Indoor Scene Recognition with Data Mining Algorithms

Classification methods to predict indoor scene classes

GENERAL DESCRIPTION OR PROPERTIES:

To begin with, the MIT indoor dataset is a public scene recognition dataset that contains 67 indoor scene categories, such as "airport_inside", "artstudio", "bar", "bookstore", and so on. The dataset consists of a training set with 5360 images and a test set with 1340 images. Each image is represented by a 512-dimensional feature descriptor that was extracted using a ResNet-18 deep learning model pre-trained on the ImageNet dataset. Each image is labeled with one of the 67 different scene classes mentioned above. The feature descriptors are provided in the form of CSV files, with each row representing an image and each column representing a feature.

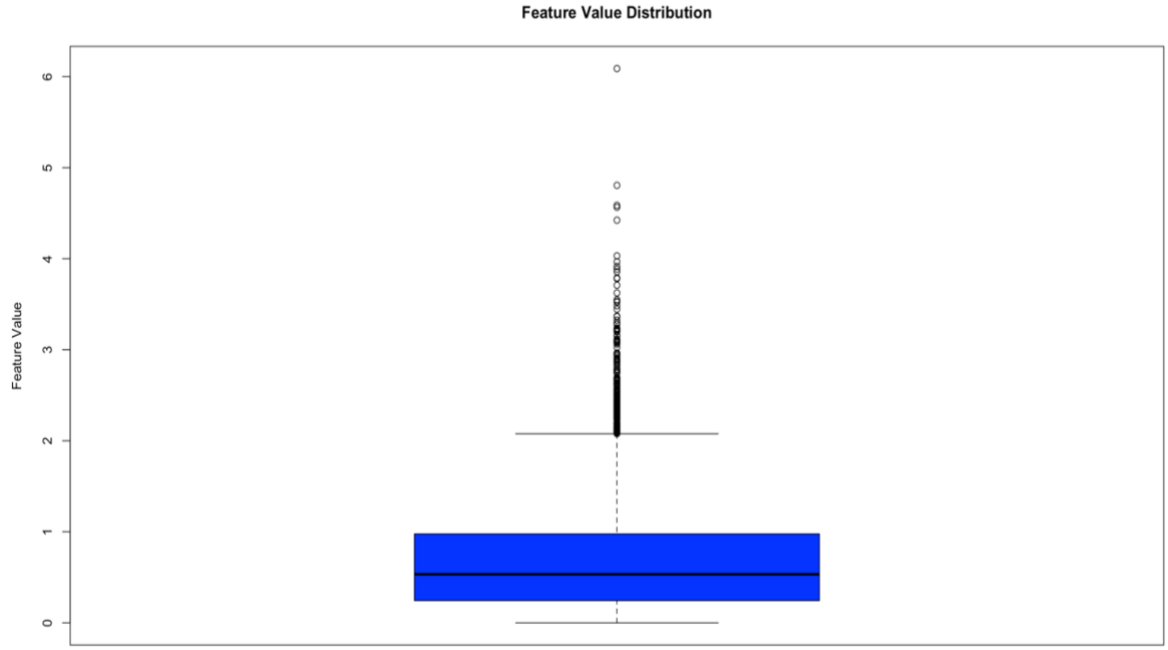
To get a better understanding of the dataset, we have plotted some basic statistics of the feature descriptors.

BOX PLOT:

Primarily, to understand the distribution and statistical summary of the feature descriptors for each class label, we have used a box plot. By examining the box plot, we can understand the central tendency, variation, and potential outliers within each class.

- The line in the center of the box represents the median value of the feature distribution. It indicates the midpoint or the 50th percentile of the data. In this case, the median appears to be around 0.5.

- The box in the plot represents the interquartile range, which is the range between the first quartile (25th percentile) and the third quartile (75th percentile) of the data. It provides information about the spread of the central part of the distribution. The larger the box, the greater the spread of the feature values.



- The whiskers extend from the box and represent the range of non-outlier data points. They can provide insights into the range and variability of the feature values. In this case, the whiskers are relatively short, indicating a limited spread of the data.

