VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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ARTIFICIAL INTELLIGENCE

LAB REPORT

Submitted by

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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

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(Autonomous Institution under VTU)

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B. M. S. College of Engineering,

Bull Temple Road, Bangalore 560019

(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the ARTIFICIAL INTELLIGEENCE Lab for Cycle 2 (CIE 2) carried out by, S K BALAJI (1BM19CS134) 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.

Signature of the Guide

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1. Create a knowledge base 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

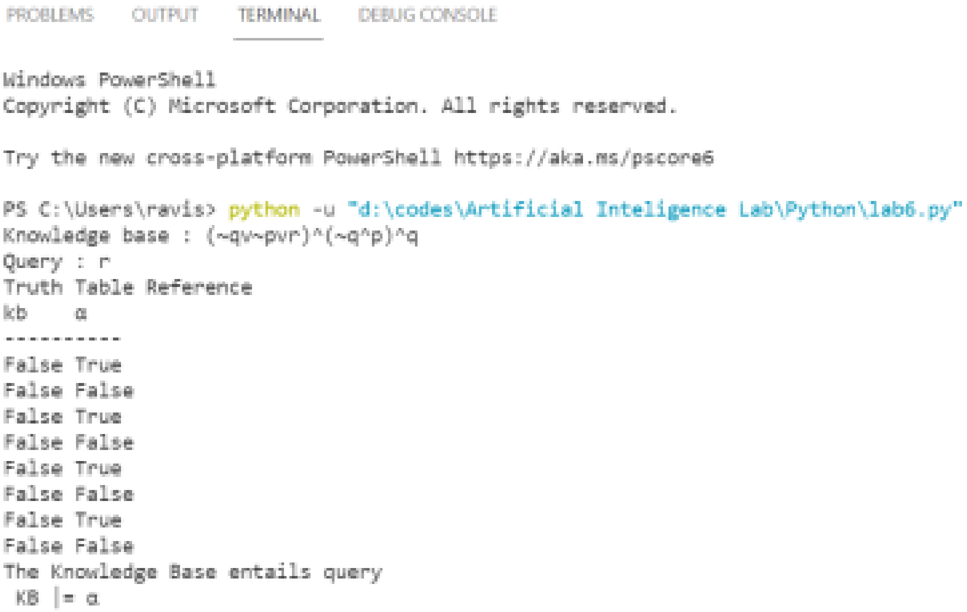

def evaluatePostfix(exp, comb):
    stack = []
    for i in exp:
        if isOperand(i):
            stack.append(comb[variable[i]])
        elif i == '~':
            val1 = stack.pop()
            stack.append(not val1)
        else:
            val1 = stack.pop()
            val2 = stack.pop()
 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

Test Case 1:



```
Windows PowerShell
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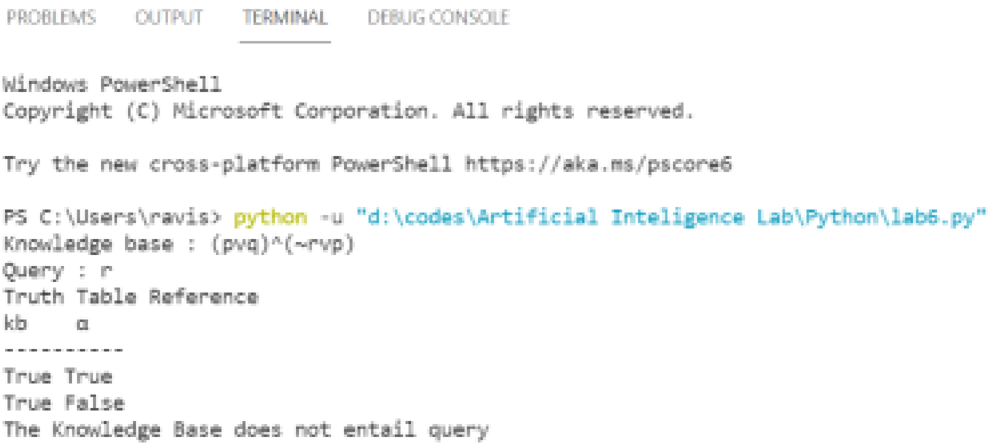
Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\ravis> python -u "d:\codes\Artificial Inteligence Lab\Python\lab6.py"
Knowledge base : (~qv~pvr)^(~q^p)^q
Query : r
Truth Table Reference
kb    α
----------
False True
False False
False True
False False
False True
False False
False True
False False
The Knowledge Base entails query
 KB |= α
```

