TCS II – 2021/22
Formal Languages and Computability
2nd Midterm (B)

10. June 2022

Solve the assignments on your own.

Time limit is 75 minutes.

Good luck!

ASSIGNMENT	POINTS	OUT OF	ASSIGNMENT	POINTS	OUT OF
1			2		
3			4		

FIRST AND LAST NAME: _____

STUDENT ID: _____

SIGNITURE: _____

1. Assignment: (30 points)

Let's define the language:

$$L_1 \;=\; \left\{0^{n+1}(12)^n \mid n \geq 0\right\}$$

(a) Construct a TM for L_1. For the TM, write down the 7-tuple defining it!

(b) Using the Instantaneous descriptions (IDs), show how your TM accepts the input string 0001212.

2. Assignment: (25 points)

You are given the following context free grammar (CFG) G, $\Sigma = \{x, y, z\}$:

$$
\begin{aligned}
&S \to XYZ \mid YZ \\
&X \to yY \mid x \\
&Y \to y \mid X \\
&Z \to z \\
&W \to xX \mid yy
\end{aligned}
$$

(a) Turn this grammar into Chomsky Normal Form (CNF).

(b) Using the CYK algorithm, check if the word $xxyxz$ is in the language defined by grammar G.

3. Assignment: (20 points)

You are given the following 4 string pairs of a Modified Post Correspondence Problem ($MPCP$) – numbered from 1. to 4.:

1. (x, xy)
2. (xyz, z)
3. (zx, x)
4. (y, zx)

(a) Reduce the given $MPCP$ to a PCP.

(b) Find a solution to the given $MPCP$ and show how this solution reduces to the solution of the PCP.

4. Assignment: (25 points)

You are given the following Boolean (or logical) expression (A, B and C are boolean variables; $concatenation$, $+$ and $-$ represent the operations AND, OR and NOT, respectively):

$$AB + C$$

(a) Convert the given Boolean expression first to Conjunctive Normal Form (CNF) and then to 3–Conjunctive Normal Form (3–CNF) (if needed).

(b) Reduce this 3–SAT problem (from the previous conversion into 3–CNF) to the Vertex Cover (VC) problem – find a satisfying assignment to the 3-CNF and the vertex cover of the related graph.