CSDS 440: Assignment 4

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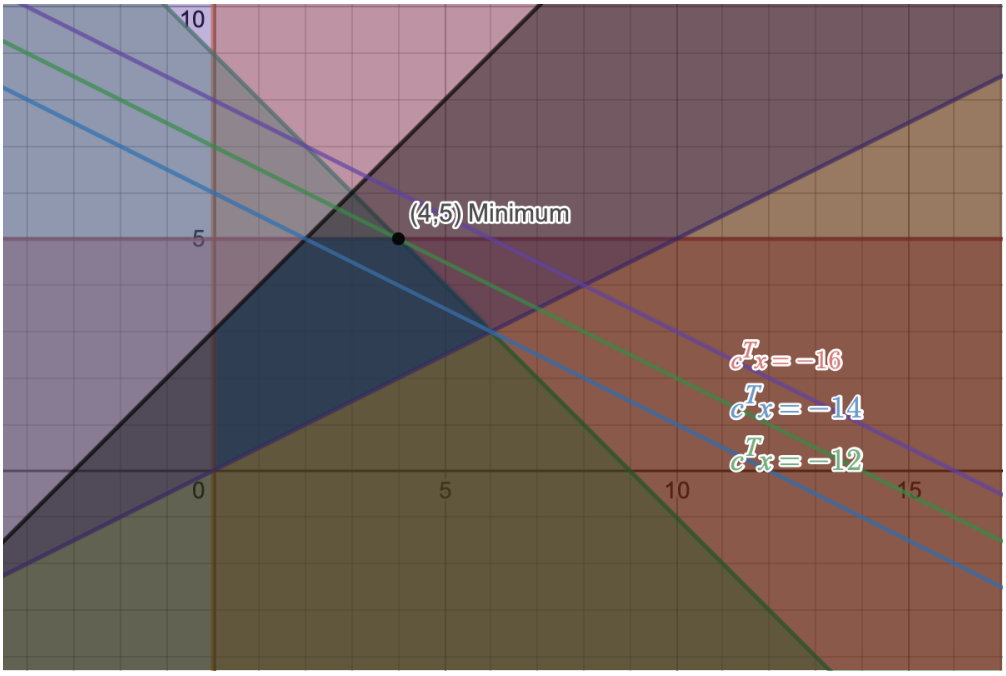
Problem 18

For the ease of description, we denotes elements in A as $\begin{pmatrix} x & y \\ x & y \\ \cdots & \end{pmatrix}$. We have the following for $Ax \geq b$:

$$\begin{aligned} 0x - y &\geq -5 \\ -x - y &\geq -9 \\ -x + 2y &\geq 0 \\ x - y &\geq -1 \end{aligned}$$

Similarly, we also have $c^T x = -x - 2y$.

(a) (b)



The area shaded by dark blue is the feasible region, the three $c^T x$ contours are labelled accordingly.

Yes. The minimun did go through a vertex of the feasible region at $(4, 5)$.

It is because to optimize a line, either the oprimized line will "overlap" with an edge of the feasible region, or it will intersect an edge / vertex of the feasible region. In the former case, any point on the "overlapped" edge is able to provide the optimized solution; and since an edge includes two vertices, the minimum can be on a vertex. In the latter case, the line will always find a direction (along the edge it intersects) to further optimize untill it reaches a vertex, so the minimum will also be on a vertex.

In this particular problem setting, among three contours the "higher" one (one with larger y-axis intersection value) on graph will have a smaller value. Since $c^T x = -16$ is not in the feasible region, we have $c^T x = -14$ being the minimum.