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Homework n

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Linear Algebra

VS Properties 1. Close + 2. Close * 3. Associative + 4. Commutative + 5. Identity + 6. Identity * 7. Inverse +
Dot Prod $a \cdot b = a_1b_1 + a_2b_2 + ... + a_nb_n$ Describes similarity of direction. If 0, orthogonal. $\cos(\theta) = \frac{a \cdot b}{||a||||b||}$
Proj. $\text{proj}_a b = \frac{a \cdot b}{a \cdot a} a$ This is the projection of b onto a.
Lin Indept $c_1v_1 + c_2v_2 + ... + c_nv_n = 0$ IFF $c_i = 0, \forall i$
Rank Number of lin indept rows/cols in a matrix.
Data Redundancy: Duplicate Rows, Pairwise similarity, Hash based uniqueness, Entropy measure $H = -\sum p(x) \log_2 p(x)$
EVal, EVec $Av = \lambda v$ Evecs are like directions, Evals are line importance on those directions.
Dimensionality Reduction Remove redundant features, keep important ones Ie most variance.
SVD $X_{n \times m} = U_{n \times n} \Sigma_{n \times m} V^T_{m \times m}$ where U and V are orthogonal; Σ diagonal with singular values (square roots of eigenvalues of X^TX).
Rank-k Approximation Use first k singular values: $X_k = \sum_{i=1}^{k} \sigma_i u_i v_i^T$
PCA Center data, compute covariance matrix $C = \frac{1}{n} X^T X$, compute eigendecomposition of C, project data onto top k eigenvectors. The top k eigenvectors correspond to the directions of maximum variance.
PCA,SVD connection The eigenvectors of X^TX are the right singular vectors V of X. The eigenvalues of X^TX are the squares of the singular values in Σ.

Probability

Correlation $\text{corr}(X, Y) = \frac{\text{cov}(X,Y)}{\sigma_X \sigma_Y}$ where $\text{cov}(X, Y) = E[(X - \mu_X)(Y - \mu_Y)]$
R^2 $R^2 = 1 - \frac{SS_{res}}{SS_{tot}}$ essentially explained variance/total variance.
(Marginal) Independence $P(A \cap B) = P(A)P(B)$
Conditional Probability $P(A|B) = \frac{P(A \cap B)}{P(B)}$
Bayes Theorem $P(A|B) = \frac{P(B|A)P(A)}{P(B)}$ where $P(B) = P(B|A)P(A) + P(B|\neg A)P(\neg A)$ (law of total probability)

Notes During Practice exam

Bias and Variance meaning
Linear reg shortcut formula
Logistic loss function
Precision, recall, F1 score formulas
Hierarchical Clustering
Look into Unsupervised learning