IN-CLASS EXERCISE (I3)

Duration: 15 mins

Date: 28/03/2023

Score: ..... / 3

Student ID:..... Student name: .....

Question 1 (2pts) Consider the following propositional knowledge base. Please check whether **KB entails Y**.
[0.5pt] Convert each sentence in the knowledge base to its rule form.

1.	5. .....
2.	6. .....
3.	7. .....
4.	

1. $\neg C \vee \neg D \vee Y$
2. $\neg R \vee \neg Z \vee C$
3. $\neg B \vee D$
4. $\neg D \vee \neg R \vee Z$
5. B
6. $R \leftrightarrow D$

[1.5pt] Perform inference by applying **Backward Chaining.** Note that, for every step, state clearly which sentences your inference comes from. Sub-goals at the same levels are processed following the alphabetical order. Add more lines if necessary

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Question 2 (1pt) *$(A \leftrightarrow B)$ entails $(A \wedge B)$*. Explain why the given statement is TRUE (or FALSE).

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Question 1 (2pts) Consider the following propositional knowledge base. Please check whether **KB entails F**.

1. $\neg B \vee \neg C \vee A$
2. $\neg D \vee \neg E \vee B$
3. $\neg G \vee \neg E \vee B$
4. $\neg E \vee C$
5. D
6. E
7. $\neg A \vee \neg G \vee F$

[0.5pt] Convert each sentence in the knowledge base to its rule form.

1.	5. .....
2.	6. .....
3.	7. .....
4.	

[1.5pt] Perform inference by applying **Backward Chaining.** Note that, for every step, state clearly which sentences your inference comes from. Sub-goals at the same levels are processed following the alphabetical order. Add more lines if necessary

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Question 2 (1pt) *Conjunctive normal form is a representation in which the KB is a conjunction of clauses where each clause is a conjunction of literals.* Explain why the given statement is TRUE (or FALSE).

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[0.5pt] Convert each sentence in the knowledge base to its rule form.

1.	5. .....
2.	6. .....
3.	7. .....
4.	

1. $\neg C \vee \neg D \vee Y$
2. $\neg R \vee \neg Z \vee C$
3. $\neg B \vee D$
4. $\neg D \vee \neg R \vee Z$
5. B
6. $R \leftrightarrow D$

[1.5pt] Perform inference by applying **Forward Chaining.** Note that, for every step, state clearly which sentences your inference comes from. If there are multiple rules that are ready to be triggered at a time, process them from top to bottom.

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Question 2 (1pt) *It is always possible to check whether a propositional knowledge base entails a query using forward chaining or backward chaining.* Explain why the given statement is TRUE (or FALSE).

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1. $\neg B \vee \neg C \vee A$
2. $\neg D \vee \neg E \vee B$
3. $\neg G \vee \neg E \vee B$
4. $\neg E \vee C$
5. D
6. E
7. $\neg A \vee \neg G \vee F$

[0.5pt] Convert each sentence in the knowledge base to its rule form.

1.	5. .....
2.	6. .....
3.	7. .....
4.	

[1.5pt] Perform inference by applying **Forward Chaining.** Note that, for every step, state clearly which sentences your inference comes from. If there are multiple rules that are ready to be triggered at a time, process them from top to bottom

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Question 2 (1pt) *Backward chaining uses breadth-first search and forward chaining uses depth-first search.* Explain why the given statement is TRUE (or FALSE).

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SOLUTION

IN-CLASS EXERCISE (I3)

Duration: 15 mins

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Score: ..... / 3

Student ID: ..... Student name: .....

Question 1 (2pts) Consider the following propositional knowledge base. Please check whether **KB entails Y**.

[0.5pt] Convert each sentence in the knowledge base to its rule form.

1. $C \wedge D \rightarrow Y$	5. B
2. $R \wedge Z \rightarrow C$	6. $R \rightarrow D$
3. $B \rightarrow D$	7. $D \rightarrow R$
4. $D \wedge R \rightarrow Z$	

1. $\neg C \vee \neg D \vee Y$
2. $\neg R \vee \neg Z \vee C$
3. $\neg B \vee D$
4. $\neg D \vee \neg R \vee Z$
5. B
6. $R \leftrightarrow D$

[1.5pt] Perform inference by applying **Backward Chaining.** Note that, for every step, state clearly which sentences your inference comes from. Sub-goals at the same levels are processed following the alphabetical order. Add more lines if necessary

The goal Y requires C and D from (1)

Subgoal C requires R and Z from (2)

Subgoal R requires D from (6) (*)

Subgoal D requires B from (3) (**)

B is given in (5)

Subgoal Z requires D and R from (4)

Both subgoals are satisfied from the above steps, (*) and (**)

Subgoal D is satisfied from the above steps (**)

Thus, KB entails Y.

