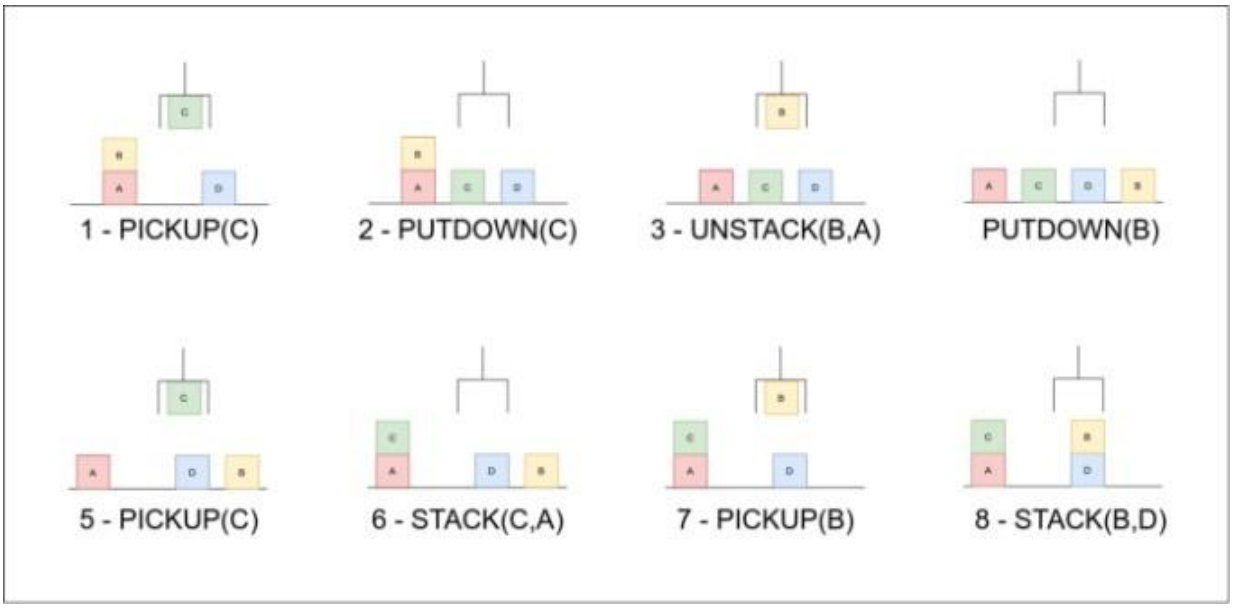
Experiment- 10 **A N V SREEVISHNU**
Date: 28.04.2021 **RA1811003010333**

(BLOCK WORLD PROBLEM)

Aim : To implement and analyse Block World Problem using Goal-State Planner

Operations :



Algorithm:

Input: a set Goal, an initial state Init, a set of
rules RULES Output: a plan P in form of a list of
operators with instantiations Auxiliary
Variable: 'Actual' for actual state
begin

0. P:=NIL;Actual:=Init
1. while goals in Goal open in Actual do 1.
1. select goal Goal that is open in Actual arbitrary choice -> backtrack point 1.
2. select instance I of operator with Goal, in add list arbitrary

choice -> backtrack point 1. 3 P:=

append(P,MEA(preconditions(I),Actual),list(I)) 1.
4 Actual := P(Init) end_do 2.
return(P) End

