# *Experiment 10*

# *Implementation of Blocks World Problem*

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**Aim-** To study and implement Implementation of Blocks world Problem.

**Code-**

```
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,operation): 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(goal)

#If Stack Top is an action elif isOperation(stack_top):

#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_satisfied = False stack.append(predicate)

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

stack.pop() steps.append(operation)

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

world_state.append(predicate)

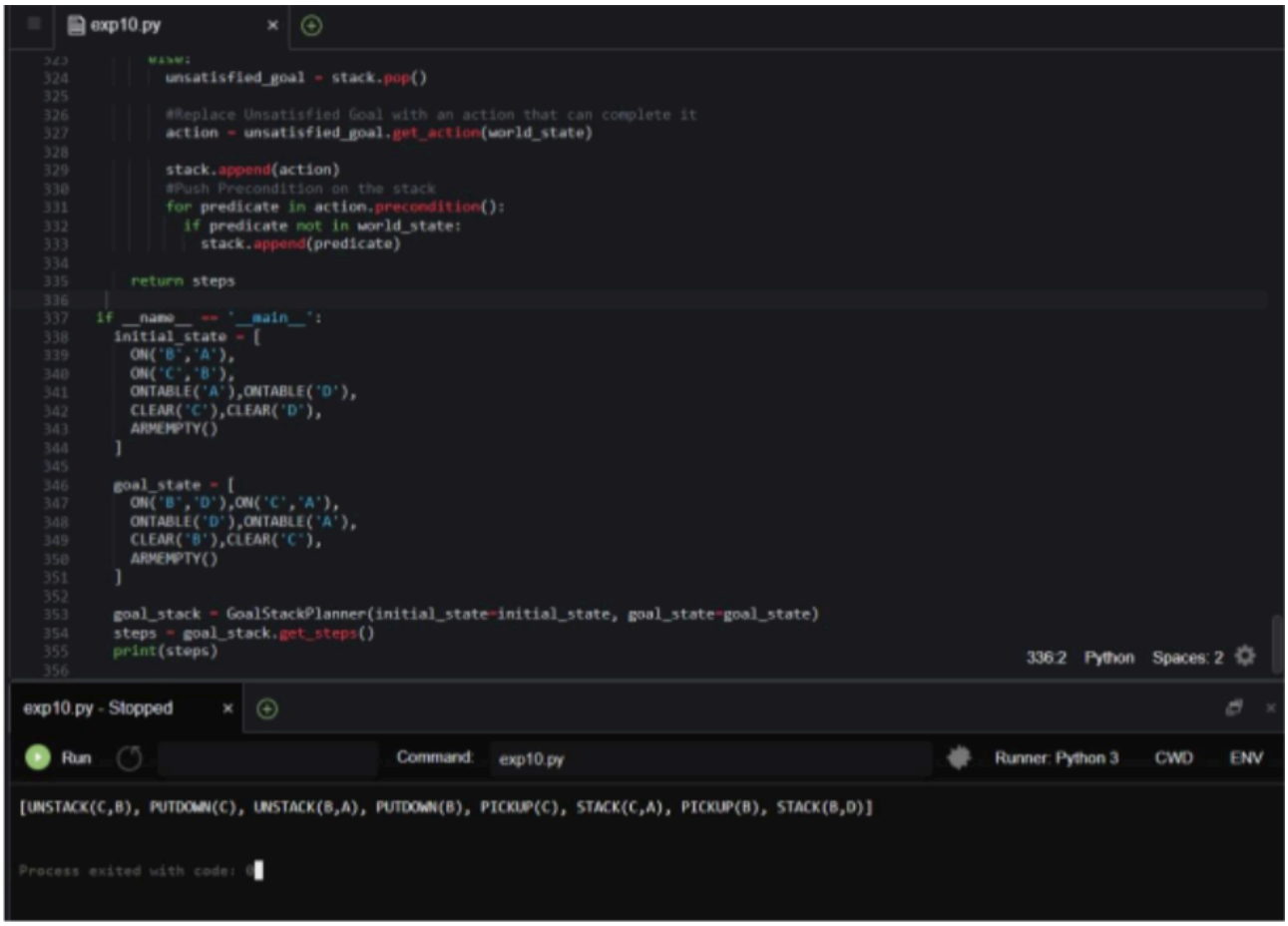
#If Stack Top is a single satisfied goal elif stack_top in world_state:

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_state = [

ON('B','A'),
ON('C','B'), ONTABLE('A'),ONTABLE('D'), CLEAR('C'),CLEAR('D'),
ARMEMPTY()

]

goal_state = [ ON('B','D'),ON('C','A'), ONTABLE('D'),ONTABLE('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-

Unification was achieved successfully.