Overview

1. Introduction

2. Statement logic/predicates
1. Introduction

2. Statement logic/predicates
Translate into statement logic Be sure and represent all the connectives of statement logic explicitly. (→, & , ∨, ~, ↔). For Example:

*Bill did not smile at Mary*

\[ p = \text{Bill smiled at Mary} \]
\[ \sim p \]

*If Bill did not smile at Mary, Mary danced a jig*

\[ p = \text{Bill smiled at Mary} \]
\[ q = \text{Mary danced a jig} \]
\[ \sim p \rightarrow q \]
Basic assumptions

1 The wrong way

p = Bill did not smile at Mary

Capture truth conditions, no more, so equivalent sentences get same translation:

a. Bill did not smile at Mary.
b. It is not the case that Bill smiled at Mary.
Basic assumptions

The wrong way

*Bill did not smile at Mary*

\[
p = \text{Bill did not smile at Mary}
\]

\[
p
\]
Basic assumptions

1. The wrong way

   Bill did not smile at Mary

   \[ p = \text{Bill did not smile at Mary} \]

2. Capture

   truth conditions, no more, so equivalent sentences get same translation:
Basic assumptions

1  The wrong way

\[ p = \text{Bill did not smile at Mary} \]

2  Capture

truth conditions, no more, so equivalent sentences get same translation:

a.  \text{Bill did not smile at Mary.}

b.  \text{It is not the case that Bill smiled at Mary.}
Conjunction

1. Bill and Mary smoked.
2. Bill smoked and Mary smoked

\[ p = \text{Bill smoked} \]
\[ q = \text{Mary smoked} \]
\[ p \& q \]
Outline

1. Introduction

2. Statement logic/predicates
Connectives

(both) ... and \( p \land q \)
(Both) John and Bill awakened.
Sue awakened (both) John and Bill.

(either) ... or \( p \lor q \)
(Either) John or Bill awakened.
Sue awakened John or Bill.

not \( \neg p \)
John didn’t sleep.
It’s not the case that John slept.

neither .. nor
Neither Sue nor Mary slept.
Sue neither ran nor swam.

not ... nor
John didn’t sleep (and) nor did Sue.

unless
John will win unless he withdraws.

because
Give up!
### Connective Principle

**Sentential Connective principle**

To translate an English sentence using a sentential connective of statement logic, you must find a logically equivalent sentence in which two full sentences are connected by an appropriate conjunction.

<table>
<thead>
<tr>
<th>John and Bill awakened.</th>
<th>John awakened and Bill awakened.</th>
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</thead>
<tbody>
<tr>
<td>( p = \text{John awakened} ); ( q = \text{Bill awakened} )</td>
<td>( p \land q )</td>
</tr>
<tr>
<td>( \text{awaken}(j) \land \text{awaken}(b) )</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Sue awakened John and Bill.</th>
<th>Sue awakened John and Sue awakened Bill.</th>
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</thead>
<tbody>
<tr>
<td>( p = \text{Sue awakened John} ); ( q = \text{Sue awakened Bill} )</td>
<td>( p \land q )</td>
</tr>
<tr>
<td>( \text{awaken2}(s,j) \land \text{awaken2}(s,b) )</td>
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Further cases

a. Everyone accompanied by a cat or a dog was invited.

b. Everyone accompanied by a cat was invited or everyone accompanied by a dog was invited.

c. John didn’t eat a donut or a muffin.

d. John didn’t eat a donut or John didn’t eat a muffin.

Note: These examples are important because if the pairs aren’t equivalent, we are completely out of tricks. We can’t translate these sentences with our current translation rules, yet we have a pretty clear idea that the truth conditions of and and or play a role.
Questions

a. Everyone accompanied by a cat or a dog was invited.
b. Everyone accompanied by a cat was invited or everyone accompanied by a dog was invited.
c. John didn’t eat a donut or a muffin.
d. John didn’t eat a donut or John didn’t eat a muffin.

1. Are (a) and (b) equivalent? If not, describe a situation in which (a) is true, and (b) is not (or vice versa). To make it clear, have “everyone” be some set of people clear from context (Alice, Bob, Carol, and Doug are popular because of their first initials), and describe which of them is invited, and which have dogs and which have cats.

2. Are (c) and (d) equivalent? Same challenge. If not, give an example in which one is true and the other isn’t.
Neither John nor Bill awakened. John didn’t awaken and Bill didn’t awaken.

\[ Q = \text{awaken}; \ p = \text{John Q’ed} ; \ q = \text{Bill Q’ed} \]
\[ \sim p \& \sim q \]
\[ \sim (p \lor q) \]

<table>
<thead>
<tr>
<th>J. Q’ed</th>
<th>B. Q’ed</th>
<th>Neither J. nor B. Q’ed</th>
<th>\sim p &amp; \sim q</th>
<th>\sim (p \lor q)</th>
</tr>
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</table>

Bill or Sue saw Tom

\[ p = \text{Bill sleeps} \]
\[ q = \text{Sue sleeps} \]
\[ p \lor q \]
Bill saw Tom and Al

\[ p = \text{Bill saw Tom} \]
\[ q = \text{Bill saw Al} \]
\[ p \& q \]

Bill or Sue saw Tom and Al. Two possibilities. Which is right?

\[ (\text{Bill or Sue saw Tom}) \text{ and } (\text{Bill or Sue saw Al}) \]
\[ (\text{Bill saw Tom or Sue saw Tom}) \text{ and } (\text{Bill saw Al or Sue saw Al}) \]

This is true if Bill saw Tom and Sue saw Al.

\[ (\text{Bill saw Tom and Al}) \text{ or } (\text{Sue saw Tom and Al}) \]
\[ (\text{Bill saw Tom and Bill saw Al}) \text{ or } (\text{Sue saw Tom and Sue saw Al}) \]

This is false if Bill saw Tom and Sue saw Al.