Test Case 2:



```
Windows PowerShell
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Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\ravis> python -u "d:\codes\Artificial Inteligence Lab\Python\lab6.py"
Knowledge base : (pvq)^(~rvp)
Query : r
Truth Table Reference
kb    α
----------
True True
True False
The Knowledge Base does not entail query
```

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

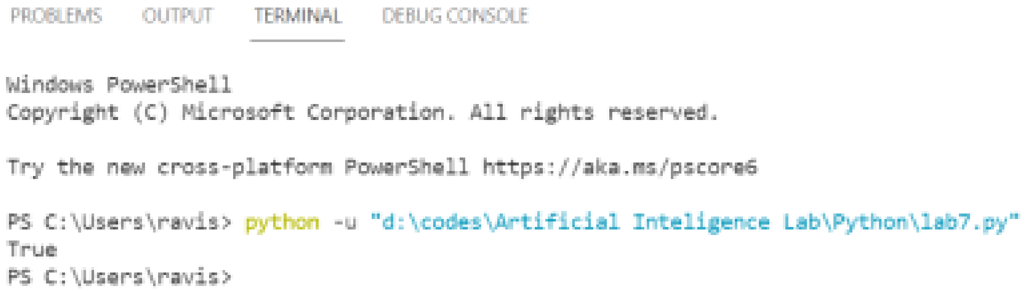

def isOrList(item):
    if type(item).__name__ == 'list':
        if len(item) > 2:
            if item[0] == 'or':
```

```
            return True
    return False

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

OUTPUT SCREEN

Test Case 1:



```
Windows PowerShell
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Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\ravis> python -u "d:\codes\Artificial Inteligence Lab\Python\lab7.py"
True
PS C:\Users\ravis>
```

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)

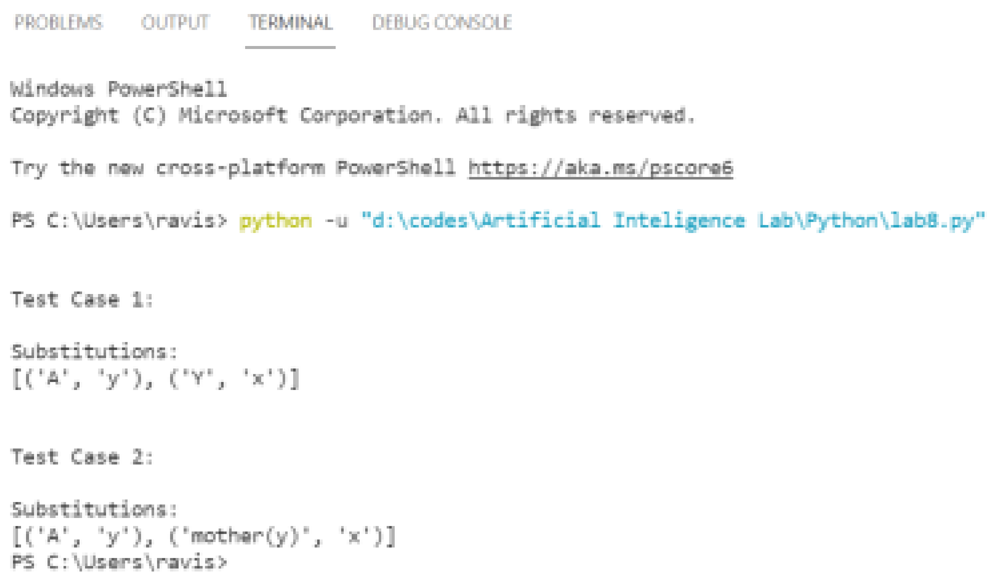
    remainingSubstitution = unify(tail1,
    tail2) if not remainingSubstitution:
        return False

