

1. ML paper review

(a)

- (i). The inputs are radiomic features (gadolinium T1WI, T2WI, and FLAIR). The data is from braintumor MR imaging performed 9 months (or later) post-radiochemotherapy performed by 2 institutions.
- (ii). They are trying to distinguish radiation necrosis from recurrent brain tumors.
- (iii). 2 classes. One is radiation necrosis and the other is recurrence necrosis.
- (iv). 58. 43 for training and 15 for testing.
- (v). They compared the outcomes of the SVM algorithms with the diagnosis of 2 professional neuroradiologists. The SVM is more accurate.

(b)

- (i) The inputs are 129450 clinical images and their labels (different kind of diseases). The data comes from different online repositories and Stanford University Medical Center, together with a pre-trained Google Architecture.
- (ii) They try to distinguish different kinds of diseases based on the images.
- (iii) 9.
- (iv) 129450. 127463 for training and 1942 for testing.
- (v) They evaluated the performance by comparing the accuracy and variation of the model's performance with dermatologists' results. For the biopsy-proven part, they evaluated performance by testing the accuracy, sensitivity, and compared it with the performance of the dermatologists'.

2. Scalar Data Types

- Categorical: c), d), h)

- Ordinal: b), g)
- Interval: e)
- Ratio: a), f), i)

3.Vector representation of Binary variables

- $tr(Z) = \sum_i z_i^X$
- $\frac{1}{N}tr(Z) = \frac{\sum_i z_i^X}{N}$
- $Z^{XY} = Z^X * Z^Y$ represents the vector of the samples which both statement X and Y are true.
- $Z^X \cdot Z^Y$ represents the sum of cases in the samples when both statement X and Y are true.
- $\frac{1}{N}(tr(Z^X) - tr(Z^{XY}))$
- $tr(Z^X) + tr(Z^Y) - tr(Z^X * Z^Y)$
- $tr(Z^X) + tr(Z^Y) - 2tr(Z^X * Z^Y)$

4.Matrix and Index Notation:

(a) $Y = X\Theta + \mathcal{E}$

(b) $\frac{1}{N}(Y - X\Theta)^T(Y - X\Theta)$

(c) $\frac{1}{N} \sum_{i=1}^{i=N} (y_i - \sum_{d=1}^{d=D} x_{i,d} \theta_d)^2$

(d) $\frac{\partial E}{\partial \theta_d} = 0 \Leftrightarrow -2 \sum_{i=1}^{i=N} (y_i - \sum_{d=1}^{d=D} x_{i,d} \theta_d) x_{i,d} = 0$

(e) $\frac{\partial E}{\partial \Theta} = 0 \Leftrightarrow \frac{\partial (Y - X\Theta)^T (Y - X\Theta)}{\partial \Theta} \Leftrightarrow X^T X \Theta = X^T Y$

5.Matrix and Index Notation II:

(a) $Y = XW^T + \mathcal{E}$

(b) $\frac{1}{NK} tr((Y - XW^T)^T (Y - XW^T))$

(c) $\frac{1}{NK} \sum_{k=1}^{k=K} \sum_{i=1}^{i=N} (y_{i,k} - \sum_{d=1}^{d=D} x_{i,d} w_{k,d})^2$

$$(d) \frac{\partial E}{\partial w_{k,d}} = 0 \Leftrightarrow -2 \sum_{i=1}^{i=N} (y_{i,k} - \sum_{d=1}^{d=D} x_{i,d} w_{k,d}) x_{i,d} = 0$$

$$(e) \frac{\partial E}{\partial W} = 0 \Leftrightarrow X^T X W^T = X^T Y$$