Foundations of Computer Science (COMP109)

Tutorial X, Week 02.12.2024 – 06.12.2024

*A reasonable attempt at answering Question X.2. should be submitted on Canvas by **14:00 on Tuesday 03.12.2024** as a text entry, a text file (txt), a pdf file, or a photo of the hand-written answer. This assignment makes up 1% of your final mark. We want to encourage you to discuss the questions with your fellow students in person or on the Canvas discussion board but do not copy your answer from anybody else.*
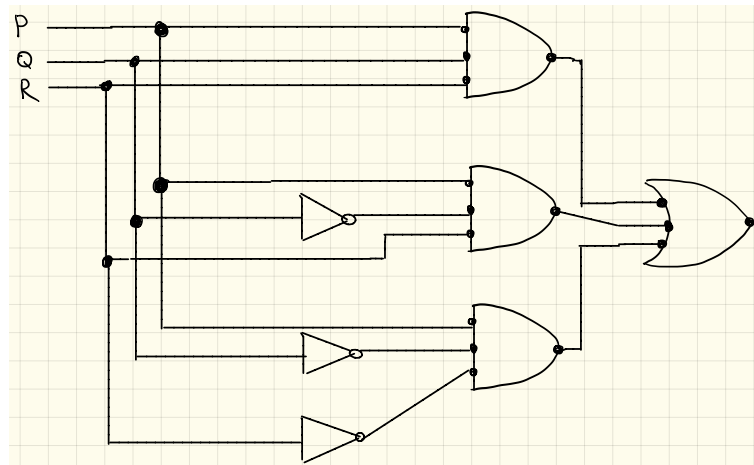
X.1. You are visiting an island that has two kinds of inhabitants, knights, who always tell the truth, and knaves, who always lie.

Two natives A and B address you as follows

- A says "Both of us are knights"
- B says "A is a knave."

Represent this scenario in propositional logic, construct the truth table and decide what A and B are.

X.2. For the circuit given below

(a) What is the output signal for the input signals $P = 0, Q = 1, R = 1$?

(b) What logical formula in Disjunctive Normal Form (DNF) describes the behaviour of the circuit?

(c) Use equivalence laws to simplify the formula from item (b).

X.3. Assuming the following are binary representations of unsigned integers, use long addition and long subraction to compute

- $1110_2 + 1010_2$
- $1110_2 - 1010_2$

X.4. Find the 8-bit two's complements for the following integers:

- 25
- 68
- 116

X.5. Assuming the following are 8-bit representations of signed integers (using two's complement), compute

- $25 + (-68)$
- $(-25) + (-68)$