

Forward and Backward Chaining

Course Title: Computational Intelligence

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Inference Engine

- Inference is reaching to a conclusion. Inference engine is component of the system that applies logical rules to the knowledge base to deduce new information
- It works in forward chaining and backward chaining
- Forward chaining or Forward reasoning starts with known facts and asserts new facts. Here the decision is taken based on available data. It is a bottom up approach and it's a data driven method used in expert systems.
- It starts with atomic sentences in the knowledge base and applies inference in forward direction (initial to goal stage)
- Backward chaining starts with a goal and works backwards to determine what facts must be asserted so that goal is achieved



Forward and backward chaining example

- Forward Chaining

- Conclude from 'A' and 'A=>B' to 'B'
- A= It is raining
- A=> If it is raining, the road is wet
- B=The road is wet

- Backward Chaining

- Conclude 'B' from 'A=>B' to 'A'
- B= The road is wet
- A=>B If it is raining, the road is wet
- A= It is raining



Example

- Rule 1: if A and C then F $A \& C \rightarrow F$
- Rule 2: if A and E then G $A \& E \rightarrow G$
- Rule 3: if b then E $B \rightarrow E$
- Rule 4: if G then D $G \rightarrow D$
- Problem: Given a database (A,B) Prove that of A and B is true then D is true using forward chaining



Forwarding Chaining

- Steps for working of Forwarding Chaining
- Step 1: We start from the already stated facts, and then, we'll subsequently choose the facts that do not have any implications at all.
- Step 2: Now, we will state those facts that can be inferred from available facts with satisfied premises.
- Step 3: In step 3 we can check the given statement that needs to be checked and check whether it is satisfied with the substitution which infers all the previously stated facts. Thus we reach our goal.



Example

- Facts: $X = 1, y = 2$
- Rules
- If ($X == 1 \ \& \ Y < 4$)
- $Z = 3$
- If($Z==3$)
- $A = 4$
- Conclusion $A=4$

Conclusion:

