Fall 2024 COT 4210 Exam #1
September 10, 2024
Sheet 1

Last Name: _____ , First Name: _____

1) (10 pts) Design a DFA that accepts the following language over the alphabet, $\Sigma = \{0\}$:

L = { w | w is an even length palindrome of 4 or more symbols}. Please draw your DFA in full detail, clearly specifying all 5 parts of the 5-tuple that define a DFA.

2) (10 pts) Below is a formal definition of a DFA. Please draw the corresponding DFA diagram accurately and completely.

Q = { a, b, c, d, e } Σ = { $, ! } q_0 = c F = { b, e }

Delta =

	$	!
a	b	e
b	a	b
c	c	a
d	c	e
e	d	c

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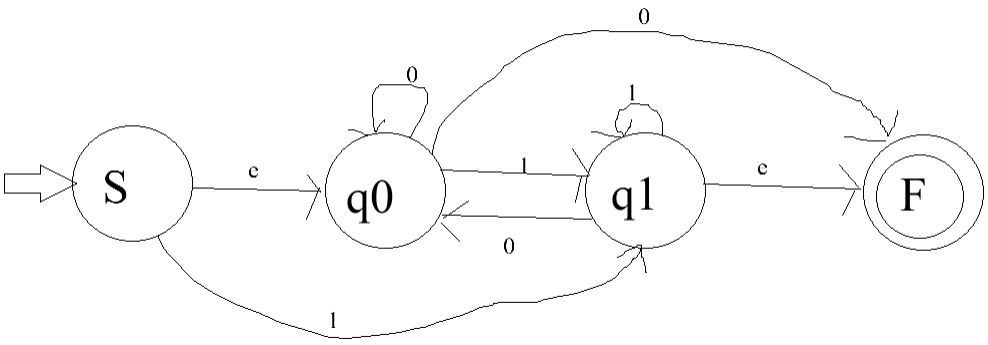
3) (10 pts) Design a regular expression for a language of strings over the alphabet $\Sigma = \{0, 1\}$, that has at most 3 occurrences of the symbol 1. Put a box clearly around your answer.

4) (20 pts) Consider the process of converting a DFA to a regular expression that expresses the same language. The initial DFA has states q0, q1 and q2. In the beginning of the process states S and F are added, with an epsilon transition from S to the start state of the DFA, q0, and epsilon transitions from the accept state(s) to F. Finally, F is denoted as the only accept state. After ripping out q2, the 4 state GNFA looks like what is shown on the next page.

Complete the process of determining the equivalent regular expression **by first ripping out q0, followed by ripping out q1.** (Note: credit will be taken off for ripping the states in the opposite order, so please follow these directions. Also, when you rip q0, there will be four transitions that need to be computed: S → F, S → q1, q1 → q1 and q1 → F.) Draw your 3 state GNFA and write down the corresponding regular expression from S → F after ripping out q1. Put a box around this regular expression (the final answer). **(Note: e in the drawing means epsilon, ε.)**


0
0
1
S
e
q0
1
q1
e
F
0
1

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5) (15 pts) Let A and B BOTH be regular languages over the alphabet $\Sigma = \{0, 1\}$. Prove, via construction, that A – B is also a regular language. Be as precise as possible in your description of the general construction. A concrete example is not necessary for full credit. (But if your description is vague an example may help clarify your description of the general case.)

6) (15 pts) Let $L = \{0^x1^y0^{x+y} \mid x, y > 0\}$, be a language defined over the alphabet $\Sigma = \{0, 1\}$. Prove, via the pumping lemma that L is not a regular language.

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7) (15 pts) The DFA below with states Q = {a, b, c, d, e} over the alphabet Σ = {0, 1} is defined below formally. Fill out the table below the formal description when running the DFA minimization algorithm on the DFA. Feel free to draw the DFA in the available space.

F = { a, e }, q_0 = a.

Delta =

	0	1
a	a	d
b	d	c
c	d	b
d	b	e
e	a	d

Drawing

State 1	State 2	Action Taken
a	e	
b	c	
b	d	
c	d	

Draw the final minimized DFA, putting the letters together for each merged state. For example, if a and b were to be merged, then make the resulting state name ab.

8) (5 pts) What kind of sweet treat does The Donut Patch serve? **Donuts**