

## Series 9 (16.11.2011)

Submission: **15:00, November, 24, 2011**, into the boxes next to the room I-21. Write every solution on the separate paper (format A4)! Don't forget to sign your solutions.

It is not sufficient to answer a single number or yes/not. Answers always have to be justified.

For every machine describe strategy how it works. Draw its diagram or write a transition function.

**Exercise 1.** Design ordinary TM, which given the input word  $w_1\#w_2$ , where  $w_1, w_2 \in \{1\}^+$  computes function  $F(w_1\#w_2) = 1^{|w_1||w_2|}$ .

**Exercise 2.** Design 3-tape TM, which calculates the same function as in exercise 1.

**Exercise 3.** Design 2-tape TM, which recognizes language  $L = \{ww \mid w \in \{a, b\}^*\}$ . Give an estimate how many computational steps it has to execute when  $|ww| = n$ . Try to design your machine to minimize the number of steps necessary for accepting the word from the language  $L$ .