

Feedback — Final Exam

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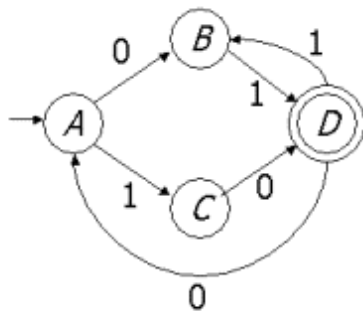
You submitted this exam on **Sun 8 Nov 2015 9:50 PM CET**. You got a score of **107.00** out of **164.00**.

Things to bear in mind:

1. There is no penalty for a wrong answer, so guessing is harmless (compared with leaving a question unanswered).
2. All multiple-choice questions (radio buttons) count 5 points.
3. All check-box questions are 1 point per box, or two points per box if the question indicates.
4. You must submit within 3 hours of downloading the exam.

Question 1

Examine the following DFA:

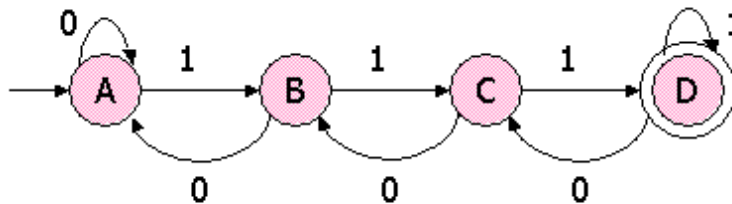


If the input is 1000101000, which edge of the automaton is NOT traversed?

Your Answer	Score	Explanation
<input type="radio"/> $D \rightarrow A$		
<input type="radio"/> $C \rightarrow D$		
<input type="radio"/> $B \rightarrow D$		
<input checked="" type="radio"/> $D \rightarrow B$	✓ 5.00	
Total	5.00 / 5.00	

Question 2

Examine the following DFA:

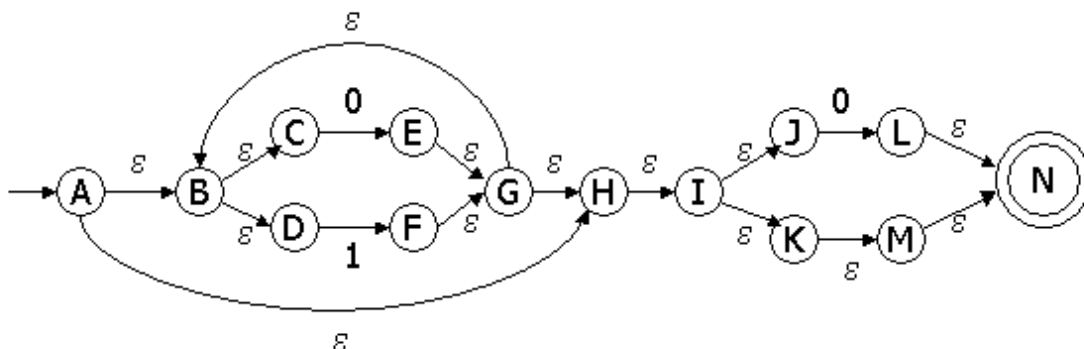


If string s is accepted by this DFA, which of the following strings **cannot** be a suffix of s ?

Your Answer	Score	Explanation
<input type="radio"/> 011		
<input type="radio"/> 10011		
<input type="radio"/> 1010101		
<input checked="" type="radio"/> 100011	5.00	✓
Total	5.00 / 5.00	

Question 3

Here is an epsilon-NFA:



State N is NOT in the epsilon-closure of which of the following states?

Your Answer	Score	Explanation
-------------	-------	-------------

☐ E

☐ A

☐ B

☒ K ✖ 0.00

Total 0.00 / 5.00

Question 4

Three of the following four regular expressions define the same language. Select the one that defines a language DIFFERENT from the language of the other three.

Your Answer	Score	Explanation
<input type="radio"/> $(00^*11^*)^+$		
<input checked="" type="radio"/> $(01^*)^*1$	✓ 5.00	
<input type="radio"/> $0(0+1)^*1$		
<input type="radio"/> $(01^*)^*011^*$		
Total	5.00 / 5.00	

Question 5

Which of the following strings is NOT in the Kleene star of the language {011, 10, 110}?