Question 2 (1pt) *$(A \leftrightarrow B)$ entails $(A \wedge B)$*. Explain why the given statement is TRUE (or FALSE).

FALSE. $(A \leftrightarrow B) \equiv (A \wedge B) \vee (\neg A \wedge \neg B)$. When A = B = false, $(A \leftrightarrow B)$ is true, yet $(A \wedge B)$ is false. Thus, not every model making $(A \leftrightarrow B)$ true also makes $(A \wedge B)$ true.

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Question 1 (2pts) Consider the following propositional knowledge base. Please check whether **KB entails F**.

1. $\neg B \vee \neg C \vee A$
2. $\neg D \vee \neg E \vee B$
3. $\neg G \vee \neg E \vee B$
4. $\neg E \vee C$
5. D
6. E
7. $\neg A \vee \neg G \vee F$

[0.5pt] Convert each sentence in the knowledge base to its rule form.

1. $B \wedge C \rightarrow A$
2. $D \wedge E \rightarrow B$
3. $G \wedge E \rightarrow B$
4. $E \rightarrow C$
5. D
6. E
7. $A \wedge G \rightarrow F$

[1.5pt] Perform inference by applying **Backward Chaining.** Note that, for every step, state clearly which sentences your inference comes from. Sub-goals at the same levels are processed following the alphabetical order. Add more lines if necessary

The goal F requires A and G from (7)

Subgoal A requires B and C from (1)

Subgoal B requires D and E from (2)

Subgoals D and E are given in (5) and (6)

Subgoal C requires E from (4)

Subgoal E is given in (6)

Subgoal G cannot be obtained from any of the available rules → the inference process fails in this step

Thus, KB does not entail F.

Question 2 (1pt) *Conjunctive normal form is a representation in which the KB is a conjunction of clauses where each clause is a conjunction of literals.* Explain why the given statement is TRUE (or FALSE).

FALSE. Conjunctive normal form is a representation in which the KB is a conjunction of clauses where each clause is a DISJUNCTION of literals.

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Question 1 (2pts) Consider the following propositional knowledge base. Please check whether **KB entails Y**.

[0.5pt] Convert each sentence in the knowledge base to its rule form.

1. $C \wedge D \rightarrow Y$
2. $R \wedge Z \rightarrow C$
3. $B \rightarrow D$
4. $D \wedge R \rightarrow Z$
5. B
6. $R \rightarrow D$
7. $D \rightarrow R$

1. $\neg C \vee \neg D \vee Y$
2. $\neg R \vee \neg Z \vee C$
3. $\neg B \vee D$
4. $\neg D \vee \neg R \vee Z$
5. B
6. $R \leftrightarrow D$

[1.5pt] Perform inference by applying **Forward Chaining.** Note that, for every step, state clearly which sentences your inference comes from. If there are multiple rules that are ready to be triggered at a time, process them from top to bottom.

The initial fact is B.

From (3) and (5), we have D (8)

From (7) and (8), we have R (9)

From (4), (8), and (9), we have Z (10)

From (6) and (9), we have D again

From (2), (9) and (10), we have C (11)

From (1), (11), and (8), we have Y

Thus, KB entails Y.

Question 2 (1pt) *It is always possible to check whether a propositional knowledge base entails a query using forward chaining or backward chaining.* Explain why the given statement is TRUE (or FALSE).

FALSE. Forward chaining and backward chaining can answer any question of entailment only when the KB contains all propositional definite clauses.

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Student ID:..... Student name: .....

Question 1 (2pts) Consider the following propositional knowledge base. Please check whether **KB entails F**.

1. $\neg B \vee \neg C \vee A$
2. $\neg D \vee \neg E \vee B$
3. $\neg G \vee \neg E \vee B$
4. $\neg E \vee C$
5. D
6. E
7. $\neg A \vee \neg G \vee F$

[0.5pt] Convert each sentence in the knowledge base to its rule form.

1. $B \wedge C \rightarrow A$
2. $D \wedge E \rightarrow B$
3. $G \wedge E \rightarrow B$
4. $E \rightarrow C$
5. D
6. E
7. $A \wedge G \rightarrow F$

[1.5pt] Perform inference by applying **Forward Chaining.** Note that, for every step, state clearly which sentences your inference comes from. If there are multiple rules that are ready to be triggered at a time, process them from top to bottom

The initial facts are D and E.

From (2), (5), and (6), we have B (8)

From (4) and (5), we have C (9)

From (1), (8), and (9), we have A (10)

We cannot generate any other clause, and we haven't reached F yet.

Thus, KB does not entail F.

Question 2 (1pt) *Backward chaining uses breadth-first search and forward chaining uses depth-first search.* Explain why the given statement is TRUE (or FALSE).

FALSE. Backward chaining uses depth-first search and forward chaining uses breadth-first search.