Tutorial 5
Karnaugh Maps

Exercise 1

Let us consider N, a 3-bit unsigned integer (C, B, A). A is the least significant bit. Using Karnaugh maps, write down the most simplified expression of $S = f(N)$ for each of the following:

- $S = 1$ iff $N \geq 2$
- $S = 1$ iff $2 < N \leq 6$
- $S = 1$ iff $N = 0, 1, 2, 4, 5$ or 6
- $S = 1$ iff $N = 1$ or 5 and S is undefined iff $N = 0, 2, 4$ or 6

Exercise 2

We want to design a circuit that performs the two's complement operation. This circuit has three inputs (C, B, A) and three outputs (C', B', A'). A and A' are the least significant bits.

1. Write down the truth table for the three outputs.
2. Write down their most simplified expressions.

We want to design a circuit that converts a natural binary number into a Gray code number. The gray code can be found at the end of Chapter 1. This circuit has three inputs (C, B, A) and three outputs (C', B', A'). A and A' are the least significant bits.

3. Write down the truth table for the three outputs.
4. Write down their most simplified expressions.

Exercise 3

Let us consider N, a 4-bit unsigned integer (D, C, B, A). A is the least significant bit. Using Karnaugh maps, write down the most simplified expression of $S = f(N)$ for each of the following:

- $S = 1$ iff $N < 6$
- $S = 1$ iff $N = 0, 4, 6, 8, 12$ or 14
- $S = 1$ iff $N = 0, 2, 5, 7, 8, 10, 13$ or 15
- $S = 1$ iff $N = 2, 10, 11$ or 14
- $S = 1$ iff $N = 2, 10, 11$ or 14 and S is undefined iff $N = 6, 9, 13$ or 15