1. 1. A(a)=1, A(b) = A(c) = 0
   2. A(a) = A(b) = A(c) = 1, A(d) = 0

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A | B | Not B | A & B | A -> Not B | (A & B) and (A -> Not B) |
| 0 | 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 | 0 | 0 |

Unsatisfiable

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A | B | Not A | Not B | Not A and Not B | (Not A and Not B) -> (Not A and Not B) |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 0 | 1 |

Satisfiable

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | C | Not A | Not B | Not A and Not B | B or C | (B or C) or A | (B or C) or A) and (Not A and Not B) |
| 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |

Satisfiable

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C | B | A | Not A | Not B | Not C or B | A or (Not C or B) | Not A & Not B | (Not A & Not B) & C | (A or (Not C or B)) & ((Not A & Not B) & C) |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |

Unsatisfiable

1. 1. ((P->Q) ^ (Q->P)) ⊨ (Q<->P)
   2. ((P->Q) ^ (R -> S) ^ (not Q or not S)) ⊨ (not P or not R)
   3. ((P->Q) ^ (R -> S) ^ (P or R)) ⊨ (Q or S)
   4. ((P->Q) ^ (R -> Q) ^ (P or R)) ⊨ Q
   5. ((P->Q) ^ (Q -> R)) ⊨ (P -> R)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| P | Q | Not P or Q | Not Q or P | (not P or Q) and (not Q or P) | P <-> Q |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P | Q | R | S | Not P | Not Q | Not R | Not S | Not P & Q | Not R & S | Not P or Not S |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |  |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |  |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |  |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |  |
| 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 |  |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 |  |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |  |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |  |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 |  |
| 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |  |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |  |
| 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |  |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |  |
| 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |  |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |  |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P | Q | R | S | P -> Q | R -> S | P or R | (P->Q) ^ (R -> S) ^ (P v R) | Q or S |
|  |  |  |  | 1 | 1 |  |  |  |
|  |  |  | 1 | 1 | 1 |  |  | 1 |
|  | 1 |  |  | 1 | 1 |  |  | 1 |
|  | 1 |  | 1 | 1 | 1 |  |  | 1 |
|  |  | 1 |  | 1 |  | 1 |  |  |
|  |  | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|  | 1 | 1 |  | 1 |  | 1 |  | 1 |
|  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 |  |  |  |  | 1 | 1 |  |  |
| 1 |  |  | 1 |  | 1 | 1 |  | 1 |
| 1 | 1 |  |  | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 |  | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 |  | 1 |  |  |  | 1 |  |  |
| 1 |  | 1 | 1 |  | 1 | 1 |  | 1 |
| 1 | 1 | 1 |  | 1 |  | 1 |  | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 |  | 1 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| P | Q | R | Not P or Q | Not R or Q | PvR | (P->Q)^ (R->Q)^ (PvR) |
| 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 | 1 | 0 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| P | Q | R | Not P or Q | Not Q or R | (Not P or Q) and (Not Q or R) | Not P or R |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 |