Translation Tips

source: "Translation Tips" by Peter Suber, Philosophy Department, Earlham College.

1. **Disjunction.** $\vee$ expresses *inclusive disjunction*: $p \vee q$ means that either p is true or q is true or both p and q are true.
   The exclusive disjunction of p and q asserts that either p is true or q is true but not both. If you want to express the exclusive disjunction of p and q, you should write $(p \vee q) \wedge \neg(p \wedge q)$, or, using the equivalence operator, $\neg(p \leftrightarrow q)$.

2. **Conjunction.** We express conjunction with many words other than "and", including "but", "moreover", "however", "although" and "even though". In English these expressions sharply contrast the two conjuncts, but they still assert conjunction (the contrast between the conjuncts is not logically relevant).

3. **And/or.** If one says "p and/or q", $p \vee q$ is meant (inclusive or).

4. **Neither ... nor ...** "Neither p nor q" means that both p and q are false: $\neg p \wedge \neg q$, or $\neg(p \vee q)$.

5. **Not both versus both not.** If "p and q are not both true", then we are denying their conjunction: $\neg(p \wedge q)$. If "p and q are both not true", then we are denying each of them: $\neg p \wedge \neg q$.

6. **Implication.** $p \to q$ translates a wide variety of English expressions, for example: "if p, then q", "if p, q", "p implies q", "p entails q", "p therefore q", "p hence q", "since p, q", "because p, q", "q if p", "q provided p", "q since p", "q because p", "q follows from p", "p is a sufficient condition of q", "q is a necessary condition of p", "p only if q".

7. **Necessary and sufficient conditions.** We say that p is a sufficient condition of q when p's truth guarantees q's truth. We say that q is a necessary condition of p when q's falsehood guarantees p's falsehood. So, if we have $p \to q$, then the antecedent p is a sufficient condition of the consequent q, and the consequent q is a necessary condition of the antecedent p.

   If p is both necessary and sufficient for q, then we have equivalence $p \leftrightarrow q$. In that case we also say p if and only if q (p if q: $p \leftarrow q$; and p only if q: $p \to q$).

8. **Canonical quantitative propositions.** Here are some often recurring expressions:

All p's are q's	$\forall X\ p(X) \to q(X)$	(tip 9)
No p's are q's	$\forall X\ p(X) \to \neg q(X)$	(tip 11)
Some p's are q's	$\exists X\ p(X) \wedge q(X)$	(tip 10)
Some p's are not q's	$\exists X\ p(X) \wedge \neg q(X)$	
All and only p's are q's	$\forall X\ p(X) \leftrightarrow q(X)$	
Only p's are q's	= All q's are p's (see above)	(tip 13)
Not all p's are q's	= Some p's are not q's (see above)	(tip 12)
All p's are not q's	No p's are q's (see above)	(tip 12)

9. **Universal quantifiers typically come with implication.** The statement "all p's are q's" can be rephrased as "for all things in the universe, if they are p's, then they are q's", and so corresponds to: $\forall X\ p(X) \to q(X)$. A common mistake is to translate it into: $\forall X\ p(X) \wedge q(X)$. But this expression says that everything in the universe is both p and q, which is a much stronger statement than was meant.

   Note that in the expression $\forall X\ p(X) \to q(X)$, we actually limit the universe of discourse: the limitation is put in the antecedent of the implication. If we want to limit the universe of discourse to things with two or more properties, we indicate this limitation with a conjunction in the antecedent. For example: "All old men are grey" is translated as $\forall X\ man(X) \wedge old(X) \to grey(X)$.

   Be prepared to translate "and" as "or". For example: "All men and women are human". It is tempting to translate the "and" here as a conjunction: $\forall X\ man(X) \wedge woman(X) \to human(X)$. But this actually says that everything that is both a man and a woman is human. What we mean is that everything that is either a man or a woman (or both) is human: $\forall X\ man(X) \vee woman(X) \to human(X)$. Note that this is equivalent to: $(\forall X\ man(X) \to human(X)) \wedge (\forall X\ woman(X) \to human(X))$.

10. **Existential quantifiers typically take conjunctions.** For example the sentence "Some women are tall" is translated as: $\exists X\ woman(X) \wedge tall(X)$.

