Name: _____
Score: _____ / _____

Midterm 1

Part 1

Study of abstract computing devices or machines is known as

- A. Computing
- B. Machine learning
- C. Automata theory
- D. Formal theory

Answer Point Value: 1.0 points
Answer Key: C

A language is a collection of sentences of finite length all constructed from a finite alphabet of symbols:

- True
- False

Answer Point Value: 1.0 points
Answer Key: True

A containment hierarchy of classes of formal languages is known as:

- A. Turing Machine
- B. Chomsky hierarchy
- C. DFA
- D. NFA

Answer Point Value: 1.0 points
Answer Key: B

We use the symbol ∑ (sigma) to denote an alphabet:

- True
- False

Answer Point Value: 1.0 points
Answer Key: True

An alphabet is not a finite set of symbols:

- True
- False

Answer Point Value: 1.0 points
Answer Key: False

Empty string is represented by:

- A. ∑ (sigma)
- B. δ (delta)
- C. ε (epsilon)
- D. α (alpha)

Answer Point Value: 1.0 points
Answer Key: C

“ If $y \geq 4$, then $2^y \geq y^2$ ” is an example of what type of proof:

- A. dumb
- B. deductive
- C. definitive
- D. decisive

Answer Point Value: 1.0 points
Answer Key: B

An intermediate result that we show to prove a larger result is known as:

- A. proof
- B. lemma
- C. corollary
- D. theorem

Answer Point Value: 1.0 points
Answer Key: B

The machine that can exist in only one state at any given time is known as:

- A. DFA
- B. NFA
- C. Turing machine
- D. Chomsky heirarchy

Answer Point Value: 1.0 points
Answer Key: A

The machine that can exist in multiple state at any given time is known as:

- A. chomsky hierarchy
- B. turing machine
- C. NFA
- D. DFA

Answer Point Value: 1.0 points
Answer Key: C

A DFA is defined by 3-tuple:

- True
- False

Answer Point Value: 1.0 points
Answer Key: False

String 00110010 will be accepted by a DFA that accepts?

- A. Only 0s
- B. 1100 as substring
- C. only 1s
- D. 1010 as substring

Answer Point Value: 1.0 points
Answer Key: B

String 00110100 will be accepted by a DFA that accepts?

- A. Only 0s
- B. only 1s
- C. 1010 as substring
- D. 1100 as substring

Answer Point Value: 1.0 points
Answer Key: C

A DFA that accepts only even number of 1s and 0s will accept which of these strings?

- A. 00000100
- B. 11111000
- C. 1010101
- D. 11000011

Answer Point Value: 1.0 points
Answer Key: D

A DFA that accepts any string that ends with 10 will accept which of these strings?

- A. 11000011
- B. 1010101
- C. 11111000
- D. 00000010

Answer Point Value: 1.0 points
Answer Key: D

Regular expressions are more like program syntax:

- True
- False

Answer Point Value: 1.0 points
Answer Key: True

L U M = all strings that are either in L or M:

- True
- False

Answer Point Value: 1.0 points
Answer Key: True

L = { w | w is a binary string which does not contain two consecutive 0s or two consecutive 1s anywhere}. What is the regular expression for this language?

- A. (01)* + (10)* + 0(10)* + 1(01)*
- B. (01)* + (10)* + 0(10)*
- C. (10)* + 0(10)* + 1(01)*
- D. (01)* + 10(10)* + 1(01)*

Answer Point Value: 1.0 points
Answer Key: A

If we introduce ε then the regular expression n(01)* + (10)* + 0(10)* + 1(01)* can be simplified to (ε +1)(01)*(ε +0)

- True
- False

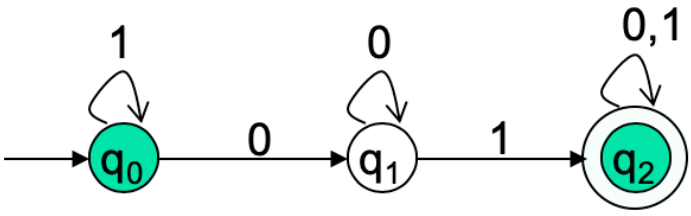
Answer Point Value: 1.0 points
Answer Key: True

True or False:
(RS + R)* RS = (RR*S)*

- True
- False

Answer Point Value: 1.0 points
Answer Key: False

What is the regular expression for this DFA?



- A. 1*00*1(0+1)*
- B. 1*01*1(01)*
- C. 0*10*1(01)*
- D. 00*1(0+1)*

Answer Point Value: 1.0 points
Answer Key: A

If we are able to construct one of the following: DFA *or* NFA *or* e -NFA *or* regular expression then the language is called:

- A. Regular
- B. Npt regular
- C. Complex
- D. Simple

Answer Point Value: 1.0 points
Answer Key: A

A technique that is used to show that a given language is not regular is known as:

- A. Dilemma
- B. DFA
- C. Pumping Lemma
- D. Regular expression

Answer Point Value: 1.0 points
Answer Key: C

Regular languages are regular under reunion.

- True
- False

Answer Point Value: 1.0 points
Answer Key: False

How to minimize a DFA?

- A. Identify reachable states.
- B. Identify empty states
- C. Not possible
- D. Remove unreachable states and Identify &condense equivalent states into one

Answer Point Value: 1.0 points
Answer Key: D

How to perform emptiness test on a language L? Provide steps.

Answer Point Value: 5.0 points
Model Short Answer:

nDecision Problem: Is L=Ø ?

nApproach:

On a DFA for L:

1.From the start state, run a *reachability* test, which returns:

1.success: if there is at least one final state that is reachable from the start state

2.failure: otherwise

2.L=Ø if and only if the reachability test fails

What are the steps to decide membership question? i.e. Given L, is w in L?

Answer Point Value: 5.0 points
Model Short Answer: 1. Build a DFA for L
2. Input w to the DFA
3. If the DFA ends in an accepting state, then yes; otherwise no.

What are the steps for finiteness question? i.e. Is L finite or infinite?

Answer Point Value: 5.0 points
Model Short Answer: Approach 1:
On a DFA for L:
a. Remove all states unreachable from the start state
b. Remove all states that cannot lead to any accepting state.
c. After removal, check for cycles in the resulting FA
d. L is finite if there are no cycles; otherwise it is infinite
Approach 2:
Build a regular expression and look for Kleene closure

Either answer is correct.

How to minimize a DFA? Only provide steps / algorithm.

Answer Point Value: 5.0 points
Model Short Answer: 1. Eliminate states unreachable from the start state
2. Identify and remove equivalent states
3. Output the resultant DFA

How to decide if two DFAs are equivalent? Provide steps.

Answer Point Value: 5.0 points
Model Short Answer: 1. Make a new dummy DFA by just putting together both DFAs.
2. Run table-filling algorithm on the unified DFA.
3. IF the start states of both DFAs are found to be equivalent,
THEN:DFA1≡ DFA2
ELSE:different