VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

ARTIFICIAL INTELLIGENCE

LAB REPORT

Submittedby

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Under the Guidance of

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in partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING

In

COMPUTER SCIENCE AND ENGINEERING

B.M.S. COLLEGE OF ENGINEERING

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(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Advance Data Structures Lab for Cycle 2 (CIE 2) carried out by**, SANNIDHI KASTURI(1BM19CS143)** who are Bonafede students of **B. M. S. College of Engineering.** It is in partial fulfilment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visveswaraiah Technological University, Belgaum during the year 2021-2022. The Lab report has been approved as it satisfies the academic requirements in respect of **ARTIFICIAL INTELLIGENCE (20CS5PCAIP)** work prescribed for the said degree.

SignatureoftheGuide	Signature of the HOD
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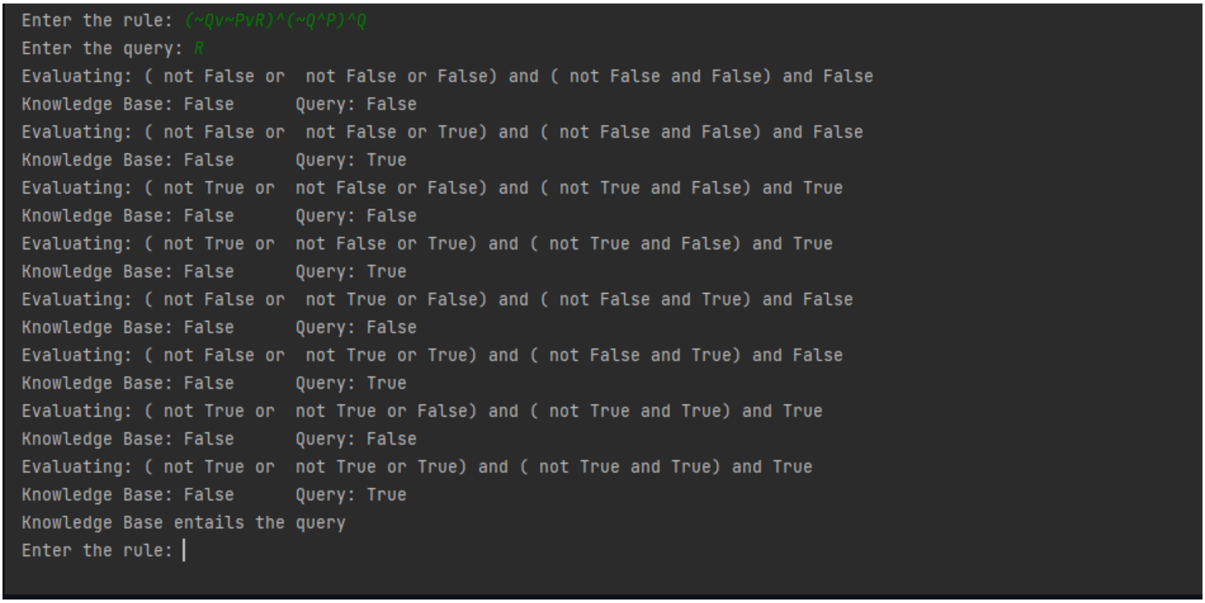
1. Create a knowledgebase using prepositional logic and show that the given query entails the knowledge base or not.

```
combinations=[(True,True, True),(True,True,False),(True,False,True),(True,False,
False),(False,True, True),(False,True, False),(False, False,True),(False,False, False)]
variable={'p':0,'q':1, 'r':2}
kb="
q="
priority={'~':3,'v':1,'^':2}


def input_rules():
    global kb, q
    kb = (input("Knowledge base : "))
    q = input("Query : ")


def entailment():
    global kb, q
    print("*10+"Truth Table Reference"+"*10)
    print('kb    α')
    print('-'*10)
    for comb in combinations:
        s = evaluatePostfix(toPostfix(kb), comb)
        f = evaluatePostfix(toPostfix(q), comb)
        print(s,  f)
        if s is True and f is False:
            return False
    return True


def isOperand(c):
    return c.isalpha() and c!='v'


def isLeftParanthesis(c):
    return c == '('


def isRightParanthesis(c):
    return c == ')'
```

```
def isEmpty(stack):
    return len(stack) == 0


def peek(stack):
    return stack[-1]


def hasLessOrEqualPriority(c1, c2):
    try:
        return priority[c1]<=priority[c2]
    except KeyError:
        return False


def toPostfix(infix):
    stack = []
    postfix = ''
    for c in infix:
        if isOperand(c):
            postfix += c
        else:
            if isLeftParanthesis(c):
                stack.append(c)
            elif isRightParanthesis(c):
                operator = stack.pop()
                while not isLeftParanthesis(operator):
                    postfix += operator
                    operator = stack.pop()
            else:
                while (not isEmpty(stack)) and hasLessOrEqualPriority(c, peek(stack)):
                    postfix += stack.pop()
                stack.append(c)
    while (not isEmpty(stack)):
        postfix += stack.pop()

    return postfix


def evaluatePostfix(exp, comb):
    stack = []
    for i in exp:
        if isOperand(i):
            stack.append(comb[variable[i]])
        elif i == '~':
            val1 = stack.pop()
            stack.append(not val1)
        else:
            val1 = stack.pop()
            val2 = stack.pop()
            stack.append(_eval(i,val2,val1))
    return stack.pop()


def _eval(i, val1, val2):
    if i == '^':
        return val2 and val1
    return val2 or val1


input_rules()
ans = entailment()
if ans:
    print("The Knowledge Base entails query")
    print(" KB |= α ")
else:
    print("The Knowledge Base does not entail query")
print("\n")
```

