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from sympy import symbols, Not, Or, And, Implies, Equivalent
from sympy.logic.boolalg import to_cnf

def fol_to_cnf(fol_expr):
    """
    Converts a First-Order Logic (FOL) statement to Conjunctive Normal Form (CNF).
    Arguments:
        fol_expr: A sympy logical expression representing the FOL statement.
    Returns:
        The CNF equivalent of the input expression.
    """
    # Step 1: Eliminate equivalences ( $A \leftrightarrow B$ ) using  $(A \rightarrow B) \wedge (B \rightarrow A)$ 
    fol_expr = fol_expr.replace(Equivalent, lambda a, b: And(Implies(a, b), Implies(b, a)))

    # Step 2: Eliminate implications ( $A \rightarrow B$ ) using  $(\neg A \vee B)$ 
    fol_expr = fol_expr.replace(Implies, lambda a, b: Or(Not(a), b))

    # Step 3: Convert to CNF
    cnf_form = to_cnf(fol_expr, simplify=True)

    return cnf_form

def main():
    # Define propositional symbols instead of first-order predicates
    P = symbols("P")
    Q = symbols("Q")
    R = symbols("R")

    # Example 1:  $P \rightarrow Q$ 
    fol_expr1 = Implies(P, Q)
    print("Example 1:  $P \rightarrow Q$ ")
    print("Original FOL Expression:")
    print(fol_expr1)


    # Convert to CNF
    cnf1 = fol_to_cnf(fol_expr1)
    print("\nCNF Form:")
    print(cnf1)

    # Example 2:  $(P \vee \neg Q) \rightarrow (Q \vee R)$ 
    fol_expr2 = Implies(Or(P, Not(Q)), Or(Q, R))
    print("\nExample 2:  $(P \vee \neg Q) \rightarrow (Q \vee R)$ ")
    print("Original FOL Expression:")
    print(fol_expr2)

    # Convert to CNF
    cnf2 = fol_to_cnf(fol_expr2)
    print("\nCNF Form:")
    print(cnf2)

if __name__ == "__main__":
    main()

```

 Example 1: $P \rightarrow Q$
 Original FOL Expression:
 $\text{Implies}(P, Q)$

CNF Form:
 $Q \mid \sim P$

Example 2: $(P \vee \neg Q) \rightarrow (Q \vee R)$
 Original FOL Expression:
 $\text{Implies}(P \mid \sim Q, Q \mid R)$

CNF Form:
Q | R