

Exercise sheet: Auto-diff

Let \mathbf{f} be a vector-valued function that maps from \mathbb{R}^3 to \mathbb{R}^2 ,

$$y_1 = f_1(x_1, x_2, x_3) = x_1 x_3 + \log(x_2 + x_1) \times e^{-x_3}$$

$$y_2 = f_2(x_1, x_2, x_3) = e^{-x_2} + \cos(x_1 x_3).$$

1. Compute the Jacobian using manual differentiation and evaluate the Jacobian at the point $(x_1 = 3, x_2 = 5, x_3 = 1)$
2. Compute the Jacobian at the same point that in the previous point, but using finite difference approximation.
3. Draw the computational graph.
4. Compute the Jacobian using AD in forward mode. Write the expressions for all the intermediate variables \dot{v}_i in the forward tangent trace.
5. Compute the Jacobian using AD in reverse mode. Write the expressions for all the adjoints \bar{v}_i in the reverse derivative trace.