

1- Given SVD $\sum_{i=1}^2 \sigma \underline{u}_i \underline{v}_i^T$ with $\underline{u}_i \in \mathbb{R}^M$ and $\underline{v}_i \in \mathbb{R}^N$. What is the maximum?

- A: 1
- B: 2
- C: M
- D: N

2- Given $f(\underline{x}) = x_1^2 x_2$. Calculate the Hessian matrix of $f(\underline{x})$.

- A: $\begin{bmatrix} 2x_2 & 2x_1 \\ 2x_1 & 0 \end{bmatrix}$
- B: $\begin{bmatrix} 2x_1 & 2x_1 \\ 2x_1 & 0 \end{bmatrix}$
- C: $\begin{bmatrix} 0 & 2x_1 \\ 2x_1 & 2x_2 \end{bmatrix}$
- D: $\begin{bmatrix} 2x_1 x_2 & 2x_1 \\ 2x_1 & 0 \end{bmatrix}$

3- Consider the multi-objective optimization problem

$$\min f_1(\underline{x}) \text{ and } \max f_2(\underline{x}) \text{ and } \min f_3(\underline{x})$$

Which reformulation of the above problem to a single-objective optimization is reasonable?

- A: $\min f_1(\underline{x}) + \alpha f_2(\underline{x}) + \beta f_3(\underline{x}), \alpha > 0, \beta > 0$
- B: $\min f_1(\underline{x}) \text{ s.t. } f_2(\underline{x}) \leq \alpha \text{ and } f_3(\underline{x}) \geq \beta$
- C: $\min f_1(\underline{x}) \text{ s.t. } f_2(\underline{x}) \leq \alpha \text{ and } f_3(\underline{x}) \leq \beta$
- D: $\min f_1(\underline{x}) \text{ s.t. } f_2(\underline{x}) \geq \alpha \text{ and } f_3(\underline{x}) \geq \beta$
- E: none of them

4- You minimize $f(\underline{x}) \in \mathbb{R}$ with $\underline{x} \in \mathbb{R}^6$ subject to 2 inequality constraints and 2 equality constraints. The feasible region R_F is in general

- A: a 2-dimensional subspace of $\mathbb{R}^6$
- B: a 4-dimensional subspace of $\mathbb{R}^6$
- C: a 5-dimensional subspace of $\mathbb{R}^6$
- D: $\mathbb{R}^6$

5- What is always a convex optimization?

A: constrained linear least-square optimization

B: constrained nonlinear least-square optimization

C: unconstrained linear least-square optimization

D: unconstrained nonlinear least-square optimization

6- What statement is wrong about the method of Lagrange multiplier

A: a method for optimization subject to inequality constraints

B: not for unconstrained optimization

C: can be applied to all continuous optimization problems

D: the original cost function leading to new Lagrange function