Translating a Sentence to a WFF

There are three main steps to translating a sentence:

1. Take the sentence apart

2. Assign letters to the atomic sentences (that is, choose a **translation scheme**)

3. Put the WFF back together

1. Take the sentence apart

We disassemble the sentence with the following procedure:

1. Find the main connecting word(s)

2. Divide the sentence into the main connecting word and its parts

Note: a ‘connecting word’ may consist of several words (‘only if’) and may have parts that are separated in the sentence (‘if ... then’, ‘either ... or’, ‘both ... and’)

Finding the main connecting word

If there are several logical connecting words in a sentence, then you must determine which one of them is the main connecting word. A good way to proceed is to begin by marking all the connecting words. For example, here's a sentence

If either Smith is foggy or Jones is not wobbly, then either today is not Wednesday or, if today is Wednesday, then it is raining only if it is not snowing.

And here it is with all the connecting words marked:

If either Smith is foggy **or** Jones is **not** wobbly, **then either** today is **not** Wednesday **or**, **if** today is Wednesday, **then** it is raining **only if** it is **not** snowing.

The main connecting word is then usually the one that will divide the sentence into one or two pieces each of which is still a sentence:

If (**either** Smith is foggy **or** Jones is **not** wobbly), **then** (**either** today is **not** Wednesday **or**, **if** today is Wednesday, **then** it is raining **only if** it is **not** snowing)

To keep track of how the sentence divides, use parentheses as above

Keep finding the main connecting words of the parts, using the same procedure

Working within the divisions marked by parentheses, find the main connecting words of the parts:

If (**either** (Smith is foggy) **or** (Jones is **not** wobbly)), **then** (**either** (today is **not** Wednesday) **or** , (**if** (today is Wednesday**), then (** (it is raining) **only if** (it is **not** snowing))))

We've left 'not' unanalyzed here since it usually gets inserted into the sentence it works on.

Move all the occurrences of 'not' out of the sentences they apply to, and indicate the range with square brackets:

If (**either** (Smith is foggy) **or** (**not**[Jones is wobbly])), **then** (**either** (**not**[today is Wednesday]) **or** , (**if** (today is Wednesday**), then** ((it is raining) **only if** (**not**[it is snowing]))))

(The reason for using square brackets is that the rules for our symbolic language do not allow parentheses surrounding a negation)

2. Assign a Translation Scheme

*Identify all the atomic sentences, and assign a **unique** letter to each one (this is called a **translation scheme)**:*

If (**either** (Smith is foggy) **or** (**not**[Jones is wobbly])), **then** (**either** (**not**[today is Wednesday]) **or** , (**if** (today is Wednesday**), then** ((it is raining) **only if** (**not**[it is snowing]))))

Translation scheme:

'Smith is foggy'	= S
'Jones is wobbly'	= J
'Today is Wednesday'	= W
'It is raining'	= R
'It is snowing'	= T

3. Put the WFF back together

We're now ready for the third step: putting the analyzed sentence back together as a WFF. Start by replacing the atomic sentences with their assigned letters:

If (either (S**) or (not[**J**])), then (either (not[**W**]) or , (if (**W**), then ((**R**) only if (not[**T**]))))**

At this point, we do have some sentence letters surrounded by parentheses. We'll fix that in a moment.

Working from the inside out, translate the connecting words. This proceeds step by step:

If (either (S**) or (**$\sim[J]$**)), then (either (**$\sim[W]$**) or , (if (**W**), then ((**R**) only if (**$\sim[T]$**))))**

At this point, let's take off the square brackets and all parentheses around negations or atomic sentences:

If (either S **or** $\sim J$ **), then (either** $\sim W$ **or , (if** W**, then (** R **only if** $\sim T$ **)))**

Now we translate the connecting words, using the standard pattern for each word.

'only if': ϕ *only if* $\psi \Rightarrow (\phi \rightarrow \psi)$*:*

If (either S **or** $\sim J$ **), then (either** $\sim W$ **or , (if** W**, then (** $R \rightarrow \sim T$ **)))**

'if ... then': *if* ϕ *then* $\psi \Rightarrow (\phi \rightarrow \psi)$

If (either S **or** $\sim J$ **), then (either** $\sim W$ **or** $(W \rightarrow (R \rightarrow \sim T))$

(Continuing ...)

'either ... or': *either* ϕ *or* $\psi \Rightarrow (\phi \vee \psi)$

If (either S **or** $\sim J$ **), then (** $\sim W \vee ($ $W \rightarrow (R \rightarrow \sim T)))$

'either ... or': *either* ϕ *or* $\psi \Rightarrow (\phi \vee \psi)$

If ($S \vee \sim J$ **), then (** $\sim W \vee ($ $W \rightarrow (R \rightarrow \sim T)))$

And now the final 'if ... then': if ϕ then $\psi \Rightarrow (\phi \rightarrow \psi)$

$$(S \vee \sim J) \rightarrow (\sim W \vee (W \rightarrow (R \rightarrow \sim T)))$$

There's one more step. We need outside parentheses surrounding the entire WFF (unless it's a negation or atomic):

$$((S \vee \sim J) \rightarrow (\sim W \vee (W \rightarrow (R \rightarrow \sim T))))$$

The Original Sentence:

If either Smith is foggy or Jones is not wobbly, then either today is not Wednesday or, if today is Wednesday, then it is raining only if it is not snowing.

Analyzed into its parts:

If (**either** (Smith is foggy) **or** (Jones is **not** wobbly)), **then** (**either** (today is **not** Wednesday) **or** , (**if** (today is Wednesday**), then** ((it is raining) **only if** (it is **not** snowing))))

Translation scheme:

'Smith is foggy' = S; 'Jones is wobbly' = J; 'Today is Wednesday' = W; 'It is raining' = R; 'It is snowing' = T

Translation:

$$((S \vee \sim J) \rightarrow (\sim W \vee (W \rightarrow (R \rightarrow \sim T))))$$

Neither Smith nor Jones attended the meeting if both Brown and Green did

Mark connecting words:

Neither Smith **nor** Jones attended the meeting **if both** Brown **and** Green did

Spell out abbreviations:

Neither Smith *attended the meeting* **nor** Jones attended the meeting **if both** Brown *attended the meeting* **and** Green *attended the meeting*

Take it apart:

(**Neither** (Smith *attended the meeting*) **nor** (Jones attended the meeting)) **if** (**both** (Brown *attended the meeting*) **and** (Green *attended the meeting*))

Translation scheme:

S = ‘Smith attended the meeting’; J = ‘Jones attended the meeting’; B = ‘Brown attended the meeting’; G = ‘Green attended the meeting’

(**Neither** (S) **nor** (J)) **if** (**both** (B) **and** (G))

Translation:

'neither ... nor': *neither* ϕ *nor* $\psi \Rightarrow \ (\phi \vee \psi)$

($\sim$ ($S \vee J$)) **if** (**both** (B) **and** (G))

'both ... and': *both* ϕ *and* $\psi \Rightarrow \ (\phi \& \psi)$

($\sim$ ($S \vee J$)) **if** (($B \& G$))

'if': ϕ *if* $\psi \Rightarrow (\psi \rightarrow \phi)$

$((B \& G) \rightarrow \sim (S \vee J))$