

# Computer Networks and Distributed Systems

## Exercise Sheet 11

**Publication:** January 9, **Discussion:** January 17—January 20, **submission not mandatory**

### Quiz questions

1. Describe the tasks of the link layer
2. Differentiate between Ethernet frames and IP packets
3. Describe the requirements for an access control mechanism
4. A. Nonymous would like to extend his textboard with unicorn-based moderation functionalities. Is it a good idea to use MAC addresses to identify the users for this task?

### Exercise 11.1 Hamming Distance

Determine the minimal Hamming distance of the following 16 bit words:  
0000000000000000, 0011001100110011, 0101010101010101,  
0000111111110000, 0011111111000000, 1100110000000000,  
1111111111111111.

State your result and describe your approach.

### Exercise 11.2 Hamming code

- (a) Why are the positions 1, 2, 4, ... used as positions for the check bits?
- (b) Determine the Hamming code (even parity) for the following 8 bit words:
  - (i) 10101010
  - i(ii) 01111000
- (c) You receive the following words in Hamming code (even parity). Correct possible 1 bit errors.
  - (i) 001011010010
  - (ii) 010000001001
  - (iii) 100110111011
- (d) By combining  $k$  code words in a block that is transmitted afterwards, it is possible to correct error bursts up to a particular maximal length. What is the maximal length? How is the data of a block transmitted?

**Exercise 11.3** CRC codes

6-bit words  $D(x)$  are encoded using CRC with the 3 bit generator polynomial  $G(x) = 101$ .

(a) Compute the code words  $T(x)$  for the following payloads:

(i)  $D(x) = 110001$

(ii)  $D(x) = 111100$

(b) Check if the following code words  $T(x)$  have been received without errors.

(i)  $T(x) = 10011101$

(ii)  $T(x) = 01101111$