**Logical Agents Homework**

1. Unicorn Problem

Mythical = M

Mortal = R  
Mammal = L

Horned = H

Magical = G

Knowledge Base:

R1: M ⇒ ¬ R

R2: ¬ M ⇒ ( R ∧ L )

R3: ( ¬ M ∨ L ) ⇒ H

R4: H ⇒ G

Proofs:

R5: ¬ M ∨ ¬ R - implication elimination R1

R6: ( M ∨ R ) ∧ ( M ∨ L ) - implication elimination R2

R7: M ∨ R - separate compound statement R6

R8: M ∨ L - separate compound statement R6

R9: ¬ R ∨ L - resolution R5, R8

R10: H - Modus Ponens R3, R9

R11: G - Modus Ponens R4, R10

R12: M - Cannot prove

2. True / False

1. False |= True: **TRUE**, anything implying True will be True
2. (A ∧ B) |= (A ⇔ B): **TRUE**, this is given by its truth table. In every instance that (A ∧ B) is True, (A ⇔ B) is True

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| --- | --- | --- | --- |
| **A** | **B** | **(A ∧ B)** | **(A ⇔ B)** |
| T | T | T | T |
| T | F | F | F |
| F | T | F | F |
| F | F | F | T |

1. A ⇔ B |= (A ∨ B): **FALSE**, the last condition leads a non-entailment relationship between these two

|  |  |  |  |
| --- | --- | --- | --- |
| **A** | **B** | **(A ⇔ B)** | **(A ∨ B)** |
| T | T | T | T |
| T | F | F | T |
| F | T | F | T |
| F | F | T | F |

1. A ⇔ B |= ¬A ∨ B: **TRUE**, for each True condition leads to a True entailment

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **A** | **B** | **¬A** | **A ⇔ B** | **¬A ∨ B** |
| T | T | F | T | T |
| T | F | F | F | F |
| F | T | T | F | T |
| F | F | T | T | T |

1. (A ∨ B) ∧ (¬A ∨ B) is satisfiable: TRUE, this is satisfiable by some model since it has true values in 2 positions.

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| **A** | **B** | **¬A** | **A ∨ B** | **¬A ∨ B** | **(A ∨ B) ∧ (¬A ∨ B)** |
| T | T | F | T | T | T |
| T | F | F | T | F | F |
| F | T | T | T | T | T |
| F | F | T | F | T | F |