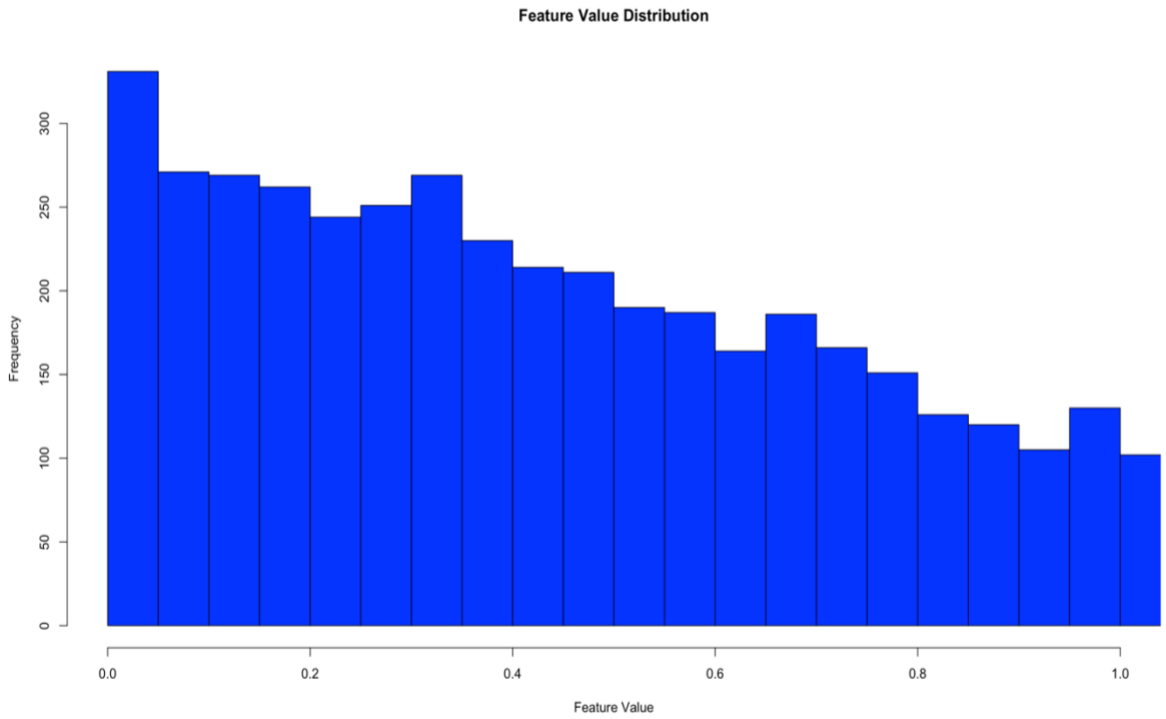
- The plot also shows individual points, known as outliers, which are data points that fall outside the whiskers. However, in this case, there are no visible outliers, suggesting that the feature values are relatively consistent and do not deviate significantly from the central distribution.

HISTOGRAM:

The histogram of the feature values provides insights into the distribution of values within the dataset. In the histogram, the x-axis represents the range of feature values, and the y-axis represents the frequency or count of occurrences. Here are some insights that can be derived from the histogram:

- The histogram appears to have a roughly bell-shaped distribution, with a peak around 0.5. This suggests that the feature values are centered around a certain range, indicating a common characteristic shared by the indoor scene images.

- The histogram provides information about the range and spread of the feature values. In this case, the feature values appear to be concentrated in a relatively narrow range, suggesting that the ResNet-18 model has produced consistent and discriminative feature descriptors for the indoor scene images.



