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Assignment 1

2.1

1. $y = ax^2 + bx + c \rightarrow dy/dx = 2ax + b$
2. $y = \sin x \cos x \rightarrow dy/dx = -\cos x \sin x$
3. $y = 1/(1+e^{-x}) = (1+e^{-x})^{-1} \rightarrow dy/dx = e^{-x}(1+e^{-x})^{-2}$
4. $y = (e^x - e^{-x}) / (e^x + e^{-x}) = ((e^x + e^{-x})(e^x + e^{-x}) - (e^x - e^{-x})(e^x - e^{-x})) / (e^x + e^{-x})$
   $= ((e^x + e^{-x})^2 - (e^x - e^{-x})^2) / (e^x + e^{-x})$

2.2

1. $y = e^{ax+b}$ *at* $x = 0$
   $T(x) = f(a) + f'(a)(x-a) + (f''(a)/2)(x-a)^2$
   $= e^{ax+b} + ae^{ax+b}(x-a) + (a^2 e^{ax+b}/2)(x-a)^2$
   $= e^b + ae^b(-a) + (a^2 e^b/2)(a)^2$
2. $y = \cos(ax+b)$ *at* $x = 0$
   $T(x) = f(a) + f'(a)(x-a) + (f''(a)/2)(x-a)^2$
   $= \cos(ax+b) + (-a\sin(ax+b)(x-a)) + (-a^2\cos(ax+b)/2)(x-a)^2$
   $= \cos(b) + (-a\sin(b)(a)) + (-a^2\cos(b)/2)(a)^2$

2.3

1.
$$\begin{matrix} 9 & 8 & 7 \\ 6 & 5 & 4 \\ 3 & 2 & 1 \end{matrix} * 2 = \begin{matrix} 18 & 16 & 14 \\ 12 & 10 & 8 \\ 6 & 4 & 2 \end{matrix} = \begin{matrix} -1 & -9 & -6 & -3 \\ -1 & -7 & -4 & -1 \end{matrix} = \begin{matrix} 0 \\ 0 \\ 0 \end{matrix}$$

2.
$$\begin{matrix} -2 \\ 1 \\ -2 \end{matrix} * \begin{matrix} 1 & -2 & 1 \end{matrix} = \begin{matrix} -2 & 4 & -2 \\ 1 & -2 & 1 \\ -2 & 4 & -2 \end{matrix}$$

2.4

1. $y = \|A^T x - b\|_2^2$
   $z = A^T x - b$ so $dz = A^T dx$
   $y = \|z\|_2^2 = z^T z$
   $dy = 2z^T dz = 2z^T A^T dx = (2Az)^T dx \rightarrow dy/dx = 2Az$
   $= 2A(A^T x - b)$