

TEORI MATEMATIKA 3
MATEMATIKA
VEKTOR GRADIEN & MATRIKS HESSIAN

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Sains Data Terapan A

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PROGRAM STUDI SAINS DATA TERAPAN

$$1., x = [0 \ 1]^T$$

$$f(x) = x_1 - x_2 + 2x_1^2 + 2x_1 x_2 + x_2^2$$

$$[0 \ 1]^T$$

$$\bullet \text{ Vektor gradient} = \begin{bmatrix} 1 + 4x_1 + 2x_2 \\ -1 + 2x_2 + 2x_1 \end{bmatrix} = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$$

$$\bullet \text{ Matriks Hessian} = \begin{bmatrix} 4 & 2 \\ 2 & 2 \end{bmatrix}$$

$$2., x = [0 \ 0]^T$$

$$f(x) = 10x_1^4 - 20x_1^2 x_2 + 10x_2^4 + x_1^2 - 2x_1 + 5$$

$$\bullet \text{ Vektor gradient} = \begin{bmatrix} 40x_1^3 - 40x_1 x_2 + 2x_1 - 2 \\ -20x_1^2 + 20x_2 \end{bmatrix} = \begin{bmatrix} -2 \\ 0 \end{bmatrix}$$

$$\bullet \text{ Matriks Hessian} = \begin{bmatrix} 120x_1^2 - 40x_2 + 2 & -40x_1 \\ -40x_1 & 20 \end{bmatrix} = \begin{bmatrix} 2 & 0 \\ 0 & 20 \end{bmatrix}$$

$$3., x = [5 \ 2 \ -4]^T$$

$$f(x) = (x_1 - 4)^4 + (x_2 - 3)^2 + 4(x_3 + 5)^4$$

$$\bullet \text{ Vektor gradient} = \begin{bmatrix} 4(x_1 - 4)^3 \cdot 1 \\ 2(x_2 - 3) \cdot 1 \\ 16(x_3 + 5)^3 \cdot 1 \end{bmatrix} = \begin{bmatrix} 4 \\ -2 \\ 16 \end{bmatrix}$$

$$\bullet \text{ Matriks Hessian} = \begin{bmatrix} 12(x_1 - 4)^2 \cdot 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 48(x_3 + 5)^2 \end{bmatrix}$$

$$= \begin{bmatrix} 12 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 48 \end{bmatrix}$$

$$4.7 \begin{bmatrix} 1 & 0 \end{bmatrix}^T$$

$$f(x) = (x_1 - 2)^4 + (x_1 - 2)^2 x_2^2 + (x_2 + 1)^2$$

$$\cdot \text{Vektor Gradient} = \begin{bmatrix} 4(x_1 - 2)^3 + 2(x_1 - 2)x_2^2 \\ 2(x_1 - 2)x_2 + 2(x_2 + 1) \end{bmatrix} = \begin{bmatrix} -4 \\ 2 \end{bmatrix}$$

$$\cdot \text{Matrizes Hession} = \begin{bmatrix} 12(x_1 - 2)^2 + 2x_2^2 & 4(x_1 - 2)x_2 \\ 4(x_1 - 2)x_2 & 2(x_1 - 2)^2 + 2 \end{bmatrix}$$

$$= \begin{bmatrix} 12 & 0 \\ 0 & 4 \end{bmatrix}$$