Program code:

```
#Base Classes

#PREDICATE - ON, ONTABLE, CLEAR, HOLDING, ARMEMPTY
class PREDICATE:
 def_str_(self):
  pass
 def_repr_(self):
  pass
 def_eq_(self, other) :
  pass
 def_hash_(self):
  pass
 def get_action(self, world_state):
  pass


#OPERATIONS - Stack, Unstack,
Pickup, Putdown class Operation:
 def_str_(self):
  pass
 def_repr_(self):
  pass
 def_eq_(self, other) :
  pass
 def precondition(self):
  pass
 def delete(self):
```

```
   pass
  def add(self):
   pass


class ON(PREDICATE):

  def __init__(self, X, Y):
   self.X =
   X self.Y
   = Y

  def_str_(self):
   return "ON({X},{Y})".format(X=self.X,Y=self.Y)

  def_repr_
   (self): return
   self._str_()
```

```
 def_eq_(self, other) :
  return self.__dict_____== other.__dict_____and self.__
  class_____== other.__class_____

 def_hash_(self):
    return
    hash(str(self))

 def get_action(self, world_state):
  return StackOp(self.X,self.Y)


class ONTABLE(PREDICATE):

 def_init_(self, X):
  self.X = X

 def_str_(self):
  return "ONTABLE({X})".format(X=self.X)

 def_repr_(self):
  return self._str_()

 def_eq_(self, other) :
  return self.__dict_____== other.__dict_____and self.__
  class_____== other.__class_____

 def_hash_(self):
    return
    hash(str(self))

 def get_action(self,
  world_state): return
```

```
    PutdownOp(self.X)


class CLEAR(PREDICATE):

  def_init_(self, X):
    self.X = X

  def_str_(self):
    return
    "CLEAR({X})".format(X=self.
    X) self.X = X

  def_repr_
    (self): return
    self._str_()

  def_eq_(self, other) :
```

```
  return self.__dict__ == other.__dict__ and self.__
  class__ == other.__class__

 def __hash__(self):
  return hash(str(self))

 def get_action(self, world_state):
  for predicate in world_state:
   #If Block is on another block, unstack
   if isinstance(predicate,ON) and predicate.Y==self.X:
    return UnstackOp(predicate.X,
  predicate.Y) return None


class HOLDING(PREDICATE):

 def __init__(self, X):
  self.X = X

 def __str__(self):
  return "HOLDING({X})".format(X=self.X)

 def __repr__(self):
  return self.__str__()

 def __eq__(self, other) :
  return self.__dict__ == other.__dict__ and self.__
  class__ == other.__class__

 def __hash__(self):
  return hash(str(self))

 def get_action(self, world_state):
  X = self.X
```

```
  #If block is on table, pick up
          if ONTABLE(X) in
                world_state:
   return PickupOp(X)
  #If block is on another
  block, unstack else:
   for predicate in world_state:
    if isinstance(predicate,ON) and
     predicate.X==X: return
     UnstackOp(X,predicate.Y)


                          class
ARMEMPTY(PREDICATE):
```

```
 def_init_(self):
  pass

 def_str_(self):
  return "ARMEMPTY"

 def_repr_(self):
  return self._str_()

 def_eq_(self, other) :
  return self.__dict__== other.__dict__and self.__
  class__== other.__class__

 def_hash_(self):
  return hash(str(self))

 def get_action(self, world_state=[]):