Your Answer	Score	Explanation
<input type="radio"/> 0111010		
<input checked="" type="radio"/> 10011101	✓ 5.00	
<input type="radio"/> 1101010		
<input type="radio"/> 01111010		
Total	5.00 / 5.00	

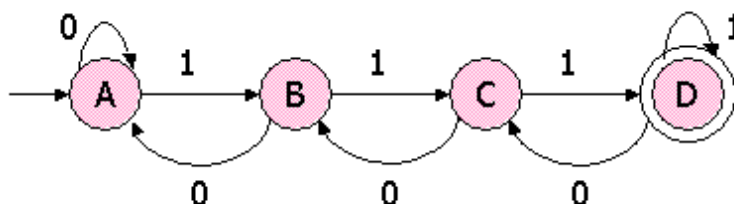
Question 6

Check all and only the languages that are regular.

Your Answer	Score	Explanation
<input type="checkbox"/> $\{0^n 10^n n \geq 0\}$	✓ 1.00	
<input checked="" type="checkbox"/> $\{10^n 1 n \text{ leaves a remainder of 1 when divided by 7 and leaves a remainder of 4 when divided by 17}\}$	✓ 1.00	
<input type="checkbox"/> $\{10^n 0^n n \geq 0\}$	✗ 0.00	
<input checked="" type="checkbox"/> $\{0^m 0^n 1 n \geq m \geq 0\}$	✓ 1.00	
Total	3.00 / 4.00	

Question 7

Converting a DFA such as the following:



to a regular expression requires us to develop regular expressions for limited sets of paths --

- those that take the automaton from one particular state to another particular state, without passing through some set of states. For the automaton above, determine the language for the following limitations:

L_{AB} = the set of path labels that go from A to B without passing through C or D.

Which of the following gives a regular expression for L_{AB} ?

Your Answer	Score	Explanation
<input type="radio"/> $L_{AB} = (0+10)^*$		
<input type="radio"/> $L_{AB} = 0(0+10)^*$		

☒ $L_{AB} = 0^*1(00^*1)^*$

✓5.00

☐ $L_{AB} = 0^*1(01+10)^*$

Total

5.00 / 5.00

Question 8

Here is the transition table of a DFA that we shall call *M*:

	0	1
→A	B	G
B	C	H
*C	D	G
*D	A	H
E	F	C
F	G	I
*G	H	C
*H	A	D
I	E	I

Find the minimum-state DFA equivalent to the above. States in the minimum-state DFA are each the merger of some of the states of *M*. In the list below, check each set of states of *M* that forms one state of the minimum-state DFA.

Your Answer		Score	Explanation
<input checked="" type="checkbox"/> {A,E}	✗	0.00	
<input type="checkbox"/> {G,H}	✓	1.00	
<input type="checkbox"/> {C,G}	✗	0.00	
<input type="checkbox"/> {D,H,I}	✓	1.00	
<input checked="" type="checkbox"/> {A}	✓	1.00	
<input type="checkbox"/> {D,H}	✗	0.00	
Total		3.00 / 6.00	

Question 9

If L is a language, and a is a symbol, then $\frac{d}{da} L$, the derivative of L with respect to a , is the set of strings w such that aw is in L . More formally: $\frac{d}{da} L = \{w \mid aw \text{ is in } L\}$. Suppose L is regular, which of the following statements is true?

Your Answer	Score	Explanation
<input checked="" type="radio"/> $\frac{d}{da} L$ is always a regular language.	✓ 5.00	
<input type="radio"/> $\frac{d}{da} L$ is never a regular language.		
<input type="radio"/> $\frac{d}{da} L$ is sometimes not regular, but is always context free.		
<input type="radio"/> $\frac{d}{da} L$ is sometimes not context-free.		
Total	5.00 / 5.00	

Question 10

Which of the following pairs of grammars define the same language?

Your Answer	Score	Explanation
<input type="radio"/> $G_1: S \rightarrow aS aa$ $G_2: S \rightarrow Sa a$		
<input checked="" type="radio"/> $G_1: S \rightarrow Sa a$ $G_2: S \rightarrow SS aa a$	✓ 5.00	
<input type="radio"/> $G_1: S \rightarrow aS aa$ $G_2: S \rightarrow SS aa a$		
Total	5.00 / 5.00	

Question 11

In this question, each checkbox is worth 2 points.

