Experiment 7

Objective

To be able to understand and implement the concepts of forward and backward chaining algorithms in the context of artificial intelligence, and to analyze the differences and similarities between the two approaches in terms of efficiency, accuracy, and applicability to real-world problem-solving scenarios.

Problem Statement

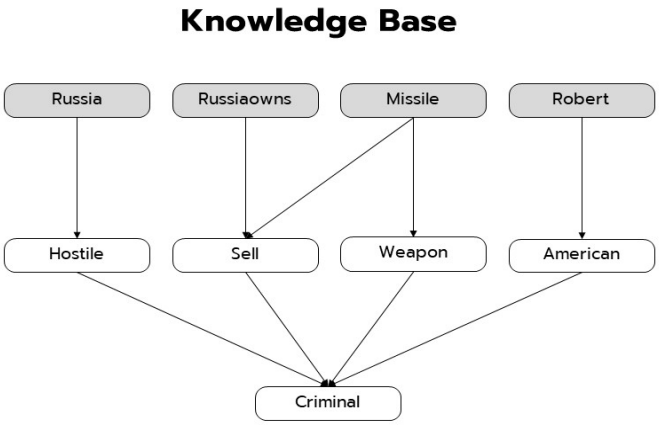
To apply forward and backward chaining algorithms in an AI system to solve a real-world problem, and compare their efficiency and accuracy in uncertain scenarios.

Lab Exercise

Write the program to find if goal statement is true using forward and backward chaining. Ask the user to provide the details of the goal statement.

Program Code

Example:

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#forward chaining in artificial intelligence

'''Knowledge Base in Horn Form
P=>Q
L^M=>P
B^L=>M
A^B=>L
A
B
'''
'''Function that reads knowledge base from file'''
def read_knoweledge_base(filename):
    kb = []
    facts=[]
    with open(filename,'r') as file:
        for line in file:
            rule = line.strip().split('=>')
            if len(rule) == 1:
                fac = rule[0].strip()
                facts.append(fac)
            else:
                consequent = rule[1].strip()
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                antecedents = rule[0].split('^')
                antecedents = [antecedent.strip() for antecedent in antecedents]
                kb1={"antecendts":antecedents,"consequent":consequent}
                kb.append(kb1)
    return kb,facts

'''Forward Chaining'''
'''While loop until there is no new facts were derived
Perform Forward Chaining'''
def forward(facts, knowledge_base):
    facts = set(facts)
    while True:
        new_facts = set()
        for rule in knowledge_base:
            if all(a in facts for a in rule['antecendts']):
                new_facts.add(rule['consequent'])

        if not new_facts.difference(facts):
            break

        facts.update(new_facts)
    return facts

'''The final list after performing Forward Chaining'''

print("\n**&&&***&&&***&&&***&&&***&&&***&&&***&&&***&&&***&&&***&&&***\n")
print("--------------- Results after performing forward chaining -----------\n")

knowledge_base2,facts2 = read_knoweledge_base('kb.txt')
re1 = forward(facts2,knowledge_base2)
if re1:
    for i in re1:print(i,end="  ")
    print(" - all this facts can be proven using initial facts:")
    for item in knowledge_base2:
        if item['consequent'] in re1:
            if type(item) == str:
                print(f"- {item}")
            else:
                print(f"- {' and '.join(item['antecendts'])} => {item['consequent']}")


'''Backward Chaining'''

'''Function for Backward Chaining that use recursion to
determine that goal is possible to derive from given knowledge base'''

def backward(goal, rules, facts, path=[]):
    # Check if the goal is already a fact
    if goal in facts:
        path.append(goal)
        return True, path

    # Check if the goal can be inferred from existing facts using a rule
    for rule in rules:
        if goal == rule["consequent"]:
            # Check if all the antecedents of the rule can be satisfied
            satisfied = True
            for antecedent in rule["antecendts"]:
                antecedent_proven, path = backward(antecedent, rules, facts, path)
                if not antecedent_proven:
                    satisfied = False
                    break
            if satisfied:
                # If all antecedents are satisfied, add the consequent as a fact and return
    True
                path.append(rule)
                facts.append(rule["consequent"])
                return True, path

    # If none of the rules can satisfy the goal, return False
    return False, path


print("\n**&&&***&&&***&&&***&&&***&&&***&&&***&&&***&&&***&&&***&&&***\n")
print("------------------- Results after performing backward chaining ---\n")

```

```python
knowledge_base3,facts3 = read_knoweledge_base('kb.txt')
print("------- Enter the Sentence that you want to Derive ------ ")
goal = str(input())


result, path = backward(goal, knowledge_base3, facts3)
if result:
    print(f"{goal} can be proven using the following facts and rules:")
    for item in path:
        if type(item) == str:
            print(f"- {item}")
        else:
            print(f"- {' and '.join(item['antecendts'])} => {item['consequent']}")
else:
    print(f"{goal} cannot be proven using the existing facts and rules.")
```

Output

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PS D:\SEM-5\AI\kb problrm> & C:/Users/ASUS/AppData/Local/Programs/Python/Python39/python.exe "d:/SEM-5/AI/kb problrm/fc and bc.py"


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----------------------------- Results after performing forward chaining ---------------------------------

Russiaowns  Hostile  Robert  Criminal  Sell  Missile  American  Weapon  Russia   - all this facts can be proven using initial facts:
- American and Weapon and Sell and Hostile => Criminal
- Robert => American
- Missile => Weapon
- Missile and Russiaowns => Sell
- Russia => Hostile


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----------------------------- Results after performing backward chaining ----------------------------------

------- Enter the Sentence that you want to Derive ------
Criminal
Criminal can be proven using the following facts and rules:
- Robert
- Robert => American
- Missile
- Missile => Weapon
- Missile
- Russiaowns
- Missile and Russiaowns => Sell
- Russia
- Russia => Hostile
- American and Weapon and Sell and Hostile => Criminal
PS D:\SEM-5\AI\kb problrm>
```

Conclusion

In conclusion, the application of forward and backward chaining algorithms in an AI system for the given knowledge base has shown the effectiveness of both approaches in inferring new information and achieving the desired goals. The backward chaining algorithm was able to determine that the sale of a missile from Russia to a hostile country is considered a criminal act based on the initial goal, starting from the conclusion and working backwards through the rules and facts in the knowledge base. On the other hand, the forward chaining algorithm was able to use the initial set of facts to derive new conclusions, which could be useful in real-world applications such as medical diagnosis or financial analysis. Overall, the success of the experiment highlights the importance of carefully choosing the appropriate algorithm based on the problem at hand and handling uncertainties and conflicts in the knowledge base to achieve accurate and reliable inference.