# HW1

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## 0.1

Given a proposition, convert it to CNF.
Proposition:

$$\phi = \neg(\neg r \to \neg(p \land q))$$

Substitutions:

$$\begin{aligned} a_\phi &= \neg(\neg r \to \neg a_{p\land q}) \\ a_{p\land q} &= (p \land q) \end{aligned}$$

Conjunction:

$$a_\phi \land (a_\phi \leftrightarrow \neg(\neg r \to \neg a_{p\land q})) \land (a_{p\land q} \leftrightarrow (p \land q))$$

where

$$(a_\phi \leftrightarrow \neg(\neg r \to \neg a_{p\land q})) = (\neg a_\phi \lor \neg r) \land (\neg a_\phi \lor a_{p\land q}) \land (r \lor \neg a_{p\land q} \lor a_\phi)$$

and

$$(a_{p\land q} \leftrightarrow (p \land q)) = (\neg a_{p\land q} \lor p) \land (\neg a_{p\land q} \lor q) \land (\neg p \lor \neg q \lor a_{p\land q})$$

so

$$\phi = (\neg a_\phi \lor \neg r) \land (\neg a_\phi \lor a_{p\land q}) \land (r \lor \neg a_{p\land q} \lor a_\phi) \land$$
$$(\neg a_{p\land q} \lor p) \land (\neg a_{p\land q} \lor q) \land (\neg p \lor \neg q \lor a_{p\land q})$$