Here is a context-free grammar G:

S → AB
A → 0A1 | 2
B → 1B | 3A

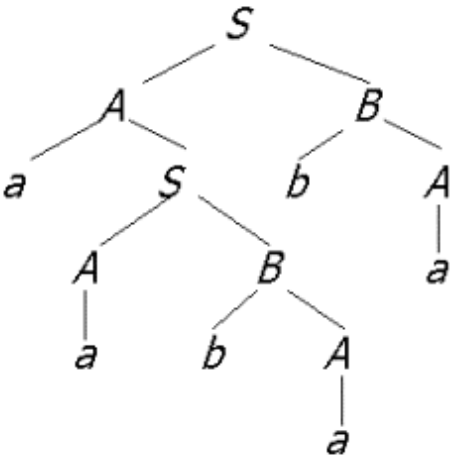
Which of the following strings are in L(G)? (Check all that are.)

Your Answer		Score	Explanation
<input type="checkbox"/> 002111021	✓	2.00	
<input checked="" type="checkbox"/> 021111300211	✓	2.00	
<input type="checkbox"/> 021113002111	✓	2.00	
<input checked="" type="checkbox"/> 2132	✓	2.00	
Total		8.00 / 8.00	

Question 12

In this question, each checkbox is worth one point.

Below is a parse tree for the grammar $S \rightarrow AB, A \rightarrow aS|a, B \rightarrow bA$.



Determine the rightmost derivation corresponding to this parse tree. Then check all and only

the boxes for right-sentential forms corresponding to this derivation?

Your Answer		Score	Explanation
<input type="checkbox"/> abaAba	✓	1.00	
<input type="checkbox"/> aabAba	✓	1.00	
<input type="checkbox"/> aABba	✗	0.00	
<input checked="" type="checkbox"/> AbA	✓	1.00	
<input checked="" type="checkbox"/> aAbAba	✓	1.00	
<input checked="" type="checkbox"/> aSba	✓	1.00	
<input checked="" type="checkbox"/> aababa	✓	1.00	
<input type="checkbox"/> aaBba	✓	1.00	
Total		7.00 / 8.00	

Question 13

In this question, each checkbox is worth 2 points.

The grammar G:

$$S \rightarrow SS \mid a \mid b$$

is ambiguous. That means at least some of the strings in its language have more than one leftmost derivation. However, it may be that some strings in the language have only one derivation. Check all and only the strings that have **exactly two** leftmost derivations in G.

Your Answer		Score	Explanation
<input checked="" type="checkbox"/> bbb	✓	2.00	
<input checked="" type="checkbox"/> aabb	✗	0.00	
<input type="checkbox"/> ab	✓	2.00	
Total		4.00 / 6.00	

Question 14

A *unit pair* (X,Y) for a context-free grammar is a pair where:

- 1. X and Y are variables of the grammar.
- 2. There is a derivation $X \Rightarrow^* Y$ that uses only unit productions (productions with a body that consists of exactly one occurrence of some variable, and nothing else).

For the following grammar:

```
S → A | B | 2
A → C0 | D
B → C1 | E
C → D | E | 3
D → E0 | S
E → D1 | S
```

Identify all the unit pairs. Then, select from the list below all pairs that are **NOT** unit pairs.

Your Answer		Score	Explanation
<input checked="" type="checkbox"/> (A,B)	✗	0.00	
<input type="checkbox"/> (C,S)	✓	1.00	
<input checked="" type="checkbox"/> (S,C)	✓	1.00	
<input checked="" type="checkbox"/> (D,C)	✓	1.00	
<input checked="" type="checkbox"/> (E,C)	✓	1.00	
<input type="checkbox"/> (C,D)	✓	1.00	
<input checked="" type="checkbox"/> (A,C)	✓	1.00	
<input checked="" type="checkbox"/> (B,C)	✓	1.00	
Total		7.00 / 8.00	

Question 15

Suppose we execute the Chomsky-normal-form conversion algorithm. Let $A \rightarrow BC0DE$ be one of the productions of the given grammar, which has already been freed of ϵ -productions and unit productions. Suppose that in our construction, we introduce new variable X_a to derive a terminal a ,

and when we need to split the right side of a production, we use new variables Y_1, Y_2, \dots

What productions would replace $A \rightarrow BC0DE$? Identify these replacing productions from the list below.