    A common mistake is to use implication in this case, like $\exists X\ woman(X) \to tall(X)$. This is equivalent to $\exists X\ \neg woman(X) \vee tall(X)$, which says that there exists something that is not a woman or that is tall, which is a much weaker statement than was meant. Existentially quantified implications are almost never good translations of English sentences. Note however that existentially quantified negated implications are acceptable, because they are disguised conjunctions. For example, $\exists X\ \neg(woman(X) \rightarrow tall(X))$ is equivalent to $\exists X\ woman(X) \wedge \neg tall(X)$, which says that there is something that is a woman and not tall (which is an English sentence that makes sense). Also, existentially quantified antecedents of implications are acceptable. For example, the sentence "If there is a God, then I am in trouble" is translated as: $(\exists X god(X)) \rightarrow in\_trouble(i)$.

11. **No p's are q's.** This is translated as $\forall X\ p(X) \rightarrow \neg q(X)$. This is equivalent to $\forall X\ q(X) \rightarrow \neg p(X)$; hence, in translation, use either one. If no p's are q's, then no q's are p's.

    It may be tempting to translate "No p's are q's" as $\forall X\ \neg(p(X) \rightarrow q(X))$. But this is equivalent to $\forall X\ p(X) \wedge \neg q(X)$, which asserts the much stronger claim that everything whatsoever is p, and nothing whatsoever is q.

    It may also be tempting to translate "No p's are q's" as $\neg(\forall X\ p(X) \rightarrow q(X))$, but this is equivalent to $\exists X\ p(X) \wedge \neg q(X)$ which asserts the much weaker claim that there is at least one thing which is p and not q.

12. **All not versus not all.** "All p's are not q's" is translated as $\forall X\ p(X) \rightarrow \neg q(X)$ ("no p's are q's").

    "Not all p's are q's" is translated as $\neg(\forall X\ p(X) \rightarrow q(X))$, or, equivalently $\exists X\ p(X) \wedge \neg q(X)$ ("some p's are not q's").

13. **Only.** "Only p's are q's" is equivalent to "All q's are p's", and hence should be translated as: $\forall X\ q(X) \rightarrow p(X)$. The following Venn diagram makes it more intuitive:

14. **None but.** We can paraphrase for example "None but ripe bananas are edible" in many equivalent ways: "No bananas except ripe ones are edible", "A banana is edible only if it is ripe", "All edible bananas are ripe": $\forall X\ banana(X) \wedge edible(X) \rightarrow ripe(X)$. Don't let these many forms confuse you.

15. **Names.** Names should be translated as constants.

16. **Bind all your variables.**

17. **Indefinite articles.** The articles "a" and "an" sometimes take existential, sometimes universal quantifiers. "A bat is a mammal" really means "All bats are mammals": $\forall X\ bat(X) \rightarrow mammal(X)$. "A bat is in my room" means "There exists a bat in my room": $\exists X\ bat(X) \wedge in\_my\_room(X)$. Because there is no hard and fast rule, paraphrase the English before translating.

18. **Definite articles.** "The" sometimes takes existential, sometimes universal quantifiers. "The horse is a noble animal" really means "All horses are noble animals": $\forall X\ horse(X) \rightarrow animal(X) \wedge noble(X)$. "The winning horse is on drugs" really means "There exists a horse, namely the winning one, who is on drugs": $\exists X\ horse(X) \wedge winning(X) \wedge on\_drugs(X)$. Because there is no hard and fast rule, paraphrase the English before translating.

19. **Any.** "Any" sometimes takes existential, sometimes universal quantifiers. "Any bat is a mammal" really means "All bats are mammals": $\forall X\ bat(X) \rightarrow mammal(X)$. "If any bats are in the room, I am outtahere" means "If there exists a bat in the room, then I am outtahere": $(\exists X\ bat(X) \wedge in\_room(X)) \rightarrow outtahere(i)$. Because there is no hard and fast rule, paraphrase the English before translating.

20. **Order of quantifiers.** When the quantifiers are of the same type, then their order does not matter. But when the quantifiers are of different types, then their order does matter. Here are some examples:

Everything attracts everything	$\forall X \forall Y attracts(X, Y)$
Everything is attracted by everything	$\forall Y \forall X attracts(X, Y)$
Something attracts something	$\exists X \exists Y attracts(X, Y)$
Something is attracted by something	$\exists Y \exists X attracts(X, Y)$
Nothing attracts anything	$\forall X \forall Y \neg attracts(X, Y)$
Nothing is attracted by anything	$\forall Y \forall X \neg attracts(X, Y)$
Everything attracts something	$\forall X \exists Y attracts(X, Y)$
(something = something or other)	
Something is attracted by everything	$\exists Y \forall X attracts(X, Y)$
(something = something in particular)	
Everything is attracted by something	$\forall Y \exists X attracts(X, Y)$
(something = something or other)	
Something attracts everything	$\exists X \forall Y attracts(X, Y)$