BRAIN TUMOR OVERALL SURVIVAL IN MRI IMAGES

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CONTENT

- Introduction
- Background
- Related Work
- Dataset
- Overview
- Proposed Method
- Results
- References

INTRODUCTION

WHAT:
Survival analysis is a branch of statistics for analyzing the expected duration of time until one or more events happen, such as death in biological organisms and failure in mechanical systems.

EXAMPLES:
customer will end their relationship
unsubscribing from mailing lists
drop out of study even before the study is finished.

WHY:
Find factors which are most correlated with that hazard
Know when this will happen to plab ahead.

BACKGROUND

The 5-year survival rate tells you what percent of people live at least 5 years after the tumor is found. Percent means how many out of 100. The 5-year survival rate for people with a cancerous brain or CNS tumor is approximately 34% for men and 36% for women. However, survival rates vary widely and depend on several factors, including the type of brain or spinal cord tumor.

It is important to remember that statistics on the survival rates for people with a brain tumor are an estimate. The estimate comes from annual data based on the number of people with this tumor in the United States. Also, experts measure the survival statistics every 5 years. So the estimate may not show the results of better diagnosis or treatment available for less than 5 years.

RELATED WORK

Rupal *et al.* [1] used age, shape and volumetric features to predict overall survival of patients with classification by random forest classifier.

Kareem *et al.* [2] used Radiomic features to predict overall survival of patients with various classifiers.

Sun *et al.* [3] used Multimodel deep learning to predict overall survival.

DATASET

- **The Multimodal Brain Tumor Image Segmentation Benchmark (BRATS) 2019**
- In this dataset, expert neuroradiologists have radiologically assessed the complete original glioma collections (HGG, n=262 and LGG, n=199) and categorized each scan as pre- or post-operative.
- Subsequently, all the pre-operative scans (135 HGG and 108 LGG) were annotated by experts for the various glioma sub-regions.
- The image datasets have following four MRI contrasts : T1, T1ce, T2, FLAIR.
- There are four types of intra-tumoral structures, namely "edema," "non-enhancing (solid) core," "necrotic (or fluid-filled) core," and "non-enhancing core."
- Additionally a OS data is provided with columns Patient Id, Age and Survival in months

OVERVIEW
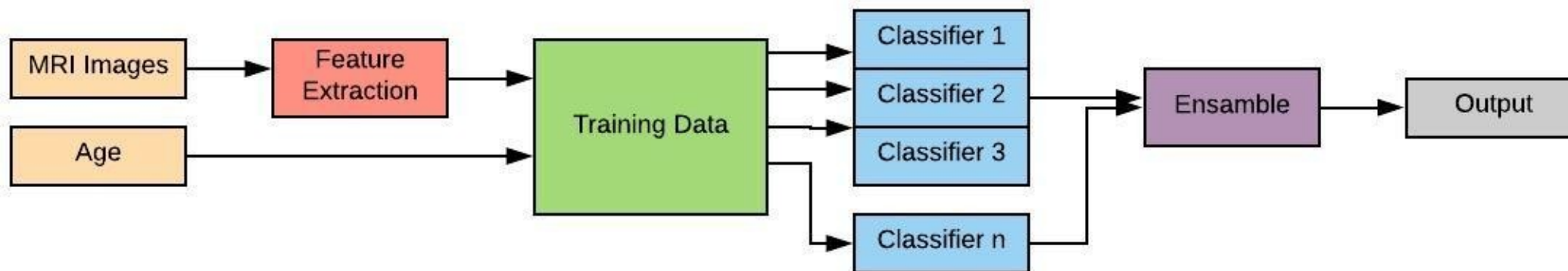
PROPOSED METHOD

open-source radiomics toolbox, Pyradiomics v1.2.0 is used Feature Extraction from MRI scans.

These features are then combined with age of patient to make compleate training data in csv format.

This data is fed to classifiers by using machine learning toolkit in MATLAB.

Top classifiers are selected and an ensamble model is trained by combining them .

