Programming Assignment Report

Assignment 05

Logical Agents, Model Checking

Solutions

1. **Convert to Conjunctive Normal Form using logical equivalence.**
2. **(A → (B ∨ C)) ↔ (¬D ∧ E) START**
3. **((A -> (B ∨ C)) -> (¬D ∧ E)) ∧ ((¬D ∧ E) -> (A -> (B ∨ C))) BICONDITIONAL**
4. **¬(¬A ∨ B ∨ C) ∨ (¬D ∧ E) ∧ ¬(¬D ∧ E) ∨ (¬A ∨ B ∨ C) IMPLICATION**
5. **(A ∧ ¬B ∧ ¬C) ∨ (¬D ∧ E) ∧ (D ∨ ¬E ∨ ¬A ∨ B ∨ C) DEMORGANS**
6. **(A ∨ ¬D) ∧ (A ∨ E) ∧ (¬B ∨ ¬D) ∧ (¬B ∨ E) ∧ (¬C ∨ ¬D) ∧ (¬C ∨ E) ∧ (D ∨ ¬E ∨ ¬A ∨ B ∨ C)**
7. **Tell whether each of the following sentences is valid or satisfiable.  
   Show the true table.**
8. **R1: Smoke ∨ Fire ∨ ~Fire**
   1. **Satisfiable: Yes**
   2. **Valid: Yes**

|  |  |  |  |
| --- | --- | --- | --- |
| **Smoke** | **Fire** | **~Fire** | **Result** |
| **F** | **F** | **T** | **T** |
| **F** | **T** | **F** | **T** |
| **T** | **F** | **T** | **T** |
| **T** | **T** | **F** | **T** |

1. **R2: (Smoke -> Fire) -> (~Smoke -> ~Fire)**
   1. **Satisfiable: Yes**
   2. **Valid: No**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Smoke** | **Fire** | **(Smoke -> Fire)** | **(~Smoke -> ~Fire)** | **Result** |
| **F** | **F** | **T** | **T** | **T** |
| **F** | **T** | **T** | **F** | **F** |
| **T** | **F** | **F** | **T** | **T** |
| **T** | **T** | **T** | **T** | **T** |

1. **R3: ( Smoke -> Fire ) -> (( Smoke ∧ Heat ) -> Fire )**
   1. **Satisfiable: Yes**
   2. **Valid: No**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Smoke** | **Fire** | **Heat** | **( Smoke -> Fire )** | **( Smoke ∧ Heat )** | **( Smoke ∧ Heat ) -> Fire** | **Result** |
| **F** | **F** | **F** | **T** | **F** | **T** | **T** |
| **F** | **F** | **T** | **T** | **F** | **T** | **T** |
| **F** | **T** | **F** | **T** | **F** | **F** | **F** |
| **F** | **T** | **T** | **T** | **F** | **F** | **F** |
| **T** | **F** | **F** | **F** | **F** | **T** | **T** |
| **T** | **F** | **T** | **F** | **T** | **T** | **T** |
| **T** | **T** | **F** | **T** | **F** | **F** | **F** |
| **T** | **T** | **T** | **T** | **T** | **T** | **T** |

1. **Implement Inference by Model Checking using Knowledge Base composed of the next sentences.**

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KB ⊨ P22: No, because P22 is not true where all KB’s are valid  
 KB ⊨ P12: No, because P12 is not true where all KB’s are valid  
 KB ⊨ P21: No, because P21 is not true where all KB’s are valid  
 KB ⊨ B12: Yes, because B12 is false where all KB’s are valid  
 KB ⊨ B21: Yes, because B21 is true when all KB’s are valid