Week 7 Wednesday Review Quiz

Q1 Closure

2 Points

In class, we saw that (1) if two languages (over a fixed alphabet Σ) are Turing-decidable, then their union is as well and (2) if two languages (over a fixed alphabet Σ) are Turing-recognizable, then their union is as well.

Q1.1

1 Point

Is the same true for intersection?

- ☐ Yes, the class of Turing-recognizable languages is closed under intersection and the class of Turing-decidable languages is closed under intersection.
- ☐ No, the class of Turing-recognizable languages is closed under intersection but the class of Turing-decidable languages is not closed under intersection.
- ☐ No, the class of Turing-recognizable languages is not closed under intersection even though the class of Turing-decidable languages is closed under intersection.
- ☐ No, the class of Turing-recognizable languages is not closed under intersection and also the class of Turing-decidable languages is not closed under intersection.

Save Answer

Q1.2
1 Point

Is the same true for set-wise concatenation?

- [ ] Yes, the class of Turing-recognizable languages is closed under set-wise concatenation and the class of Turing-decidable languages is closed under set-wise concatenation.

- [ ] No, the class of Turing-recognizable languages is closed under set-wise concatenation but the class of Turing-decidable languages is not closed under set-wise concatenation.

- [ ] No, the class of Turing-recognizable languages is not closed under set-wise concatenation even though the class of Turing-decidable languages is closed under set-wise concatenation.

- [ ] No, the class of Turing-recognizable languages is not closed under set-wise concatenation and also the class of Turing-decidable languages is not closed under set-wise concatenation.

Save Answer

Q2 New Turing machines from old

4 Points

Consider the construction of a new Turing machine M from Turing machines M_1 and M_2.
$M =$ "On input w
1. Run M_1 on w
2. If it accepts, accept.
3. If it rejects, go to step 4.
4. Run M_2 on w
5. If it accepts, accept.
6. If it rejects, reject."

Consider the following possible counterexamples to this construction witnessing the closure of the class of recognizable languages under intersection.

Q2.1
2 Points

Example Turing machines M_1, M_2 and string w with M_1 rejecting w and M_2 accepting w.

- Not a counterexample
- Counterexample

Save Answer

Q2.2
2 Points

Example Turing machines M_1, M_2 and string w with M_1 looping on w and M_2 accepting w.

- Not a counterexample
- Counterexample

Save Answer

Q3 Construction

2 Points

Let M_1 and M_2 be Turing machines. Consider the following new Turing machine.

$M =$ "On input x

1. For $i = 0, 1, 2 \ldots$

2. If $x = 0^i$, accept.

3. Run M_1 on x for (at most) i steps

3a. If it accepts, accept.

3b. If it rejects or doesn't halt within the i steps, go to step 4.

4. Run M_2 on x for (at most) i steps

4a. If it accepts, accept.

4b. If it rejects or doesn't halt within the i steps, increment i and go back to step 2."

What is $L(M)$?

- $L(M_1) \cup L(M_2)$
- $L(0^*) \cup L(M_1) \cup L(M_2)$
- $L(0^*) \circ L(M_1) \cup L(0^*) \circ L(M_2)$
- None of the above

Save Answer

Q4 Languages and Turing machines
2 Points

Which of the following are languages? (Select all that apply)

- ☐ $\{ L \mid L \text{ is a language and } L \text{ is decidable } \}$
- ☐ $\{ M \mid M \text{ is a Turing machine and } L(M) \text{ is infinite } \}$
- ☐ $\{\langle M\rangle \mid M \text{ is a Turing machine and } L(M) \text{ is finite } \}$
- ☐ $\{\langle M, w\rangle \mid M \text{ is a Turing machine and } w \text{ is a string and } w \text{ is in } L(M) \}$
- ☐ $\{ w \mid w \text{ is accepted by } M_0\}$ (Assume that M_0 is some fixed Turing machine)

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

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Week 7 Friday Review Quiz

Q1 Type checking

2 Points

Consider the Turing machine described by the high-level description:

M = "On input $\langle D \rangle$, where D is a DFA over $\{0,1\}$,

1. If the number of states in D is less than 4, accept"

Q1.1

1 Point

Suppose x is a string that is *not* the encoding of any DFA D over $\{0,1\}$. What does the computation of M on x do?

- Stop the computation with an error
- Loop (never halt) the computation
- Halt and reject
- Halt and acccept

Save Answer

Q1.2

1 Point

What is $L(M)$?

- There's no such thing as $L(M)$ because M has inputs that are DFAs rather than strings.
- $\{\langle D \rangle \mid D \text{ is a DFA over } \{0,1\} \text{ and } |L(D)| < 4\}$
- $\{\langle D \rangle \mid D = (Q, \{0,1\}, \delta, q_0, F) \text{ is a DFA } \text{ and } |Q| < 4\}$
- $\{\langle D \rangle \mid D = (Q, \{0,1\}, \delta, q_0, F) \text{ is a DFA } \text{ and } |F| < 4\}$
- None of the above

Save Answer

Q2 More type checking

1 Point

Consider the Turing machine X, defined as follows:

"On input $\langle M, w\rangle$ where M is a Turing machine and w is a string: ...."
(where the ... are filled in with the steps of the algorithm).

What happens if we run X on input string x, where x is not of the form $\langle M, w\rangle$ for any Turing machine M or string w?

- The computation of X on x gets stuck and does not proceed to step 1.
- The computation of X on x implicitly type checks x and rejects.
- The computation of X on x defaults to accept the string when it's not of the declared type.
- The computation of X on x runs all possible computations of X on input $\langle M, w\rangle$ for any TM M.
- It depends on whether the Turing machine M halts/loops on w, where \$x= \langle M,w \rangle\$\$.

