Sheet 5
Chain Rule

Questions

1. In a neural network, the goal is to compute the cost on the forward pass and the derivative (gradient) on the backward pass. If the cost function is $J = \cos(\sin(x^2) + 3x^2)$, and the forward pass is as follows: $J = \cos(u)$, $u = u_1 + u_2$, $u_1 = \sin(t)$, $u_2 = 3t$, $t = x^2$. Calculate the partial derivatives of J with respect to x using the chain rule for backward propagation.

2. Consider the cost function $J = x^2 + y^2 + z^2$, where x, y, and z are variables. Suppose that $x = u + v$, $y = u - v$, and $z = u^2 + v^2$, where u and v are also variables.Perform a forward propagation and then calculate the partial derivatives of J with respect to u and v using the chain rule for backward propagation.

3. Consider the function $f(x, y) = x^3 + 3xy^2 - y^3$. Let $u = x^2 - y^2$ and $v = 2xy$. Express $f(x, y)$ in terms of u and v, and then calculate the partial derivatives of f with respect to u and v using the chain rule.

4. Get backpropagation for the logistic regression, so our forward pass will be as follows:

$$J = \hat{y} \log(y + (1 - \hat{y})) - \log(1 - y)$$

$$y = \frac{1}{1 + e^{-\alpha}}$$

$$\alpha = \sum_{j=0}^{n} \theta_j x_j$$

   Express the derivative of J with respect to the model parameters θ_j using the chain rule.

Deliverable

- This sheet is to be solved **Individually**.
- You are required to submit a PDF file named **ID_FirstName_LastName_sheet5.pdf**, any other naming format will not be accepted and file will be discarded.
- Any copied sheets will be immediately zeroed and other penalties may be applied.

Good Luck