Formal Languages and Automata Theory
SS2020
Exam, Variant 1
June 17th, 2020
Time Limit: 60 Minutes

Name: _____
Group: _____

This exam contains 4 questions. Total of points is 10.

Grade Table (for teacher use only)

Question	Points	Score
1	1	
2	4	
3	2	
4	3	
Total:	10	

Remarks:

- All subjects are mandatory.
- All the results must be accompanied with detailed solution.
- Carefully read and apply the instructions from the Exam assignment on Google Classroom.

1. (1 point) Write a regular expression to match phone numbers, with or without area codes. The phone numbers with area codes are of the form, for example (609) 555-1234. Those without are codes are of the form, for example 555-1234.

2. (4 points) **(a)** (0.5 points) Write a grammar of type 2 which constructs a palindrome from your first name. Example: From $Madalina$ one gets $MadalinaaniladaM$.

   (b) (0.25 points) Formally define a PDA. Explain each notation from the definition.

   (c) (0.5 points) What are the similarities and dissimilarities of a PDA and a FA? Use the definitions of the two automata in this comparison.

   (d) (1.25 point) Construct a PDA which accepts the palindrome generated by your first name and rejects any other string.

   (e) (2 points) How does the PDA work on the accepted string? Give 10 instantaneous descriptions and explain the type of acceptance.

3. (2 points) Let $\Sigma = \{a, b, ..., z\}$ and L the language of your first and last name.

   (a) (0.2 points) Write regular expressions for the first, respectively, the last name.

   (b) (0.8 points) From these regular expressions, construct the corresponding $\varepsilon-$NFA using the Thomson encoding. Apply also the Thomson encoding for constructing the $\varepsilon-$NFA for L.

   (c) (1 point)Using the eager construction algorithm, transform the $\varepsilon-$NFA into a DFA.

4. (3 points) **(a)** (0.10 + 0.10 points) What is an algorithm for DFA minimization doing and what are its benefits?

   (b) (0.10 + 0.70 points) Give example of such an algorithm and explain its steps.

(c) (2 points) Minimize the following DFA using the algorithm at (b). Explain all decisions and steps:

	0	1
$\rightarrow A$	B	E
B	C	F
$^*C$	D	H
D	E	H
E	F	I
$^*F$	G	B
G	H	B
H	I	C
$^*I$	A	E