OUTPUT SCREENSHOT



```
Enter the rule: (~Qv~PvR)^(~Q^P)^Q
Enter the query: R
Evaluating: ( not False or  not False or False) and ( not False and False) and False
Knowledge Base: False      Query: False
Evaluating: ( not False or  not False or True) and ( not False and False) and False
Knowledge Base: False      Query: True
Evaluating: ( not True or  not False or False) and ( not True and False) and True
Knowledge Base: False      Query: False
Evaluating: ( not True or  not False or True) and ( not True and False) and True
Knowledge Base: False      Query: True
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Knowledge Base: False      Query: True
Evaluating: ( not True or  not True or False) and ( not True and True) and True
Knowledge Base: False      Query: False
Evaluating: ( not True or  not True or True) and ( not True and True) and True
Knowledge Base: False      Query: True
Knowledge Base entails the query
Enter the rule: 
```

2. Create a knowledgebase using prepositional logic and prove the given query using resolution.

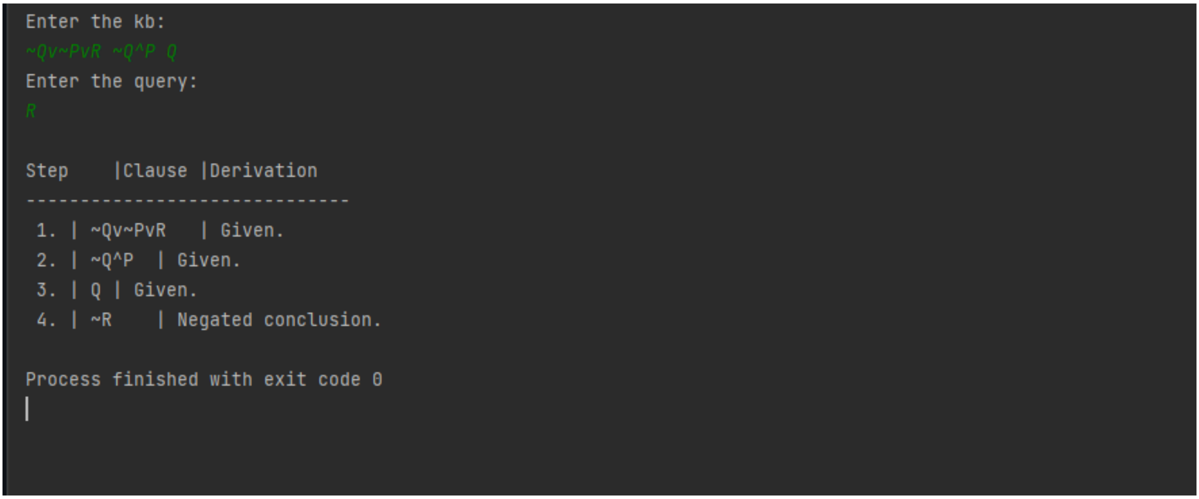
```
# Global variable kb (knowledge base)
kb = []

# Reset kb to an empty list
def Clear():
    global kb
    kb = []

# Insert sentence to the kb
def AddSentence(sentence):
    global kb
    # If the sentence is a clause, insert directly.
    if isClause(sentence):
        kb.append(sentence)
    # If not, convert to CNF, and then insert clauses one by one.
    else:
        sentenceCNF = convertCNF(sentence)
        if not sentenceCNF:
            print("Illegal input")
            return
        # Insert clauses one by one when there are multiple clauses
        if isAndList(sentenceCNF):
            for s in sentenceCNF[1:]:
                kb.append(s)
        else:
            kb.append(sentenceCNF)

# 'Query' the kb whether a sentence is True or not
def Query(sentence):
    global kb
    # Negate the sentence, and convert it to CNF accordingly.
    if isClause(sentence):
        neg = negation(sentence)
    else:
        sentenceCNF = convertCNF(sentence)
        if not sentenceCNF:
            print("Illegal input")
            return
        neg = convertCNF(negation(sentenceCNF))
    # Insert individual clauses that we need to ask to ask_list.
    ask_list = []
    if isAndList(neg):
        for n in neg[1:]:
            nCNF = makeCNF(n)
            if type(nCNF).__name__== 'list':
                ask_list.insert(0, nCNF)
            else:
                ask_list.insert(0, nCNF)
    else:
        ask_list = [neg]
# Create a new list combining the asked sentence and kb.
    # Resolution will happen between the items in the list.
    clauses = ask_list + kb[:]

    # Recursivly conduct resoltion between items in the clauses list
    # until it produces an empty list or there's no more pregress.
    while True:
        new_clauses = []
        for c1 in clauses:
            for c2 in clauses:
                if c1 is not c2:
                    resolved = resolve(c1, c2)
                    if resolved == False:
                        continue
                    if resolved == []:
                        return True
                    new_clauses.append(resolved)

        if len(new_clauses) == 0:
            return False
        new_in_clauses = True
        for n in new_clauses:
            if n not in clauses:
                new_in_clauses = False
                clauses.append(n)
        if new_in_clauses:
            return False
    return False
# Conduct resolution on two CNF clauses.
def resolve(arg_one, arg_two):
    resolved = False
```

```
s1 = make_sentence(arg_one)
s2 = make_sentence(arg_two)

resolve_s1 = None
resolve_s2 = None

# Two for loops that iterate through the two clauses.
for i in s1:
    if isNotList(i):
        a1 = i[1]
        a1_not = True
    else:
        a1 = i
        a1_not = False

    for j in s2:
        if isNotList(j):
            a2 = j[1]
            a2_not = True
        else:
            a2 = j
            a2_not = False

        # cancel out two literals such as 'a' $ ['not', 'a']
        if a1 == a2:
            if a1_not != a2_not:
                # Return False if resolution already happend
                # but contradiction still exists.
                if resolved:
                    return False
                else:
                    resolved = True
                    resolve_s1 = i
                    resolve_s2 = j
                    break
                # Return False if not resolution happened
if not resolved:
    return False
# Remove the literals that are canceled
s1.remove(resolve_s1)
s2.remove(resolve_s2)
```

```
    # # Remove duplicates
    result = clear_duplicate(s1 + s2)

    # Format the result.
     if len(result) == 1:
        return result[0]
    elif len(result) > 1:
        result.insert(0, 'or')

    return result

# Prepare sentences for resolution.
def make_sentence(arg):
    if isLiteral(arg) or isNotList(arg):
        return [arg]
    if isOrList(arg):
        return clear_duplicate(arg[1:])
    return

# Clear out duplicates in a sentence.
def clear_duplicate(arg):
    result = []
    for i in range(0, len(arg)):
        if arg[i] not in arg[i+1:]:
            result.append(arg[i])
    return result

