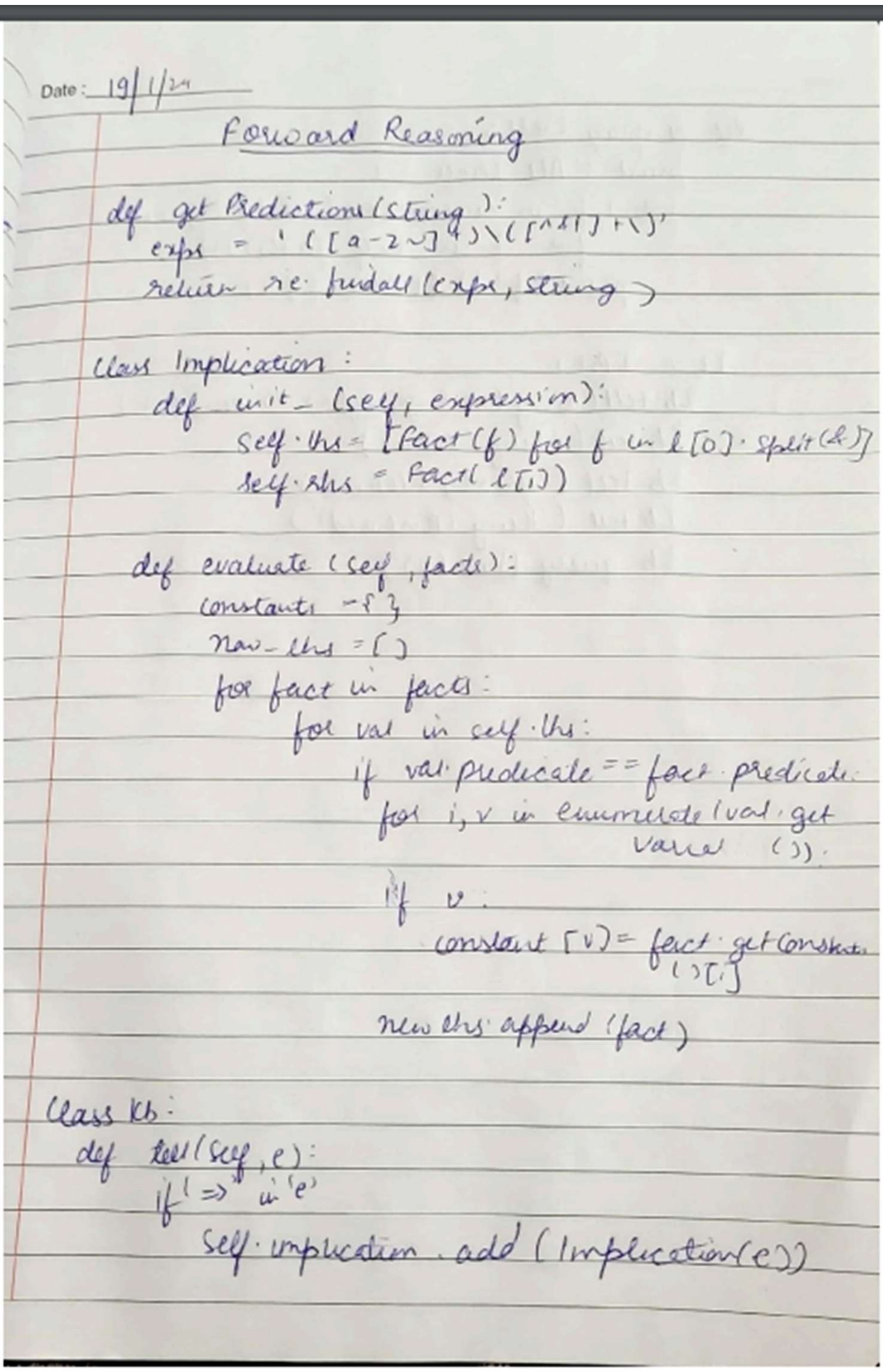
Program 10 : Forward Reasoning

Code:

```
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("Kanjika Singh-1BM21CS086")
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("Kanjika Singh-1BM21CS086")

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)')
```

Observation:



