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118CS0597
Soft Computing Lab – 11
4th April 2022

Explanation:

Value function: $x+y$.

$V(x, y) = x+y$

$\frac{dV}{dx} = 1 \quad \frac{dV}{dy} = 1$

Constraint: $x^2+y^2 = 1$

$C(x, y) = x^2+y^2-1$

$\frac{dC}{dx} = 2x \quad \frac{dC}{dy} = 2y$

Equations to solve:

$1 = 2x\lambda$ ——(i)

$1 = 2y\lambda$ ——(ii)

$x^2+y^2 = 1$ ——(iii).

Code:

```
from sympy import symbols, Eq, solve


"""
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   Created: 2022-04-04 13:51 IST
"""


def problem_1():
   print("Online marketing department problem")
   print("==================================")
   s, t, l = symbols('s t l')

   eq1 = Eq((21/4)*((t**(1/4))/s**(1/4)) - 25*l, 0)
   eq2 = Eq((7/4)*(s**(3/4)/t**(3/4)) - 250*l, 0)
   eq3 = Eq(25*s+250*t - 2500, 0)
   eqs = [eq1, eq2, eq3]

   ans = solve(eqs, [s, t, l], simplify=False)
   print(f'(s, t, l) = {ans}', end='\n\n')


def problem_2():
   print("Maximizing x + y under the constraint that x^2 + y^2 = 1")
```

```
    print("=========================================================")
    x, y, l = symbols('x y l')

    eq1 = Eq(2*x*l - 1, 0)
    eq2 = Eq(2*y*l - 1, 0)
    eq3 = Eq(x**2 + y**2 - 1, 0)
    eqs = [eq1, eq2, eq3]

    possible_solutions = solve(eqs, [x, y, l], simplify=False)
    print(f'Possible solutions: (x, y, l) = {possible_solutions}')

    def value(x, y): return x + y

    print(f'Iterating through all the possible solutions and maximizing x + y...')
    NEG_INF = -(1e9+5)
    curr_value = NEG_INF
    solution = ()
    for possible_solution in possible_solutions:
        x = possible_solution[0]
        y = possible_solution[1]
        val = value(x, y)
        if val > curr_value:
            curr_value = val
            solution = possible_solution

    print(f'Solution: (x, y) = {solution}')


def main():
    problem_1()
    problem_2()


if __name__ == '__main__':
    main()
```

Output:

```
(ml) (env) koushik :: ~/nitr/soft-computing-lab »  (master %=)$ python lagrange.py
Online marketing department problem
==================================
(s, t, l) = [(75.0000000000000, 2.50000000000000, 0.0897302713432092)]

Maximizing x + y under the constraint that x^2 + y^2 = 1
=========================================================
(x, y) = (sqrt(2)/2, sqrt(2)/2, sqrt(2)/2)
(ml) (env) koushik :: ~/nitr/soft-computing-lab »  (master %=)$ python lagrange.py
Online marketing department problem
==================================
(s, t, l) = [(75.0000000000000, 2.50000000000000, 0.0897302713432092)]

Maximizing x + y under the constraint that x^2 + y^2 = 1
=========================================================
Possible solutions: (x, y, l) = [(-sqrt(2)/2, -sqrt(2)/2, -sqrt(2)/2), (sqrt(2)/2, sqrt(2)/2, sqrt(2)/2)]
Iterating through all the possible solutions and maximizing x + y...
Solution: (x, y) = (sqrt(2)/2, sqrt(2)/2, sqrt(2)/2)
```