# Check whether a sentence is a legal CNF clause.
def isClause(sentence):
    if isLiteral(sentence):
        return True
    if isNotList(sentence):
        if isLiteral(sentence[1]):
            return True
        else:
            return False
    if isOrList(sentence):
        for i in range(1, len(sentence)):
            if len(sentence[i]) > 2:
                return False
            elif not isClause(sentence[i]):
                return False
        return True
    return False

# Check if a sentence is a legal CNF.
def isCNF(sentence):
    if isClause(sentence):
        return True
    elif isAndList(sentence):
        for s in sentence[1:]:
            if not isClause(s):
                return False
        return True
    return False

# Negate a sentence.
def negation(sentence):
    if isLiteral(sentence):
        return ['not', sentence]
    if isNotList(sentence):
        return sentence[1]

    # DeMorgan:
    if isAndList(sentence):
        result = ['or']
        for i in sentence[1:]:
            if isNotList(sentence):
                result.append(i[1])
            else:
                result.append(['not', sentence])
        return result
    if isOrList(sentence):
        result = ['and']
        for i in sentence[:]:
            if isNotList(sentence):
                result.append(i[1])
            else:
                result.append(['not', i])
        return result
    return None

# Convert a sentence into CNF.
def convertCNF(sentence):
    while not isCNF(sentence):
        if sentence is None:
            return None
        sentence = makeCNF(sentence)
    return sentence


def makeCNF(sentence):
   if isLiteral(sentence):
        return sentence

    if (type(sentence).__name__== 'list'):
        operand = sentence[0]
        if isNotList(sentence):
            if isLiteral(sentence[1]):
                return sentence
            cnf = makeCNF(sentence[1])
            if cnf[0] == 'not':
                return makeCNF(cnf[1])
            if cnf[0] == 'or':
                result = ['and']
                for i in range(1, len(cnf)):
                    result.append(makeCNF(['not', cnf[i]]))
                return result
            if cnf[0] == 'and':
                result = ['or']
                for i in range(1, len(cnf)):
                    result.append(makeCNF(['not', cnf[i]]))
                return result
            return "False: not"

        # Implication Elimination:
        if operand == 'implies' and len(sentence) == 3:
            return makeCNF(['or', ['not', makeCNF(sentence[1])], makeCNF(sentence[2])])
            # Biconditional Elimination:
        if operand == 'biconditional' and len(sentence) == 3:
            s1 = makeCNF(['implies', sentence[1], sentence[2]])
            s2 = makeCNF(['implies', sentence[2], sentence[1]])
            return makeCNF(['and', s1, s2])

        if isAndList(sentence):
            result = ['and']
            for i in range(1, len(sentence)):
                cnf = makeCNF(sentence[i])
                # Distributivity:
                if isAndList(cnf):
                    for i in range(1, len(cnf)):
                        result.append(makeCNF(cnf[i]))
                    continue
                result.append(makeCNF(cnf))
            return result

        if isOrList(sentence):
            result1 = ['or']
            for i in range(1, len(sentence)):
                cnf = makeCNF(sentence[i])
                # Distributivity:
                if isOrList(cnf):
                    for i in range(1, len(cnf)):
                        result1.append(makeCNF(cnf[i]))
                    continue
                result1.append(makeCNF(cnf))
                # Associativity:
            while True:
                result2 = ['and']
                and_clause = None
                for r in result1:
                    if isAndList(r):
                        and_clause = r
                        break

                # Finish when there's no more 'and' lists
                # inside of 'or' lists
                if not and_clause:
                    return result1

                result1.remove(and_clause)

                for i in range(1, len(and_clause)):
                    temp = ['or', and_clause[i]]
                    for o in result1[1:]:
                        temp.append(makeCNF(o))
                    result2.append(makeCNF(temp))
                result1 = makeCNF(result2)
                return None
        return None


# Below are 4 functions that check the type of a variable
def isLiteral(item):
    if type(item).__name__== 'str':
        return True
    return False


def isNotList(item):
    if type(item).__name__== 'list':
        if len(item) == 2:
            if item[0] == 'not':
                return True
    return False


def isAndList(item):
    if type(item).__name__== 'list':
        if len(item) > 2:
            if item[0] == 'and':
                return True
    return False


def isOrList(item):
    if type(item).__name__== 'list':
        if len(item) > 2:
            if item[0] == 'or':
                return True
    return False

AddSentence(['and', 'p', 'q'])
AddSentence(['or', 'r', 's'])
print(Query(['and',['or','p','r'], ['or', 'q', 's']]))
```

