

## Course Quiz “Complexity Theory”

Name: \_\_\_\_\_ Prenome: \_\_\_\_\_

MatrNr: \_\_\_\_\_ Field of study: \_\_\_\_\_

**Hints:** Using auxiliary resources is not allowed. Please, first read the questions and problems carefully. Working time is **30 minutes**. Good luck!

Problems	1	2	total
points achievable	15	15	30
points achieved			

### Problem 1:

15 points

Consider the language  $DW =_{\text{def}} \{ x\#x \mid x \in \{0,1\}^* \}$ . Note that  $\#$  is a separating symbol not belonging to the alphabet  $\{0,1\}$ .

Find resource bounds  $t : \mathbb{N} \rightarrow \mathbb{N}$ , as small as possible, such that  $DW \in \Phi(O(t))$ , where  $\Phi$  stands for the following complexity measures:

(a) T-DTIME

(b) 1-T-DTIME

(c) 2T-DTIME

(d) T-NTIME

(e) coT-NTIME

*Hint:* Think of  $\overline{DW} \in \text{T-NTIME}(t)$ .

**Problem 2: Relating space and time classes****15 points**

Relate the following complexity classes

$$\text{DTIME}(2^{O(\log n)}), \quad \text{NSPACE}(2^{O(\log n)}), \quad \text{DSPACE}(2^{O(\log n)})$$

$$\text{NTIME}(2^{O(\log n)}), \quad \text{coNSPACE}(\text{Pol } n), \quad \text{coNTIME}(\text{Pol } n)$$

with respect to set inclusion. That is, fill  $\subseteq$ ,  $=$ ,  $\supseteq$  in the box connecting the row containing class  $\mathcal{A}$  and the column containing  $\mathcal{B}$  iff  $\mathcal{A} \subseteq \mathcal{B}$ ,  $\mathcal{A} = \mathcal{B}$ ,  $\mathcal{A} \supseteq \mathcal{B}$ , respectively. Use X in case that you believe that  $\mathcal{A}$  and  $\mathcal{B}$  are incomparable.

	NSPACE( $2^{O(\log n)}$ )	DSPACE( $2^{O(\log n)}$ )	NTIME( $2^{O(\log n)}$ )	coNSPACE(Pol $n$ )	coNTIME(Pol $n$ )
DTIME( $2^{O(\log n)}$ )					
NSPACE( $2^{O(\log n)}$ )					
DSPACE( $2^{O(\log n)}$ )					
NTIME( $2^{O(\log n)}$ )					
coNSPACE(Pol $n$ )					

**Notes.** Please indicate the problem you are referring to.