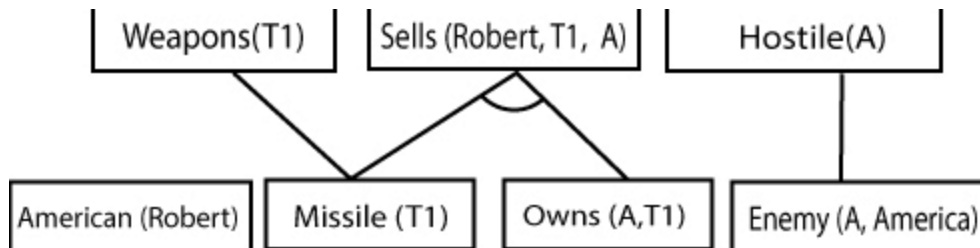


Example-Forward Chaining

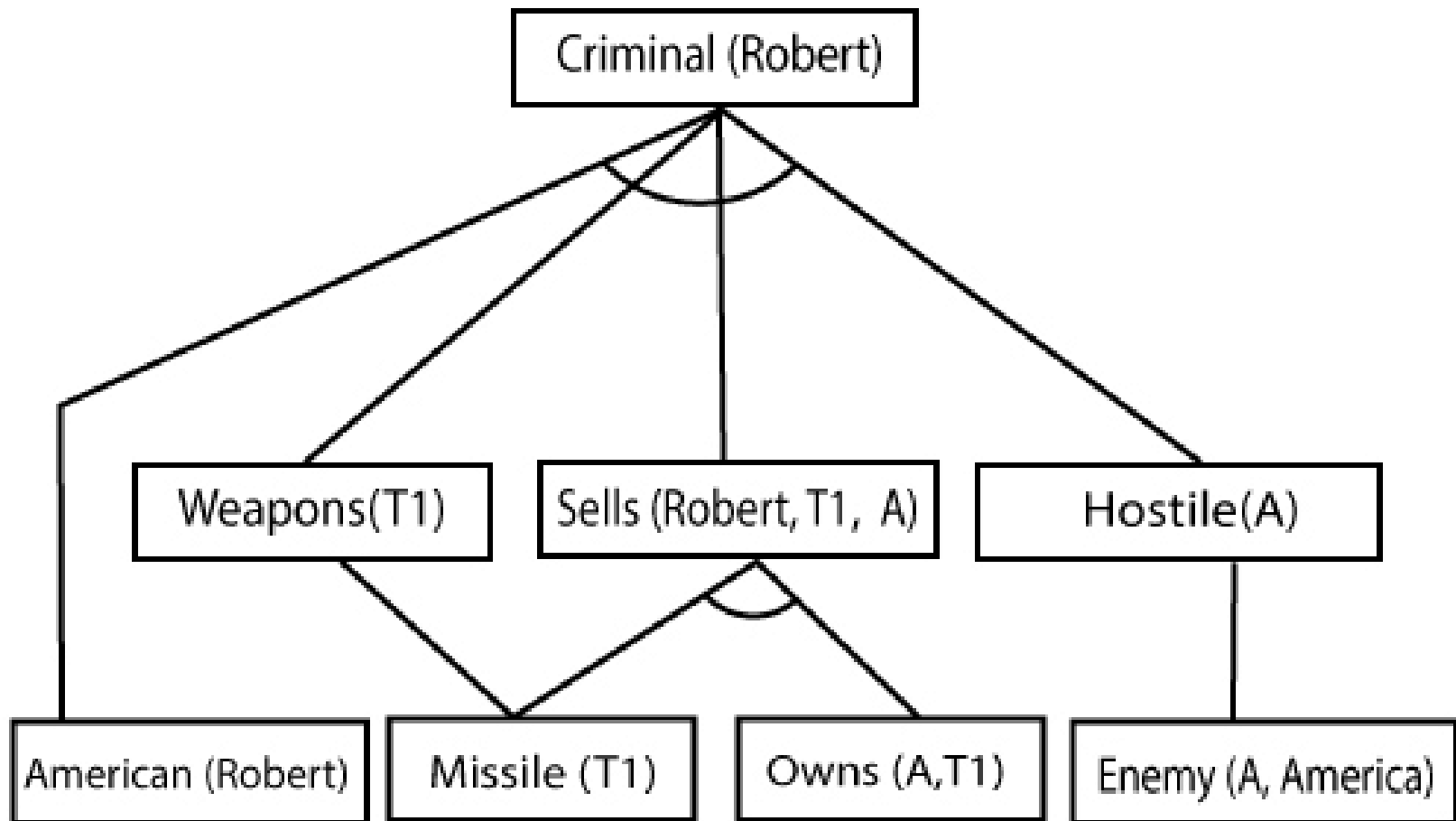
- “As per the law, it is a crime for an American to sell weapons to hostile nations. Country A, an enemy of America, has some missiles, and all the missiles were sold to it by Robert, who is an American citizen.”
- Prove that “Robert is a criminal.”
- Step 1: Here all the stated facts are stated which don't have any implications at all.



- Step 2: We choose the facts that can be inferred from available facts with satisfied premises.



Step 3: In step 3 we can check the given statement that needs to be checked and check whether it is satisfied with the substitution which infers all the previously stated facts. Thus we reach our goal.



Backward Chaining

- Backward chaining is a form of reasoning, which starts with the goal and works backward, chaining through rules to find known facts that support goal. It follows depth first search method.
- It is a top-down approach
- The goal is broken into sub-goals and sub-goals to prove the fact is true. It is a goal driven approach, as a list of goals decides which rules are selected and used
- It is used in game theory, automated proving tools, inference engines and different AI applications



Backward Chaining

- Suppose Goal state is Z
- Given facts are: A,E,B,C
- Rules are: $F \ \& \ B \rightarrow Z$, $C \ \& \ D \rightarrow F$, $A \rightarrow D$



References

- Artificial Intelligence A Modern Approach Third Edition by Stuart J. Russell and Peter Norvig