    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 SCREEN



```
Windows PowerShell
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PS C:\Users\ravis> python -u "d:\codes\Artificial Inteligence Lab\Python\lab8.py"


Test Case 1:

Substitutions:
[('A', 'y'), ('Y', 'x')]


Test Case 2:

Substitutions:
[('A', 'y'), ('mother(y)', 'x')]
PS C:\Users\ravis>
```

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)")))

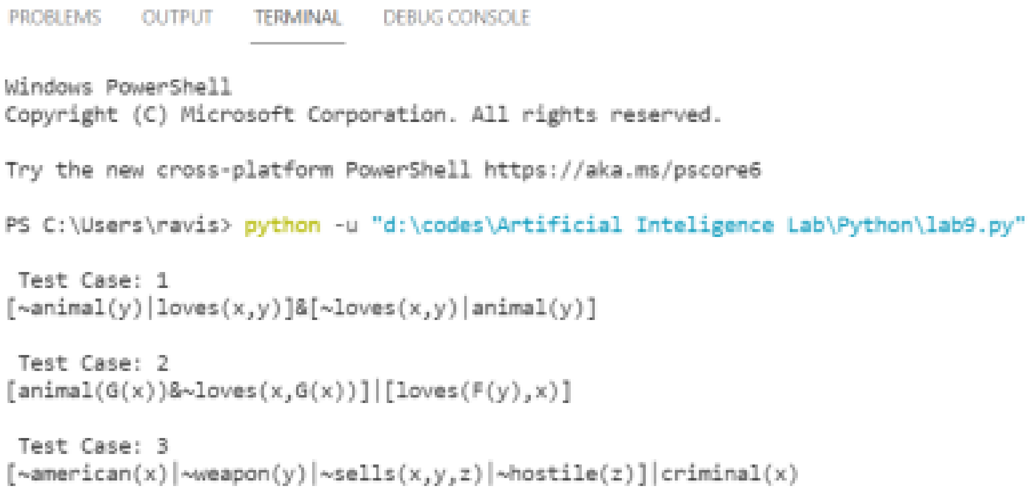
print("\n Test Case: 2")

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)]=>criminal(x)")))

