG
  "boy" { pikkupoika N10-D } HUM %SUBJ DEF N NOM SG
"<lives>"
  "live" { elää V53 FRONT O-ADE } %+FMAINV V PRES SG3
  "live" { asua V52 O-ADE } %+FMAINV V PRES SG3
"<there>"
  "there" { siinä } LOC %ADVL ADV
  "there" { siellä } LOC %ADVL ADV
  "there" { sinne } LOC %ADVL ADV
  "there" { NOGLOSS } LOC %ADVL ADV
  "there" { tuossa } LOC %ADVL ADV
  "there" { tuolla } LOC %ADVL ADV
  "there" { tuohon } LOC %ADVL ADV
  "there" { tuonne } LOC %ADVL ADV
```

After disambiguation the result is as in (7).

```
(7)
"<boy>"
  "boy" { poika N10-D } %SUBJ HUM DEF N NOM SG SG @NOM
"<sits>"
  "sit" { istua V52 } %+FMAINV O-INE V PRES SG3 SG
"<there>"
  "there" { tuossa } %ADVL LOC ADV
"<.>"
  "." { . }
```

```
"<<s>>"
  "<s>" { <s> }
"<boy>"
  "boy" { poika N10-D } %SUBJ HUM DEF N NOM SG SG @NOM
"<lives>"
  "live" { elää V53 FRONT } %+FMAINV O-ADE V PRES SG3 SG
"<there>"
  "there" { tuolla } %ADVL LOC ADV
```

In the first sentence, the defined locative *tuossa* was chosen. In the second sentence, the undefined locative *tuolla* was chosen. Both choices were made on the basis of the tag in the verb.

When the locative adverbs *here* and *there* are used to mean *motion to*, it is often difficult to define whether defined or undefined locative should be chosen. Examples in (8) illustrate this.

(8)

```
"<boy>"
  "boy" { poika N10-D } HUM %SUBJ DEF N NOM SG
  "boy" { pikkupoika N10-D } HUM %SUBJ DEF N NOM SG
"<comes>"
  "come" { tulla V67 O-LOC3 } MOVE %+FMAINV V PRES SG3
  "come" { tulla V67 O-LOC2 } MOVE %+FMAINV V PRES SG3
  "come" { olla V67b kotoisin } MOVE %+FMAINV V PRES SG3
"<here>"
  "here" { tässä } LOC %ADVL ADV
  "here" { täällä :2 } LOC %ADVL ADV
  "here" { tähän :4 } LOC %ADVL ADV
  "here" { tänne :3 } LOC %ADVL ADV
  "here" { NOGLOSS } LOC %ADVL ADV
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<boy>"
  "boy" { poika N10-D } HUM %SUBJ DEF N NOM SG
  "boy" { pikkupoika N10-D } HUM %SUBJ DEF N NOM SG
"<moves>"
  "move" { siirtää V54-K FRONT O-ACC } %+FMAINV V PRES SG3
  "move" { siirtyä V52-K FRONT MOVE } %+FMAINV V PRES SG3
  "move" { muuttaa V53-C MOVE O-LOC2 } %+FMAINV V PRES SG3
  "move" { muuttaa V53-C MOVE O-LOC3 } %+FMAINV V PRES SG3
  "move" { liikkua V52-A MOVE } %+FMAINV V PRES SG3
  "move" { liikuttua V52-C } %+FMAINV V PRES SG3
  "move" { liikuttaa V53-C O-ACC } %+FMAINV V PRES SG3
"<here>"
  "here" { tässä } LOC %ADVL ADV
  "here" { täällä :2 } LOC %ADVL ADV
  "here" { tähän :4 } LOC %ADVL ADV
  "here" { tänne :3 } LOC %ADVL ADV
```

"here" { NOGLOSS } LOC %ADVL ADV

After disambiguation the result is as in (9).

(9)