OUTPUT SCREENSHOT

Test Case 1:



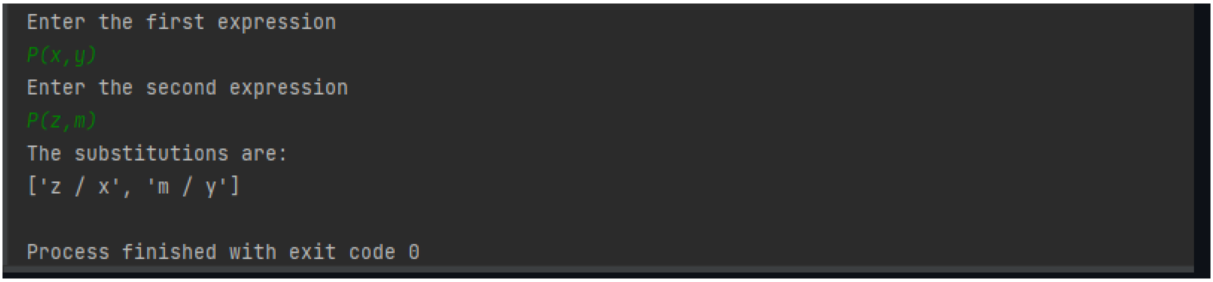
```
Enter the kb:
~Qv~PvR ~Q^P Q
Enter the query:
R

Step    |Clause |Derivation
------------------------------
 1. | ~Qv~PvR   | Given.
 2. | ~Q^P  | Given.
 3. | Q | Given.
 4. | ~R    | Negated conclusion.

Process finished with exit code 0
```

