# HW-1

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## 1 Problem 1

### 1.1

$$f(x,y) = x^2 + \ln(y) + xy + y^3$$

$$\frac{\partial f}{\partial x} = 2x + y$$

$$\frac{\partial f}{\partial y} = \frac{1}{y} + x + 3y^2$$

$$\nabla f(x,y) = \left(2x + y, \frac{1}{y} + x + 3y^2\right)$$

$$\nabla f(10,-10) = \left(2(10) + (-10), \frac{1}{(-10)} + (10) + 3(-10)^2\right)$$

$$\nabla f(10,-10) = (10, 309.9)$$

### 1.2

$$f(x,y,z) = \tanh(x^3y^3) + \sin(z^2)$$

$$\frac{\partial f}{\partial x} = \frac{1}{cosh^2(x^3y^3)} * 3x^2y^3$$

$$\frac{\partial f}{\partial y} = \frac{1}{cosh^2(x^3y^3)} * 3x^3y^2$$

$$\frac{\partial f}{\partial z} = 2z * cos(z^2)$$

$$\nabla f(-1,0,\pi/2) = \left(\frac{3(-1)^2 * (0)^3}{cosh^2((-1)^3(0)^3}, \frac{3(-1)^3 * (0)^2}{cosh^2((-1)^3(0)^3}, 2(\frac{\pi}{2}) * cos(\frac{\pi^2}{4}\right)$$

$$\nabla f(-1,0,\pi/2) = (0, 0, -2.45)$$

## 2 Problem 2

### 2.1

$$\begin{bmatrix} 10 \\ -5 \\ 2 \\ 8 \end{bmatrix} \quad \begin{bmatrix} 0 & 3 & 0 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 10 * 0 + (-5) * 3 + 2 * 0 + 8 * 1 \end{bmatrix}$$

$$\begin{bmatrix} -7 \end{bmatrix}$$

### 2.2

$$\begin{bmatrix} 1 & -1 & 6 & 7 \\ 9 & 0 & 8 & 1 \\ -8 & 1 & 2 & 3 \\ 10 & 4 & 0 & 1 \end{bmatrix} \quad \begin{bmatrix} 6 & 2 & 0 \\ 0 & -1 & 1 \\ -3 & 0 & 4 \\ 3 & 4 & 7 \end{bmatrix}$$

$$
\begin{aligned}
C_{11} &= (1 \times 6) + (-1 \times 0) + (6 \times (-3)) + (7 \times 3) \\
&= 6 + 0 - 18 + 21 \\
&= 9
\end{aligned}
$$

$$
\begin{aligned}
C_{12} &= (1 \times 2) + (-1 \times (-1)) + (6 \times 0) + (7 \times 4) \\
&= 2 + 1 + 0 + 28 \\
&= 31
\end{aligned}
$$

$$
\begin{aligned}
C_{13} &= (1 \times 0) + (-1 \times 1) + (6 \times 4) + (7 \times 7) \\
&= 0 - 1 + 24 + 49 \\
&= 72
\end{aligned}
$$

$$
\begin{aligned}
C_{21} &= (9 \times 6) + (0 \times 0) + (8 \times (-3)) + (1 \times 3) \\
&= 54 + 0 - 24 + 3 \\
&= 33
\end{aligned}
$$

$$
\begin{aligned}
C_{22} &= (9 \times 2) + (0 \times (-1)) + (8 \times 0) + (1 \times 4) \\
&= 18 + 0 + 0 + 4 \\
&= 22
\end{aligned}
$$

$$
\begin{aligned}
C_{23} &= (9 \times 0) + (0 \times 1) + (8 \times 4) + (1 \times 7) \\
&= 0 + 0 + 32 + 7 \\
&= 39
\end{aligned}
$$

$$
\begin{aligned}
C_{31} &= (-8 \times 6) + (1 \times 0) + (2 \times (-3)) + (3 \times 3) \\
&= -48 + 0 - 6 + 9 \\
&= -45
\end{aligned}
$$

$$
\begin{aligned}
C_{32} &= (-8 \times 2) + (1 \times (-1)) + (2 \times 0) + (3 \times 4) \\
&= -16 - 1 + 0 + 12 \\
&= -5
\end{aligned}
$$

$$
\begin{aligned}
C_{33} &= (-8 \times 0) + (1 \times 1) + (2 \times 4) + (3 \times 7) \\
&= 0 + 1 + 8 + 21 \\
&= 30
\end{aligned}
$$

$$
\begin{aligned}
C_{41} &= (10 \times 6) + (4 \times 0) + (0 \times (-3)) + (1 \times 3) \\
&= 60 + 0 + 0 + 3 \\
&= 63
\end{aligned}
$$

$$
\begin{aligned}
C_{42} &= (10 \times 2) + (4 \times (-1)) + (0 \times 0) + (1 \times 4) \\
&= 20 - 4 + 0 + 4 \\
&= 20
\end{aligned}
$$

$$
\begin{aligned}
C_{43} &= (10 \times 0) + (4 \times 1) + (0 \times 4) + (1 \times 7) \\
&= 0 + 4 + 0 + 7 \\
&= 11
\end{aligned}
$$

$$\begin{bmatrix} 9 & 31 & 72 \\ 33 & 22 & 39 \\ -45 & -5 & 30 \\ 63 & 20 & 11 \end{bmatrix}$$