Your Answer		Score	Explanation
<input checked="" type="checkbox"/> $Y_2 \rightarrow X_0Y_3$	✓	1.00	
<input checked="" type="checkbox"/> $A \rightarrow BY_1$	✓	1.00	
<input checked="" type="checkbox"/> $Y_3 \rightarrow DE$	✓	1.00	
<input type="checkbox"/> $Y_3 \rightarrow DY_4$	✓	1.00	
<input type="checkbox"/> $Y_3 \rightarrow Y_4D$	✓	1.00	
<input checked="" type="checkbox"/> $Y_1 \rightarrow CY_2$	✓	1.00	
<input type="checkbox"/> $Y_2 \rightarrow Y_3X_0$	✓	1.00	
<input type="checkbox"/> $A \rightarrow BY_2$	✓	1.00	
Total		8.00 / 8.00	

Question 16

Consider the pushdown automaton with the following transition rules:

1. $\delta(q, 0, Z_0) = \{(q, XXZ_0)\}$
2. $\delta(q, 0, X) = \{(q, XXX)\}$
3. $\delta(q, 1, X) = \{(q, X)\}$
4. $\delta(q, \epsilon, X) = \{(p, \epsilon)\}$
5. $\delta(p, \epsilon, X) = \{(p, \epsilon)\}$

The start state is q . For which one of the following inputs can the PDA for the first time enter state p with the input empty and the stack containing $XXXZ_0$ [i.e., the ID $(p, \epsilon, XXXZ_0)$]?

Your Answer		Score	Explanation
<input checked="" type="radio"/> 010111111	✓	5.00	
<input type="radio"/> 10101			
<input type="radio"/> 010111110			
<input type="radio"/> 1111111010			

Total

5.00 / 5.00

Question 17

If we convert the context-free grammar G:

$$B \rightarrow \emptyset B \mid B1 \mid \emptyset \mid 1$$

to a pushdown automaton that accepts $L(G)$ by empty stack, using the construction rule introduced in class, which of the following is NOT a rule of the PDA?

Your Answer	Score	Explanation
<input type="radio"/> $\delta(q,0,0) = \{(q,\epsilon)\}$		
<input type="radio"/> $\delta(q,\epsilon,B) = \{(q,0B), (q,B1), (q,0), (q,1)\}$		
<input type="radio"/> $\delta(q,1,1) = \{(q,\epsilon)\}$		
<input checked="" type="radio"/> $\delta(q,\epsilon,B) = \{(q,0), (q,1)\}$	✓ 5.00	
Total	5.00 / 5.00	

Question 18

Suppose one transition rule of some PDA P is $\delta(q,0,X) = \{(p,YZ), (r,XY)\}$. If we convert PDA P to an equivalent context-free grammar G in the manner described in class, which of the following is a production of G derived from this transition rule? You may assume s and t are states of P, as well as p , q , and r .

Your Answer	Score	Explanation
<input checked="" type="radio"/> $[qXr] \rightarrow 0[pXs][sYr]$	✗ 0.00	
<input type="radio"/> $[qXp] \rightarrow 0[rXq][qYp]$		
<input type="radio"/> $[qXs] \rightarrow 0[qYr][rZp]$		
<input type="radio"/> $[qXr] \rightarrow 0[pYs][tZr]$		
Total	0.00 / 5.00	

Question 19

A Turing machine M with start state q_0 and accepting state q_f has the following transition function:

$\delta(q,a)$	0	1	B
q_0	$(q_1,0,R)$	-	-
q_1	-	$(q_0,1,R)$	(q_f,B,R)
q_f	-	-	-

Select from the following list the string that M will accept by final state.

Your Answer	Score	Explanation
<input type="radio"/> 1		
<input checked="" type="radio"/> 0111010	✖ 0.00	
<input type="radio"/> 010101010100		
<input type="radio"/> 01010		
Total	0.00 / 5.00	

Question 20

What is satisfying truth assignment for the boolean formula $(\neg x \vee (\neg y)) \wedge (\neg y \vee z)$? Note: we're using \neg for NOT, \vee for OR, and juxtaposition for AND.

Your Answer	Score	Explanation
<input type="radio"/> $x=\text{true}, y=\text{true}, z=\text{true}$		
<input checked="" type="radio"/> $x=\text{false}, y=\text{true}, z=\text{false}$	✖ 0.00	
<input type="radio"/> $x=\text{true}, y=\text{true}, z=\text{false}$		
<input type="radio"/> $x=\text{false}, y=\text{true}, z=\text{true}$		
Total	0.00 / 5.00	

Question 21

In the table below is an instance of Post's Correspondence Problem

Index	First String	Second String
1	11	110
2	1010	00
3	010	10
4	10	101

Which statement below is true about this instance?

Your Answer

Score

Explanation

☐ There are solutions starting with index 4.

☒ There are solutions starting with index 3.

✖ 0.00

☐ There are no solutions.

☐ There are solutions starting with index 2.

