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Summer 2024

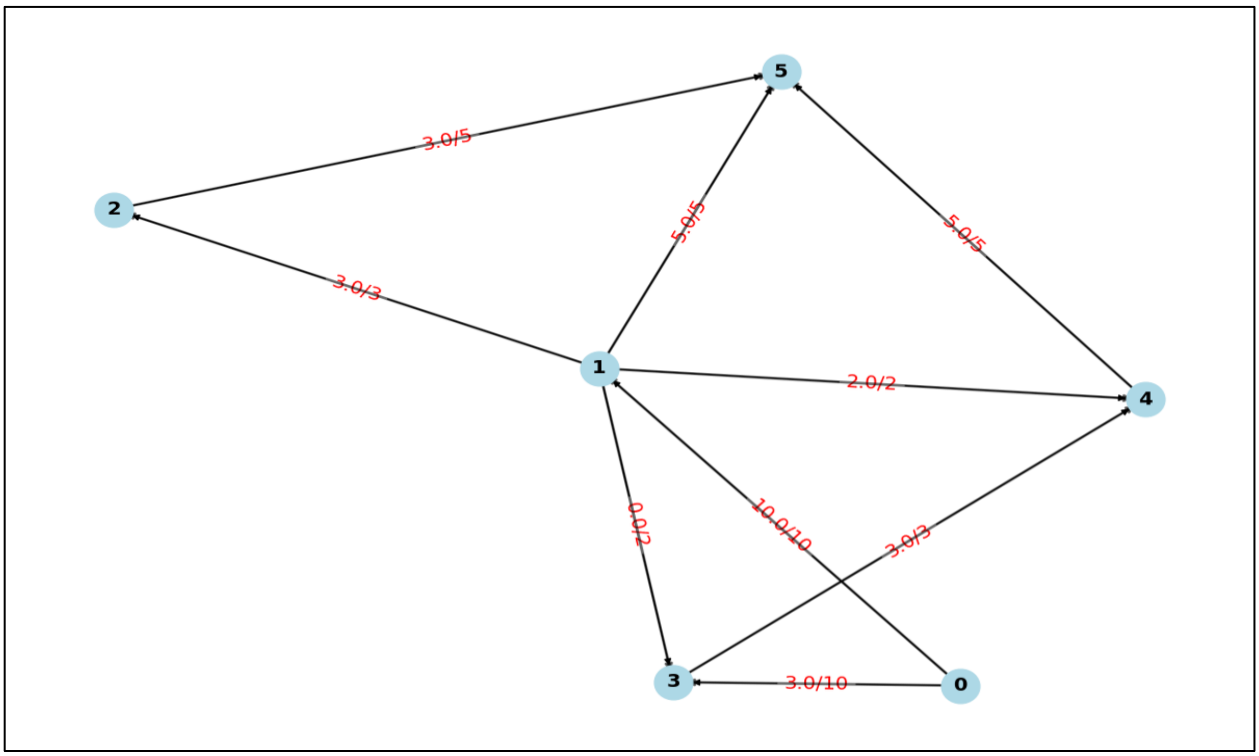
CS 5800 Algorithms (Seattle)