FEATURE EXTRACTION:

16 shape
19 first-order statistics
27 gray level co-occurrence matrix
16 gray level size zone matrix
16 gray level run length matrix features were extracted from each
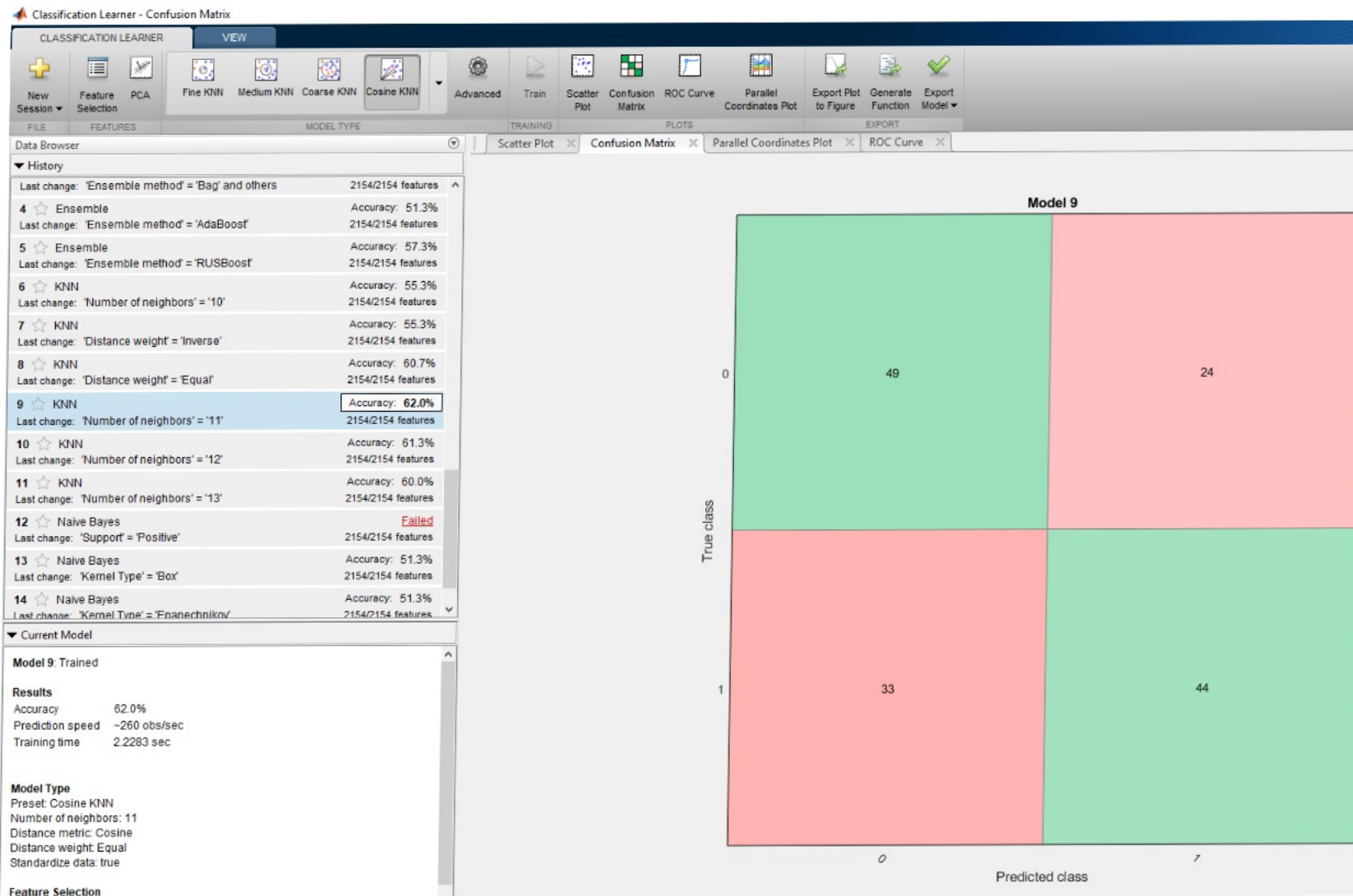Intensity-based features: coiflet wavelet transform filter (8 decompositions)

phenotype region of interest with the following image:mask combinations: T1ce:NCR, FLAIR:ED, T1ce:ET.

