CS 3350 Automata, Computability, and Formal Languages Fall 2018, Test 1

Last 4 digits of your UTEP ID number: _ ____________________

General comments:

- you are allowed up to 5 pages of handwritten notes;
- if you need extra pages, place the last 4 digits of ID number on each extra page;
- the main goal of most questions is to show that you know the corresponding algorithms; so, if you are running of time, just follow the few first steps of the corresponding algorithm;
- each question will be graded on its own merit; so, for example, if when answering to the first part of the question, you got a wrong automaton, but on the second part, you correctly traced the new automaton, you will get full credit for the second part.

Good luck!

1-4. In class, we studied an automaton for recognizing valid Java identifies. This automaton has 3 states: start (s), identifier (i), and error (e). Start is the starting state, identifier is the only final state. The transitions are as follows:

- from s, any letter (a, ..., z, A, ..., Z) leads to i, any other symbol leads to e;
- from i, any letter, any digit (0, ..., 9), or an underscore symbol _ lead back to i, while any other symbol leads to e;
- from e, every symbol leads to e.

1. Is any of the three states a sink state? Explain your answer.

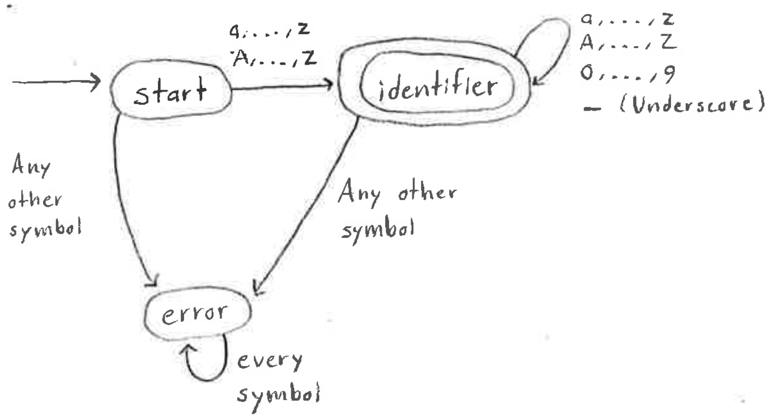
2-3. Trace, step-by-step, how this finite automaton will check whether the following two words (sequences of symbols) represent a valid Java identifier:

- the word number2 (which this automaton should accept) and
- the word 2ndNumber (which this automaton should reject).

4. Write down the tuple <Q, Σ, δ, q_0, F> corresponding to this automaton:

- Q is the set of all the states,
- Σ is the alphabet, i.e., the set of all the symbols that this automaton can encounter;
- $\delta: Q \times \Sigma \to Q$ is the function that describes, for each state q and for each symbol s, the state $\delta(q, s)$ to which the automaton that was originally in the state q moves when it sees the symbol s (you do not need to describe all possible transitions this way, just describe two of them);
- q_0 is the staring state, and
- F is the set of all final states.

1-4.



. Yes. The error (e) state is a sink state because any symbol would lead back to e, meaning that it is impossible to leave or move from this state.

-3. • number 2

| n | u | m | b | e | r | 2 |
s i i i i i i (i)

• 2nd Number

| 2 | n | d | N | u | m | b | e | r |
st e e e e e e e e e

1. $Q = \{ start, identifier, error \}$

$\Sigma = \{ a, \ldots, z, A, \ldots, Z, 0, \ldots, 9, \text{any other symbol} \}$

$\delta(start, a) = identifier$

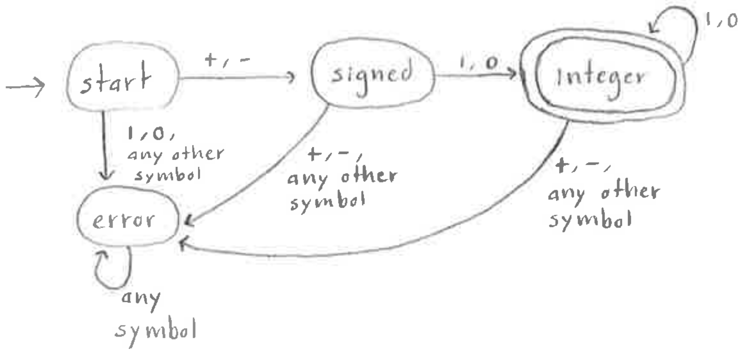
$\delta(start, +) = error$

$q_0 = start$

$F = \{ identifier \}$

10/10

5. Draw an automaton for recognizing all possible binary signed integers. Trace this automaton on the example of numbers +10 (that it should accept), −10 (also accepted), and 10 (should be rejected).



- +10

| + | 1 | 0 |
st si i (i)

- −10

| − | 1 | 0 |
st si i (i)

- 10

| 1 | 0 |
st e e

6-8. Let A be an automaton described in Problem 1. Let B be the following automaton that accepts all the strings that contain only letters but not any other symbols. This automaton has two states: the start state which is also a final state, and the sink state. The transitions are as follows:

- from the start state, any letter leads back to the start state, every other symbol leads to sink;
- from the sink state, any symbol leads back to sink.

