Test 1

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Exercise 1

- $c_{ij}x_{ij}$ - transportation cost of x from i to j
- $c_{ij}^2 y_{ij}$ - transportation cost of y from i to j

Hence, the optimization problem:

$$\begin{aligned} \min_{x,y} \quad & \sum_{i=1}^{n}\sum_{j=1}^{m} c_{ij}x_{ij} + \sum_{i=1}^{n}\sum_{j=1}^{m} c_{ij}^2 y_{ij} \\ \text{s.t.} \quad & \sum_{j=1}^{m} x_{ij} \le a_{i,1}, \sum_{j=1}^{m} y_{ij} \le a_{i,2}, \forall i = 1, \dots, n \\ & \sum_{i=1}^{n} x_{ij} \ge b_{j,1}, \sum_{i=1}^{n} y_{ij} \ge b_{j,2}, \forall j = 1, \dots, m \end{aligned}$$

Answer: b

Exercise 2

$f_i(w) = (z_{3,0} - 0) + \dots + (z_{3,j-1} - 0) + (z_{3,j} - 1) + (z_{3,j+1} - 0) + \dots + (z_{3,9} - 0)$ is not a loss function. This is because we can choose the wrong answer, which will give 0.

Answer: b

Exercise 3

Let $M = 1, D = 10, n = 1000, 1 - \delta = 0.999 \to \delta = 0.001$

$$\sqrt{\frac{M^2 D^2 n \ln(m) \ln(\frac{n}{\delta})}{m}} \le 10^{-3} \implies m \ge 10^{14}$$

Answer: d

Exercise 4

Let $\hat{x} = \underset{x \in \mathbb{R}^n}{\operatorname{argmin}} \sum_{i=1}^{m} |y_i - \langle a^i, x \rangle|^{\frac{3}{2}}$, then $\hat{y}_i \sim N(\langle a^i, x \rangle|^{\frac{3}{2}}, \sigma^2)$. Hence, $p(\xi_i) \sim \exp(-\alpha|\xi_i|^{\frac{3}{2}})$.

Answer: c

Exercise 5

Let $f(x) \in \mathbb{R}^n$ - M-Lipschitz w.r.t. l_2 norm, then $|f(x) - f(y)| \leq M\|x - y\|_2, \forall x, y \in \mathbb{R}^n$

Answer: c