

## AM SC SS 21

1.1 Given  $\underline{x} = [-8, -6, 0]^T$  with  $\|\underline{x}\|_p = 2$ . Which value of  $p$  is correct?

- A:  $p = 0$
- B:  $p = 1$
- C:  $p = 2$
- D:  $p = \infty$

1.2 Given  $\mathbf{X} = \begin{bmatrix} -2 & 1+j \\ 1-j & \alpha \end{bmatrix}$ . What is correct?

- A:  $\mathbf{X}$  is Hermitian for any  $a \in \mathbb{C}$ .
- B:  $\mathbf{X}$  is only Hermitian for  $\alpha \geq 0$ .
- C:  $\mathbf{X}$  is antihermitian.
- D:  $\mathbf{X}$  is symmetric
- E: none of them

1.3 Let  $\mathbf{X} \in \mathbb{R}^{4 \times 4}$ . It contains 6 independent real parameters. Which kind of matrix is  $\mathbf{X}$ ?

- A: Diagonal
- B: Toeplitz
- C: Symmetric
- D: Antisymmetric

1.4 Let 2 and -1 be the eigenvalues of the symmetric matrix  $\mathbf{X} \in \mathbb{R}^{2 \times 2}$ . What is correct?

- A:  $\mathbf{X}$  is positive definite
- B:  $\mathbf{X}$  is non-negative definite
- C:  $\mathbf{X}$  is negative definite
- D:  $\mathbf{X}$  is indefinite

1.5 Given  $\underline{f}(\underline{x}) = \begin{bmatrix} x_1 x_2^2 \\ \sin(x_1) \end{bmatrix}$  with  $\underline{x} = [x_1, x_2]^T$ . Calculate the Jacobi matrix of  $\underline{f}(\underline{x})$ .

A:  $\begin{bmatrix} x_2^2 & 2(x_1)(x_2) \\ \cos(x_1) & 0 \end{bmatrix}$

B:  $\begin{bmatrix} x_2^2 & \cos(x_1) \\ 2(x_1)(x_2) & 0 \end{bmatrix}$

C:  $\begin{bmatrix} x_2^2 & 2(x_1)(x_2) \\ -\cos(x_1) & 0 \end{bmatrix}$

D:  $\begin{bmatrix} 2(x_1)(x_2) & x_2^2 \\ \cos(x_1) & 0 \end{bmatrix}$

1.6 Given  $\mathbf{X} = [\mathbf{x}_i] \in \mathbb{R}^{1 \times 3}$  and  $\mathbf{Y} = [\mathbf{y}_{ij}] \in \mathbb{R}^{2 \times 2}$ . Determine the elements of  $\mathbf{Y} \otimes \mathbf{X}$  at the position (1,5) and (2,3)?

A:  $x_2 y_{21}, x_3 y_{11}$

B:  $x_3 y_{11}, x_2 y_{21}$

C:  $x_3 y_{21}, x_2 y_{12}$

D:  $x_2 y_{12}, x_3 y_{21}$

1.7 You are looking for a job after your university study. The comparison of job offers based on the criteria company and salary is an optimization problem. What statement is wrong?

A: It is a non-convex optimization

B: It is a multi-objective optimization

C: It is a smooth optimization

D: It is not a continuous optimization

1.8 Consider the multi-objective optimization problem

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

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

A:  $\min f_1(\underline{x}) + \alpha f_2(\underline{x}) + \beta f_3(\underline{x})$ ,  $\alpha > 0$  and  $\beta > 0$

B:  $\min f_1(\underline{x})$  s.t.  $f_2(\underline{x}) \leq \alpha$  and  $f_3(\underline{x}) \geq \beta$

C:  $\min f_1(\underline{x})$  s.t.  $f_2(\underline{x}) \leq \alpha$  and  $f_3(\underline{x}) \leq \beta$

D:  $\min f_1(\underline{x})$  s.t.  $f_2(\underline{x}) \geq \alpha$  and  $f_3(\underline{x}) \geq \beta$

1.9 You minimize  $f(\underline{x}) \in \mathbf{R}$  with  $\underline{x} \in \mathbf{R}^6$  subject to 1 inequality constraint and 2 equal constraints. The feasible region  $\mathbf{R}_f$  is in general a

A: 3-dimensional subspace of  $\mathbf{R}^6$

B: 4-dimensional subspace of  $\mathbf{R}^6$

C: 5-dimensional subspace of  $\mathbf{R}^6$

D: none of them

1.10 Which statement is wrong about convex optimization?

A: The cost function is always a convex function

B: There is no danger of getting stuck in a local minimum

C: A linear program is always convex

D: A LS problem is always convex

1.11 Which statement is wrong when comparing gradient descent and Newton method numerical minimization?

A: Gradient descent method requires first-order derivative (gradient vector) only

B: Newton method requires second-order derivative (Hessian matrix) only.

C: Both are iterative methods.

D: Newton method has a higher complexity than gradient descent method.