NEGATED CONCLUSION→NULL SET→PROVED.

3. Implement unification in first order logic.

```
import re

def getAttributes(expression):
    expression = expression.split("(")[1:]
    expression = "(".join(expression)
    expression = expression[:-1]
    expression = re.split("(?<!\(.),(?!.\))", expression)
    return expression


def getInitialPredicate(expression):
    return expression.split("(")[0]

def isConstant(char):
    return char.isupper() and len(char) == 1

def isVariable(char):
    return char.islower() and len(char) == 1

def replaceAttributes(exp, old, new):
    attributes = getAttributes(exp)
    for index, val in enumerate(attributes):
        if val == old:
            attributes[index] = new
    predicate = getInitialPredicate(exp)
    return predicate + "(" + ",".join(attributes) + ")"

def apply(exp, substitutions):
    for substitution in substitutions:
        new, old = substitution
        exp = replaceAttributes(exp, old, new)
    return exp

def checkOccurs(var, exp):
    if exp.find(var) == -1:
        return False
    return True


def getFirstPart(expression):
    attributes = getAttributes(expression)
    return attributes[0]


def getRemainingPart(expression):
    predicate = getInitialPredicate(expression)
    attributes = getAttributes(expression)
    newExpression = predicate + "(" + ",".join(attributes[1:]) + ")"
    return newExpression

def unify(exp1, exp2):
    if exp1 == exp2:
        return []

    if isConstant(exp1) and isConstant(exp2):
        if exp1 != exp2:
            return False

    if isConstant(exp1):
        return [(exp1, exp2)]

    if isConstant(exp2):
        return [(exp2, exp1)]

    if isVariable(exp1):
        if checkOccurs(exp1, exp2):
            return False
        else:
            return [(exp2, exp1)]

    if isVariable(exp2):
        if checkOccurs(exp2, exp1):
            return False
        else:
            return [(exp1, exp2)]

    if getInitialPredicate(exp1) != getInitialPredicate(exp2):
        print("Predicates do not match. Cannot be unified")
        return False

    attributeCount1 = len(getAttributes(exp1))
    attributeCount2 = len(getAttributes(exp2))
    if attributeCount1 != attributeCount2:
        return False

    head1 = getFirstPart(exp1)
    head2 = getFirstPart(exp2)
    initialSubstitution = unify(head1, head2)
    if not initialSubstitution:
        return False
    if attributeCount1 == 1:
        return initialSubstitution

    tail1 = getRemainingPart(exp1)
    tail2 = getRemainingPart(exp2)

    if initialSubstitution != []:
        tail1 = apply(tail1, initialSubstitution)
        tail2 = apply(tail2, initialSubstitution)

    remainingSubstitution = unify(tail1, tail2)
    if not remainingSubstitution:
        return False

    initialSubstitution.extend(remainingSubstitution)
    return initialSubstitution

print("\n\nTest Case 1:\n")
exp1 = "knows(A,x)"
exp2 = "knows(y,Y)"
substitutions = unify(exp1, exp2)
print("Substitutions:")
print(substitutions)

print("\n\nTest Case 2:\n")
exp1 = "knows(A,x)"
exp2 = "knows(y,mother(y))"
substitutions = unify(exp1, exp2)
print("Substitutions:")
print(substitutions)
```