Date : 19/1/24

Forward Reasoning

```
def get Predictions(string):
    exps = '([a-z~]+)\([^&|]+\)'
    return re.findall(exps, string)

class Implication:
    def init_(self, expression):
        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.get
                                    Varia  ()).
                if v:
                    constant[v] = fact.getConstant
                                   ()[i]
                new lhs.append(fact)

class Kb:
  def tell(self, e):
      if '=>' in 'e'
      Self.implication.add(Implication(e))
```

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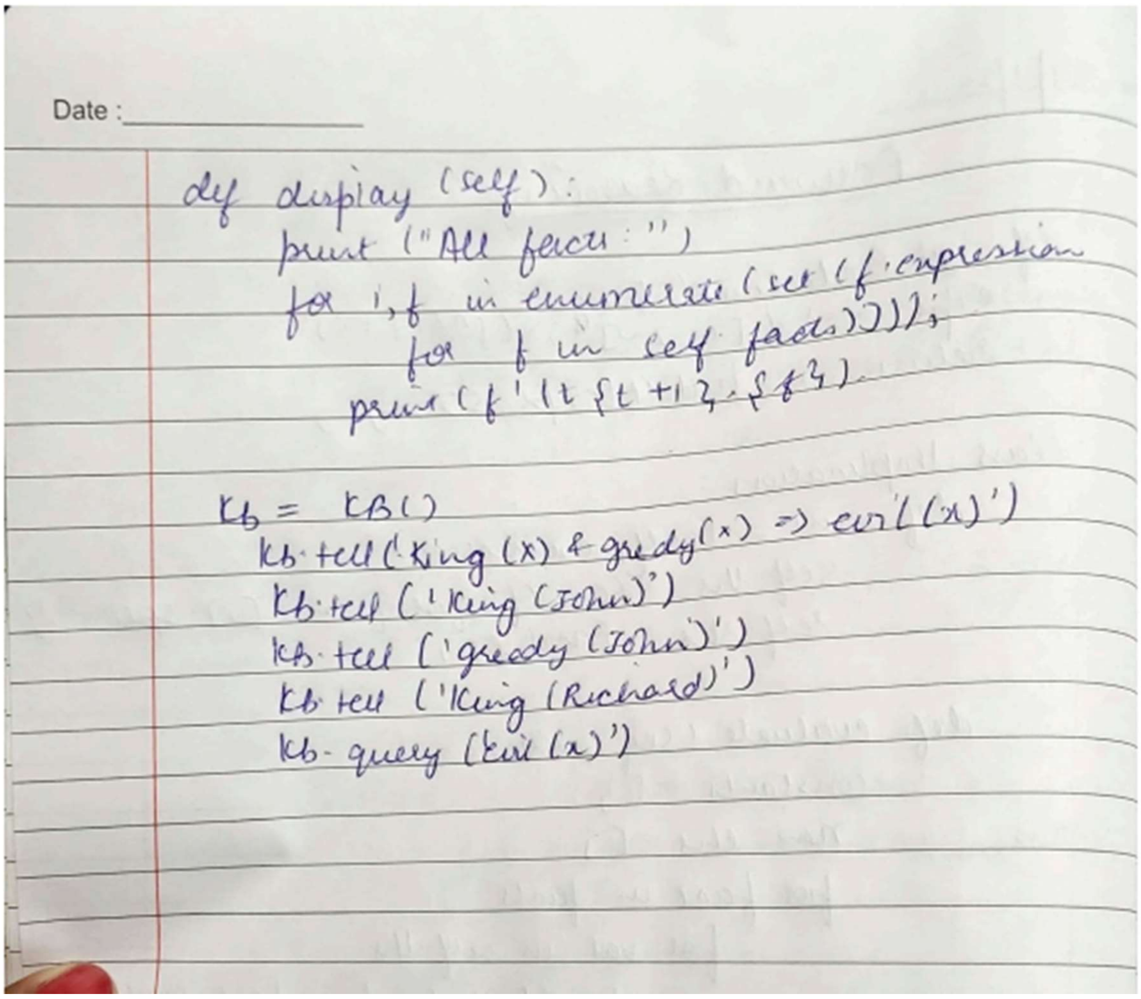
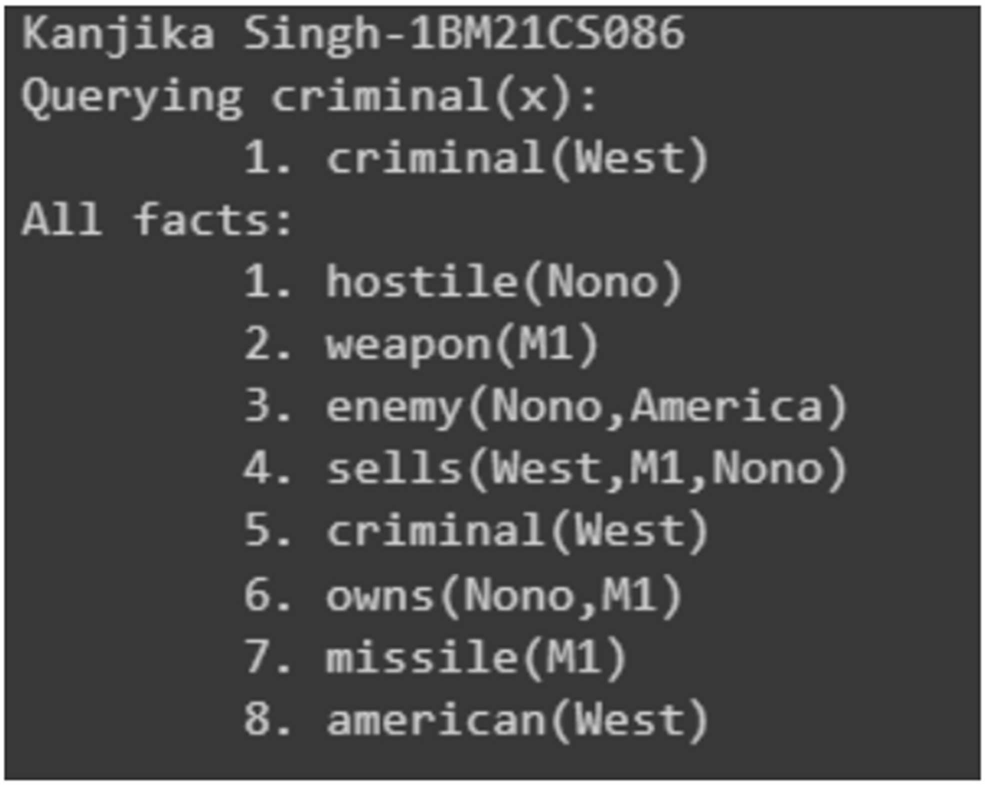