  for predicate in world_state:
   if isinstance(predicate,HOLDING):
    return
  PutdownOp(predicate.X)
  return None


class StackOp(Operation):

 def_init_(self, X, Y):
  self.X =
  X self.Y
  = Y

 def_str_(self):
  return "STACK({X},{Y})".format(X=self.X,Y=self.Y)
```

```
def_repr_(self):
 return self._str_()

def_eq_(self, other) :
 return self.__dict_____== other.__dict_____and self.__
 class_____== other.__class_____

def precondition(self):
 return [ CLEAR(self.Y) , HOLDING(self.X) ]

def delete(self):
 return [ CLEAR(self.Y) ,

HOLDING(self.X) ] def add(self):
```

```
   return [ ARMEMPTY() , ON(self.X,self.Y) ]


class UnstackOp(Operation):

  def init (self, X, Y):
   self.X =
   X self.Y
   = Y

  def str (self):
   return "UNSTACK({X},{Y})".format(X=self.X,Y=self.Y)

  def repr (self):
   return self. str ()

  def eq (self, other) :
   return self.__dict__ == other.__dict__ and self.__
   class__ == other.__class__

  def precondition(self):
   return [ ARMEMPTY() , ON(self.X,self.Y) , CLEAR(self.X) ]

  def delete(self):
   return [ ARMEMPTY() , ON(self.X,self.Y) ]

  def add(self):
   return [ CLEAR(self.Y) , HOLDING(self.X) ]


class PickupOp(Operation):

  def init (self, X):
   self.X = X
```

```
def_str_(self):
 return "PICKUP({X})".format(X=self.X)

def_repr_(self):
 return self._str_()

def_eq_(self, other) :
 return self.__dict__== other.__dict__and self.__
 class__== other.__class__

def precondition(self):
 return [ CLEAR(self.X) , ONTABLE(self.X) , ARMEMPTY() ]
```

```
  def delete(self):
   return [ ARMEMPTY() , ONTABLE(self.X) ]

  def add(self):
   return [ HOLDING(self.X) ]


class PutdownOp(Operation):

  def __init__(self, X):
   self.X = X

  def __str__(self):
   return "PUTDOWN({X})".format(X=self.X)

  def __repr__(self):
   return self.__str__()

  def __eq__(self, other) :
   return self.__dict__ == other.__dict__ and self.__
   class__ == other.__class__

  def precondition(self):
   return [ HOLDING(self.X) ]

  def delete(self):
   return [ HOLDING(self.X) ]

  def add(self):
   return [ ARMEMPTY() , ONTABLE(self.X) ]


def isPredicate(obj):
```

```
 predicates = [ON, ONTABLE, CLEAR, HOLDING, ARMEMPTY]
 for predicate in predicates:
  if isinstance(obj,predicate):
   return
 True
 return
 False

def isOperation(obj):
 operations = [StackOp, UnstackOp,
 PickupOp, PutdownOp] for operation in
 operations:
  if
   isinstance(obj,operati
   on): return True
```

```
 return False

def arm_status(world_state):
 for predicate in world_state:
  if isinstance(predicate, HOLDING):
   return
 predicate
 return
 ARMEMPTY()


class GoalStackPlanner:

 def init (self, initial_state, goal_state):
  self.initial_state =
  initial_state
  self.goal_state =
  goal_state

 def get_steps(self):

  #Store Steps
  steps = []

  #Program
  Stack stack =
  []

  #World State/Knowledge
  Base world_state =
  self.initial_state.copy()

  #Initially push the goal_state as compound
```