OUTPUT SCREENSHOT

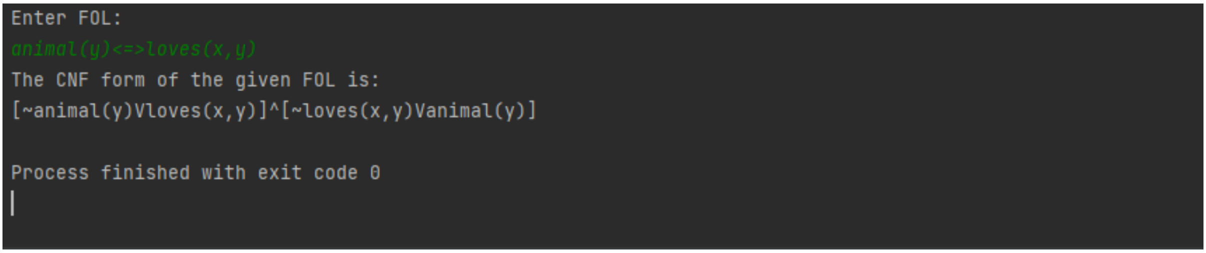


```
Enter the first expression
P(x,y)
Enter the second expression
P(z,m)
The substitutions are:
['z / x', 'm / y']

Process finished with exit code 0
```

4. Convert given first order logic statement into Conjunctive Normal Form (CNF).

```
def getAttributes(string):
    expr = '\([^)]+\)'
    matches = re.findall(expr, string)
    return [m for m in str(matches) if m.isalpha()]

def getPredicates(string):
    expr = '[a-z~]+\([A-Za-z,]+\)'
    return re.findall(expr, string)

def DeMorgan(sentence):
    string = ".join(list(sentence).copy())
    string = string.replace('~~',")
    flag = '[' in string
    string = string.replace('~[',")
    string = string.strip(']')
    for predicate in getPredicates(string):
        string = string.replace(predicate, f'~{predicate}')
    s = list(string)
    for i, c in enumerate(string):
        if c == '|':
            s[i] = '&'
        elif c == '&':
            s[i] = '|'
    string = ".join(s)
    string = string.replace('~~',")
    return f'[{string}]' if flag else string

def Skolemization(sentence):
    SKOLEM_CONSTANTS = [f'{chr(c)}' for c in range(ord('A'), ord('Z')+1)]
    statement = ".join(list(sentence).copy())
    matches = re.findall('[∀ ∃ ].',
    statement) for match in matches[::-1]:
        statement = statement.replace(match, ")
        statements = re.findall('\[\[[^]]+\]]', statement)
        for s in statements:
            statement = statement.replace(s, s[1:-1])
        for predicate in getPredicates(statement):
            attributes = getAttributes(predicate)
            if ".join(attributes).islower():
                statement = statement.replace(match[1],SKOLEM_CONSTANTS.pop(0))
            else:
                aU = [a for a in attributes if not a.islower()][0]
                statement = statement.replace(aU,
f'{SKOLEM_CONSTANTS.pop(0)}({match[1]})')
    return statement


import re

def fol_to_cnf(fol):

    statement = fol.replace("<=>", "_")
    while '_' in statement:
        i = statement.index('_')
        new_statement = '[' + statement[:i] + '=>' + statement[i+1:] + ']&['+ statement[i+1:] +
'=>' + statement[:i] + ']'
        statement = new_statement
    statement = statement.replace("=>", "-")
    expr = '\[([^]]+)\]'
    statements = re.findall(expr, statement)
    for i, s in enumerate(statements):
        if '[' in s and ']' not in s:
            statements[i] += ']'
    for s in statements:
        statement = statement.replace(s, fol_to_cnf(s))
    while '-' in statement:
        i = statement.index('-')
        br = statement.index('[') if '[' in statement else 0
        new_statement = '~' + statement[br:i] + '|' + statement[i+1:]
        statement = statement[:br] + new_statement if br > 0 else new_statement
    while '~∀ ' in statement:
        i = statement.index('~∀ ')
        statement = list(statement)
        statement[i], statement[i+1], statement[i+2] = '∃ ', statement[i+2],
        '~' statement = ".join(statement)
    while '~∃ ' in statement:
        i =
        statement.index('~∃ ') s
        = list(statement)
        s[i], s[i+1], s[i+2] = '∀ ', s[i+2],
        '~' statement = ".join(s)
    statement = statement.replace('~[∀ ','[~∀ ')
    statement =
    statement.replace('~[∃ ','[~∃ ') expr =
    '(~[∀ |∃ ].)'
    statements = re.findall(expr, statement)
    for s in statements:
        statement = statement.replace(s, fol_to_cnf(s))
    expr = '~\[[^]]+\]'
    statements = re.findall(expr, statement)
    for s in statements:
        statement = statement.replace(s, DeMorgan(s))
    return statement


print("\n Test Case: 1")

print(Skolemization(fol_to_cnf("animal(y)<=>loves(x,y)")))

print("\n Test Case: 2")

print(Skolemization(fol_to_cnf("∀ x[∀ y[animal(y)=>loves(x,y)]]=>[∃ z[loves(z,x)]]

"))) print("\n Test Case: 3")

print(Skolemization(fol_to_cnf("[american(x)&weapon(y)&sells(x,y,z)&hostile(z)]=>crim
inal(x)")))

print("\n \n ")
```

