Exercise sheet 1:
Propositional Logic

Exercise 1
Represent the following sentences in propositional logic, using the connectives \(\neg\), \(\rightarrow\), \(\land\) and \(\lor\) (make clear what your propositional variables stand for):

1. Cats chase mice or birds, but not at the same time.
2. If it rains the beach will be empty.
3. If Jane bought a piano today, she either sold her old one or took out a bank loan.

Also draw the truth tables for each statement.

Exercise 2
Is the proposition \(P \land (P \rightarrow Q)\) satisfiable? If so, give an interpretation that satisfies it. Is it valid? Why or why not?

Exercise 3
The truth table for the following NAND expression, \(p \mid q\) is:

\[
\begin{array}{c|c|c|c}
 p & q & p \mid q \\
 \hline
 t & t & f \\
 t & f & t \\
 f & t & t \\
 f & f & t \\
\end{array}
\]

Show that \(\mid\) alone can be used to define the connectives: \(\neg\), \(\land\), \(\lor\) and \(\rightarrow\).