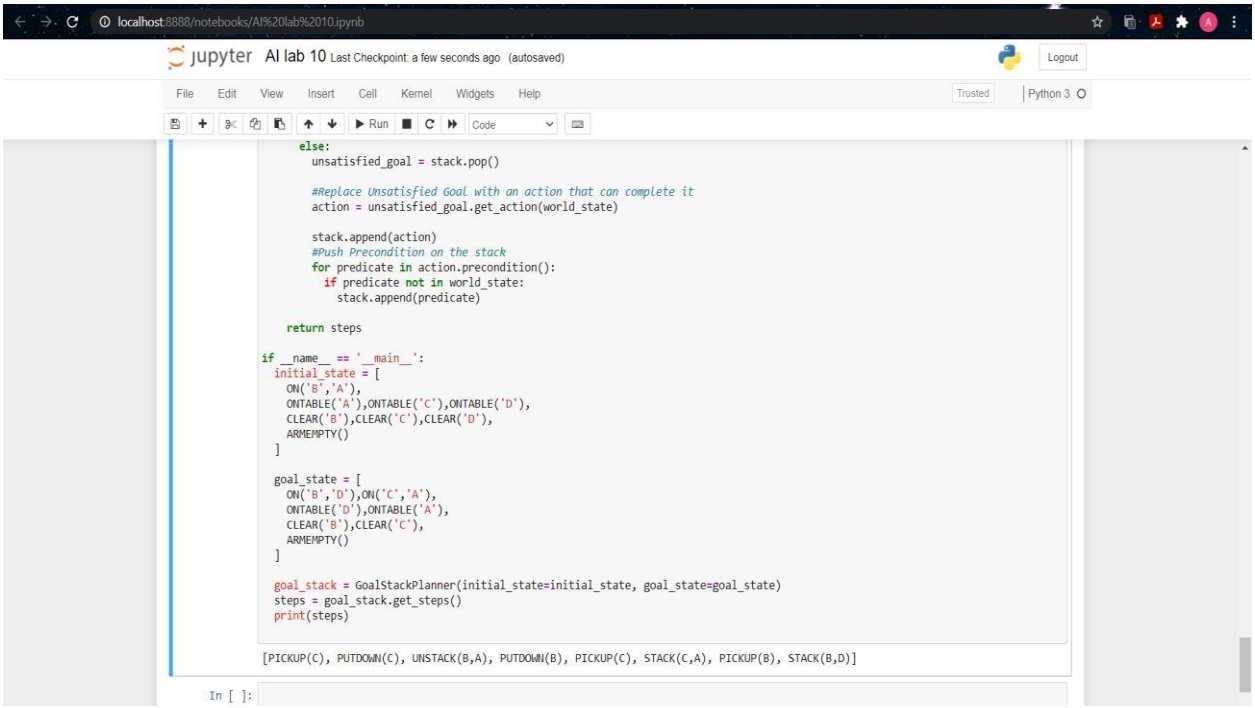
```
goal onto the stack
stack.append(self.goal_state.copy())

#Repeat until the stack
is empty while
len(stack)!=0:

 #Get the top of the stack
 stack_top = stack[-1]

 #If Stack Top is Compound Goal, push its unsatisfied
 goals onto stack if type(stack_top) is list:
  compound_goal =
  stack.pop() for goal in
  compound_goal:
   if goal not in
    world_state:
    stack.append(goa
    l)

 #If Stack Top is an
 action elif
 isOperation(stack_t
 op):
```

```
 #Peek the operation
 operation = stack[-1]

 all_preconditions_satisfied = True

 #Check if any precondition is unsatisfied and push it
 onto program stack for predicate in operation.delete():
  if predicate not in
    world_state:
    all_preconditions_satisfie
    d = False
    stack.append(predicate)

 #If all preconditions are satisfied, pop operation from
 stack and execute it if all_preconditions_satisfied:

  stack.pop()
  steps.append(ope
  ration)

  for predicate in
    operation.delete():
    world_state.remove(pre
    dicate)
  for predicate in operation.add():
    world_state.append(predicate)


#If Stack Top is a single
satisfied goal elif stack_top
in world_state:
```

```
        stack.pop()

      #If Stack Top is a single
      unsatisfied goal else:
        unsatisfied_goal = stack.pop()

        #Replace Unsatisfied Goal with an action that
        can complete it action =
        unsatisfied_goal.get_action(world_state)

        stack.append(action)
        #Push Precondition on the stack
        for predicate in
          action.precondition(): if
          predicate not in
          world_state:
          stack.append(predicate)

    return steps

if __name_____== '_main_':
```

```
initial_stat
 e = [
 ON('B','A'
 ),
 ONTABLE('A'),ONTABLE('C'),ONTABLE('D'),
 CLEAR('B'),CLEAR('C'),CLEAR('D'),
 ARMEMPTY()
]

goal_state = [
 ON('B','D'),ON('C','A'),
 ONTABLE('D'),ONTABL
 E('A'),
 CLEAR('B'),CLEAR(
 'C'), ARMEMPTY()
]

goal_stack = GoalStackPlanner(initial_state=initial_state,
goal_state=goal_state) steps = goal_stack.get_steps()
print(steps)
```

Output :



Result : The given Blocks world problem was designed, analysed, implemented using Goal State Planner and the output was obtained for the same.