Assignment #2

Date Due: October 30, 2026

Total: 100 marks

We have the following languages, which are also computed in Assignment #1:
$L_1 = \{$the set of all strings over the alphabet $\{0,1,2\}$ that begin with 1010$\}$,
$L_2 = \{$the set of all strings over the alphabet $\{0,1,2\}$ that end with 01011$\}$,
$L_3 = \{$the set of all strings over the alphabet $\{0,1,2\}$ having 010 a a subword$\}$,
$L_4 = \{$the set of all strings over the alphabet $\{0,1,2\}$ having an odd number of 0's$\}$,
$L_5 = \{$the set of all strings over the alphabet $\{0,1,2\}$ having an even number of 1's$\}$,
$L_6 = \{$the set of all strings over the alphabet $\{0,1,2\}$ having the fifth symbol from the right end a 1$\}$,
$L_7 = \{$the set of all strings over the alphabet $\{0,1,2\}$ beginning with 22021$\}$,
$L_8 = \{$the set of all strings over the alphabet $\{0,1,2\}$ ending in 22021$\}$,
$L_9 = \{$the set of all strings over the alphabet $\{0,1,2\}$ having the number of 1's multiple of 6$\}$,
$L_10 = \{$the set of all strings over the alphabet $\{0,1,2\}$ having the number of 1's multiple of 5$\}$,
$L_{11} = \{$the set of all strings over the alphabet $\{a,b\}$ having the number of a's multiple of 7$\}$,
$L_{12} = \{$the set of all strings over the alphabet $\{a,b\}$ having the number of b's multiple of 5$\}$,
$L_{13} = \{$the set of all strings consisting of alternating groups of 12 and 02
(12 and 02 *alternates* at least once)$\}$,
and the following homomorphisms
$h : \{a,b\} \longrightarrow \{0,1,2\}^*$, $g : \{0,1,2\} \longrightarrow \{a,b\}^*$, $h(a) = 01$, $h(b) = 21$, $g(0) = a$, $g(1) = ba$. and

1. $L_{20} = L_1 \cap L_2$.
2. $L_{21} = 01011\Sigma^* \cap \Sigma^*1010$
3. $L_{22} = L_{13}$
4. $L_{23} = L_6$
5. $L_{24} = L_7 \cap L_8$
6. $L_{25} = L_{11} \setminus L_{12}$
7. $L_{26} = h^{-1}(L_4)$
8. $L_{27} = h^{-1}(L_1^R) \cap h^{-1}(L_5)$
9. $L_{28} = g(L_1^R)$

1. For each of the following languages give a regular expression generating them over the alphabet $\{0,1,2\}$ or $\{a,b,c\}$, depending on the description of the language:

(a) L_{20}
(b) L_{21}
(c) L_{22}
(d) L_{23}
(e) L_{24}
(f) L_{25}
(g) L_{26}
(h) L_{27}
(i) L_{28}

2. Write regular expressions for the following languages over the alphabet $\Sigma = \{0, 1, 2, 3, 5\}$:

   (a) the set of all strings beginning with a 1, 3 or 5, that, when the string is interpreted as an integer in base 9, is a multiple of 5 plus 2. For example:
   - strings 13,30,35,1333,1316,1613,513,563,55563 and 563635663 are in the language;
   - the strings 3,5,6, 135,136,20, 00, 022, 0020, 37 , 23, 5057, 223, 2325, 2375, 32222, 505, 22, 72, and 035 are not.

   (b) The set of all strings that ends with a 1, 3, or 5 and when the string is interpreted ***in reverse*** as an integer in base 9, is a multiple of 5 plus 2.
   - Examples of strings in the language are 31, 03, 53, 3331, 6131, 3161, 315, 365, 36555, and 36653636.
   - Examples of strings that are not in the language are: 3,5,6, 531,631,02, 00, 220, 0200, 73 , 32, 7505, 322, 5232, 5732, 22223, 505, 22, 27, and 530.

3. Consider the DFA with the following transition table:

		0	1
$\rightarrow$	$*$ 0	1	0
	1	2	1
	$*$ 2	3	2
	3	0	3

   (a) (10 marks) Find the equivalent regular expression using the algorithms learned in class.
   (b) (10 marks) Transform the regular expression into an ε-NFA
   (c) (10 marks) Transform the ε-NFA into a DFA.

4. Check your results with Grail+ and comment on the Grail+ experiments.

Marking Scheme: The marks for assignments are added together.

- 0 marks: no submission or plagiarism, or almost no correct solution.
- 1 mark: most exercises are started and some are correct.
- 2 marks: most exercises are started and the majority are correct.
- 3 marks: almost all exercises are started and almost all are correct