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Knowledge base entailment

Entailment refers to the logical relationship between a kb (a set of statement or rules) and a query.

If kb entails a statement, it means that whenever the statements in the kb are true, the given query must also be true.

$$KB \models Q$$

Knowledge base resolution

The resolution rule involves taking two clauses that contain complementary literals and resolving them to produce a new clause.

Knowledge base entailment

Kb

- If it's raining (p) then the ground is wet
- If the ground is wet (q) , then the plants will grow (r)
- It's not the case that plants will grow. $(\neg r)$

Query is whether it's raining p . $\neg r \vee p = T$

$\neg r$ and r are complement to each other p .

The ground is wet which means that it is raining, because the ground is wet.

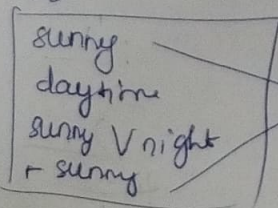
'p' entails the query

Knowledge base resolution

Input a kb and an expression, negate the expression add it to kb and find a contradiction, if contradiction is found, the negated statement is false hence the original statement is true.

Is it sunny? $\text{sunny} = \text{TRUE?}$ Prove sunny

Kb



contradiction

$\text{sunny} = \text{FALSE}$
 $\text{sunny} = \text{TRUE}$

Code:

→ Knowledge Base entailment:

```
from sympy import symbols, And, Not, Implies, satisfiable

def create-knowledge-base():
    p = symbols('p')
    q = symbols('q')
    r = symbols('r')

    knowledge-base = And(
        Implies(p, q),
        Implies(q, r),
        Not(r)
    )

    return knowledge-base

def query-entails(knowledge-base, query):
    entailment = satisfiable(And(knowledge-base, Not(query)))
    return not entailment

if __name__ == "__main__":
    kb = create-knowledge-base()
    query = symbols('p')
    result = query-entails(kb, query)
    print("Knowledge Base:", kb)
    print("Query:", query)
    print("Query entails Knowledge Base:", result)
```

Output:

Knowledge Base: $r \wedge (\text{Implies}(p, q)) \wedge \text{Implies}(q, r)$
Query: p
Query entails Knowledge Base: False

Knowledge Base: $\sim r \ \& \ (\text{Implies}(p, q)) \ \& \ (\text{Implies}(q, r))$

Query: p

Query entails Knowledge Base: False