Assignment 7

Date: 07/20/2024

Question 1: PART A

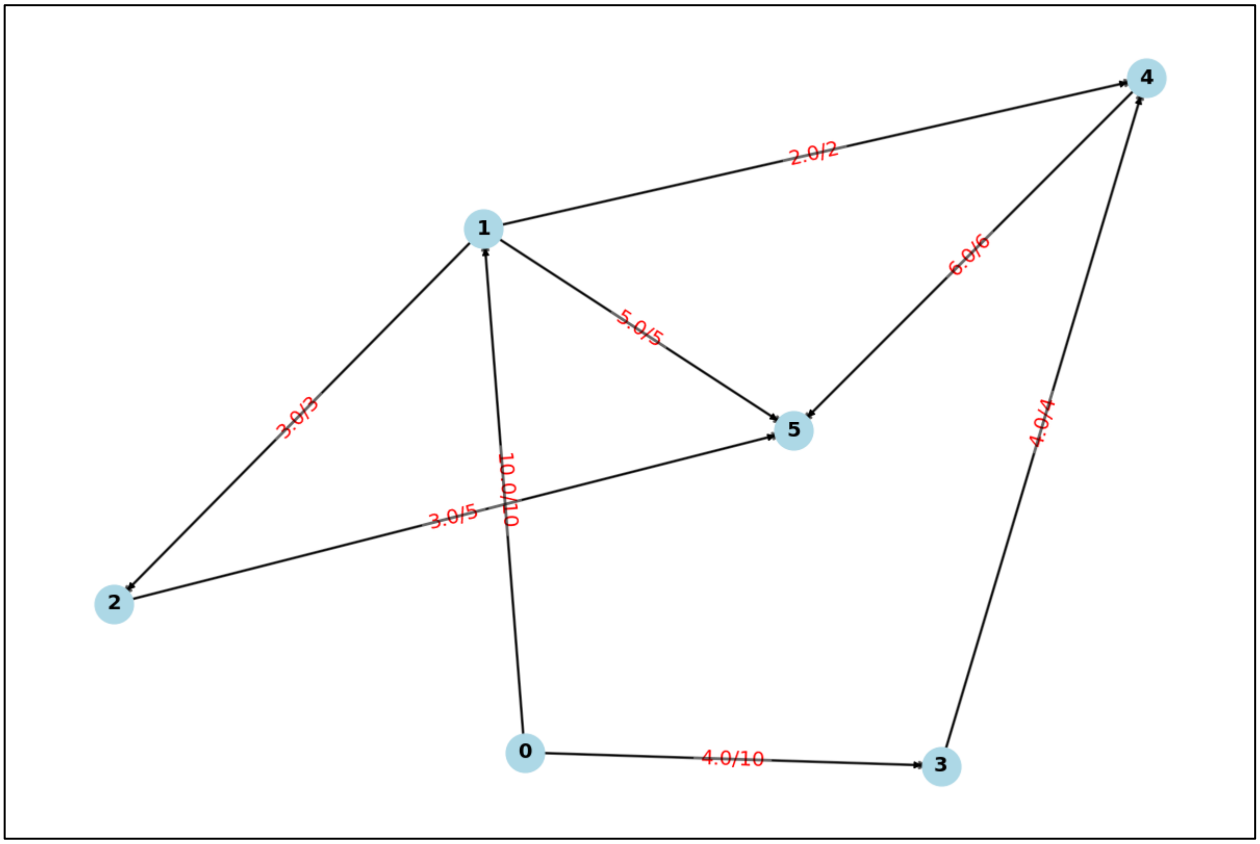
```
/usr/bin/python3
/Users/payalchavan/Documents/Algorithms/Assignment7/flow_network.py

Part - A

Optimal flow: 13.0

Flow values on edges: [10.  3.  3.  0.  2.  5.  3.  3.  5.]
```



The above graph depicts the maximum flow from vertex 0 (source, S) to vertex 5 (target, T) with a total max-flow value of 13. The maximum flow path output is the same as the solved problem from the Exercise Que 1.

