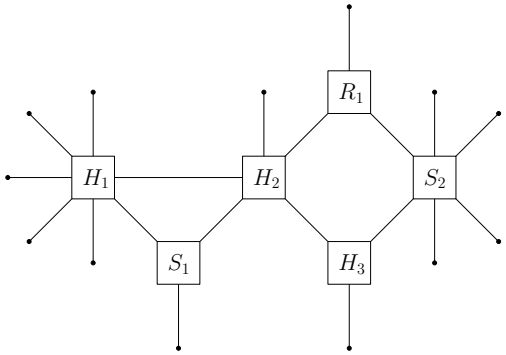
COMPUTER NETWORKS
EXERCISES LIST 2

1. St. Bernard dog is running with the speed of 20km/h on the distance of 1km carrying a box of 100 recorded DVDs ($4.7 \cdot 10^9$ bytes each). What is the bandwidth of this link? Is it a simplex, half-duplex or full-duplex connection? Why don't we use these types of transmissions for all applications?

2. In the coaxial cable, the electric signal propagates with the speed of $10^8\,\mathrm{m/s}$. The standard limits the distance between any pair of computers to at most 2.5km.[1] Assuming that the data is transmitted with the speed of 10Mbit/s, compute what is the minimal length of the Ethernet frame (including headers).

3. On the figure below, hubs are denoted by H, switches by S, and routers by R. Dots represent connected computers. Mark the collision and broadcast domains.



How will they change if we replace hub H_1 with a switch, and hub H_3 with a router?

4. Let's consider CSMA/CD algorithm discussed during a lecture, ie. in each turn every (from pool of n) communication participant attempt to send a frame with p probability. Let's denote probability of successful transmission (ie. without a collision) by one of the stations by $P(p,n)$. What is the value of $P(p,n)$? Show that $P(p,n)$ reaches maximal value for $p = 1/n$. Calculate $\lim_{n\to\infty} P(1/n,n)$.

5. By *Ethernet capture*, we describe an event where one node transmits frames more frequently than any other one, though they all conform to CSMA/CD protocol. Describe how such situation may arise (you'll find an explanation in the Internet).

6. Calulate control sum, that will be attached to message `1010`. Assume that CRC uses x^2+x+1 polynomial. How CRC will change if we use $x^{10}+1$ polynomial?

7. Show that CRC-1, which uses the polynomial $G(x) = x+1$, works exactly the same as parity bit.

8. Assume that CRC employs $G(x)$ polynomial of degree n with x^0 term. Having a message M, show that if we choose any substring of length n from M and modify it arbitrarily (ie. we'll flip non-zero number of bits in it), then CRC will detect the modification. Can we make such claim if $G(x)$ does not contain term x^0?

9. Consider CRC sum that employs $G(x) = x^3+x+1$ polynomial. Show it will detect any message corruption, where two bits were flipped provided that the distance between them is lesser than 6 (ie. between two flipped bits there's no more than 5 other bits).

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[1] Repeaters are needed to maintain such distance.