

# Translating Between English and Propositional Logic

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## English Sentences Expressing Complex Propositions and Their Usual PL Counterparts

In the following,  $E$  and  $F$  abbreviate English declaratives that are translated into PL as  $\varphi$  and  $\psi$ , respectively.

**Negation** is easy to recognize because it almost always includes the word *not*, as in *it's not the case that  $E$*  or *it's not true that  $E$* . Other instances include declarative expressions containing and embedded *not*. Example:

- (1) a. Clint went to the Chatterbox Cafe.
- b. Clint did not go to the Chatterbox Cafe.

If (1a) is translated as  $\varphi$ , then (1b) is translated as  $\neg\varphi$ .

**Conjunction** sometimes involves the word *and*, but not always. If  $E$  and  $F$  are English declaratives, then  *$E$  and  $F$* ,  *$E$  but  $F$* ,  *$E$  nonetheless  $F$* ,  *$E$  however  $F$* ,  *$E$  nevertheless  $F$* , and  *$E$  moreover  $F$*  are all translated as PL conjunctions. For example:

- (2) Pastor Ingqvist is a Lutheran but Father Wilmer is not.

If *Pastor Ingqvist is a Lutheran* is translated as  $\varphi$  and *Father Wilmer is a Lutheran* as  $\psi$ , then (2) is translated as  $\varphi \wedge \neg\psi$ .

**Disjunction** usually involves the word *or* (but is inclusive in PL). Sentences like  *$E$  or  $F$*  and *either  $E$  or  $F$*  are translated using *or* as  $\varphi \vee \psi$ .

**Implication** is used to capture conditionality. English sentences like *if  $E$  then  $F$* ,  *$F$  provided that  $E$* , *assuming  $E$ ,  $F$* ,  *$E$  only if  $F$* ,  *$F$  if  $E$*  and  *$F$  given  $E$*  are all translated using PL implication.

- (3) Wally eats Powdermilk biscuits only if Evelyn makes them.

With *Wally eats Powdermilk biscuits* as  $\varphi$  and *Evelyn makes them* as  $\psi$ , we translate (3) into PL as  $\varphi \rightarrow \psi$ .

**Bimplication** makes a stronger claim than the conditional. It's used to translate English sentences of the form  *$E$  if and only if  $F$*  and  *$E$  just in case  $F$* .

Translating certain English constructions into PL may involving combining one or more of the approaches described above.

- English sentences like *neither ... nor ...* are essentially a negated disjunction, a negative version of *either ... or ...*.

(4) Florian neither washed the car nor went to the mercantile.

With *Florian washed the car* as  $\varphi$  and *Florian went to the mercantile* as  $\psi$ , we translate (4) as  $\neg(\varphi \vee \psi)$ .

- Sometimes we also negate conjunctions in English. This kind of sentence usually takes the form *it's not true that both E and F* or *not E and F*.

(5) It's not true that Clint owns both a Ford and a Chevy dealership.

Given that *Clint owns a Ford dealership* is translated as  $\varphi$  and *Clint owns a Chevy dealership* is translated as  $\psi$ , a translation of (5) would be  $\neg(\varphi \wedge \psi)$ .

- One of the more confusing English words to translate is *unless*. This word expresses a dependency between two propositions, but one which is not always as straightforward as the conditional with *if ... then ...*. For example:

(6) Myrtle doesn't cook a Walleye unless Clint catches it.

If *Myrtle cooks a Walleye* is  $\varphi$  and *Clint catches a Walleye* is  $\psi$ , then (6) can be translated as either  $\neg\psi \rightarrow \neg\varphi$ ,  $\varphi \rightarrow \psi$ , or  $\neg\varphi \vee \psi$ .

## Homework

**Problem 1.** Come up with a translation of each of the following English sentences into PL:

- a. It didn't rain in Lake Wobegon, however it did snow there.
- b. Provided the lutefish shipment arrives on time, Pastor Ingqvist can have the festival on Sunday.
- c. Clarence goes down the fish shack just in case the weather is perfect.
- d. Myrtle didn't make it to the Sidetrack Tap today.
- e. Either the mercantile is closed for repairs, or it's not a weekday.
- f. Neither Clint nor Clarence were able to catch a Walleye.
- g. Wally and Evelyn don't both have to show up to work the beer cart.