**Intelligent Systems**

**Exercise 11. Reasoning in   
 Propositional Logic**



# Exercise description

The objective of this exercise is to apply the concepts of reasoning in Propositional Logic.

**Team m embers**

Write the student id, name, and campus of each member in a different line.

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**Reasoning in Propositional Logic:**

1. Are the statements and logically equivalent? Explain your answer including a truth table.

**Applying the distributive law which states to the left hand side of the equation but replacing the operation for in the formula we obtain the right hand side of the statement , which implies the equivalence holds true.**

**The following truth table shows in detail this statement:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| P | Q | R | (QvR) | **P -> (QvR)** | P -> Q | P->R | **(P -> Q) v (P -> R)** |
| 1 | 1 | 1 | 1 | **1** | 1 | 1 | **1** |
| 1 | 1 | 0 | 1 | **1** | 1 | 0 | **1** |
| 1 | 0 | 1 | 1 | **1** | 0 | 1 | **1** |
| 1 | 0 | 0 | 0 | **0** | 0 | 0 | **0** |
| 0 | 1 | 1 | 1 | **1** | 1 | 1 | **1** |
| 0 | 1 | 0 | 1 | **1** | 1 | 1 | **1** |
| 0 | 0 | 1 | 1 | **1** | 1 | 1 | **1** |
| 0 | 0 | 0 | 0 | **1** | 1 | 1 | **1** |

1. Use the truth table method to verify whether the next logical consequence is correct:

**Yes, the logical consequence is correct because when every premise is true, the conclusion is also true.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **P** | **Q** | **P -> Q** | **Q -> P** | **P v Q** | **P ^ Q** |
| **1** | **1** | 1 | 1 | 1 | 1 |
| **1** | **0** | 0 | 1 | 1 | 0 |
| **0** | **1** | 1 | 0 | 1 | 0 |
| **0** | **0** | 1 | 1 | 0 | 0 |

1. Reduce the following formula to its clausal form:
2. Remove implications and Biconditionals

(p -> q) ^ (q -> p) -> r *by biconditional elimination*

(~p v q) ^ (~q v p) -> r  *by implication elimination on the left hand side*

**~(**(~p v q) ^( ~q v p)**)** v r  *by implication elimination on the remaining implication*

1. Introduce negations

(~(~p v q) v ~(~q v p))v r *by Introducing negations*

((p ^ ~q) v (q ^ ~p) )v r *by Introducing negations*

1. Distribute disjunctions over conjuctions

((p ^ ~q) v r) ^ ((q ^ ~p) v r) *by distributivity (disjunctions over conjuctions)*

(p v r) ^ (~q v r) ^ (q v r) ^ (~p v r) *by distributivity (disjunctions over conjuctions)*

1. Clauses:

C1: p v r

C2: ~q v r

C3: q v r

C4: ~p v r

1. Propositional reasoning by resolution:

Consider the following relationships among concepts:

"persons who consume neither meat nor fish food are vegetarians;"

"vegans consume no animal food nor milk products,"

"to consume meat is to consume animal food,"

"to consume fish food is to consume animal food."

Do the above relationships among concepts imply that vegans are vegetarians?

1. Define a vocabulary of positive propositions.

M: people who consume meat

F: people who consume fish food

V: people who are vegetarians

B: people who are vegans

A: people who consume animal food

L: people who consume milk products

1. Translate the above claims into a set of propositional formulas.
   1. (~M ^ ~F) -> V
   2. B -> (~A ^ ~L)
   3. M -> A
   4. F -> A
2. Reduce the translated claims to their clausal forms.

Claims:

1. V-> (~M ^ ~F)
2. B -> (~A ^ ~L)
3. M -> A
4. F -> A
   1. V v~(~M ^ ~ F) ≡ V v (M v F) *by implication elimination and negation*
      1. V v M
      2. V v F
   2. ~B v (~A ^ ~L) ≡ (~B v ~A) ^ (~B v ~L) *by implication elimination and distributive*
      1. ~B v ~A
      2. ~B v ~L
   3. ~M v A *by implication elimination*
   4. ~F v A *by implication elimination*
5. Using resolution by refutation to check if the implication is proved.

Demonstrate if **B ⊨ V**

Refutation theorem: instead of proving **P,** shows that its negation **~P** leads to an inconsistency or contradiction.

***a ⊨ b*** *if and only if* ***(a ^ ~b)*** *is not satisfiable*

Proof by refutation:

Since is proof by contradiction we introduce the **B** and **~V** to our **KB**, which looks as follows:

**KB:**

**V v M**

**V v F**

**~B v ~A**

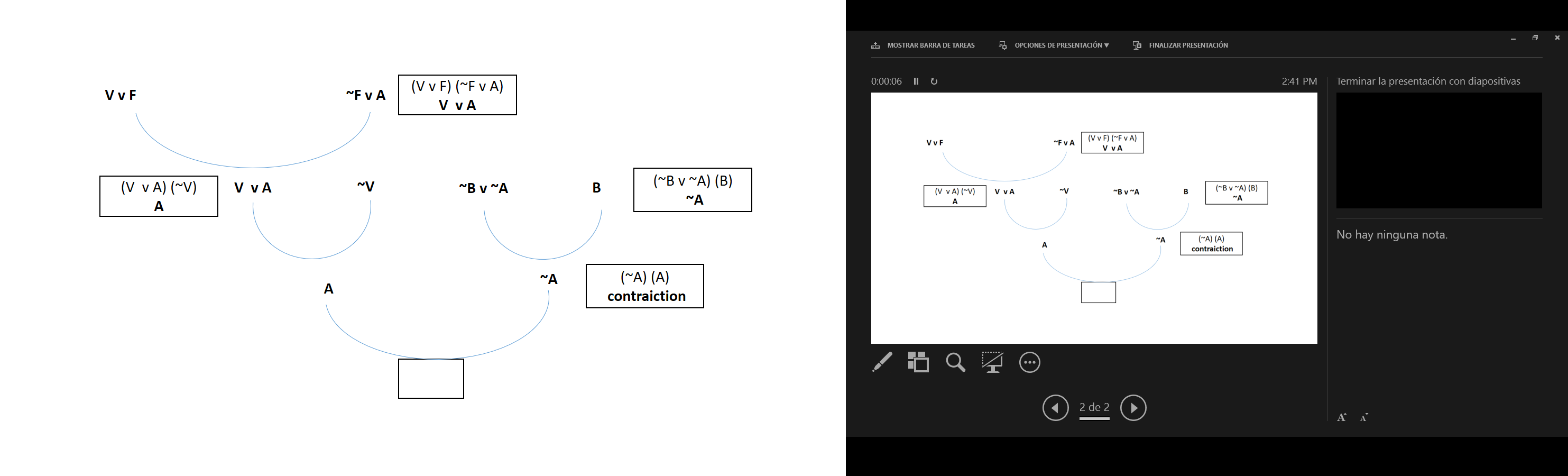
**~B v ~L**

**~M v A**

**~F v A**

**B**

**~V**



So this implies B ⊨ V holds false ∎