OUTPUT SCREENSHOT

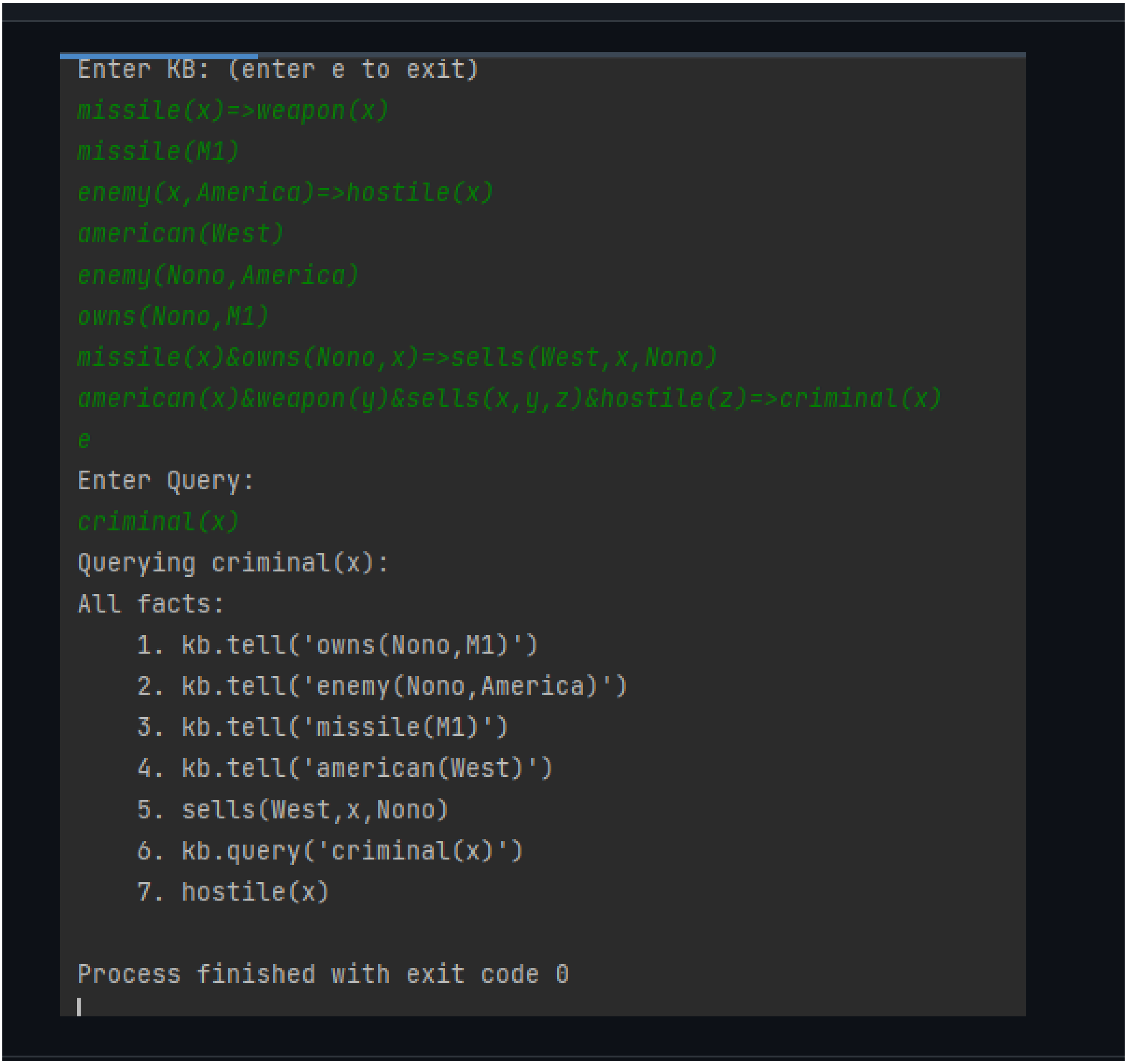


```
Enter FOL:
animal(y)<=>loves(x,y)
The CNF form of the given FOL is:
[~animal(y)Vloves(x,y)]^[~loves(x,y)Vanimal(y)]

Process finished with exit code 0
```