10/10

6. Use the algorithm that we had in class to describe the following two new automata:

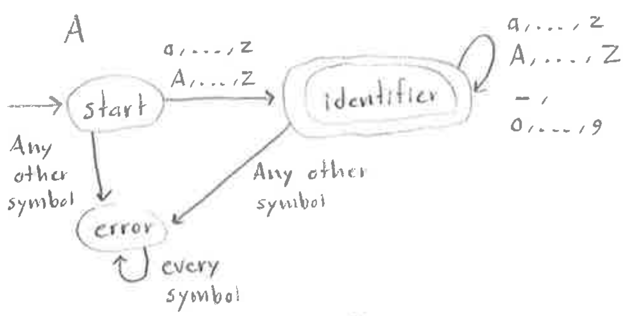
- the automaton that recognizes the union A U B of the two corresponding languages, and
- the automaton that recognizes the intersection of the languages A and B.

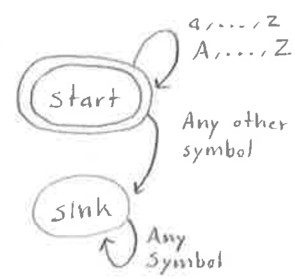
20/20

7-8. Test these two new automata step-by-step on the following words:

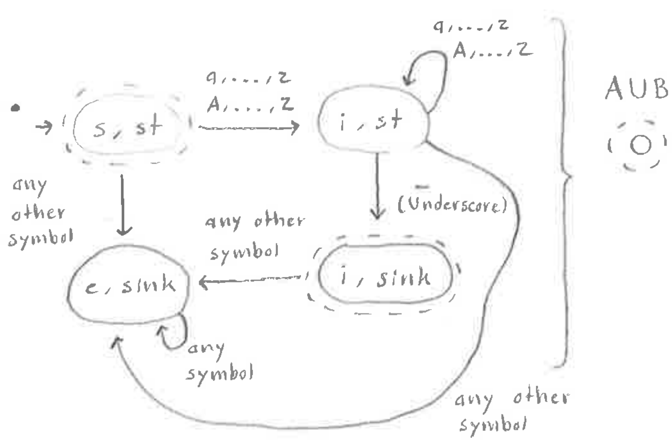
- test the union automaton on the example of the words Var (that it should accept) and 2words (that it should reject);
- test the intersection automaton on the example of the words Var (that it should accept) and Var2 (that it should reject).

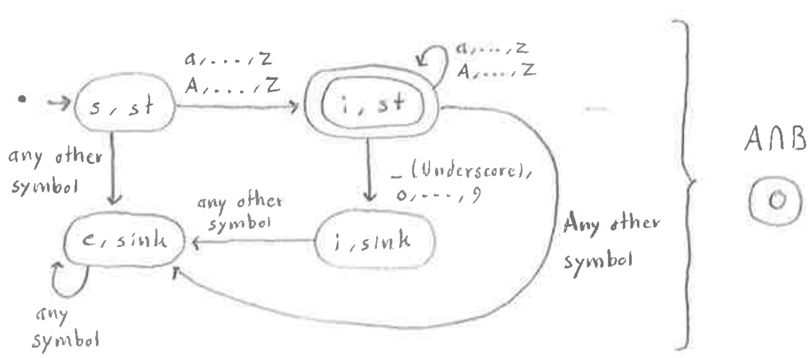
6-8.





6.





7 - 8.

- Var

| V | a | r |

s,st i,st i,st i,st

2 words

| 2 | w | o | r | d | s |

s,st e,sink e,sink e,sink e,sink e,sink e,sink

- Var

| V | a | r |

s,st i,st i,st i,st

Var 2

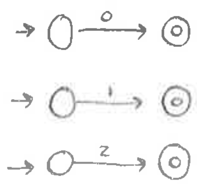
| V | a | r | 2 |

s,st i,st i,st i,st i,sink

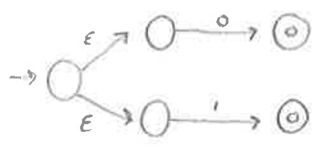
20/20

9-10. Use the general algorithm that we learned in class to design a non-deterministic finite automaton that recognizes the language (0 U 1)(1 U 2):

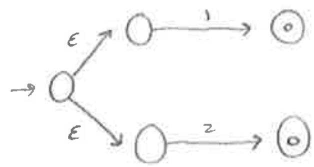
- first, describe the automata for recognizing 0, 1, and 2;
- then, combine them into the automata for recognizing the unions 0 U 1 and 1 U 2;
- finally, combine the two union automata into an automaton for recognizing the composition (0 U 1)(1 U 2) of the two union languages.



- 0 U 1



1 U 2



- (0U1)(1U2)