Report of the Assignment1
CSC486B
Zhilun Liu V00822606

2.1

1. $y = ax^2 + bx + c$

   $\frac{dy}{dx} = 2ax + b$

2. $y = \sin x \cos x$

   $\frac{dy}{dx} = \cos^2 x - \sin^2 x = \cos(2x)$

3. $y = \frac{1}{1+e^{-x}} = (1 + e^{-x})^{-1}$

   $\frac{dy}{dx} = -(1+e^{-x})^{-2} \cdot (-e^{-x}) = (1+e^{-x})^{-2} \cdot (e^{-x}) = \frac{e^{-x}}{(1+e^{-x})^2}$

4. $y = \frac{e^x - e^{-x}}{e^x + e^{-x}} = (e^x - e^{-x}) \cdot (e^x + e^{-x})^{-1}$

   $\frac{dy}{dx} = \frac{\frac{d}{dx}(e^x - e^{-x})(e^x + e^{-x})^{-1} - \frac{d}{dx}(e^x + e^{-x})(e^x - e^{-x})}{(e^x + e^{-x})^2}$

   $= \frac{(e^x + e^{-x})^2 - (e^x - e^{-x})^2}{(e^x + e^{-x})^2} = \frac{4}{(e^x + e^{-x})^2}$

2.2

1. $y = e^{ax+b}$

   Taylor expansion: $= e + aex + \frac{a^2}{2}ex^2 + \frac{a^3}{6}ex^3 + \cdots$

2. $y = \sin(ax+b)$

   T.E. $= \sin(b) + a\cos(b)x - \frac{a^2\sin(b)}{2}x^2 + \frac{a^3\cos(b)}{6}x^3 + \cdots$

2.3.

   $3\times3 \quad \times \quad 1\times3 \quad = 1\times3$

1. $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \times \begin{bmatrix} -1 \\ 2 \\ -1 \end{bmatrix}$

   $= \begin{bmatrix} 1 & -1 & 4 & 2 & -8 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

   $1\times3 \quad \times \quad 3\times1 \quad = 3\times3$

2. $\begin{bmatrix} -1 \\ 2 \\ -1 \end{bmatrix} \times \begin{bmatrix} 1 & -2 & 1 \end{bmatrix}$

   $= \begin{bmatrix} -1 & 2 & -1 \\ 2 & -4 & 2 \\ -1 & 2 & -1 \end{bmatrix}$

2.4

$$y = (A^T x - b)^T (A^T x - b)$$

$$= [(A^T x)^T - b^T](A^T x - b)$$

$$= (x^T A - b^T)(A^T x - b)$$

$$\frac{dy}{dx} = \frac{d}{dx}(x^T A - b^T)(A^T x - b) + (x^T A - b^T)\frac{d}{dx}(A^T x - b)$$
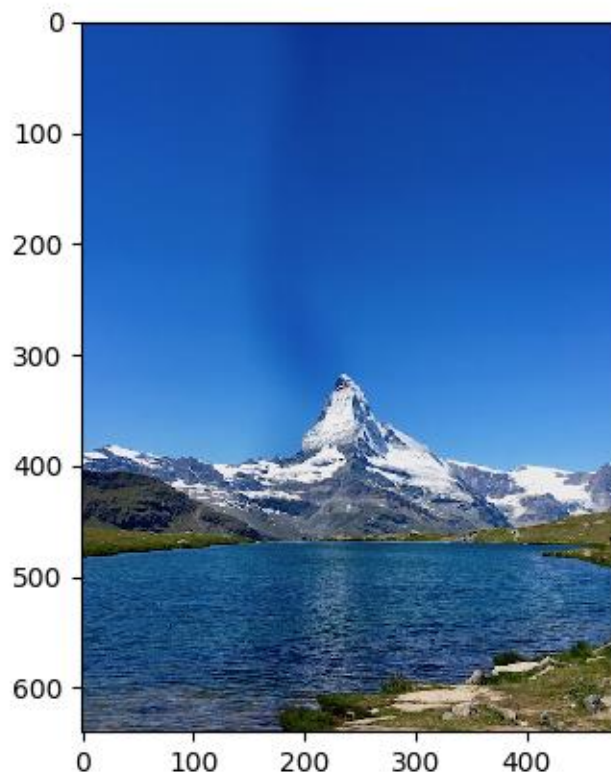
$$= [(A + A^T)x - 0]\cdot(A^T x - b) + (x^T A - b^T)(A)$$

$$= (A + A^T)(A^T x - b) + A(x^T A - b^T)$$

Figure1

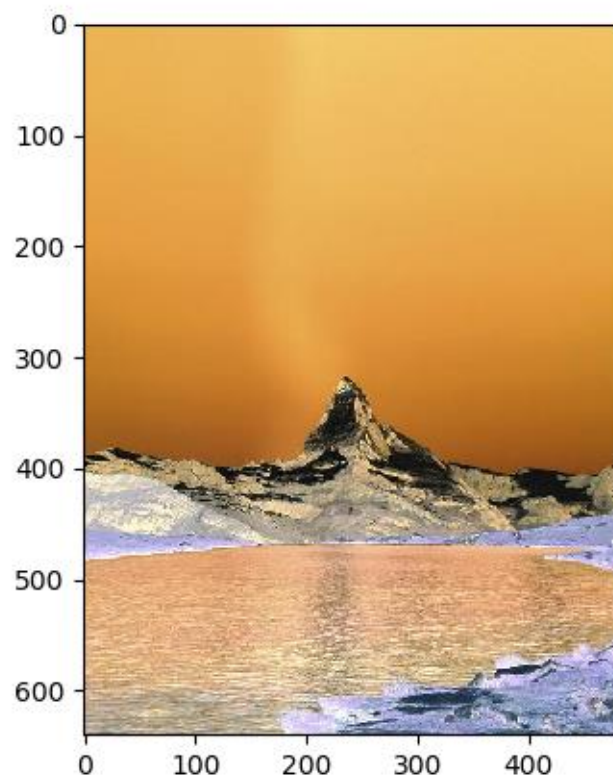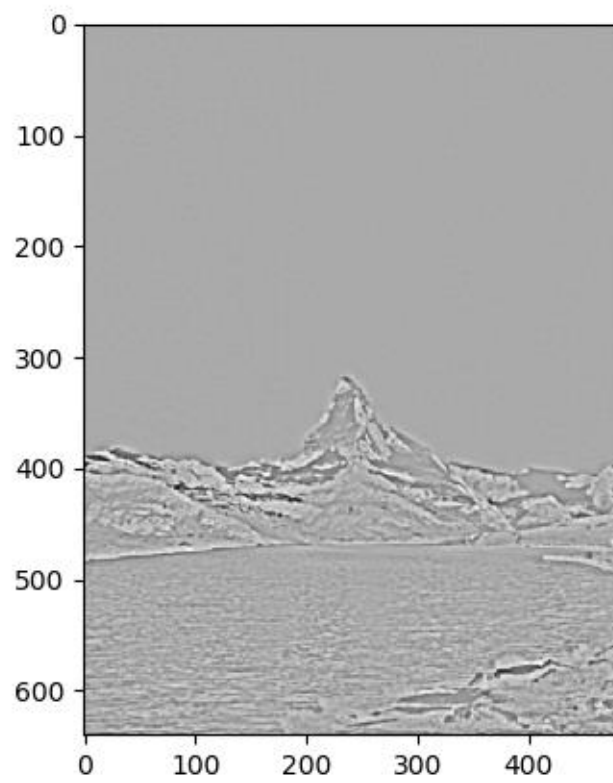Figure 2

Figure 3