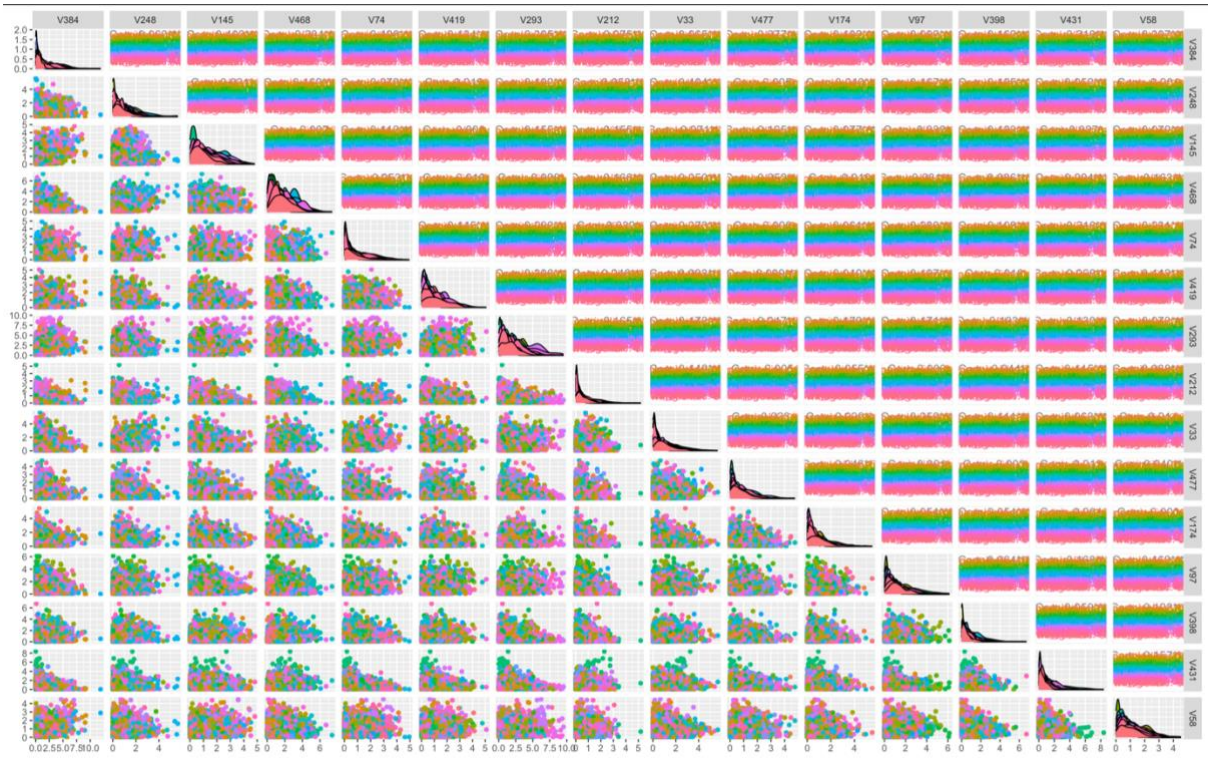
- The histogram can also reveal the presence of outliers, which are data points that significantly deviate from most of the distribution. In this case, there are no apparent outliers, as there are no bars in the histogram that extend far beyond most of the data.

SCATTERPLOT AND CORRELATION MATRIX:

To understand the correlation between the pairs of attributes, a scatter plot matrix has been used, which provides a visual representation of the relationships better. By examining the scatter plots, you can observe patterns, clusters, or trends in the data, and assess the strength and direction of relationships between variables. After a lot of trial and errors, the following attributes pairs have displayed a good relationship:

V384, V248, V145, V468, V74, V419, V293, V212, V33, V477, V174, V97, V398, V431, V58

This scatter plot matrix provides us a visual representation of the relationships between the attributes selected previously.



- From the scatter plot it can be noticed that the selected attributes present a reasonable correlation with data points forming an almost straight line, but substantially inclined towards the negative as some of the data points start at high *y*-values on the *y*-axis and progress down to low values, indicating that the variables have a subtle negative correlation. However, the selected attributes showcase the best correlation among other combinations that have been tried.

- As previously mentioned in other plots, the dataset does not seem to have any prominent outliers as also seen in the scatter plot.

- The overall spread or tightness of data points in a scatter plot can provide an indication of the strength of the relationship between the variables. The clusters in the plot are narrow and well-defined suggesting a strong correlation.

In addition, a correlation matrix was also made for the previously mentioned ideal pair of attributes, to support the attribute correlations which would eventually impact the classification models. The matrix provides a numerical representation of the pairwise correlations between the selected attributes.

- At the first glance at the matrix, positive correlation can be observed as most of the coefficient values of the attribute variables are positive towards +1. The magnitude of the correlation coefficients also indicates a stronger correlation.