718 features extracted for each phenotype, i.e. 2154 features in total for each sample.

SCREENSHOTS

SCREENSHOTS

```
>> ens = custom_ensemble;
>> ens.learners = {knn1 , knn2 }

ens =

  custom_ensemble with properties:

            models: {}
          learners: {[function_handle]  [function_handle]}
          features: {}
        meta_model: {}
      meta_learner: {}
              mode: {}
           classes: {}

>> ens = ens.fit(XX, YY);
fit function is calling>> y_ens = ens.predict(XX);
>> c = confusionmat(YY, y_ens)

c =

    56    17
    37    40

>> acc = sum(sum(c.*eye(size(c))))/sum(sum(c))

acc =

    0.6400
```
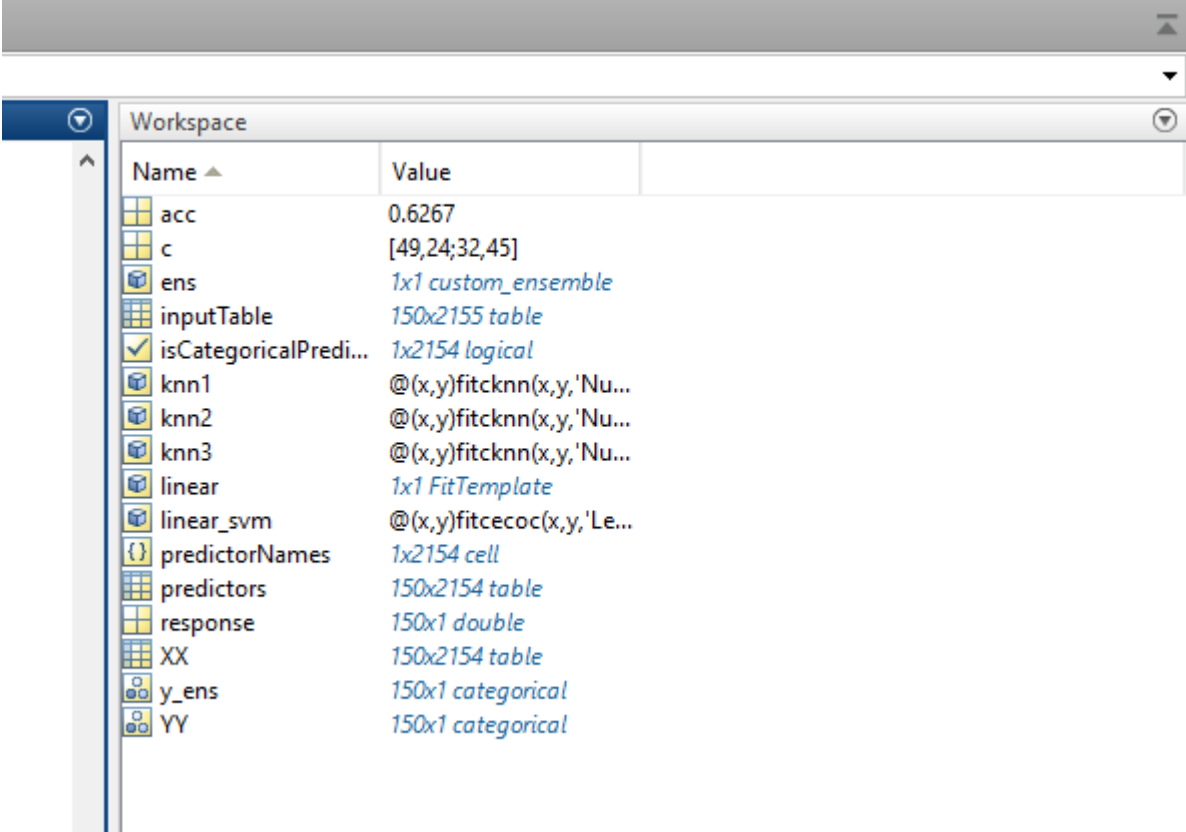
| Name ▲	Value
acc	0.6267
c	[49,24;32,45]
ens	1x1 custom_ensemble
inputTable	150x2155 table
isCategoricalPredi...	1x2154 logical
knn1	@(x,y)fitcknn(x,y,'Nu...
knn2	@(x,y)fitcknn(x,y,'Nu...
knn3	@(x,y)fitcknn(x,y,'Nu...
linear	1x1 FitTemplate
linear_svm	@(x,y)fitcecoc(x,y,'Le...
predictorNames	1x2154 cell
predictors	150x2154 table
response	150x1 double
XX	150x2154 table
y_ens	150x1 categorical
YY	150x1 categorical

