Assignment No.6

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Question taken from

1 Question 2.4

Solve the following system of inequalities graphically.

$$x + 2y \leq 8 \tag{1.0.1}$$

$$2x + y \leq 8 \tag{1.0.2}$$

$$x \geq 0 \, y \geq 0 \tag{1.0.3}$$

2 Solution

From the given inequalities we have,

$$\begin{pmatrix} -1 & -2 \\ -2 & -1 \\ 1 & 0 \\ 0 & 1 \end{pmatrix} \mathbf{x} \geq \begin{pmatrix} -8 \\ -8 \\ 0 \\ 0 \end{pmatrix} \tag{2.0.1}$$

Which can be further written as

$$\begin{pmatrix} -1 & -2 \\ -2 & -1 \end{pmatrix} \mathbf{x} \geq \begin{pmatrix} -8 \\ -8 \end{pmatrix} \tag{2.0.2}$$

Let $u_1 \geq 0, u_2 \geq 0$. This may be expressed as

$$\mathbf{u} = \begin{pmatrix} u_1 \\ u_2 \end{pmatrix} \geq \mathbf{0} \tag{2.0.3}$$

Now we have,

$$\begin{pmatrix} -1 & -2 \\ -2 & -1 \end{pmatrix} \mathbf{x} \geq \begin{pmatrix} -8 \\ -8 \end{pmatrix} + \mathbf{u} \tag{2.0.4}$$

$$\mathbf{x} = \begin{pmatrix} -1 & -2 \\ -2 & -1 \end{pmatrix}^{-1} \begin{pmatrix} -8 \\ -8 \end{pmatrix} + \begin{pmatrix} -1 & -2 \\ -2 & -1 \end{pmatrix}^{-1} \mathbf{u} \tag{2.0.5}$$

$$\implies \mathbf{x} = \frac{-1}{3} \begin{pmatrix} -8 \\ -8 \end{pmatrix} + \frac{-1}{3} \begin{pmatrix} -1 & 2 \\ 2 & -1 \end{pmatrix} \mathbf{u} \tag{2.0.6}$$

$$\mathbf{x} = \begin{pmatrix} \frac{8}{3} \\ \frac{8}{3} \end{pmatrix} + \frac{-1}{3} \begin{pmatrix} -1 & 2 \\ 2 & -1 \end{pmatrix} \mathbf{u} \tag{2.0.7}$$

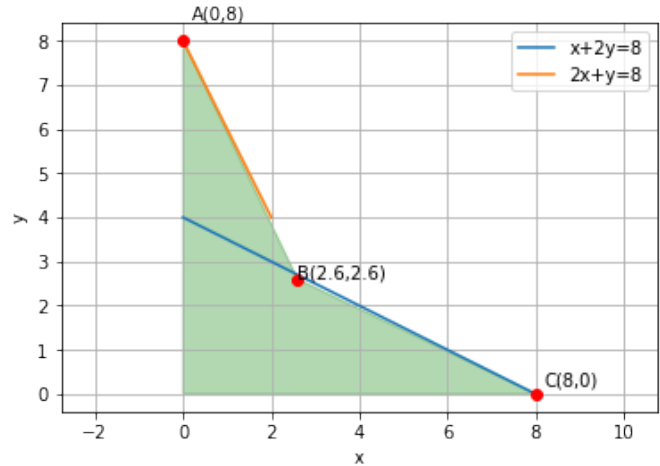Thus the solution of the system of inequalities can be determined graphically, which is represented in Fig.

Fig. 0: Graphical solution