

CS7643: Deep Learning
Spring 2022
Computational Graph Practice Set Solutions

1. a) See Fig. 1.

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

b) Using one-sided difference:

$$\frac{\partial \mathbf{f}}{\partial \mathbf{w}} \approx \left[\frac{\mathbf{f}(1+\Delta w, -1) - \mathbf{f}(1, -1)}{\Delta w}, \frac{\mathbf{f}(1, -1+\Delta w) - \mathbf{f}(1, -1)}{\Delta w} \right]$$

$$\frac{\partial \mathbf{f}}{\partial \mathbf{w}} \approx \begin{bmatrix} 48.192 & 4.764 \\ 0.00 & 1.00 \end{bmatrix}$$

Or, using central differences:

$$\frac{\partial \mathbf{f}}{\partial \mathbf{w}} \approx \left[\frac{\mathbf{f}(1+\Delta w, -1) - \mathbf{f}(1-\Delta w, -1)}{2\Delta w}, \frac{\mathbf{f}(1, -1+\Delta w) - \mathbf{f}(1, -1-\Delta w)}{2\Delta w} \right]$$

$$\frac{\partial \mathbf{f}}{\partial \mathbf{w}} \approx \begin{bmatrix} 47.316 & 4.711 \\ 0.0 & 1.00 \end{bmatrix}$$

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

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

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

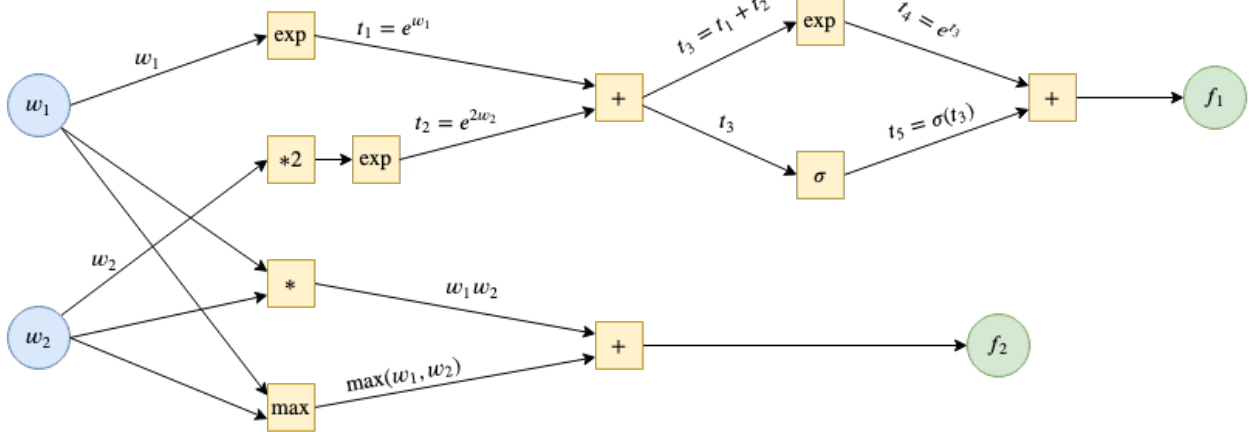
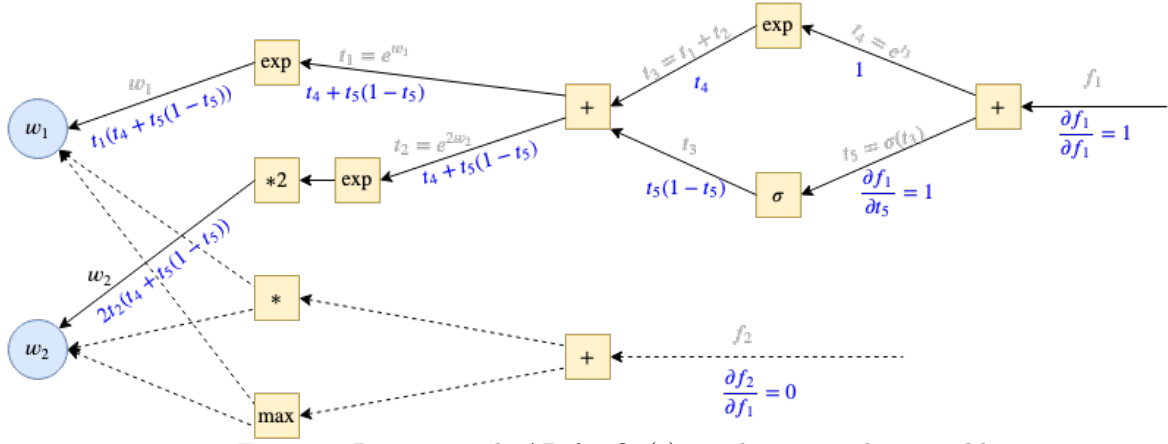
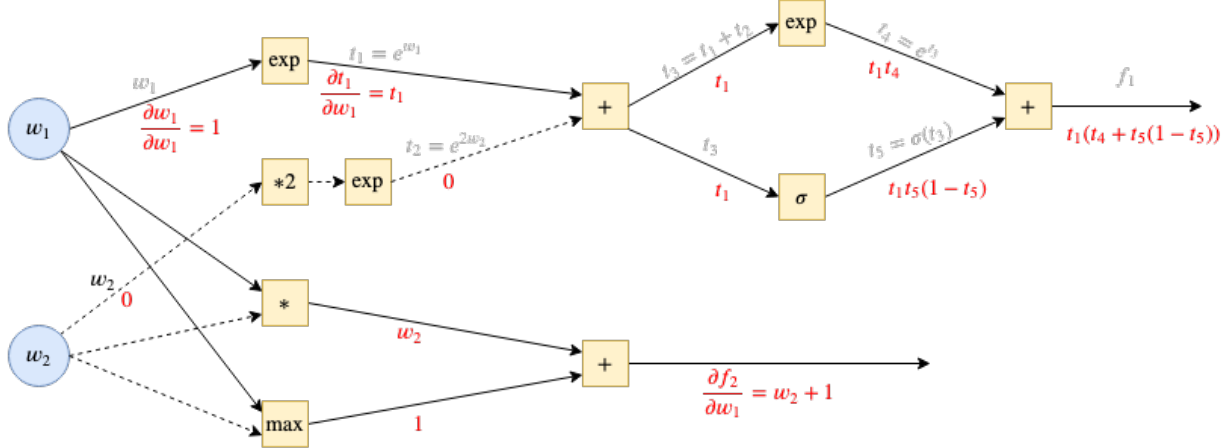


Figure 1: Computation graph figure for Q5(a)



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