```
"<boy>"
  "boy" { poika N10-D } %SUBJ HUM DEF N NOM SG SG @NOM
"<comes>"
  "come" { tulla V67 } %+FMAINV O-LOC3 MOVE V PRES SG3 SG
"<here>"
  "here" { tänne } %ADVL LOC ADV
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<boy>"
  "boy" { poika N10-D } %SUBJ HUM DEF N NOM SG SG @NOM
"<moves>"
  "move" { muuttaa V53-C } %+FMAINV MOVE O-LOC3 V PRES SG3 SG
"<here>"
  "here" { tänne } %ADVL LOC ADV
```

When the sentence has an object, it is sometimes easier to define, which locative should be chosen (10).

(10)

```
"<*put>"
  "put" { panna V67 O-ACC V-3INF-ILL } O-LOC3 %+FMAINV CAPINIT
V IMP
  "put" { lähettää V53-C FRONT O-ACC V-3INF-ILL } O-LOC3
%+FMAINV CAPINIT V IMP
  "put" { PROP-CAND } O-LOC3 %+FMAINV CAPINIT V IMP
"<knife>"
  "knife" { veitsi N30 FRONT } %OBJ DEF N SG
  "knife" { puukko N1-A } %OBJ DEF N SG
"<here>"
  "here" { tässä } LOC %ADVL ADV
  "here" { täällä :2 } LOC %ADVL ADV
  "here" { tänne :3 } LOC %ADVL ADV
  "here" { tähän :4 } LOC %ADVL ADV
  "here" { NOGLOSS } LOC %ADVL ADV
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<*bring>"
  "bring" { tuoda V64 O-ACC O-ALL } %+FMAINV CAPINIT V IMP
  "bring" { PROP-CAND } %+FMAINV CAPINIT V IMP
"<knife>"
  "knife" { veitsi N30 FRONT } %OBJ DEF N SG
```

```
"knife" { puukko N1-A } %OBJ DEF N SG
"<here>"
"here" { tässä } LOC %ADVL ADV
"here" { täällä :2 } LOC %ADVL ADV
"here" { tänne :3 } LOC %ADVL ADV
"here" { tähän :4 } LOC %ADVL ADV
"here" { NOGLOSS } LOC %ADVL ADV
```

After the disambiguation the result is as in (11).

```
(11)
"<*put>"
"put" { panna V67 } %+FMAINV O-ACC V-3INF-ILL O-LOC3 CAPINIT
V IMP SG2
"<knife>"
"knife" { veitsi N30 FRONT } %OBJ DEF N SG SG @ILL
"<here>"
"here" { tähän } %ADVL LOC ADV
"<.>"
"." { . }
"<<s>>"
"<s>" { <s> }
"<*bring>"
"bring" { tuoda V64 } %+FMAINV O-ACC O-ALL CAPINIT V IMP SG2
"<knife>"
"knife" { veitsi N30 FRONT } %OBJ DEF N SG SG @ACC-N
"<here>"
"here" { tänne } %ADVL LOC ADV
```

3 Expressing locatives in nouns

When location is attached to nouns, English marks it using prepositions such as *in*, *on*, *at*, *with*, *by*, *to*, *into*, *for*, *of*, *from*, *over*, *through*, and *around*. Finnish marks location attached to nouns using one of six locative cases. These cases are (12):

