Symbolization

1. Stuff to remember.

1) Conditional: '→'

P even if Q = P

only if = only when = only

① P → Q:

→ If P, then Q ; Q if P

→ P only when Q ; Only if Q, P ; Only P if Q

→ Whenever P, Q ; Q whenever P

→ Provided that P, Q ; Q provided that P

→ Assuming that P, Q ; Q assuming that P

→ Given that P, Q ; Q given that P.

→ P is sufficient for Q ; It's sufficient to have P for Q

→ P is enough for Q.

→ P only on the condition that Q

② Q → P:

→ P on the condition that Q

→ P is necessary for Q ; It is necessary to have P for Q

→ P is required for Q

→ P is needed for Q

→ P in case that Q

→ you must / have to have P for Q.

2) Biconditional : $P \leftrightarrow Q$

① P if and only if Q ; P iff Q.

② P exactly on the condition that Q.

③ P just in case that Q.

④ P is the necessary and sufficient condition of Q

3). Conjunction : $P \wedge Q$

① P and Q

② P but Q.

③ P however Q

④ P although Q.

⑤ P even though Q

⑥ P not with standing Q

⑦ P in addition to Q

⑧ P also Q

⑨ P nonetheless Q.

⑩ P moreover Q

4) Disjunction : $P \vee Q$ $(\sim Q \rightarrow P)$

① P or Q

② either P or Q.

③ P unless Q.

5) Negation : $\sim P$

① Not P

② It's not the case that P

③ other than P

6) Other important:

① Neither P nor Q

→ $\sim P \wedge \sim Q$

→ $\sim(P \vee Q)$

② Not both P and Q

→ $\sim(P \wedge Q)$

→ $\sim P \vee \sim Q$

③ P or Q (exclusive or)

→ $(P \wedge \sim Q) \vee (\sim P \wedge Q)$

→ $(P \vee Q) \wedge \sim(P \wedge Q)$

→ $\sim(P \leftrightarrow Q)$

④ At least / At most / Exactly.

→ All of P, Q and R: $P \wedge Q \wedge R$.

→ Not all of P, Q and R: $\sim(P \wedge Q \wedge R)$

$= \sim P \vee \sim Q \vee \sim R$

→ None of P, Q, and R: $\sim(P \vee Q \vee R)$

$= \sim P \wedge \sim Q \wedge \sim R$

★→ At least one of P, Q, and R: $P \vee Q \vee R$

★→ At least two ……: $(P \wedge Q) \vee (P \wedge R) \vee (P \wedge Q)$

→ Exactly one of ……: $(P \wedge \sim Q \wedge \sim R) \vee (\sim P \wedge Q \wedge \sim R) \vee$

$(\sim P \wedge \sim Q \wedge R)$

→ Exactly two ……: $(P \wedge Q \wedge \sim R) \vee (P \wedge \sim Q \wedge R) \vee$

$(\sim P \wedge Q \wedge R)$

→ At most one of ……: None ∨ Exactly One.

→ At most two of ……: None ∨ Exactly One ∨ Exactly Two.

$= \sim (P \wedge (Q \wedge R))$

⑤ In that case (that 指最近的那一个 sentence，不是变成符号后最近的符号).

different from: P in case that Q: $(Q \to P)$

→ If P, then Q; and in that case R.

$(P \to Q) \wedge (Q \to R)$ ↖ Q.

→ Only P, Q, and in that case R.

$(Q \to P) \wedge (Q \to R)$ ↖ Q.

⑥ In the latter case R. (指后者)

→ P or Q, and ~ R.

$(P \vee Q) \wedge (Q \to R)$

⑦ In the former case R (指前者).

→ P or Q, and ~ R.

$(P \vee Q) \wedge (P \to R)$.

⑧ Non-Restrictive Clause (which, who, whom): 主从句并列. '∧' 连接，共用主语

→ Bob, who P, Q

$P \wedge Q$.

↑ 把从句加上主语先写出即可.

2. Symbolization Procedure

X: Steve arrives before 6pm.

W: Steve will bring food.

Y: We will have to order dinner.

English Sentence:

Assuming that Steve will bring food, if Steve arrives before 6pm then we won't have to order dinner.

1) Replace Sentences / Phrases with Symbols from the Translation-Scheme:

e.g. Assuming that W, if X then not-Y.

2) Put Parentheses around 'sub-sentences'

e.g. Assuming that W. (if X then not-Y)

3). Replace english connectives in Sub-sentences with Appropriate Symbols:

e.g. Assuming that W. (if X then $\sim$Y)

4). Replace main connectives with Appropriate Symbols.

e.g. Assuming that W. $(X \rightarrow \sim Y)$

$W \rightarrow (X \rightarrow \sim Y)$

3. Commas' Importance.

1) Assuming that Steve will bring food, if he arrives before 6 p.m. then we won't have to order dinner.

$W \rightarrow (X \rightarrow \sim Y)$

2) Assuming that Steve will bring food if he arrives before 6 p.m., we won't have to order dinner

$(X \rightarrow W) \rightarrow \sim Y$

4. Practices.

P: Steve feels like cooking.
Q: Dinner is very difficult to prepare.
R: Steve will cook dinner.

If Steve feels like cooking, unless dinner is very difficult to prepare he will cook dinner.

1) ① If P, unless Q R
② If P, (Q ∨ R)
③ P → (Q ∨ R)

If Steve feels like cooking unless dinner is very difficult to prepare, he will cook dinner.

2) ① If P unless Q, R
② If P ∨ Q, R
③ (P ∨ Q) → R

Given that Steve will cook dinner, if he feels like cooking then dinner is not very difficult to prepare.

3) ① Given that R, if P then not Q
② Given that R, (P → ~Q)
③ R → (P → ~Q)

Given that Steve will cook dinner if he feels like cooking, dinner is not very difficult to prepare.

4) ① Given that R if P, ~Q
② Given that (R if P), ~Q
③ (P → R) → ~Q

Only when dinner is not very difficult to prepare and Steve feels like cooking, will he make dinner.

5) ① Only when not Q and P, R

② Only when $(\sim Q \wedge P)$, R

③ $R \rightarrow (\sim Q \wedge P)$

It is not the case that Steve will cook dinner if he doesn't feel like cooking.

6) ① Not R if $\sim P$

Ambiguous.

→ Not (R if $\sim P$) $= \sim(\sim P \rightarrow R)$

→ (Not R) if $\sim P$ $= \sim P \rightarrow \sim R$.