ETH
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Distributed Computing

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Computer Engineering II

Exercise Sheet 10

Basic

1 MAC Addresses vs. IP Addresses

a) List a few differences between MAC addresses and IP addresses.

b) Why don't we only use MAC addresses?

c) Why don't we only use IP addresses?

2 Escape Sequences

Recall Definition 10.34 from the lecture:

Definition 1 (Escape Sequences)**.** *Given some critical byte* `X`*, we choose a byte* $Y \neq X$ *as* escape byte *and use it to define two* escape sequences *consisting of two bytes each, say,* `YA` *and* `YB` *(*$A \neq X$*,* $B \neq X$*,* $A \neq B$*). The sender replaces every* `Y` *in the original body with* `YA` *and every* `X` *with* `YB`*. The receiver in turn performs the substitution in reverse.*

If we perform such a substitution in a string, we say we *escape* the string.

a) When is it possible to tell whether a given (character) string has been escaped by a given escaping scheme?

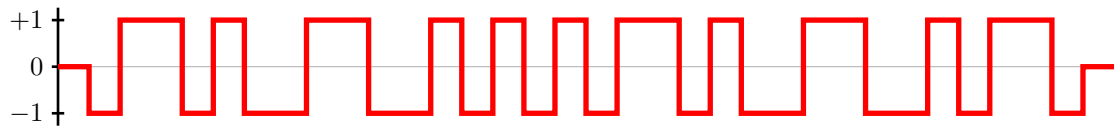
b) In software, it is common to drop the conditions $A \neq X$ and $B \neq X$. When is this possible?

c) Escape the following string using `X` = `"`, `Y` = \, `A` = \, `B` = `"`:

```
"Oh no," Jon said, "my cat \"Garfield\" is locked outside in the rain!"
```

3 Manchester Decoding

Decode the message in the following Manchester encoded byte string.
Hint: `ascii('a') == 97`.



4 Bit Stuffing

Consider the scenario of transmitting a packet as a string of bits. The string `S` = `011110` will be prepended and appended to the packet to be used as a synchronization header resp. footer.

a) Propose a bit stuffing technique for transforming the packet such that it does not contain `S` as a substring.

Hint: Solutions based on escape sequences are a lot simpler than ones based on COBS!

b) By prepending and appending `S` to the bit stuffed packet additional instances of `S` may appear. When does this occur?

Does your bit stuffing technique from a) prevent these? (probably not)
Extend your technique to prevent the combined string from containing `S` as substring anywhere but the once at the start and the end each.

5 AM/FM/PM Demodulation

A mad scientist has decided to combine all three types of modulation! Each symbol now consists of 4 bits. The first sets the frequency, the second sets the amplitude and the last two determine the phase shift. The following table shows all combinations:

Symbol	Frequency f	Amplitude a	Phase ϕ
0000	2	0.25	± 0
0001	2	0.25	$+\pi/2$
0010	2	0.25	$\pm\pi$
0011	2	0.25	$-\pi/2$
0100	2	1.00	± 0
0101	2	1.00	$+\pi/2$
0110	2	1.00	$\pm\pi$
0111	2	1.00	$-\pi/2$
1000	3	0.25	± 0
1001	3	0.25	$+\pi/2$
1010	3	0.25	$\pm\pi$
1011	3	0.25	$-\pi/2$
1100	3	1.00	± 0
1101	3	1.00	$+\pi/2$
1110	3	1.00	$\pm\pi$
1111	3	1.00	$-\pi/2$

The signal at time t is given by $a \cdot \sin(f \cdot t + \phi)$. Decode their message from the following signal: