Consider an example with two inputs (x_1, x_2) and two outputs given as

$$f_1(x_1, x_2) = x_1 x_2 + exp(x_1 x_2) - sin(x_2)$$

$$f_2(x_1, x_2) = (x_1 x_2 - sin(x_2))exp(x_1 x_2)$$

Provide the expression for $\frac{\partial f}{\partial x}$, with f and x defined for the outputs and inputs mentioned above. To solve this, please make use of the following primal variables

$$v_1 = x_1$$
$$v_2 = x_2$$
$$v_3 = v_1 v_2$$
$$v_4 = sin(v_2)$$
$$v_5 = exp(v_3)$$
$$v_6 = v_3 - v_4$$
$$v_7 = v_5 + v_6$$
$$v_8 = v_5 v_6$$

Draw the forward propagation diagram with the help of these variables, and use back-propagation to compute $\frac{\partial f}{\partial x}$. Provide your final answer in terms of the primal variables before giving the final expression in terms of x_1 and x_2.