Date :

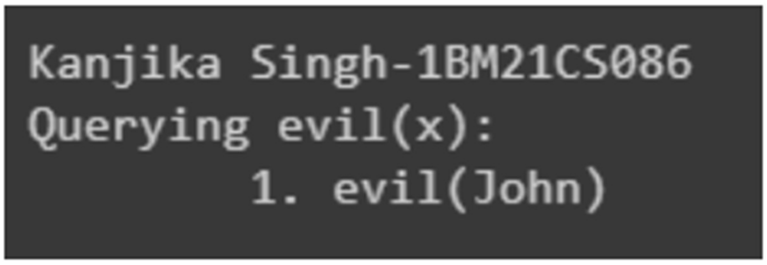
```
def display (self):
    print ("All facts: ")
    for i,f in enumerate (set (f.expression
            for f in self.facts))));
        print(f'\t {i+1}. {f}')

kb = KB()
  kb.tell('King (x) & gredy(x) => evil((x)')
  kb.tell ('King (John)')
  kb.tell ('greedy (John)')
  kb.tell ('King (Richard)')
  kb.query ('evil (x)')
```

Output:



```
Kanjika Singh-1BM21CS086
Querying criminal(x):
        1. criminal(West)
All facts:
        1. hostile(Nono)
        2. weapon(M1)
        3. enemy(Nono,America)
        4. sells(West,M1,Nono)
        5. criminal(West)
        6. owns(Nono,M1)
        7. missile(M1)
        8. american(West)
```



```
Kanjika Singh-1BM21CS086
Querying evil(x):
        1. evil(John)
```