Akshat Verma
av2zf@virginia.edu
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Assignment 1
SYS 6582 : Reinforcement Learning

Present Value/Fair Price of Lease = 876000.0, calculated using algorithm implemented in Python. The steps are explained in the comments in the code.The value of different states (state information includes number of barrels of oil left at the start of a year, current price and the current year) are shown in the table after the code.

Code:

```
'''
Created on Feb 9, 2016

@author: akshat
'''

from itertools import product
from functools import reduce

# Initialize variables
init_barrels = 100000.0
years = 3
prices = [20,30]

#List of tuples containing possible options of oil percentages that can be drilled in a year and associated costs
options = [(0.0,0),(0.2,130000),(0.36,300000)]


# Create all possible states of number of barrels left at start of each year
barrels= set()
for year in range(years,0,-1):
    for option in product(next(zip(*options)), repeat = year-1):
        if len(option) == 0:
            barrels.add((1,init_barrels))
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        elif len(option) == 1 :
            barrels.add((2,(1-option[0])*init_barrels))
        else:
            barrels.add((year,round(reduce(lambda x, y: (1-x)*(1-y), option)*init_barrels,1)))

# Tuple containing possible number of barrels at start of each year and the year
print(barrels)
#{(3, 100000.0), (3, 80000.0), (3, 64000.0), (3, 51200.0), (3, 40960.0), (2, 100000.0), (2, 80000.0), (2,
64000.0), (1, 100000.0)}

# Cartesian product of barrels and prices, gives all possible states where state information includes
barrels,price and time
states = set(product(barrels,prices))
print(states)
#{((1, 100000.0), 20), ((2, 100000.0), 30), ((2, 80000.0), 30), ((2, 100000.0), 20), ((3, 80000.0), 20), ((3,
64000.0), 20), ((3, 100000.0), 30), ((3, 80000.0), 30), ((3, 64000.0), 30), ((3, 100000.0), 20), ((3, 51200.0), 20),
((3, 51200.0), 30), ((3, 40960.0), 20), ((3, 40960.0), 30), ((2, 64000.0), 20), ((2, 80000.0), 20), ((2, 64000.0),
30), ((1, 100000.0), 30)}


# Dictionary initially populated with the maximum profits possible in a given state in the third year
states_dict = {}
for state in states:
    if(state[0][0]==years):
        states_dict[state] = max(0,max([option[0]*state[0][1]*state[1]-option[1] for option in options]))


print(states_dict)
#{((3, 40960.0), 30): 142367.99999999994, ((3, 100000.0), 30): 780000.0, ((3, 40960.0), 20): 33840.0, ((3,
100000.0), 20): 420000.0, ((3, 80000.0), 30): 564000.0, ((3, 64000.0), 30): 391200.0, ((3, 51200.0), 30):
252960.0, ((3, 80000.0), 20): 276000.0, ((3, 51200.0), 20): 74800.0, ((3, 64000.0), 20): 160800.0}

# Add to the dictionary, maximum profit for state at time t based on possible transition states at time t+1
for t in range(years-1,0,-1):
    for state in states:
        if state[0][0]==t:
            possible_next_barrels_and_profit = [(state[0][1]*(1-option[0]),option[0]*state[0][1]*state[1]-
option[1]) for option in options]
            max_profit = 0
            for val in possible_next_barrels_and_profit:
                max_profit = max(max_profit,val[1]+(1/2)*(states_dict[((t+1,val[0]),prices[0])]+states_dict[((t
+1,val[0]),prices[1])]))
            states_dict[state] = max_profit

print(states_dict)
# Final States: {((2, 64000.0), 30): 479304.0, ((2, 80000.0), 20): 466000.0, ((3, 100000.0), 30): 780000.0,
((3, 80000.0), 20): 276000.0, ((3, 51200.0), 30): 252960.0, ((2, 100000.0), 30): 1056000.0, ((3, 64000.0), 20):
160800.0, ((2, 100000.0), 20): 696000.0, ((3, 40960.0), 20): 33840.0, ((2, 80000.0), 30): 727880.0, ((3,
40960.0), 30): 142367.99999999994, ((1, 100000.0), 30): 1164592.0, ((2, 64000.0), 20): 289880.0, ((3,
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80000.0), 30): 564000.0, ((3, 64000.0), 30): 391200.0, ((3, 100000.0), 20): 420000.0, ((3, 51200.0), 20): 74800.0, ((1, 100000.0), 20): 876000.0}

Final State Values:

Number of barrels at start of the year	Time (Year)	Price	Value
100000	3	30	780000
100000	3	20	420000
80000	3	30	564000
80000	3	20	276000
64000	3	30	391200
64000	3	20	160800
512000	3	30	252960
512000	3	20	74800
40960	3	30	142368
40960	3	20	33840
100000	2	30	1056000
100000	2	20	696000
80000	2	30	727880
80000	2	20	466000
64000	2	30	479304
64000	2	20	289880
100000	1	30	1164592
100000	1	20	876000

So, present value of lease when initial price is 20 = 876000.