DQ9 (L9)

Due 26 Mar at 23:59 **Points** 20 **Questions** 5
Available after 20 Mar at 12:00 **Time limit** None
Allowed attempts Unlimited

Instructions

- This quiz is NOT GRADED. However, it is HIGHLY RECOMMENDED that you use these questions to complement your review of the lecture content.
- The questions are based on content from the Lecture 9 and from part of Chapter 7 of the AIMA (4th Ed.) textbook (i.e., 7.1-7.5).

Take the quiz again

Attempt history

	Attempt	Time	Score
KEPT	**Attempt 2**	2 minutes	20 out of 20
LATEST	**Attempt 2**	2 minutes	20 out of 20
	Attempt 1	10 minutes	13 out of 20

Submitted 20 Mar at 12:38

Question 1

2 / 2 pts

Determine if the following statement is true or false and select the best option for its reasoning.

The size of the knowledge base of a logical agent is **monotonic.** The set of entailed sentences does not decrease as information is added to the knowledge base.

Correct!

◉ True. For any sentences α and β, if KB ⊨ α then KB ∧ β ⊨ α. We can only add new sentences to our knowledge base.

False. The knowledge base of a logical agent can be nonmonotonic, as sentences can be removed from the knowledge base.

Question 2

2 / 2 pts

Which of the following statements regarding **entailment** is true?

- α ⊨ β if and only if the sentence (α ∧ ¬β) is satisfiable.
- α ⊨ β if and only if the sentence (α ∧ β) is unsatisfiable.

Correct!

- α ⊨ β if and only if the sentence (α ∧ ¬β) is unsatisfiable.
- α ⊨ β if and only if the sentence (α ∧ β) is satisfiable.

Question 3

2 / 2 pts

Determine if the following statement is true or false and select the best option for its reasoning.

Inferring new sentences through resolution is more efficient than the truth table enumeration.

False. Truth table enumeration may be more efficient due to it searching depth-first for new sentences.

Correct!

True. Resolution utilises proof-finding which is more efficient because proofs can ignore irrelevant propositions, regardless of how many they are.

With resolution, We are only concerned with checking related propositions - i.e., α and all the sentences in KB that are related to α.

Essentially, in this case, we are growing a smaller truth table since we only use the variables in sentances relating to α. We do not include unrelated variables in the truth table. Of course, we do not directly use a truth table, we instead find and eliminate pairs of complementary literals. Consequently, in cases where there are millions of sentences containing literals that are not related to the query or the subset of sentences that are related to the query, R, then resolution only applies to the subset α ∪ R, whereas, truth-table enumeration would apply to α ∪ KB.

Question 4

7 / 7 pts

From the lecture, we know that resolution is based upon the following.

- Given KB ≡ (P ∨ x) ∧ (Q ∨ ¬x) holds.
- Then α ≡ (P ∨ Q) must also hold.

PART A: Complete the following truth table.

P	Q	x	KB ≡ (P ∨ x) ∧ (Q ∨ ¬x)	α ≡ P ∨ Q
1	1	1	1	1
1	1	0	1	1
1	0	1	0	1
1	0	0	1	1
0	1	1	1	1
0	1	0	0	1

0	0	1	0	0
0	0	0	0	0

PART B: Does M(KB) ⊆ M(α)? [T/F]

Answer: T

PART C: Does KB ⊨ α (i.e., can we infer α from KB)? [T/F]

Answer: T

Answer 1:

Correct! 1

Answer 2:

Correct! 1

Answer 3:

Correct! 1

Answer 4:

Correct! 1

Answer 5:

Correct! 0

Answer 6:

Correct! 1

Answer 7:

Correct! 1

Answer 8:

Correct! 1

Answer 9:

Correct! 1

Answer 10:

Correct! 1

Answer 11:

Correct! 0

Answer 12:

Correct! 1

Answer 13:

Correct! 0

Answer 14:

Correct! 0

Answer 15:

Correct! 0

Answer 16:

Correct! 0

Answer 17:

Correct! T

Answer 18:

Correct! T

Question 5

7 / 7 pts

Suppose we are given the following premises in our knowledge base:

- P1. $B \rightarrow A$
- P2. $W \rightarrow B$
- P3. $\neg A$
- P4. $W \vee B \vee X$

PART A: What is the minimum number of steps in the resolution that is required to prove X?

Note the following:

- *Assume that the negation of the query (sentence to infer) is already added*
- *Assume that all conversions to CNF has already been performed. You must do this yourself for your working.*
- *Each reduction via resolution (of exactly ONE literal with its negation) counts as 1 step*
- *Each law applied to simplify a sentence/clause further during resolution counts as 1 step*

Answer: 5

PART B: How many premises are added to the KB as a result of the above resolution?

Answer: 1

Answer 1:

Correct! 5

Answer 2:

Correct! 1

Given:

- P1. ¬B ∨ A
- P2. ¬W ∨ B
- P3. ¬A
- P4. W ∨ B ∨ X
- P5: ¬X

Resolution 1:

1. P6: ¬B (resolution of P1, P3)
2. P7: ¬W (resolution of P2, P6)
3. P8: W ∨ B (resolution of P4, P5)
4. P9: W (resolution of P6, P8)
5. ∅ (resolution of P7, P9)

Resolution 2:

1. P6: W ∨ B (resolution of P4, P5)
2. P7: B ∨ B (resolution of P2, P6)
3. P8: B (idempotent on P7)
4. P9: A (resolution of P1, P8)
5. ∅ (resolution of P3, P9)

We can see that there are **minimally 5 steps**. After resolution is performed, we **add the query** (α ≡ X) to the KB since KB ⊨ α.

Additional Notes:

- Notice that when applying resolution, you only ever eliminate ONE pair of complementary literals.
- With resolution the application of idempotence is done via **factoring.**
- We **only** add the query.