```
(12)
inessive (definite, no movement)
elative (definite, movement from)
illative (definite, movement to)
adessive (indefinite, no movement)
ablative (indefinite, movement from)
allative (indefinite, movement to)
```

Cases in Finnish are marked using suffixes. Case suffixes are primary suffixes, so that when other suffixes are added, case suffixes come first. Case suffixes also undergo such processes as gradation and front/back concordance.

The English prepositions that encode location, have also many other functions. Examples in (13) illuminate the complexity.

(13)
in { M-LOC1 , M-LOC2 , M-LOC3 , NOGLOSS M-INE , NOGLOSS M-ADE ,
NOGLOSS M-ESS , NOGLOSS M-TRA , NOGLOSS M-ILL , NOGLOSS M-ELA ,
NOGLOSS M-ALL , vuonna , vuosina } ;
on { M-LOC1 , M-LOC2 , M-LOC3 , NOGLOSS M-ADE , NOGLOSS M-ILL ,
NOGLOSS M-PAR , NOGLOSS M-ELA , NOGLOSS M-ALL , NOGLOSS M-ESS ,
NOGLOSS M-INE } ;
at { M-LOC1 , M-LOC2 , M-LOC3 , NOGLOSS M-ADE , NOGLOSS M-INE ,
NOGLOSS M-ELA , NOGLOSS M-ILL , NOGLOSS M-ESS , luona M-GEN POST ,
kohti POST , kello , vuotiaana POST } ;
with { kanssa M-GEN POST , mukana M-GEN POST , NOGLOSS M-ADE POST
, NOGLOSS M-INE POST , NOGLOSS M-ILL POST , COMMA jolla on O-ACC-N
, COMMA joilla on :2 O-ACC-N , NOINFL , NOGLOSS M-ELA , NOGLOSS M-
ESS , NOGLOSS M-KOM } ;
by { kanssa M-GEN POST , mennessä M-ILL POST :1 , NOGLOSS M-ADE ,
NOGLOSS AG-PART , NOGLOSS M-INS , avulla M-GEN POST , vuoksi M-GEN
POST , taholta M-GEN POST } ;
to { M-LOC3 , NOGLOSS M-ALL , NOGLOSS M-ILL , NOGLOSS M-PAR , tai
, - DASH , sinne } ;
into; into { NOGLOSS M-ILL , NOGLOSS M-TRA , NOGLOSS M-ALL } ;
for { M-LOC3 , M-LOC2 , NOGLOSS M-ALL , varten M-PAR , NOGLOSS M-
PAR , NOGLOSS M-TRA , NOGLOSS M-ILL , NOGLOSS M-NOM , NOGLOSS M-
ELA , ajan M-GEN , puolesta M-GEN , M-INF , NOGLOSS M-ADE , tähden
M-GEN :2 , NOGLOSS M-GEN } POST ;
of { M-LOC2 , NOGLOSS M-GEN , NOGLOSS M-ELA , NOGLOSS M-ABL ,
NOGLOSS M-ACC-N , NOGLOSS M-PAR , NOGLOSS :2 } ;
from; from { M-LOC2 , NOGLOSS M-ELA , NOGLOSS M-ABL , NOGLOSS M-
GEN } ;
over { yli M-GEN POST , yli M-GEN PREP , ajan M-GEN POST , NOGLOSS
M-INE , NOGLOSS M-ELA , taa M-GEN POST } ;
through { kautta M-GEN , avulla M-GEN , läpi M-GEN , NOGLOSS M-ADE
, NOGLOSS M-ILL } POST ;
around { ympärillä M-GEN POST , tiimoilla M-GEN POST , ympäri M-
GEN :2 , ympäri M-PAR :3 , NOGLOSS M-INE , NOGLOSS M-ILL , noin } ;

We see that the prepositions above encode various locative cases, but also non-locative functions. Below we will discuss various methods, which can be used for handling these highly ambiguous structures in machine translation.

We see in (13) that there are two types of locative codes. The codes such as M-LOC1, M-LOC2 and M-LOC3 are meta codes meaning that each of them stands for two specific codes. M-LOC1 stands for M-INE and M-ADE, M-LOC2 stands for M-ELA and M-ABL, and M-LOC3 stands for M-ILL and M-ALL.

By using meta codes it is possible to simplify rule writing, which in any case becomes very complex. Consider the examples in (14).

(14)
"<*he>"
"he" { hän Np9 FRONT } %SUBJ HUM OUT CAPINIT PRON PERS NOM
SG3 @NOM


