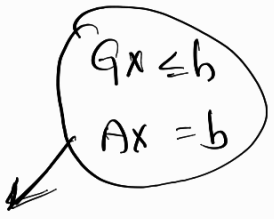
Quadratic Programming :-

↳ QP is particular class in mathematical optimization problem.

QP is used in curve fitting, SVM (support)

$\Rightarrow \left(\frac{1}{2}\right) x^T P x + q^T x$ ⇒ objective function.

⇒



→ General constraints

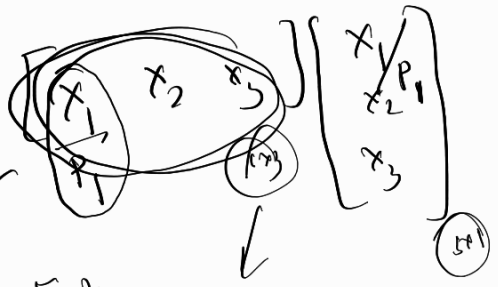
⇒

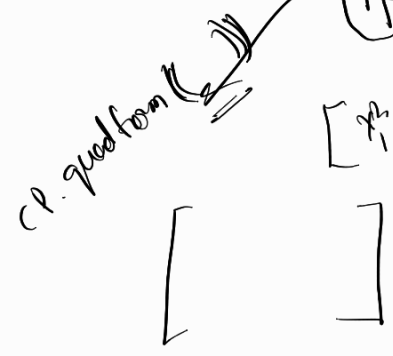
Assume 3 edge nodes & 1 file :-

$$\Rightarrow f \begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix} \begin{matrix} e1 \\ e2 \\ e3 \end{matrix} \begin{bmatrix} x_1/P_1 \\ x_2/P_2 \\ x_3/P_3 \end{bmatrix} + \begin{bmatrix} t_1 x_1 & x_2 & x_3 \end{bmatrix} \begin{bmatrix} t_2/t_1 x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

(1xe) (ex1)

$$\Rightarrow \left(\frac{x_1^2}{P_1} + \frac{x_2^2}{P_2} + \frac{x_3^2}{P_3}\right)$$





Quadratic Programming:

↳ $\frac{1}{2}(x^T P x)$

$$+ \begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix} \begin{bmatrix} x_1/c_1 \\ x_2/c_2 \\ x_3/c_3 \end{bmatrix} + \begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix} \begin{bmatrix} (x_2/c_2 + x_3/c_3) + 2(x_1/t_1) \\ (x_1/c_1 + x_3/c_3) + 2(x_2/t_2) \\ (x_1/c_1 + x_2/c_2) + 2(x_3/t_3) \end{bmatrix}$$

$$\frac{x_1^2}{c_1} + \frac{x_2^2}{c_2} + \frac{x_3^2}{c_3} +$$

Quadratic Programming: → It has a objective which is Quadratic function of decision variables.

↳ $(2x_1^2 + 3x_2^2 + 4x_1x_2)$

↳ $x_1, x_2, \ldots$

(In Quadratic Programming the constraints are linear).

$$[x_1\ x_2\ x_3\ \cdots] \underset{1\times e}{\begin{bmatrix} & \\ & \end{bmatrix}} \underset{e\times 1}{\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ \vdots \\ x_4 \end{bmatrix}} =$$

$$[x_1\ x_2\ x_3] \begin{bmatrix} & \\ & \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

$$[x_1\ x_2\ x_3] \underset{1\times e}{\begin{bmatrix} x_1/c_1 \\ x_2/c_2 \\ x_3/c_3 \end{bmatrix}_{e\times 1}} + [x_1\ x_2\ x_3] \underset{1\times e}{\begin{bmatrix} x_2/c_2 + x_3/c_3 + 2x_1/100 \\ x_1/c_1 + x_3/c_3 + 2x_2/100 \\ x_1/c_1 + x_2/c_2 + 2x_3/100 \end{bmatrix}_{e\times 1}}$$

$$\Rightarrow x_1^2/c_1 + x_2^2/c_2 + x_3^2/c_3 + \frac{x_1x_2}{c_2} + \frac{x_1x_3}{c_3} + \frac{2x_1^2}{100}$$

$$+ \frac{x_1x_2}{c_1} + \frac{x_2x_3}{c_3} + \frac{2x_2^2}{100}$$

$$+ \frac{x_1x_3}{c_1} + \frac{x_2x_3}{c_2} + \frac{2x_3^2}{100}$$

$$\underset{1\times3}{\begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix}} \underset{3\times3}{\begin{bmatrix} p_1 & p_2 & p_3 \\ p_4 & p_5 & p_6 \\ p_7 & p_8 & p_9 \end{bmatrix}} \underset{3\times1}{\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}} + \begin{bmatrix} q_1 & q_2 & q_3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

$$\underset{1\times3}{\begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix}} \underset{3\times1}{\begin{bmatrix} p_1x_1 + p_2x_2 + p_3x_3 \\ p_4x_1 + p_5x_2 + p_6x_3 \\ p_7x_1 + p_8x_2 + p_9x_3 \end{bmatrix}} + q_1x_1 + q_2x_2 + q_3x_3$$

$$\Rightarrow p_1x_1^2 + p_2x_1x_2 + p_3x_1x_3 + p_4x_1x_2 + p_5x_2^2 + p_6x_2x_3 + p_7x_1x_3 + p_8x_2x_3 + p_9x_3^2$$

$$\Rightarrow p_1x_1^2 + p_5x_2^2 + p_9x_3^2 + x_1x_2(p_2 + p_4) + x_1x_3(p_3 + p_7) + x_2x_3(p_6 + p_8)$$

$$x_1^2\left(\frac{1}{c_1} + \frac{1}{50}\right) + x_2^2\left(\frac{1}{c_2} + \frac{1}{50}\right) + x_3^2\left(\frac{1}{c_3} + \frac{1}{50}\right)$$

$$+ x_1x_2\left(\frac{1}{c_2} + \frac{1}{c_1}\right) + x_1x_3\left(\frac{1}{c_3} + \frac{1}{c_1}\right)$$

$$+ x_2x_3\left(\frac{1}{c_2} + \frac{1}{c_3}\right)$$