Stamatics Task 01

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1 Ans 1

1.1 1(a)

Let

$$\vec{y} = A\vec{x}$$

Calculating,

$$\frac{\partial y_i}{\partial x_j}$$

where

$$y_i = \sum_{k=1}^{n} A_{ik} x_k$$

Now,

$$\frac{\partial y_i}{\partial x_j} = A_{ij}$$

if j=k and 0 otherwise
Hence

$$\frac{dA\vec{x}}{d\vec{x}} = \vec{x}$$

1.2 1(b)

Let

$$\vec{y} = \vec{x}^T A\vec{x}$$

Calculating,

$$\frac{\partial y}{\partial x_j}$$

where

$$y = \sum_{i=1}^{n} \sum_{j=1}^{n} x_i A_{ij} x_j$$

For

$$i \neq j$$

, the above partial derivative will be 0. But, for i=j(implies that A is a symmetric matrix), the partial derivative term becomes 2x$_i A_{ij}$

Hence

$$\frac{d\vec{x}^T A\vec{x}}{d\vec{x}} = 2A\vec{x}^T$$

where A is a symmetric matrix.
Replacing 2A with

$$A + A^T$$

since it is also a symmetric matrix.
Thus

$$\frac{d\vec{x}^T A\vec{x}}{d\vec{x}} = (A + A^T)\vec{x}^T$$

2 Ans 2

We will get a 3D matrix of dimensions m x n x k

3 Ans 3

3.1 3(a)

$$A_{2\times 2} = \begin{bmatrix} 2sin(2x)cos(y) & -2sin^2(x)sin(y) \\ 2x + 3e^y & x^2 + 3e^y \end{bmatrix}$$

3.2 3(b)

$$A_{2\times 4} = \begin{bmatrix} 6xy + xzw & 3x^2 + yzw & xyw & xyz \\ 2xcos(x^2 + yw - z) & wcos(x^2 + yw - z) & -cos(x^2 + yw - z) & ycos(x^2 + yw - z) \end{bmatrix}$$

4 Ans 4

Applying the product rule, the answer would be $\beta^T e^{\beta^T \vec{x}}$