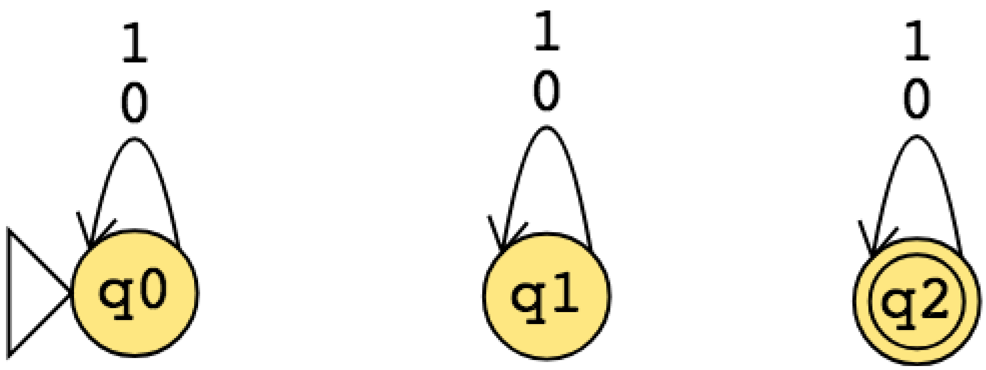
Save Answer

Q3 Computational problems

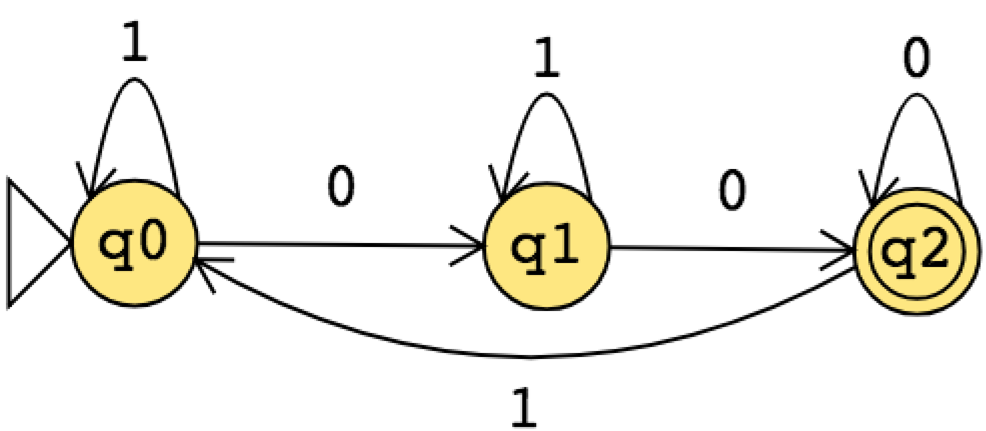
3 Points

Consider the following three DFA over the alphabet $\{0, 1\}$, whose state diagrams are below.

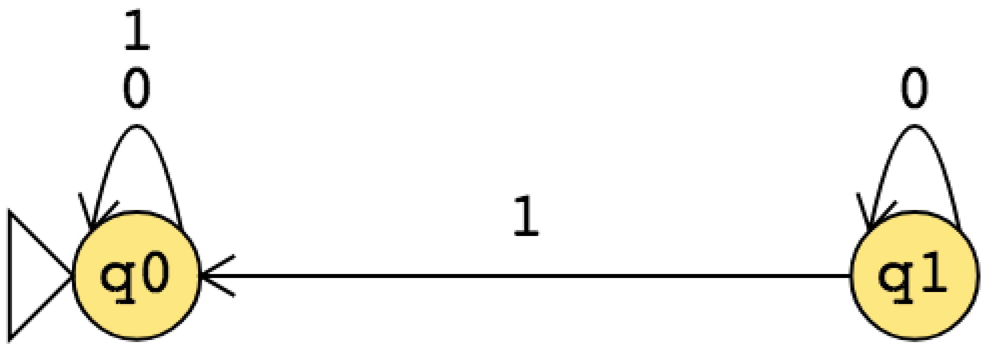
A1



A2



A3



Select all and only true statements below.

- [ ] $\langle A1 \rangle \in A_{DFA}$
- [ ] $\langle A1 \rangle \in E_{DFA}$
- [ ] $\langle A1 \rangle \in EQ_{DFA}$
- [ ] $\langle A2, 0 \rangle \in A_{DFA}$
- [ ] $\langle A2, 00 \rangle \in E_{DFA}$
- [ ] $\langle A2, 00 \rangle \in EQ_{DFA}$
- [ ] $\langle A3, A1 \rangle \in A_{DFA}$
- [ ] $\langle A3, A2 \rangle \in E_{DFA}$
- [ ] $\langle A3, A3 \rangle \in EQ_{DFA}$

Save Answer

Q4 Acceptance problems

2 Points

Select all and only the acceptance problems below that are decidable.

- [ ] The acceptance problem for DFA, A_{DFA}
- [ ] The acceptance problem for NFA, A_{NFA}
- [ ] The acceptance problem for regular expressions, A_{REX}
- [ ] The acceptance problem for PDA, A_{PDA}
- [ ] The acceptance problem for CFG, A_{CFG}

Save Answer

Q5 Emptiness problems

2 Points

Select all and only the emptiness problems below that are decidable.

- [ ] The emptiness problem for DFA, E_{DFA}
- [ ] The emptiness problem for NFA, E_{NFA}
- [ ] The emptiness problem for regular expressions, E_{REX}

Save Answer

Q6 Feedback

0 Points

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

Save Answer