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part one

(Q1

1. for each instance $\vec{x}_i$ $\longrightarrow$ $f_i = \underset{1\times D}{\vec{x}_i} \cdot \underset{D\times 1}{\vec{W}_D} = \|\vec{x}_i\| \cdot \|\vec{w}_D\| \cdot \cos\theta$

2. $\vec{f}_N = [f_1, f_2, \dots, f_N]^T$

3. $\bar{f} = \frac{1}{N}\sum_{i=1}^{N} f_i$

4. $\mathrm{var}(\vec{f}_N) = \frac{1}{N}\sum_{i=1}^{N}(f_i - \bar{f})^2 = \frac{1}{N}\sum_{i=1}^{N}\|f_i - f\|^2$

(Q2

1. $\|\vec{w}\|^2 = 1$, $\vec{g}_D^T \cdot \vec{w} = \sum_{i=1}^{D} g_i w_i \longrightarrow \|\vec{w}\| = 1$

2. $\|\vec{g}_D\| \cdot \|\vec{w}\| \cdot \cos\theta \xrightarrow[\cos\theta = 1]{\theta = 0}$ $\theta = 0 \longrightarrow$ w یکانی = g یکانی

3. g یکانی $= \frac{\vec{g}}{\|\vec{g}\|} = \frac{\vec{\omega}}{\|\vec{\omega}\| = 1} = \vec{\omega}$

(Q3

$\arg\min_{\vec{r}}$ → دنبال $\vec{r}$ ی هستیم که این را به min برساند ←

1. $\min \sum_{n=1}^{N} \|\vec{x}_n - \vec{r}\|_p^q$

2. $q = p = 1 \longrightarrow \min \sum_{n=1}^{N} \|\vec{x}_n - \vec{r}\|$ minimize sum of absolute differences
manhattan distance

$\vec{r}$ $p = q = 1 \longrightarrow$ Median

3. $q = \infty, p = 2 \longrightarrow \min \max \|\vec{x}_n - \vec{r}\|_2$

↳ minimizing the maximum Euclidean distance.

↳ $\vec{r}$ $p = 2, q = \infty \longrightarrow$ Middle $= \frac{1}{2} \times$ min euclidean + max euclidean

4) $q = ?,\ p = ?$ $\quad \vec{r} \rightarrow$ Mode

$q = 0,\ p = 1$ $\quad$ num-non-zero$(\vec{x}_n \neq \vec{r})$

(Q4

1) $\prod_{i=1}^{6} P_i^{N_i} \xrightarrow{\log} \sum_{i=1}^{6} N_i \log(P_i) \rightsquigarrow \max \vec{n}_6^T \cdot \lg(\vec{P})$

$\vec{n}_6^T = [1, 2, 3, \dots 6]^T$

2) $\sum_{i=1}^{6} P_i = 1 \longrightarrow \vec{1}_6^T \cdot \vec{P} = 1$

3) $\vec{P} \geq \vec{0} \leftarrow P_i \geqslant 0$

(Q5

1) $M^2 \rightarrow$ each intermediate city $\underline{k}$ when calculating the probability of moving from city i to city j in exactly two steps.

$$(M^2)_{i,j} = \sum_K m_{i,K} \times m_{Kj}$$

in column-row interpretation $A \cdot B = C \rightarrow C = \sum_K C_K$

$\hookrightarrow$ $\underline{k} \rightarrow$ each intermediate city $\underline{k}$

$\underline{k}$ شهرهای واسطه ، یعنی هر outer product برابر با ماتریسی است که یک شهر را واسطه

دو شهر i, j قرار داده است.

CS CamScanner

1) element-wise: → each element of the covariance matrix Σ represents the covariance between two features. the covariance of between the i-th and j-th columns of X, divided by N-1 (where N is the number of instances) (Q6

2) Column-wise → Each column in the covariance matrix represents the covariances of a particular feature with all other features. $\sum_k \vec{X}^T_k x_{k,col} = X^T \vec{X}_{col} = \vec{\Sigma}_{col}$. عمودي

3) Row-wise → Each row in the covariance matrix represents how a particular feature covaries with all other features

$$\sum_k x_{row,k} \vec{x}^T_k = \vec{0}^T_{row}$$ سطري

4) Matrix-wise → The entire covariance matrix can be viewed as a summary of the linear relationships between all pairs of features in the dataset, it shows how all features are correlated.