Week 3 Monday Review Quiz

Student Name

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Q1 NFA and DFA

2 Points

True or False: The state diagram of any DFA is also the state diagram of a NFA.

- ○ True
- ○ False

True or False: The state diagram of any NFA is also the state diagram of a DFA.

- ○ True
- ○ False

True or False: The formal definition $(Q, \Sigma, \delta, q0, F)$ of any DFA is also the formal definition of a NFA.

- ○ True
- ○ False

True or False: The formal definition $(Q, \Sigma, \delta, q0, F)$ of any NFA is also the formal definition of a DFA

- ○ True
- ○ False

Save Answer

Q2 Working with a language

4 Points

Fix the alphabet $\Sigma = \{a, b\}$ for this whole question. Consider the language $\{w \in \Sigma^* \mid w \text{ has an } a \text{ and ends in } b\}$.

Q2.1

1 Point

Select all and only of the following strings of length 3 that are in this language.

- [ ] aaa
- [ ] aab
- [ ] aba
- [ ] abb
- [ ] baa
- [ ] bab
- [ ] bba
- [ ] bbb

Save Answer

Q2.2

1 Point

What are other ways of representing this language? (Select all and only correct choices)

- ☐ $\{w \in \Sigma^* \mid w \text{ has an } a\} \circ \{w \in \Sigma^* \mid w \text{ ends with } b\}$
- ☐ $\{w \in \Sigma^* \mid w \text{ has an } a\} \cup \{w \in \Sigma^* \mid w \text{ ends with } b\}$
- ☐ $\{w \in \Sigma^* \mid w \text{ has an } a\} \cap \{w \in \Sigma^* \mid w \text{ ends with } b\}$
- ☐ $\{w \in \Sigma^* \mid w \text{ has an } a\}^* \{w \in \Sigma^* \mid w \text{ ends with } b\}^*$

Save Answer

Q2.3

2 Points

What are other ways of representing this language? (Select all and only correct choices)

- ☐ $\{w \in \Sigma^* \mid w \text{ is not the empty string}\}$
- ☐ $\{w \in \Sigma^* \mid w \text{ has an } a \text{ or ends in } b\}$
- ☐ $\{w \in \Sigma^* \mid w \text{ has } ab \text{ as a substring}\}$
- ☐ $\{w \in \Sigma^* \mid w \text{ ends with } ab\}$
- ☐ $\{w \in \Sigma^* \mid w \text{ starts with } ab\}$
- ☐ None of the above

Save Answer

Q3 Construction for NFA

1 Point

In the formal construction of a NFA that recognizes the union of languages recognized by given NFA (in today's notes and also in Theorem 1.45 on page 59 of the book), we have this part of the definition of the transition function: $\delta(q_0, x) = \emptyset$ for $x \in \Sigma$. Why?

(Select the best description)

- ○ Because we have spontaneous moves from the start state of the new NFA for all possible inputs.
- ○ Because there are no non-spontaneous moves from the start state of the new NFA.

Save Answer

Q4 Construction for DFA

3 Points

In the formal construction of a DFA that recognizes the union of languages recognized by given DFA (in today's notes and also in Theorem 1.25 on page 45 of the book), the set of states is the Cartesian product of the sets of states of the two given DFAs.

Let Q_1 and Q_2 be the sets of states of the given DFA.
Let F_1 and F_2 be the sets of accepting states of the given DFA.

(Select all and only correct options)

- [ ] If we are constructing a DFA that recognizes the **union** of the languages recognized by the given DFA, the set of **accepting** states is $F_1 \times F_2$
- [ ] If we are constructing a DFA that recognizes the **union** of the languages recognized by the given DFA, the set of **accepting** states is $Q_1 \times Q_2$
- [ ] If we are constructing a DFA that recognizes the **union** of the languages recognized by the given DFA, the set of **accepting** states is $F_1 \cup F_2$
- [ ] If we are constructing a DFA that recognizes the **union** of the languages recognized by the given DFA, the set of **accepting** states is $Q_1 \cup Q_2$
- [ ] If we are constructing a DFA that recognizes the **union** of the languages recognized by the given DFA, the set of **accepting** states is $(Q_1 \times F_2) \cup (F_1 \times Q_2)$
- [ ] If we are constructing a DFA that recognizes the **intersection** of the languages recognized by the given DFA, the set of **accepting** states is $F_1 \times F_2$
- [ ] If we are constructing a DFA that recognizes the **intersection** of the languages recognized by the given DFA, the set of **accepting** states is $Q_1 \times Q_2$
- [ ] If we are constructing a DFA that recognizes the **intersection** of the languages recognized by the given DFA, the set of **accepting** states is $F_1 \cap F_2$
- [ ] If we are constructing a DFA that recognizes the **intersection** of the languages recognized by the given DFA, the set of **accepting** states is $Q_1 \cap Q_2$
- [ ] If we are constructing a DFA that recognizes the **intersection** of the languages recognized by the given DFA, the set of **accepting** states is $(Q_1 \times F_2) \cap (F_1 \times Q_2)$

