

VIETNAM NATIONAL UNIVERSITY
UNIVERSITY OF SCIENCE

CSC14003 - INTRODUCTION TO ARTIFICIAL INTELLIGENCE

REPORT LAB 02

LOGIC

Student ID: 22120336

Student name: Vo Tuan Thanh

Instructor:

Nguyen Ngoc Duc, M.S.



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1 Completion Level Self-Assessment

Algorithm	Self-Assessment
1. Logic	100%
2. Propositional logic	100%
3. Who is the liar	100%
4. Inference	100%

2 Test Cases

2.1 Test Case Structure

2.1.1 Input format

- **First line:** The query α to be proved.
- **Second line:** Number of clauses (n) in the knowledge base.
- **Next n lines:** The clauses in the knowledge base.

2.1.2 Output format

- **Step-wise Information:**
 - Number of new clauses generated in each step.
 - The new clauses derived during that step.
- **Final Result:**
 - **YES:** If the knowledge base (KB) entails the query (α), denoted as $\text{KB} \models \alpha$.
 - **NO:** If the query (α) cannot be proved from the knowledge base (KB).

2.2 Test Cases Analysis

2.2.1 Test Case 1

Input:

C
7
A OR B
-A OR C
-B OR C
D OR E
-D OR C
-E OR C
-C OR F

Output:

12
B OR C
A OR C
-A OR F
-A
-B OR F
-B
C OR E
C OR D
-D OR F
-D
-E OR F
-E
10
B OR F
B
A OR F
A
C
E OR F
E
D OR F
D
C OR F
3
F
F
{ }
YES

2.2.2 Test Case 2

Input:

Q
6
P OR -R
-P OR Q
R OR S
-S OR Q
T OR -Q
-T

Output:

7
-R OR Q
P OR S
-P OR T
-P
Q OR R
-S OR T
-S
11
-R OR T
-R
P OR Q
Q OR S
R OR T
R
Q
S OR T
S
P OR T
P
4
Q OR T
Q OR T
T
{}
YES

2.2.3 Test Case 3

Input:

D
5
A OR B OR C
-A OR D
-B OR D
-C OR D
-D OR E

Output:

9
B OR C OR D
A OR C OR D
A OR B OR D
-A OR E
-A
-B OR E
-B
-C OR E
-C
12
B OR C OR E
B OR C
A OR C OR E
A OR C
A OR B OR E
A OR B
C OR D
B OR D
A OR D
C OR D OR E
B OR D OR E
A OR D OR E
8
D
D OR E
C OR E
B OR E
A OR E
C
B
A
3
E
E
{ }
YES

2.2.4 Test Case 4

Input:

Z
8
X OR Y
-X OR W
-Y OR W
W OR -Z
A OR B
-A OR -W
-B OR -W
Z

Output:

12
W OR Y
W OR X
-A OR -X
-B OR -X
-A OR -Y
-B OR -Y
-A OR -Z
-B OR -Z
W
-W OR B
-W OR A
{}
YES

2.2.5 Test Case 5

Input:

C
5
A OR B
-A OR C
-B OR C
D OR E
-E OR C

Output:

6
B OR C
A OR C
-A
-B
C OR D
-E
4
B
A
C
D
1
{}
YES

3 Evaluation and Proposed Solution

3.1 Advantages

- Complete and Sound Resolution
 - Guarantees finding proof if one exists
 - Maintains soundness through systematic clause resolution
- Efficient Data Structures

- Uses set operations for clause manipulation
- Fast membership testing and literal comparison

3.2 Disadvantages

- Time complexity is $\mathcal{O}(n^2)$
- No garbage collection mechanism

3.3 Optimization

3.3.1 Structural Optimizations

Clause Indexing:

- Index clauses by literals.
- Quick lookup for resolvable pairs.

Benefits:

- Reduces search space.
- Faster complementary literal finding.
- Avoids redundant comparisons.

Subsumption Checking:

- Remove subsumed clauses.
- Maintain minimal clause set.

Benefits:

- Smaller knowledge base.
- Fewer resolution steps.
- Better memory usage.

References

1. Russell, S., Norvig, P. (2021). *Artificial Intelligence: A Modern Approach (4th edition)*.
2. Stanford Encyclopedia of Philosophy. (n.d.). *Logic-Based Artificial Intelligence*. Retrieved November 18, 2024, from <https://plato.stanford.edu/entries/logic-ai/>.