DUALITY-1

$$\min \quad 6x_1 + 4x_2 + 2x_3$$

$$4x_1 + 2x_2 + x_3 \geq 5$$

$$x_1 + x_2 \geq 3$$

$$x_2 + x_3 \geq 4$$

$$x_i \geq 0$$

} primal problem

$$4y_1 + y_2 + 0y_3 \leq 6$$

$$2y_1 + y_2 + y_3 \leq 4$$

$$y_1 + 0y_2 + y_3 \leq 2$$

} dual problem.

$$\max. \quad 5y_1 + 3y_2 + 4y_3$$

$$y_i \geq 0$$

$\min c^T x \qquad c = [6 \; 4 \; 2]^T$

$Ax \leq b \qquad A = \begin{bmatrix} 4 & 2 & 1 \\ 1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix} \qquad b = \begin{bmatrix} 5 \\ 3 \\ 4 \end{bmatrix}$

$x \geq 0$

max. $c = [5 \quad 3 \quad 4]$

$$A = \begin{bmatrix} 4 & 1 & 0 \\ 2 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix}$$

$$b = \begin{bmatrix} 6 \\ 4 \\ 2 \end{bmatrix}$$

max $b^T y$

st. $A^T y \leq c$

$y \geq 0$.

primal $\Leftrightarrow$ dual

dual (dual) = primal.

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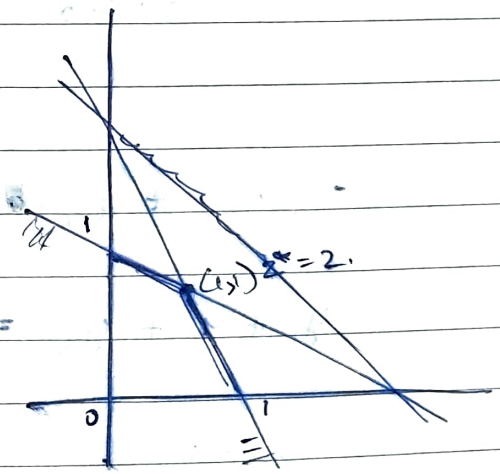
max $x_1 + x_2$

$x_1 + 2x_2 \leq 2$

$2x_1 + x_2 \leq 2$

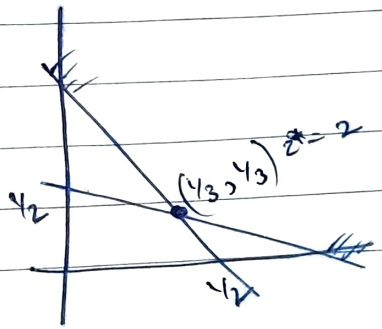
$x_1, x_2 \geq 0$

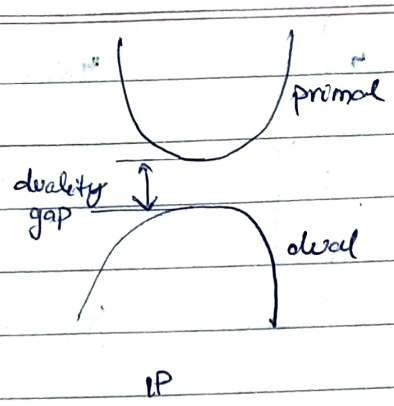


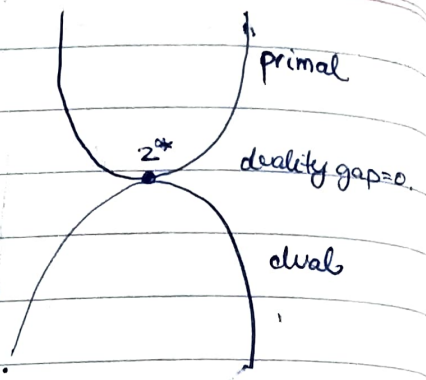
min. $3y_1 + 3y_2$

$y_1 + 2y_2 \geq 1$

$2y + y_2 \geq 1$







$\min\ -x_1 - x_2$ ⇔ $\max\ y_1 + 3y_2 + 2y_3$

$-x_1 + x_2 \leq 1$ s.t. $-y_1 + y_2 \geq -1$

$x_1 \leq 3$ $y_1 + y_3 \geq -1$

$x_2 \leq 2$ $y_1 \geq 0$

$x_i \geq 0$

$-y_1 + y_2 + y_4 = -1$

$y_1 + y_3 + y_5 = -1$

$y_i \geq 0$

max $Z = 3x_1 + 4x_2 + 5x_3$

$3x_1 + 3x_2 + 3x_3$ 10

3+ 40

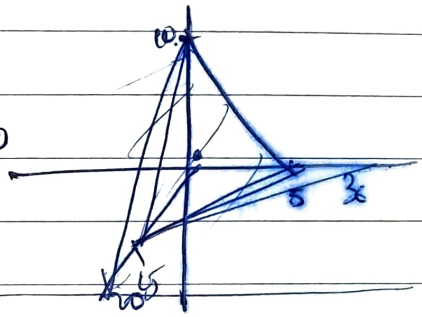
80

80

$2x_1 + x_2 \leq 10$

$2x_2 + x_3 \leq 20$

$x_1 + 2x_3 \leq 30$



85 m + y

y-1