Question 1: PART B

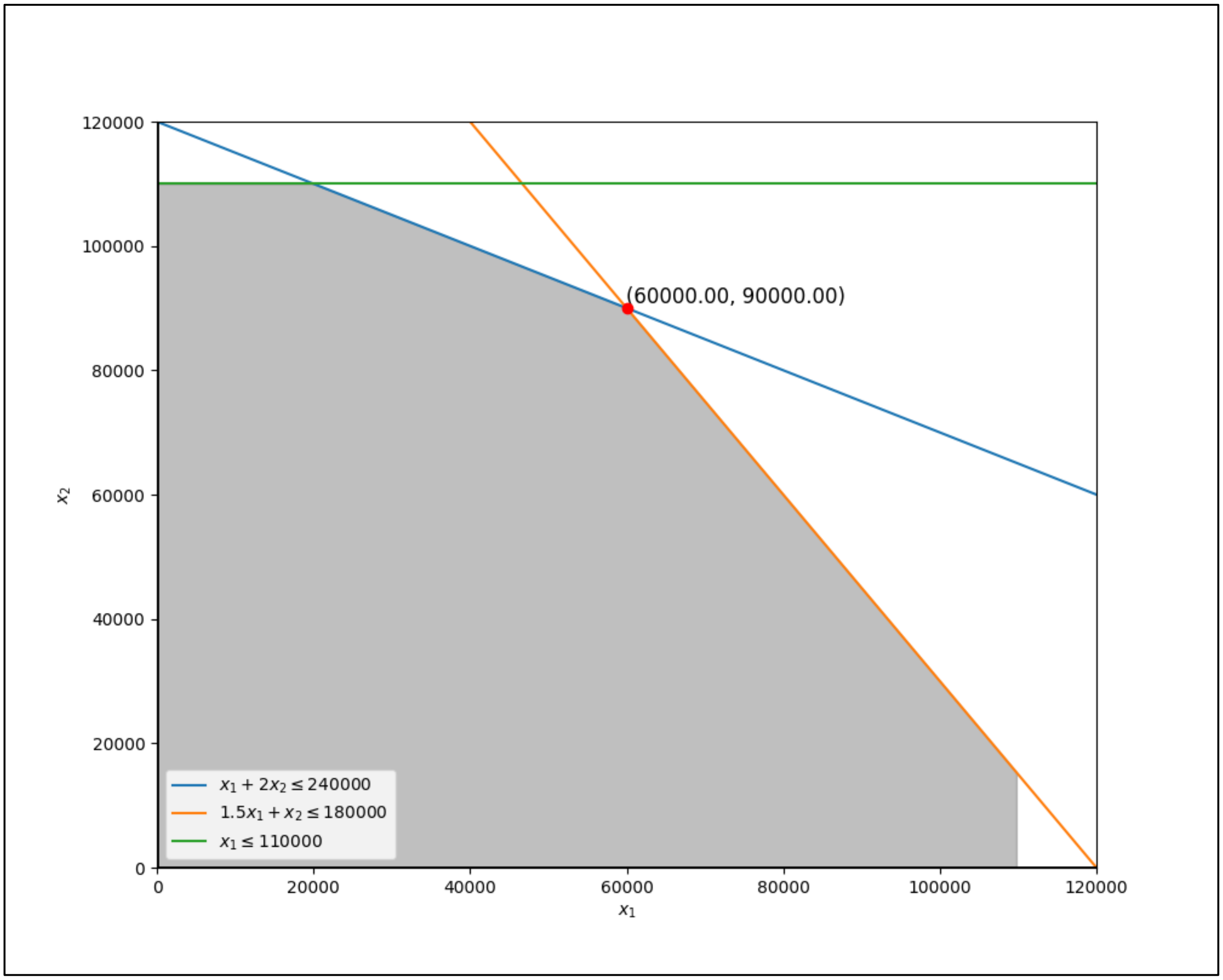
```
Part - B

Optimal flow: 14.0

Flow values on edges: [10.  4.  3.  2.  5.  3.  4.
6.]
```



The above graph illustrates the maximum flow (14) obtained after removing the edge AD. Subsequently, we increased the capacity of edge AD (1--3) by splitting it into two: one for the edge DF (3--4) (resulting in a capacity of 4, i.e., 3 + 1) and another for the edge FT (4--5) (yielding a capacity of 6, i.e., 5 + 1). This modification effectively maximized the flow from source (S--0) to target (T--5), highlighting the positive correlation between weight and maximum flow.

Question 2:

```
/usr/bin/python3
/Users/payalchavan/Documents/Algorithms/Assignment7/Max_Profit.py
Optimal value of x1: 60000.0
Optimal value of x2: 90000.0
Maximum value of the objective function: 222000.0
```



For the given linear programming problem, we will define the following constraints:
Here, x1 = Frisky Pup, and x2 = Husky Hound

1. Total cereal available in a month: x1 + 2x2 <= 240000
2. Total meat available in a month: 1.5x1 + x2 <= 180000
3. Frisky Pup can produce at the most package: x1 <= 110000
4. x1 >= 0
5. x2 >=0

Next, we are given that the package of Husky Hound contains 2 pounds of cereal and cost 1$/pound and 1 pound of meat costs 2$/pound and sells for total cost (6$). So total production cost includes cost of production of cereal and meat and package cost (0.60$).

And we are also given that the package of Frisky Pup contains 1 pounds of cereal and cost 1$/pound and 1.5 pounds of meat costs 2$/pound and sells for total cost (7$). So total production cost includes cost of production of cereal and meat and package cost (1.40$).

Profit = Selling Price – [Production Cost of Cereal + Production Cost of Meat + Package Cost]

Therefore, Profit (Frisky Pup) = 7 – [1 + 3 + 1.40] = 1.60$

And Profit (Husky Hound) = 6 – [2 + 2 + 0.60] = 1.40$

So, to maximize the profit, we can obtain the objective function as--- max $1.6x1 + 1.4x2$ and hence this is our optimal goal to achieve.

From the above graph, it is clear that we will obtain maximum profit from $x1 = 60000$, and $x2 = 90000$.

So, our maximum profit will be: $1.6x1 + 1.4x2 = 1.6 (60000) + 1.4 (90000) = 222000$