

AI & NN
Unit 2

Resolution for Theorem Proving:

Statement to Prove (Goal):

If a user downloads a file from an untrusted source and the file is malicious, then the system is compromised.

We want to **prove**:

$\forall x (\text{UntrustedSource}(x) \wedge \text{Malicious}(x) \rightarrow \text{Compromised}(x))$

Given Knowledge Base (in predicate logic):

1. $\text{UntrustedSource}(\text{file1})$
2. $\text{Malicious}(\text{file1})$
3. $\forall x (\text{UntrustedSource}(x) \wedge \text{Malicious}(x) \rightarrow \text{Compromised}(x))$

Step 1: Convert to Clause Form (CNF)

Given Rule in CNF:

$\forall x (\neg \text{UntrustedSource}(x) \vee \neg \text{Malicious}(x) \vee \text{Compromised}(x))$

Facts as unit clauses:

- $\text{UntrustedSource}(\text{file1})$
- $\text{Malicious}(\text{file1})$

Step 2: Negation of the Statement to Prove

We assume the **negation** of what we want to prove:

"file1 is not compromised"

So, we add:

$\neg \text{Compromised}(\text{file1})$

Step 3: Apply Resolution

Use resolution to derive a contradiction:

Clause 1:

$\text{UntrustedSource}(\text{file1})$

Clause 2:

$\text{Malicious}(\text{file1})$

Clause 3 (General Rule Instantiated for file1):

$\neg \text{UntrustedSource}(\text{file1}) \vee \neg \text{Malicious}(\text{file1}) \vee$
 $\text{Compromised}(\text{file1})$

Clause 4 (Negated conclusion):

$\neg \text{Compromised}(\text{file1})$

Resolution Steps:

- Resolve Clause 3 and Clause 4 , you will get the following:
 $\neg \text{UntrustedSource}(\text{file1}) \vee \neg \text{Malicious}(\text{file1})$
(Because **Compromised(file1)** and $\neg \text{Compromised}(\text{file1})$ cancel)
- Now resolve with Clause 1, you will get the following:
 $\neg \text{Malicious}(\text{file1})$
- Now resolve with Clause 2, , you will get the following:
 \square (Empty clause — contradiction)

We derived a contradiction, so the negation of the statement is false. Hence, the **original statement is proven true**:

“If a file is from an untrusted source and malicious, then the system will be compromised.”