```
"<sent>"
  "send" { lähettää V53-C FRONT } %+FMAINV O-ACC O-LOC3 V PAST
SG
"<letter>"
  "letter" { kirje N48 FRONT } %OBJ DEF N SG SG @ACC
"<to>"
  "to" { M-LOC3 } %ADVL PREP
"<hospital>"
  "hospital" { sairaala N13 } %<P PLACE IN DEF N NOM SG SG
@ILL
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<*he>"
  "he" { hän Np9 FRONT } %SUBJ HUM OUT CAPINIT PRON PERS NOM
SG3 @NOM
"<sent>"
  "send" { lähettää V53-C FRONT } %+FMAINV O-ACC O-LOC3 V PAST
SG
"<letter>"
  "letter" { kirje N48 FRONT } %OBJ DEF N SG SG @ACC
"<to>"
  "to" { M-LOC3 } %ADVL PREP
"<me>"
  "i" { minä Np5 } %<P HUM OUT PRON PERS SG1 @ALL
```

The sentences are identical except that non-object arguments are different. The verb *send* has a tag O-LOC3. This code is used in disambiguating the preposition *to*. The interpretation with the tag M-LOC3 is chosen. This means that the head word of the preposition must be in one of the two locative cases, illative or allative. Which one of the two cases is chosen depends on whether the head requires defined locative inflection or undefined locative inflection. In order to facilitate the choice, the head is provided with the tag IN or OUT. As a result, the system marks *hospital* with @ILL and *me* with @ALL. On the basis of these tags the words are converted into surface form (15).

```
(15)
"<*he>"
  "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<sent>"
  "send" { lähetti } %+FMAINV O-ACC O-LOC3 V PAST SG
"<letter>"
  "letter" { kirjeen } %OBJ DEF N SG ACC
"<to>"
  "to" { M-LOC3 } %ADVL PREP
"<hospital>"
  "hospital" { sairaalaan } %<P ACE IN DEF N SG ILL
"<.>"
  "." { . }
"<<s>>"
```

```
"<s>" { <s> }
"<*he>"
  "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<sent>"
  "send" { lähetti } %+FMAINV O-ACC O-LOC3 V PAST SG
"<letter>"
  "letter" { kirjeen } %OBJ DEF N SG ACC
"<to>"
  "to" { M-LOC3 } %ADVL PREP
"<me>"
  "i" { minulle } %<P HUM OUT PRON PERS SG ALL
```

We can test the same phenomenon with the option *movement from*. The most common preposition for marking this is *from*. Examples in (16) illuminate the point.

(16)

```
"<*he>"
  "he" { hän Np9 FRONT } %SUBJ HUM OUT CAPINIT PRON PERS NOM
SG3 @NOM
"<sent>"
  "send" { lähettää V53-C FRONT } %+FMAINV O-ACC O-LOC3 V PAST
SG
"<letter>"
  "letter" { kirje N48 FRONT } %OBJ DEF N SG SG @ACC
"<from>"
  "from" { M-LOC2 } %ADVL PREP
"<hospital>"
  "hospital" { sairaala N13 } %<P PLACE IN DEF N NOM SG SG
@ELA
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<*he>"
  "he" { hän Np9 FRONT } %SUBJ HUM OUT CAPINIT PRON PERS NOM
SG3 @NOM
"<sent>"
  "send" { lähettää V53-C FRONT } %+FMAINV O-ACC O-LOC3 V PAST
SG
"<letter>"
  "letter" { kirje N48 FRONT } %OBJ DEF N SG SG @ACC
"<from>"
  "from" { NOGLOSS M-ABL } %ADVL PREP
"<farm>"
  "farm" { farmi N5 } %<P OUT DEF N NOM SG SG @ABL
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<*he>"
```

