

MidtermMONDAY, 7 MARCH 2022
10:30–11:20 AM

There are 5 problems each worth 6 points for a total of 30 points. No notes, no collaboration. Please respect and uphold the integrity of the examination process. Sign the cover page to show agreement with these instructions.

Name: _____

Problem	Credit
1	
2	
3	
4	
5	
Total	

1. Give an DFA that accepts the language,

$$\{ s \in \{0, 1\}^* \mid s \text{ does not contain the substring } 101 \}$$

You must draw the diagram of the DFA, making sure to indicate the start and accept states and all necessary arrows.

Rubric:

- 0 points: not awarded.
- 1 point: not possible evaluate due to plentiful missing arrows, non-deterministic arrows, or with only 2 states.
- 2 points: feasible as an FA, language implemented completely wrong.
- 3 points: basic form of a correct implementation, but many errors.
- 4 points: one arrow needs displacing (and perhaps an obvious arrow added).
- 5 points: correct solution with one obvious missing arrow.
- 6 points: correct solution.

2. (a) Use the pumping lemma to show that the language

$$\{s \in \{0, 1\}^* \mid s = (01)^i(10)^i \text{ for } i \geq 0\}$$

is not regular.

Rubric:

- 0 points: nothing to evaluate
- 1 point: pumping lemma set up, however on a single case for y is considered
- 2 points: pumping lemma set up, and at least 2 cases for y are considered.
- 3 points: correct solution

- (b) Show that the language

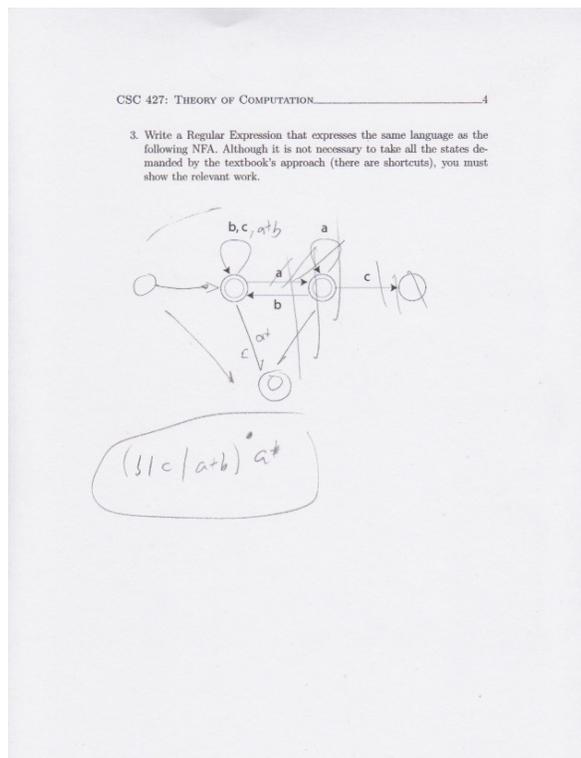
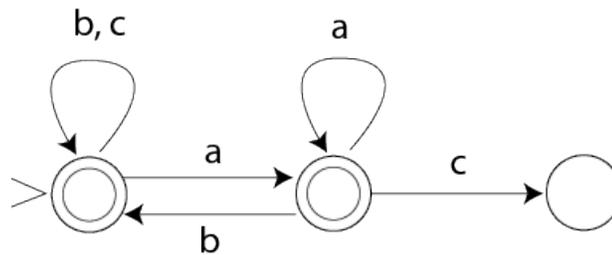
$$\{s \in \{0, 1\}^* \mid s = (01)^i(01)^i \text{ for } i \geq 0\}$$

is regular.

Rubric:

- 0 points: nothing to evaluate
- 1 point: attempting to prove by pumping lemma, no notice of 0101, other.
- 2 points: the idea is of a Regular type string but no implicit or explicit presentation of an RE or FA.
- 3 points: FA or RE given, not accepting ϵ is forgiven.

3. Write a Regular Expression that expresses the same language as the following NFA. Although it is not necessary to take all the states demanded by the textbook's approach (there are shortcuts), you must show the relevant work.



Rubrick, see pages following

MIDTERM CSC 427 222 PROBLEM 3 RUBRIC						
number right of a given length						grade
0	1	2	3	4	5	
0	0	0	3	18	80	1
0	1	1	6	25	98	
1	0	2	12	44	148	
0	0	1	7	29	105	
0	0	1	7	27	100	
0	0	2	7	27	100	
0	1	3	9	30	104	1
1	1	3	11	37	124	
1	0	3	7	31	105	
1	1	4	14	47	154	
1	1	4	9	32	105	
1	1	4	13	43	140	
0	1	5	17	52	156	
0	1	5	16	46	134	
1	3	5	11	32	106	
1	3	5	12	35	112	
1	3	5	12	34	109	2
1	3	7	21	65	201	
1	3	8	21	57	162	
1	3	8	22	63	186	
1	3	8	21	55	144	
1	3	8	20	52	145	
1	3	8	21	55	144	
1	3	8	20	52	145	
1	3	8	21	55	144	
1	3	8	21	57	162	
1	3	9	21	57	162	3
1	3	9	25	68	188	
1	3	9	26	74	211	6
1	3	9	27	81	243	
1	3	9	27	81	243	
1	3	9	27	81	243	total cases

4. Write a Context Free Grammar that expresses the same language as a Regular Expression,

$$0^*1^*0^*0$$

Rubric:

- 0 points if not a CFG (nothing to assess), or only a single rule for a single word
- 1 point finite language with more than 1 word after reduction, or does not terminate,
- 2 points, grade never assigned
- 3 points partial credit;
- 4 points, grade never assigned
- 5 points, correct with a small flaw
- 6 completely correct.

Some answers, in rough order of commonality,

- $S \rightarrow XYX0; X \rightarrow 0X \mid \epsilon; Y \rightarrow 1Y \mid \epsilon$
- $R \rightarrow X0; X \rightarrow 0X \mid X0 \mid Z \mid \epsilon; Z \rightarrow Z1 \mid \epsilon$
- $S \rightarrow 0S \mid X; X \rightarrow 1X \mid Y; Y \rightarrow 0Y \mid Z; Z \rightarrow 0$
- $S \rightarrow 0 \mid A; A \rightarrow 0A \mid B; B \rightarrow 1B \mid C; C \rightarrow 0C \mid 0$

5. (a) Check () the box if the operation is closed for the language class,

	Regular	Context Free
Union		
Concatenation		
Star		
Intersection		
Complement		

- (b) Are all Regular languages also Context Free languages?

Yes	No

- (c) Given a Context Free language and a Regular language, their intersection can be (check all that apply),

Regular	Context Free	neither

Rubric:

- (a) For each wrong box of the ten boxes,
- 3 points for no wrong boxes
 - 2 points for 1 or 2 wrong boxes
 - 1 point for 3, 4 or 5 wrong boxes
 - no points for 6 or more wrong boxes.
- (b) One point for completely correct, else no points.
- (c) The context free box must be checked; otherwise full credit only for fully correct answer.
- Two points for Regular and Context Free checked;
 - else one point of context free checked;
 - else no points