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

OUTPUT SCREEN



```
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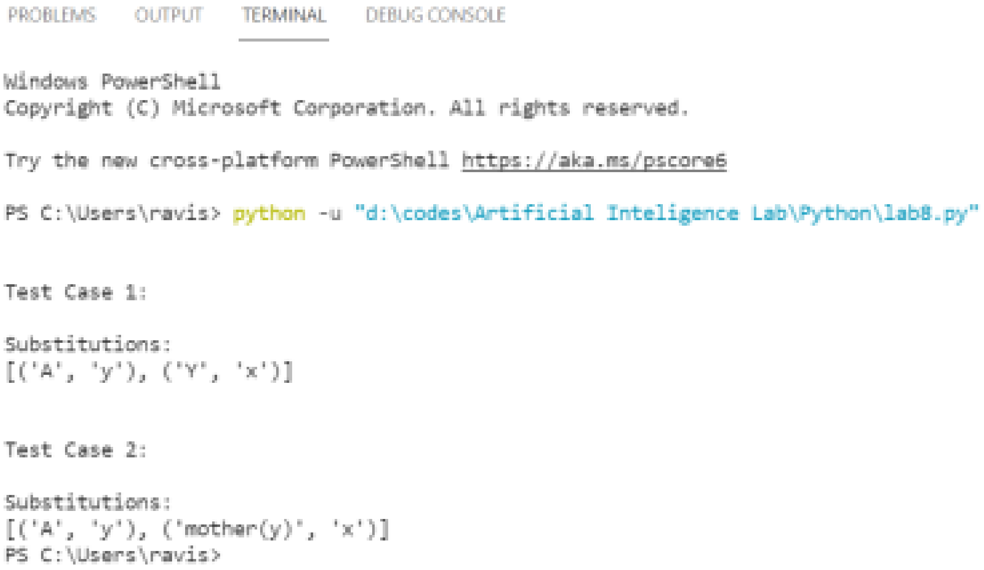
PS C:\Users\ravis> python -u "d:\codes\Artificial Inteligence Lab\Python\lab9.py"

 Test Case: 1
[~animal(y)|loves(x,y)]&[~loves(x,y)|animal(y)]

 Test Case: 2
[animal(G(x))&~loves(x,G(x))]|[loves(F(y),x)]

 Test Case: 3
[~american(x)|~weapon(y)|~sells(x,y,z)|~hostile(z)]|criminal(x)
```



```
Windows PowerShell
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Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\ravis> python -u "d:\codes\Artificial Inteligence Lab\Python\lab8.py"


Test Case 1:

Substitutions:
[('A', 'y'), ('Y', 'x')]


Test Case 2:

Substitutions:
[('A', 'y'), ('mother(y)', 'x')]
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```

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}')

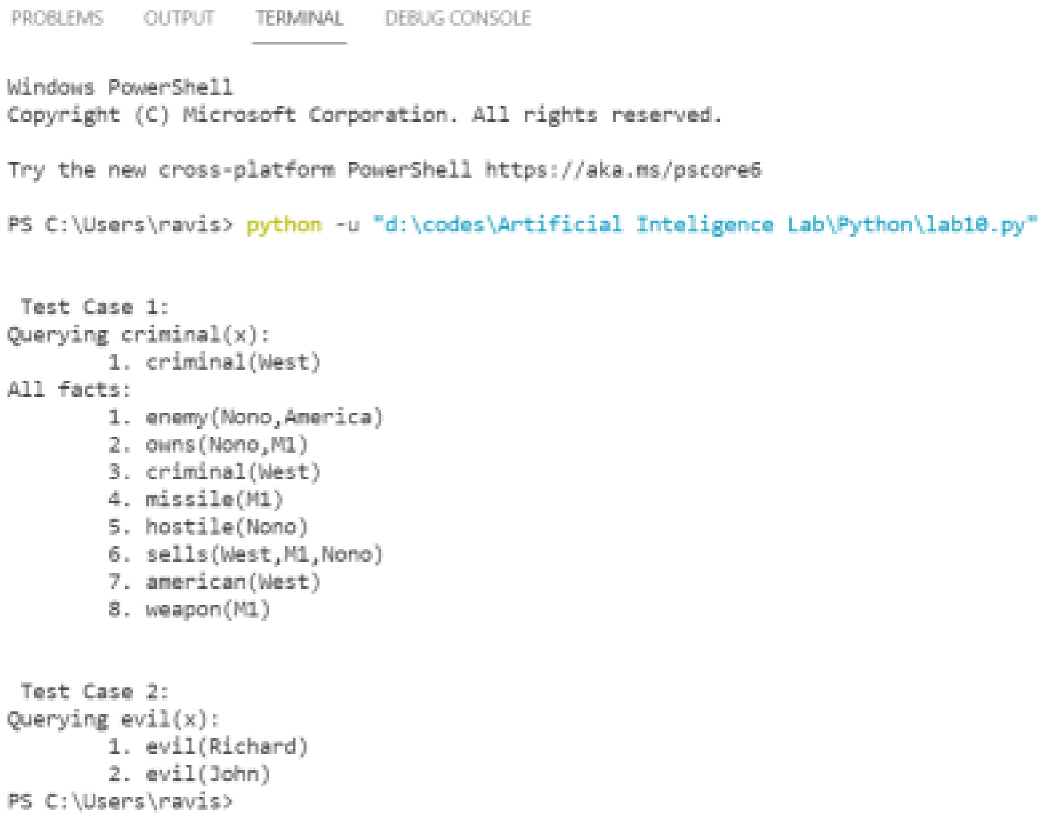
print("\n \n Test Case 1:")

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 SCREEN



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PS C:\Users\ravis> python -u "d:\codes\Artificial Inteligence Lab\Python\lab10.py"


 Test Case 1:
Querying criminal(x):
        1. criminal(West)
All facts:
        1. enemy(Nono,America)
        2. owns(Nono,M1)
        3. criminal(West)
        4. missile(M1)
        5. hostile(Nono)
        6. sells(West,M1,Nono)
        7. american(West)
        8. weapon(M1)


 Test Case 2:
Querying evil(x):
        1. evil(Richard)
        2. evil(John)
PS C:\Users\ravis>
```