

Foundations of Computer Science (COMP109)

Tutorial IX (bring solutions between 27.11.2017 – 01.12.2017)

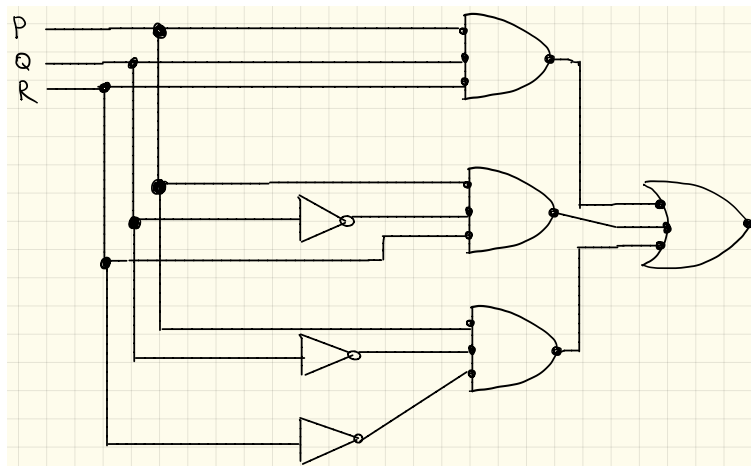
IX.1. You are visiting an island that has two kinds of inhabitants, knights, who always tell the truth, and knaves, who always lie.

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.

IX.2. For the circuit given below



- What is the output signal for the input signals $P = 0, Q = 1, R = 1$?
- What logical formula in Disjunctive Normal Form (DNF) describes the behaviour of the circuit?
- Use equivalence laws to simplify the formula from item (b).

IX.3. Is $\neg(P \wedge Q)$ logically equivalent to $(\neg P \wedge \neg Q)$?

IX.4. In the lectures we've seen that the NAND gate (Sheffer stroke) is universal (that is, the NOT, AND and OR gates constructed from NAND gates). Show that the NOR gate (Pierce arrow) is also universal.

IX.5. Represent 42 in binary. Show your working.

IX.6. Use long addition and long subtraction to compute

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