CONVEX OPTIMISATION ASSIGNMENT

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Question 1

(a)

Problem (2), (3) and (4) are always convex but Problem (3) are not always convex because hessian of objective for problem (1) is,

$$\mathbf{H} = \mathbf{A}^T\mathbf{A} + \alpha\mathbf{I}$$

Positive definitness of hessian is dependent on the value α.

(b)

$$\Delta Objective = \left(\partial\frac{\overline{x}^T(\mathbf{A}^T\mathbf{A} + \alpha\mathbf{I})\overline{x} - \overline{y}^T\mathbf{A}\overline{x} + \overline{y}^T\overline{y}}{\partial\overline{x}}\right)^T$$
$$\implies \Delta Objective = 2(\mathbf{A}^T\mathbf{A} + \alpha\mathbf{I})\overline{x} - \overline{y}^T\mathbf{A}$$

(b)

$$\Delta Objective = 0$$
$$\implies \overline{x}^* = 0.5(\mathbf{A}^T\mathbf{A} + \alpha\mathbf{I})^{-1}\mathbf{A}^T\overline{y}$$

Question 2

Question 3

Question 4

Question 5

Question 6