```

    "he" { hän Np9 FRONT } %SUBJ HUM OUT CAPINIT PRON PERS NOM
SG3 @NOM
"<sent>"
    "send" { lähettää V53-C FRONT } %+FMAINV O-ACC O-LOC3 V PAST
SG
"<letter>"
    "letter" { kirje N48 FRONT } %OBJ DEF N SG SG @ACC
"<from>"
    "from" { M-LOC2 } %ADVL PREP
"<distant>"
    "distant" { kaukainen N38 } %A> NEN INDEF A ABS SG
"<area>"
    "area" { alue N48 } %<P OUT INDEF N NOM SG SG @ABL

```

In the first sentence, the tag attached to the preposition *from* is M-LOC2. This is not chosen on the basis of the verb *send*, because it has the tag O-LOC3, which does not correspond with the tag M-LOC2. In fact, the default tag for *from* is M-LOC2. Because the head *hospital* has the tag IN, it requires the inflection according to elative.

In the second sentence, the tag of the preposition is M-ABL. Note that this is not a meta tag, although in the third sentence the corresponding tag is a meta tag. There is no specific reason for this difference. The system is constructed so that if the head has a tag IN or OUT, a meta tag for the preposition is chosen, unless there is a rule which overrides this principle. This is precisely the case in the second sentence, where a definite tag M-ABL is chosen, although the head has the tag OUT. This is because of a rule, which was written before the implementation of the meta tags. Such rules have not been removed, in case they do not cause any harm to the system.

In the third sentence, the rule system functions as it is intended. The preposition *from* does not have such tag alternatives that would match with the tag of the verb (see above 13). Therefore, the default tag M-LOC2 is chosen. On the basis of this, the inflection tag @ABL is added to the head. On the basis of this information, the words are converted into surface form (17).

```

(17)
"<*he>"
    "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<sent>"
    "send" { lähetti } %+FMAINV O-ACC O-LOC3 V PAST SG
"<letter>"
    "letter" { kirjeen } %OBJ DEF N SG ACC
"<from>"
    "from" { M-LOC2 } %ADVL PREP
"<hospital>"
    "hospital" { sairaalasta } %<P ACE IN DEF N SG ELA
"<.>"
    "." { . }
"<<s>>"
    "<s>" { <s> }
"<*he>"
    "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM

```

```
"<sent>"
  "send" { lähetti } %+FMAINV O-ACC O-LOC3 V PAST SG
"<letter>"
  "letter" { kirjeen } %OBJ DEF N SG ACC
"<from>"
  "from" { NOGLOSS M-ABL } %ADVL PREP
"<farm>"
  "farm" { farmilta } %<P OUT DEF N SG ABL
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<*he>"
  "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<sent>"
  "send" { lähetti } %+FMAINV O-ACC O-LOC3 V PAST SG
"<letter>"
  "letter" { kirjeen } %OBJ DEF N SG ACC
"<from>"
  "from" { M-LOC2 } %ADVL PREP
"<distant>"
  "distant" { kaukaiselta } %A> NEN INDEF A ABS SG ABL
"<area>"
  "area" { alueelta } %<P OUT INDEF N SG ABL
```

Another example of the varying ways of applying inflection rules is in (18).

(18)

```
"<*he>"
  "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<is>"
  "be" { on } %+FMAINV V-4INF-TRA V PRES SG
"<in>"
  "in" { M-LOC1 } %ADVL PREP
"<hospital>"
  "hospital" { sairaalassa } %<P ACE IN DEF N SG INE
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<*he>"
  "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<is>"
  "be" { on } %+FMAINV V-4INF-TRA V PRES SG
"<in>"
  "in" { NOGLOSS M-ADE } %ADVL PREP
"<farm>"
  "farm" { farmilla } %<P OUT DEF N SG ADE
"<.>"
  "." { . }
"<<s>>"
```