- These identified correlated attributes can be important in feature selection, as they may provide redundant information or indicate the influence of certain attributes on the classification task.

```
> print(correlation_matrix)
             V384        V248        V145        V468         V74
V384  1.00000000  0.060363741  0.401999512 -0.204012483  0.4257816447
V248  0.06036374  1.000000000  0.030938983  0.162083434  0.2720402781
V145  0.40199951  0.030938983  1.000000000  0.007291115  0.1123749816
V468 -0.20401248  0.162083434  0.007291115  1.000000000 -0.0534865906
V74   0.42578164  0.272040278  0.112374982 -0.053486591  1.0000000000
V419  0.13420162  0.018744570 -0.005587906 -0.015644316  0.1451421324
V293  0.30530625  0.101780445  0.154630000 -0.028092754  0.2960221550
V212 -0.07537477  0.057799159 -0.154640169 -0.165615861  0.0319347520
V33   0.06519219  0.404015236 -0.070512769  0.050118776  0.3726048896
V477 -0.07728522  0.005075967 -0.164891651 -0.051722826  0.0004183684
V174  0.10157514  0.040446323  0.077265778 -0.018688012  0.0613002448
V97   0.09229696  0.166646740 -0.032233333 -0.080847324  0.2796106611
V398  0.16214020  0.125472328  0.123333390  0.086297996  0.1084191910
V431 -0.21032391  0.052391243  0.027277937  0.224416617 -0.2161186476
V58   0.30658797 -0.001003975  0.072143329 -0.162771288  0.2314624101
             V419        V293        V212         V33         V477
V384  0.134201617  0.30530625 -0.075374775  0.06519219 -0.0772852193
V248  0.018744570  0.10178044  0.057799159  0.40401524  0.0050759668
V145 -0.005587906  0.15463000 -0.154640169 -0.07051277 -0.1648916505
V468 -0.015644316 -0.02809275 -0.165615861  0.05011878 -0.0517228260
V74   0.145142132  0.29602215  0.031934752  0.37260489  0.0004183684
V419  1.000000000  0.30570333  0.046029645  0.09342316  0.0991612464
V293  0.305703331  1.00000000 -0.165005886  0.17284473 -0.0472884848
V212  0.046029645 -0.16500589  1.000000000  0.14172930 -0.0048405144
V33   0.093423164  0.17284473  0.141729299  1.00000000  0.0229108437
V477  0.099161246 -0.04728848 -0.004840514  0.02291084  1.0000000000
V174  0.048551973  0.17853182 -0.054798968  0.03927433 -0.0459924287
V97   0.197484774  0.17135757  0.006072235  0.25198203  0.0007486321
V398  0.015824917 -0.10308590 -0.043676675  0.11071427 -0.0025691418
V431 -0.068091144 -0.12989710  0.115417231  0.06281696 -0.0130572072
V58   0.111714461  0.07274876  0.068306299  0.01406414  0.0402565158
             V174         V97         V398         V431
V384  0.1015751395  0.0922969561  0.162140199 -0.2103239098
V248  0.0404463228  0.1666467398  0.125472328  0.0523912429
V145  0.0772657777 -0.0322333327  0.123333390  0.0272779365
V468 -0.0186880117 -0.0808473240  0.086297996  0.2244166166
V74   0.0613002448  0.2796106611  0.108419191 -0.2161186476
V419  0.0485519734  0.1974847735  0.015824917 -0.0680911439
V293  0.1785318152  0.1713575687 -0.103085896 -0.1298971024
V212 -0.0547989682  0.0060722353 -0.043676675  0.1154172306
V33   0.0392743331  0.2519820349  0.110714270  0.0628169624
V477 -0.0459924287  0.0007486321 -0.002569142 -0.0130572072
V174  1.0000000000  0.0507747784  0.053868481 -0.0007731687
V97   0.0507747784  1.0000000000  0.064264662 -0.1683844392
V398  0.0538684812  0.0642646625  1.000000000  0.0498881053
V431 -0.0007731687 -0.1683844392  0.049888105  1.0000000000
V58  -0.0001781832  0.1622225464 -0.102184652 -0.1571816240
             V58
V384  0.3065879655
V248 -0.0010039753
V145  0.0721433295
V468 -0.1627712883
V74   0.2314624101
V419  0.1117144615
V293  0.0727487606
V212  0.0683062987
V33   0.0140641395
V477  0.0402565158
V174 -0.0001781832
V97   0.1622225464
V398 -0.1021846522
V431 -0.1571816240
V58   1.0000000000
```