Week 10 Lab: Concept Check Exercises

Conditional Probability Models

1. In each of the following, assume $X_1, \ldots, X_n$ are an i.i.d. sample from the given distribution.

   (a) Compute the MLE for p assuming each $X_i \sim \text{Geom}(p)$ with PMF $f_X(k) = (1 - p)^{k-1}p$ for $k \in \mathbb{Z}_{\geq 1}$.

   (b) Compute the MLE for λ assuming each $X_i \sim \text{Exp}(\lambda)$ with PDF $f_X(x) = \lambda e^{-\lambda x}$.

2. We want to fit a regression model where $Y|X = x \sim \text{Unif}([0, e^{w^T x}])$ for some $w \in \mathbb{R}^d$. Given i.i.d. data points $(X_1, Y_1), \ldots, (X_n, Y_n) \in \mathbb{R}^d \times \mathbb{R}$, give a convex optimization problem that finds the MLE for w.

3. Explain why softmax is related to computing the maximum of a list of values.