5. Create a knowledgebase consisting of first order logic statements and prove the given query using forward reasoning.

```
import re

def isVariable(x):
    return len(x) == 1 and x.islower() and x.isalpha()

def getAttributes(string):
    expr = '\([^)]+\)'
    matches = re.findall(expr, string)
    return matches

def getPredicates(string):
    expr = '([a-z~]+)\([^&|]+\)'
    return re.findall(expr, string)

class Fact:
    def_init_(self, expression):
        self.expression = expression
        predicate, params = self.splitExpression(expression)
        self.predicate = predicate
        self.params = params
        self.result = any(self.getConstants())

    def splitExpression(self, expression):
        predicate = getPredicates(expression)[0]
        params = getAttributes(expression)[0].strip('()').split(',')
        return [predicate, params]

    def getResult(self):
        return self.result

    def getConstants(self):
        return [None if isVariable(c) else c for c in self.params]

    def getVariables(self):
        return [v if isVariable(v) else None for v in self.params]

    def substitute(self, constants):
        c = constants.copy()
        f = f"{self.predicate}({','.join([constants.pop(0) if isVariable(p) else p for p in
self.params])})"
        return Fact(f)

class Implication:
    def_init_(self, expression):
        self.expression = expression
        l = expression.split('=>')
        self.lhs = [Fact(f) for f in l[0].split('&')]
        self.rhs = Fact(l[1])

    def evaluate(self, facts):
        constants = {}
        new_lhs = []
        for fact in facts:
            for val in self.lhs:
                if val.predicate == fact.predicate:
                    for i, v in enumerate(val.getVariables()):
                        if v:
                            constants[v] = fact.getConstants()[i]
                    new_lhs.append(fact)
        predicate, attributes = getPredicates(self.rhs.expression)[0],
str(getAttributes(self.rhs.expression)[0])
        for key in constants:
            if constants[key]:
                attributes = attributes.replace(key, constants[key])
        expr = f'{predicate}{attributes}'
        return Fact(expr) if len(new_lhs) and all([f.getResult() for f in new_lhs]) else None

class KB:
    def__init__(self):
        self.facts = set()
        self.implications = set()

    def tell(self, e):
        if '=>' in e:
            self.implications.add(Implication(e))
        else:
            self.facts.add(Fact(e))
        for i in self.implications:
            res = i.evaluate(self.facts)
            if res:
                self.facts.add(res)

    def query(self, e):
        facts = set([f.expression for f in self.facts])
        i = 1
        print(f'Querying {e}:')
        for f in facts:
            if Fact(f).predicate == Fact(e).predicate:
                print(f'\t{i}. {f}')
                i += 1

    def display(self):
        print("All facts: ")
        for i, f in enumerate(set([f.expression for f in self.facts])):
            print(f'\t{i+1}. {f}')

print("\n \n Test Case 1:")

kb = KB()
kb.tell('missile(x)=>weapon(x)')
kb.tell('missile(M1)')
kb.tell('enemy(x,America)=>hostile(x)')
kb.tell('american(West)')
kb.tell('enemy(Nono,America)')
kb.tell('owns(Nono,M1)')
kb.tell('missile(x)&owns(Nono,x)=>sells(West,x,Nono)')
kb.tell('american(x)&weapon(y)&sells(x,y,z)&hostile(z)=>criminal(x)')
kb.query('criminal(x)')
kb.display()


print("\n \n Test Case 2:")

kb_ = KB()
kb_.tell('king(x)&greedy(x)=>evil(x)')
kb_.tell('king(John)')
kb_.tell('greedy(John)')
kb_.tell('king(Richard)')
kb_.query('evil(x)')
```

OUTPUT SCREENSHOT



```
Enter KB: (enter e to exit)
missile(x)=>weapon(x)
missile(M1)
enemy(x,America)=>hostile(x)
american(West)
enemy(Nono,America)
owns(Nono,M1)
missile(x)&owns(Nono,x)=>sells(West,x,Nono)
american(x)&weapon(y)&sells(x,y,z)&hostile(z)=>criminal(x)
e
Enter Query:
criminal(x)
Querying criminal(x):
All facts:
    1. kb.tell('owns(Nono,M1)')
    2. kb.tell('enemy(Nono,America)')
    3. kb.tell('missile(M1)')
    4. kb.tell('american(West)')
    5. sells(West,x,Nono)
    6. kb.query('criminal(x)')
    7. hostile(x)

Process finished with exit code 0
```