Save Answer

Week 3 Wednesday Review Quiz

Q1 Set-wise concatenation

4 Points

For alphabet Σ, given languages L_1 and L_2 over Σ, the set-wise concatenation is defined as $L_1 \circ L_2 = \{w \in \Sigma^* \mid w = uv \text{ for some strings } u \in L_1 \text{ and } v \in L_2\}$

Q1.1

1 Point

Consider the alphabet $\{a, b\}$. How many strings are in the set $\{\varepsilon, a, b\} \circ \{\varepsilon, a, b\}$?

- ○ 0 (i.e.\ the set is empty)
- ○ 3
- ○ 6
- ○ 9
- ○ Some other (finite) number
- ○ Infinitely many unique strings

Save Answer

Q1.2

2 Points

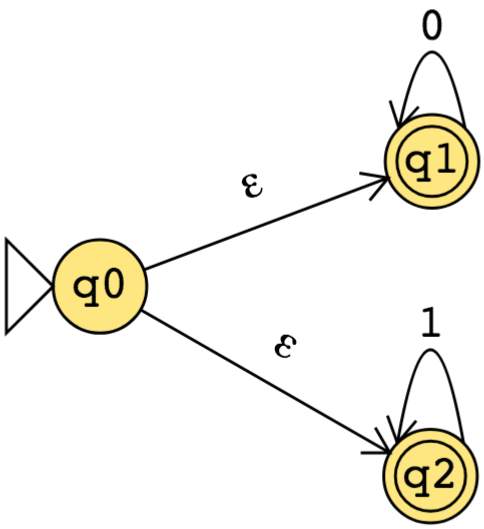
Let $N_1 = (Q_1, \Sigma, \delta_1, q_1, F_1)$ and $N_2 = (Q_2, \Sigma, \delta_2, q_2, F_2)$ be NFAs. When applying the construction in Theorem 1.47 to build the NFA $N = (Q, \Sigma, \delta, q_1, F_2)$ that recognizes $L(N_1) \circ L(N_2)$, select all and only the statements below that are universally true.

- ☐ $|Q| > |Q_1|$
- ☐ $|Q| > |Q_2|$
- ☐ $|Q| > 2$
- ☐ $|Q| = |Q_1| + |Q_2|$
- ☐ $|Q| = |Q_1| \cdot |Q_2|$

Save Answer

Q1.3
1 Point

The NFA whose state diagram below



is the result of applying the set-wise concatenation construction to obtain a machine that recognizes the language $\{w \in \{0,1\}^* | w \text{ has zeros followed by 1s}\}$

- True
- False, it is the result of applying the union construction instead to obtain the machine that recognizes the language $\{w \in \{0,1\}^* | w \text{ has all zeros or all 1s}\}$
- False, it is the result of applying the intersection construction instead to obtain the machine that recognizes the language $\{w \in \{0,1\}^* | w \text{ has all zeros and all 1s}\}$
- False, it is the result of applying the Kleene star construction instead to obtain the machine that recognizes the language $\{0,1\}^*$

Save Answer

Q2 Kleene star

2 Points

Q2.1

1 Point

Select all and only the languages below for which $L^* = L$.

- [ ] $\emptyset$
- [ ] $\{\varepsilon\}$
- [ ] $\{0\}$
- [ ] $\{0, 1\}$
- [ ] $\{0, 1\}^*$

Save Answer

Q2.2

1 Point

True or False: The construction from Theorem 1.49 for an NFA that recognizes L^* from an NFA that recognizes L always gives the smallest number of states required in an NFA that recognizes L^*.