Total

0.00 / 5.00

Question 22

A Turing machine M with start state q_0 and accepting state q_f has the following transition function:

$\delta(q,a)$	0	1	B
q_0	(q_1, B, R)	(q_0, B, R)	-
q_1	(q_1, B, R)	-	(q_f, B, L)
q_f	-	-	-

Which of the following input strings is NOT accepted by this Turing machine?

Your Answer

Score

Explanation

☐ 111000

☒ 00

✖ 0.00

☐ 11

0

Total

0.00 / 5.00

Question 23

In this question, each checkbox is worth 2 points. Suppose there are three languages (i.e., problems), of which we know the following:

1. L_1 is in P.
2. L_2 is NP-complete.
3. L_3 is not in NP.

Suppose also that we do not know anything about the resolution of the "P vs. NP" question; for example, we do not know definitely whether $P=NP$. Classify each of the following languages as (a) Definitely in P, (b) Definitely in NP (but perhaps not in P and perhaps not NP-complete) (c) Definitely NP-complete (d) Definitely not in NP:

- $L_1 \cup L_2$.
- $L_1 \cap L_2$.
- $L_2 c L_3$, where c is a symbol not in the alphabet of L_2 or L_3 (i.e., the *marked concatenation* of L_2 and L_3 , where there is a unique marker symbol between the strings from L_2 and L_3).
- The complement of L_3 .

Based on your analysis, pick the correct, definitely true statements from the list below.

Your Answer	Score	Explanation
<input type="checkbox"/> The complement of L_3 is definitely not in P.	✗ 0.00	
<input type="checkbox"/> $L_1 \cup L_2$ is definitely NP-complete.	✓ 2.00	
<input type="checkbox"/> $L_1 \cup L_2$ is definitely in P.	✓ 2.00	
<input type="checkbox"/> $L_2 c L_3$ is definitely not in NP.	✗ 0.00	
<input checked="" type="checkbox"/> $L_1 \cap L_2$ is definitely in NP.	✓ 2.00	
<input type="checkbox"/> $L_1 \cup L_2$ is definitely in NP.	✗ 0.00	
<input type="checkbox"/> $L_1 \cap L_2$ is definitely in P.	✓ 2.00	
<input type="checkbox"/> $L_2 c L_3$ is definitely NP-complete.	✓ 2.00	
Total	10.00 / 16.00	

Question 24

In this question, each checkbox is worth 2 points.

Let us call a problem X "NP-Easy" if it is polynomial-time reducible to some problem Y that is in NP. Let us denote as "NP-Equivalent", the class of problems that are both NP-Easy and NP-Hard. Let A,B,C,D and E be problems such that A is NP-Hard, B is NP-Complete, C is NP-Equivalent, D is NP-Easy and E is in NP. Which of the following statements are TRUE?










Your Answer		Score	Explanation
<input type="checkbox"/> If $P=NP$ then D is in P.	✗	0.00	
<input type="checkbox"/> If $P=NP$ then A is in P.	✓	2.00	
<input type="checkbox"/> If C is in P then so is A.	✓	2.00	
<input checked="" type="checkbox"/> If E is in P then so is A.	✗	0.00	
<input type="checkbox"/> If C is in P then $P=NP$.	✗	0.00	
<input type="checkbox"/> If $P=NP$ then C is in P	✗	0.00	
<input type="checkbox"/> If B is in P then so is A.	✓	2.00	
<input type="checkbox"/> If D is in P then so is A.	✓	2.00	
Total		8.00 / 16.00	

Question 25

The classes of languages P and NP are closed under certain operations, and not closed under others, just like classes such as the regular languages or context-free languages have closure properties. Decide whether P and NP are closed under each of the following operations.

1. Union.
2. Intersection.
3. Intersection with a regular language.
4. Kleene closure (star).
5. Homomorphism.
6. Inverse homomorphism.

Then, check each of the statements that are true.

Your Answer	Score	Explanation
<input checked="" type="checkbox"/> P is closed under homomorphism.	 0.00	
<input type="checkbox"/> P is closed under Kleene closure.	 0.00	
<input type="checkbox"/> P is not closed under union.	 1.00	
<input type="checkbox"/> NP is not closed under intersection with a regular language.	 1.00	
<input type="checkbox"/> P is not closed under homomorphism.	 0.00	
<input type="checkbox"/> NP is closed under inverse homomorphism.	 0.00	
<input type="checkbox"/> NP is not closed under union.	 1.00	
<input type="checkbox"/> NP is not closed under intersection.	 1.00	
<input type="checkbox"/> NP is not closed under homomorphism.	 0.00	
Total	4.00 / 9.00	