Exercise 7

January 15, 2021

1. Compute the derivative $f'(x)$ for:

   $f(x) = log(x^4)sin(x^3)$

2. Compute the derivative $f'(x)$ of logistic sigmoid:

   $f(x) = \frac{1}{1+exp(-x)}$

3. Compute the derivative $f'(x)$ of function:

   $f(x) = exp(-\frac{1}{2\sigma^2}(x-\varphi)^2)$
   Where σ and $\varphi \in R$ are constant

4. Compute the Taylor polynomial $T_n, n = 0, ..., 5$ of $f(x) = sin(x) + cos(x)$ at $x_0 = 0$

5. Compute the derivatives df/dx of the following functions. Provide the dimensions of every single partial derivative. Describe your steps in detail.

   (a) Use the chain rule. Provide the dimensions of every single partial derivative.
   $f(z) = exp(-\frac{1}{2z})$
   $z = g(y) = y^T S^{-}1y$
   $y = h(x) = x - \mu$

   (b) $f(x) = tr(xx^T + \sigma^2 y), x \in R^D$ Here $tr(A)$ is the trace of A, i.e., the sum of the diagonal elements A_{ii}.
   Hint: Explicitly write out the outer product

(c) Use the chain rule. Provide the dimensions of every single partial derivative. You do not need to compute the product of the partial derivatives explicitly.
$f = tanh(z) \in R^M$
$z = Ax + b, x \in R^N, A \in R^M, b \in R^M$
Here, tanh is applied to every component of z.