```
"<s>" { <s> }
"<*he>"
  "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<is>"
  "be" { on } %+FMAINV V-4INF-TRA V PRES SG
"<in>"
  "in" { NOGLOSS M-ADE } %ADVL PREP
"<distant>"
  "distant" { kaukaisella } %A> NEN DEF A ABS SG ADE
"<area>"
  "area" { alueella } %<P OUT DEF N SG ADE
```

The first sentence has the meta code M-LOC1 indicating that the verb does not involve movement. The tag IN in the head adds the tag INE.

The second sentence has the tag M-ADE, which means that another (older) rule has applied. The same is true of the third sentence. These tags produce the correct surface forms.

Finnish place names constitute a problem in that some of them inflect according to defined locative cases, and others according to the undefined locative cases. No formal criteria can be used for determining which option to choose in each case. Each of them must be encoded separately either with IN or OUT tag. When this is done. The rules are able to produce the correct locative forms for each place name. In (19) are some examples.

```
(19)
"<*he>"
  "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<lives>"
  "live" { elää } %+FMAINV O-ADE V PRES SG
"<in>"
  "in" { NOGLOSS M-INE } %ADVL PREP
"<*turku>"
  "turku" { *turussa } %<P ACE IN CAP N SG INE
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<*he>"
  "he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<lives>"
  "live" { elää } %+FMAINV O-ADE V PRES SG
"<in>"
  "in" { NOGLOSS M-ADE } %ADVL PREP
"<* tampere>"
  " tampere" { * tampereella } %<P ACE OUT CAP N SG ADE
"<.>"
  "." { . }
"<<s>>"
  "<s>" { <s> }
"<*he>"
```

```
"he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<went>"
"go" { meni } %+FMAINV O-LOC3 MOVE V PAST SG
"<to>"
"to" { M-LOC3 } %ADVL PREP
"<*turku>"
"turku" { *turkuun } %<P ACE IN CAP N SG ILL
"<.>"
"." { . }
"<<s>>"
"<s>" { <s> }
"<*he>"
"he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<went>"
"go" { meni } %+FMAINV O-LOC3 MOVE V PAST SG
"<to>"
"to" { M-LOC3 } %ADVL PREP
"<*tampere>"
"tampere" { *tampereelle } %<P ACE OUT CAP N SG ALL
"<.>"
"." { . }
"<<s>>"
"<s>" { <s> }
"<*he>"
"he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<came>"
"come" { tuli } %+FMAINV O-LOC3 MOVE V PAST SG
"<from>"
"from" { M-LOC2 } %ADVL PREP
"<*turku>"
"turku" { *turusta } %<P ACE IN CAP N SG ELA
"<.>"
"." { . }
"<<s>>"
"<s>" { <s> }
"<*he>"
"he" { hän } %SUBJ HUM OUT CAPINIT PRON PERS SG3 NOM
"<came>"
"come" { tuli } %+FMAINV O-LOC3 MOVE V PAST SG
"<from>"
"from" { M-LOC2 } %ADVL PREP
"<*tampere>"
"tampere" { *tampereelta } %<P ACE OUT CAP N SG ABL
```

Here again we see that for the preposition in the definite tag was chosen instead of the meta tag M-LOC1, although this is the default tag for the preposition in (see 13 above). Old rules do the job in this case. For the rest of sentences, meta tags have been chosen. Nevertheless, correct surface forms have been achieved with both methods.

4 Conclusion

Here we have seen some very basic examples of how to implement locatives in English to Finnish machine translation. English leaves much of the specifications of locative expressions open. While the human being can often figure out what the writer or speaker precisely means, for computers this is very difficult. Various tags added to verbs and prepositions for directing the processing helps in producing the correct surface form. The use of meta tags simplifies rule writing. This requires, however, some marking in the lexicon for guiding the choice. The tags such as IN and OUT are an example of such tags. For a number of reasons, such tags can be added only to part of nouns. Many nouns are ambiguous and allow defined and undefined locative inflection. For practical reasons, IN is considered as default. This means, that if the noun has neither the tag IN nor OUT, and if no rule applies, the noun will be inflected according to inessive, elative, and illative (as if it had the tag IN). Therefore, only the tag OUT needs to be added to a noun if required.