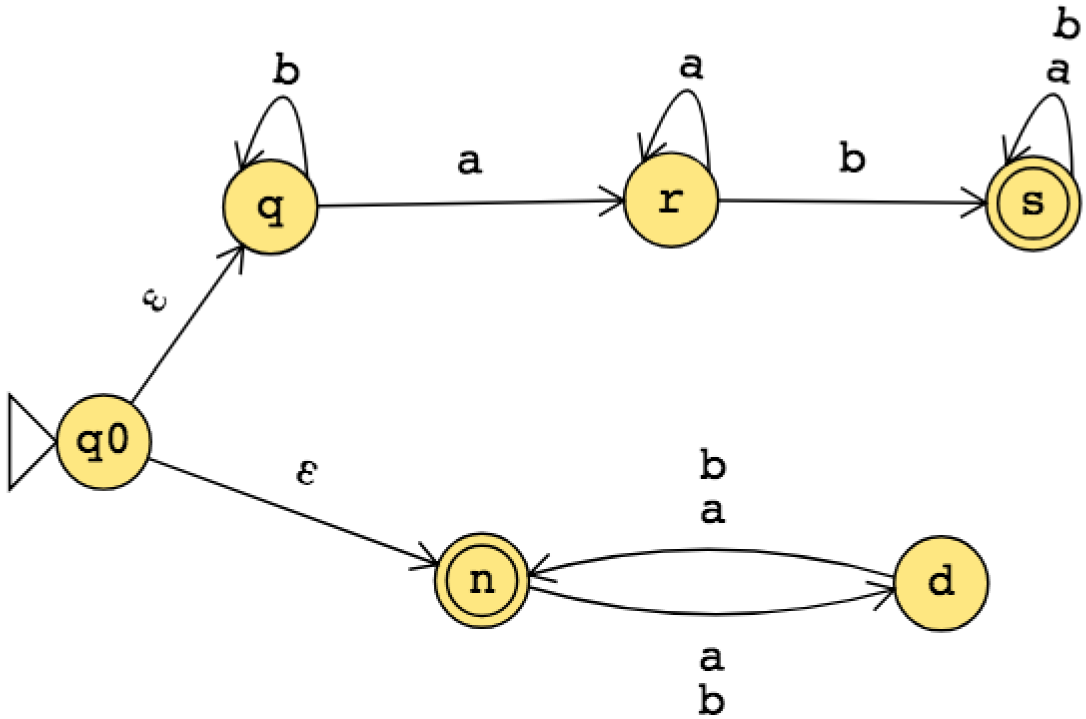
- ○ True
- ○ False

Save Answer

Q3 NFA to DFA

2 Points

Consider the following state diagram of a NFA over the alphabet $\{a, b\}$.



Answer the following questions about applying the construction for building an equivalent DFA from Theorem 1.39.

What is the start state of the equivalent DFA?

- ○ $q0$
- ○ $\{q0\}$
- ○ $\{q0, q, n\}$

What is the output of the transition function for the equivalent DFA from the start state on reading the character a?

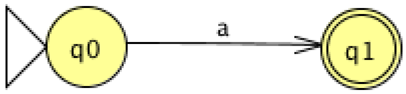
- ○ $\emptyset$
- ○ $\{q0\}$
- ○ $\{q\}$
- ○ $\{n\}$
- ○ $\{q, n\}$
- ○ $\{q, d\}$
- ○ $\{r, n\}$
- ○ $\{r, d\}$
- ○ None of the above, because DFA have a single state as the output of each transition function application, not a set of states.

Save Answer

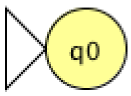
Q4 Regular expression to NFA

1 Point

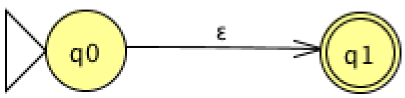
First diagram:



Second diagram:



Third diagram:



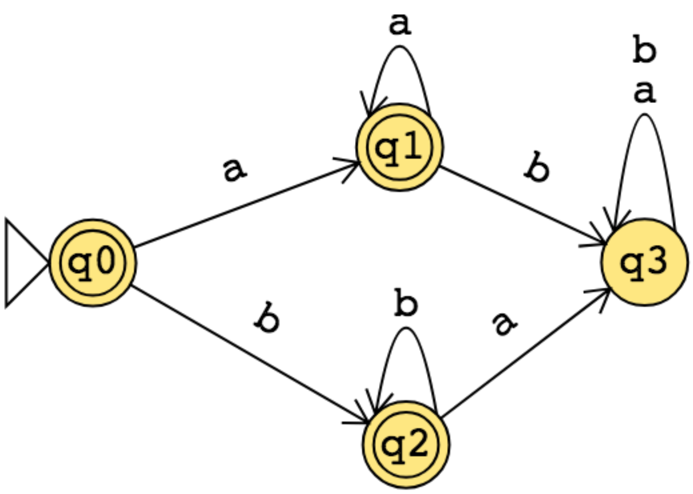
Which of the three diagrams above is a state diagram over the alphabet $\{a, b\}$ for a NFA that recognizes the language $L = \emptyset$?

