MA0301 ELEMENTARY DISCRETE MATHEMATICS
NTNU, SPRING 2018

1. Homework Set 12

Exercise 1. (Grimaldi, 5. ed., Exercises 6.1, page 317) *Exercise 18 (Proof of Thm. 6.2 in G's book, i.e., Thms. IX. 8 of the course)*

Exercise 2. (Grimaldi, 5. ed., Exercises 6.1, page 317) *Exercise 1*

Exercise 3. (Grimaldi, 5. ed., Exercises 6.1, page 317) *Exercise 9*

Exercise 4. (Grimaldi, 5. ed., Exercises 6.1, page 317) *Exercise 12 d), e), f)*

Exercise 5. (Grimaldi, 5. ed., Exercises 6.2, page 324) *Exercise 5*

Exercise 6. (Grimaldi, 5. ed., Exercises 6.3, page 332) *Exercise 7 b), c)*

Exercise 7. *Let $\Sigma := \{a, b, c, d\}$ be an alphabet. Find regular languages corresponding to the following regular expressions. Note, if the set is infinite, then list the first ten elements.*

a) $a(b \vee c \vee d)a$

b) $a^*b^*c^*$

c) $a(bc)^*d$

Exercise 8. *Let $\Sigma := \{a, b, c, d\}$ be an alphabet. Find regular expressions that correspond to the following regular languages.*

a) $\{ab, ac, ad\}$

b) $\{ab, ac, bb, bc\}$

c) $\{a, ab, abb, abbb, abbb, \ldots\}$

Exercise 9. *Let $\Sigma := \{a, b, c\}$ be an alphabet.*

a) Give a regular expression for the language $L_1 \subset A^*$ where all elements have exactly two b's.

b) Give a regular expression for the language $L_2 \subset A^*$ where all elements have exactly two b's and two c's.

c) Give a regular expression for the language $L_3 \subset A^*$ where all elements have have one or more a's, followed by one or more b's and then one or more c's.

Exercise 10. *a) Draw the state diagram $D(M)$ of the automaton M with states $S := \{s_0, s_1, s_2\}$, accepting states $Y := \{s_1\}$, input alphabet $I := \{a, b\}$, described in the state table $T(M)$ on top of the next page.*

b) Write a regular expression for the language accepted by M.

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	ν	
	a	b
s_0	s_0	s_1
s_1	s_0	s_2
s_2	s_2	s_2

Exercise 11. *Find an automaton M that accepts the regular language given by the regular expression $(a^*(ba)^*bb^*a)^*$.*

2. Classroom Set 12

Exercise 12. (Grimaldi, 5. ed., Exercises 6.1, page 317) *Exercise 18 (Proof of Thm. 6.1 in G's book, i.e., Thms. IX. 11 of lecture 26)*

Exercise 13. (Grimaldi, 5. ed., Exercises 6.1, page 317) *Exercise 12 a), b), c)*

Exercise 14. (Grimaldi, 5. ed., Exercises 6.2, page 324) *Exercise 3*

Exercise 15. (Grimaldi, 5. ed., Exercises 6.3, page 332) *Exercise 7 a)*

Exercise 16. *Find regular languages corresponding to the following regular expressions. Note, if the set is infinite, then list the first ten elements.*

a) $(a \vee b)(c \vee d)$

b) $(ab^*\lambda) \vee (cd)^*$

Exercise 17. *Let $\Sigma := \{a, b, c, d\}$ be an alphabet. Find regular expressions that correspond to the following regular languages.*

a) $\{ab, abab, ababab, abababab, \ldots\}$

b) $\{ab, abb, aab, aabb\}$

Exercise 18. *Let $\Sigma := \{a, b, c\}$ be an alphabet.*

a) Give a regular expression for the language $L_1 \subset A^*$ where all elements have two or more b's.

b) Give a regular expression for the language $L_2 \subset A^*$ where all elements begin and end with a and contain at least one b and one c.

Exercise 19. *a) Draw the state diagram $D(M)$ of the automaton M with states $S := \{s_0, s_1, s_2\}$, accepting states $Y := \{s_0, s_2\}$, input alphabet $I := \{a, b\}$, described in the state table $T(M)$ on top of the next page.*

b) Which of the following input words are accepted by M?

1) abba

2) aabbb

3) babab

	ν	
	a	b
s_0	s_1	s_0
s_1	s_2	s_0
s_2	s_2	s_1

4) aaabbb

5) bbaab

Exercise 20. *a) Draw the state diagram $D(M)$ of the automaton M with states $S := \{s_0, s_1, s_2\}$, accepting states $Y := \{s_0\}$, input alphabet $I := \{a, b\}$, described in the state table $T(M)$:*

	ν	
	a	b
s_0	s_0	s_1
s_1	s_0	s_2
s_2	s_2	s_2

b) Write a regular expression for the language accepted by M.

Exercise 21. *Find an automaton M that accepts the regular language given by the regular expression $aa^*bb^*cc^*$.*