OMSCS 7643: Deep Learning Fall 2020

Computational Graph Practice Set Solutions

August 27, 2020

1. a) See Fig. 1.

$$f(1,2) = [18.296, 0]$$

b) Using one-sided difference:

$$\frac{\partial \mathbf{f}}{\partial \mathbf{w}} \approx \begin{bmatrix} \frac{\mathbf{f}(1+\Delta w,-1)-\mathbf{f}(1,-1)}{\Delta w}, & \frac{\mathbf{f}(1,-1+\Delta w)-\mathbf{f}(1,-1)}{\Delta w} \end{bmatrix}
\frac{\partial \mathbf{f}}{\partial \mathbf{w}} \approx \begin{bmatrix} 48.192 & 4.764 \\ 0.00 & 1.00 \end{bmatrix}$$

Or, using central differences:

$$\begin{split} \frac{\partial \mathbf{f}}{\partial \mathbf{w}} &\approx \left[\frac{\mathbf{f}(1 + \Delta w, -1) - \mathbf{f}(1 - \Delta w, -1)}{2\Delta w}, \quad \frac{\mathbf{f}(1, -1 + \Delta w) - \mathbf{f}(1, -1 - \Delta w)}{2\Delta w} \right] \\ \frac{\partial \mathbf{f}}{\partial \mathbf{w}} &\approx \begin{bmatrix} 47.316 & 4.711 \\ 0.0 & 1.00 \end{bmatrix} \end{split}$$

c) The derivatives with respect to w_1 using forward-mode AD are shown in Fig. 2. w_2 is derived symmetrically.

$$\frac{\partial \mathbf{f}}{\partial \mathbf{w}} = \begin{bmatrix} 47.303 & 4.710 \\ 0 & 1 \end{bmatrix}$$

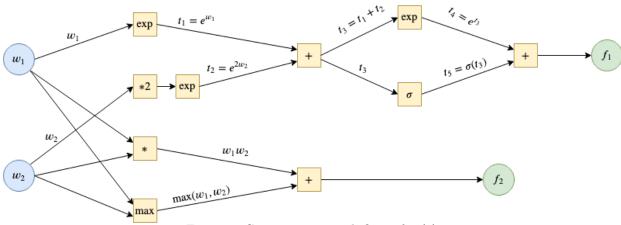


Figure 1: Computation graph figure for (a)

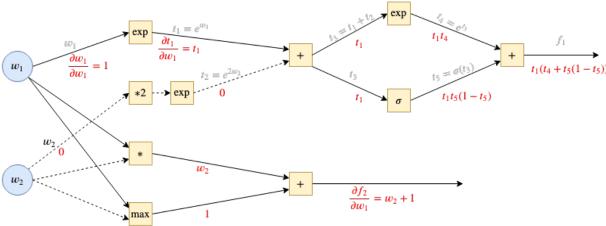


Figure 2: Forward-mode AD for (c), gradients are shown in red

d) The derivatives of f_1 using reverse-mode AD are shown in Fig. 3. f_2 is derived symmetrically.

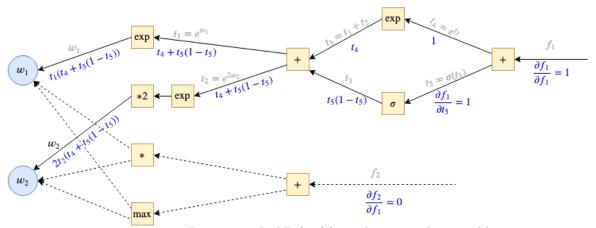


Figure 3: Reverse-mode AD for (c), gradients are shown in blue

$$\frac{\partial \mathbf{f}}{\partial \mathbf{w}} = \begin{bmatrix} 47.303 & 4.710 \\ 0 & 1 \end{bmatrix}$$