- first diagram
- second diagram
- third diagram
- None of the above

Save Answer

Q5 DFA to regular expression

1 Point



Which of the following regular expressions describe the language recognized by the DFA with state diagram above? (Select all and only that apply.)

- [ ] $a^+ \cup b^+$
- [ ] $\varepsilon \cup aa^* \cup bb^*$
- [ ] $a^*a \cup b^*b \cup \varepsilon$
- [ ] $aa^*b(a \cup b)^* \cup bb^*a(a \cup b)^*$
- [ ] $a^+b(a \cup b)^* \cup b^+a(a \cup b)^*$

Save Answer

Q6 Feedback

0 Points

Any feedback about this week's material or comments you'd like to share? (Optional; not for credit)

Save Answer

Week 3 Friday Review Quiz

Q1 Cardinality of sets

2 Points

Which of the following sets are countably infinite? (select all that apply)

- ☐ The set of all languages over $\{0, 1\}$
- ☐ The set of all regular languages over $\{0, 1\}$
- ☐ The set of all strings over $\{0, 1\}$
- ☐ The set $\{0, 1\}$
- ☐ The set of all DFAs over $\{0, 1\}$ (whose states are labelled by integers)
- ☐ The set of all regular expressions over $\{0, 1\}$

Save Answer

Q2 True/ False

3 Points

True/ False: Every proper subset of a regular set is regular.

- ◯ True
- ◯ False

True/ False: Every proper subset of a nonregular set is nonregular.

- ◯ True
- ◯ False

True/ False: The complement of a regular set is regular.

- ◯ True
- ◯ False

True/False: The complement of a nonregular set is nonregular

- ◯ True
- ◯ False

True/ False: The union of any two regular sets is regular.

- ◯ True
- ◯ False

True/ False: The union of two nonregular sets is nonregular.

- ◯ True
- ◯ False

Save Answer

Q3 Pumping Lemma

2 Points

Select all and only true statements.

- [ ] All regular languages have pumping lengths.
- [ ] To prove that a language is regular, it's enough to show that it has a pumping length.
- [ ] To prove that a language is nonregular, it's enough to show that it does not have any pumping lengths.
- [ ] To prove that a specific positive integer is not a pumping length for a given language, we need to show that all strings are not "pumpable" relative to that length.
- [ ] To prove that a specific positive integer is not a pumping length for a given language, we need to show that all strings in that language that are longer than that number are not "pumpable" relative to that length.

Save Answer

Q4 Pumping length

3 Points

Definition A positive integer p is a *pumping length* of a language L over Σ means that, for each string $s \in \Sigma^*$, if $|s| \geq p$ and $s \in L$, then there are strings x, y, z such that $s = xyz$ and $|y| > 0$, for each $i \geq 0$, $xy^iz \in L$, and $|xy| \leq p$.

In particular, this means that a positive integer p is **not a pumping length** of a language L over Σ iff

$\exists s \left(|s| \geq p \wedge s \in L \wedge \forall x \forall y \forall z \left((s = xyz \wedge |y| > 0 \wedge |xy| \leq p \right) \rightarrow \exists i (i \geq 0 \wedge xy^iz \notin L)\right)$

True/ False: A pumping length for $A_1 = \{1, 01, 001, 0001, 00001\}$ is $p = 4$

- ◯ True
- ◯ False

True/ False: A pumping length for $A_2 = \{0^j 1 \mid j \geq 0\}$ is $p = 3$

- ◯ True
- ◯ False

True/ False: For any language A, if p is a pumping length for A and $p' > p$, then p' is also a pumping length for A.

- ◯ True
- ◯ False

Save Answer

Q5 Feedback

0 Points

Any feedback about this week's material or comments you'd like to share? (Optional; not for credit)

Save Answer