Workspace

RESULTS

1. Accuracy: 64.00
2. Precision: 70.17
3. Recall: 41.33

TABLE 4 | Evaluation result of survival prediction.

Stage	Classification accuracy
Validation	46.4%
Test	61.0%

Survival Classification Task
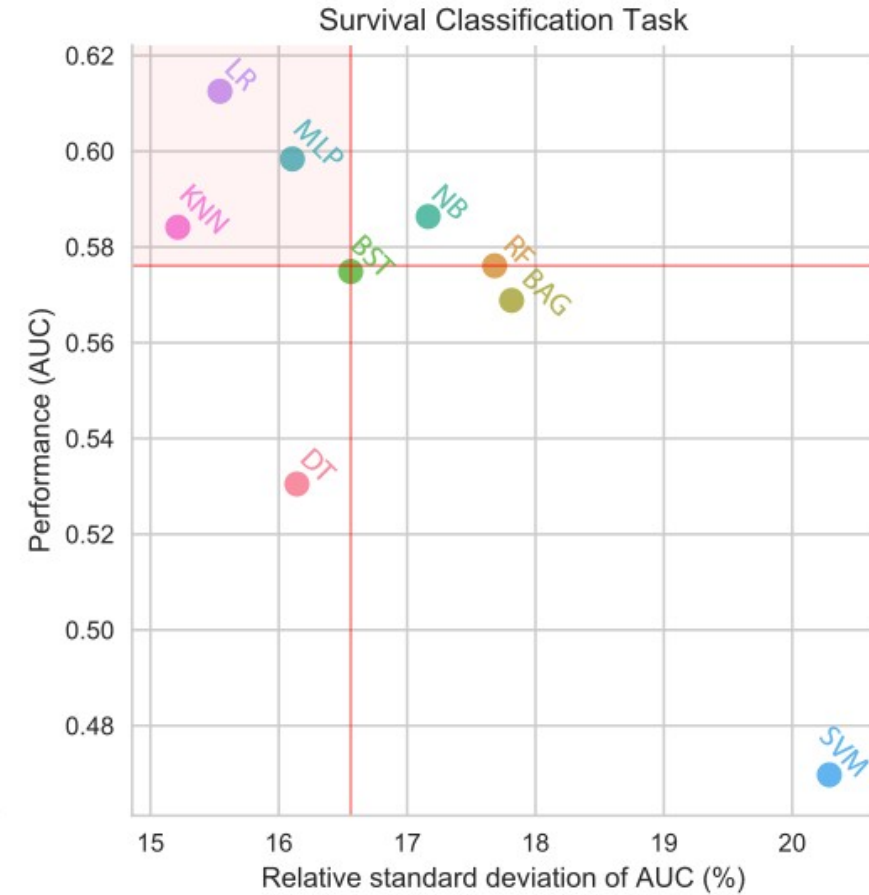
REFERENCES

1. Agravat, Rupal, and Mehul S. Raval. "Prediction of overall survival of brain tumor patients." arXiv preprint arXiv:1909.04596 (2019).

2. Kareem Wahid et al. "Radiomic Prediction of Tumor Grade and Overall Survival from the BraTS Glioma Dataset: An Exploratory Analysis of Dimensionality Reduction Techniques and Machine Learning Classifiers" Colen Lab, MD Anderson Cancer Center

3. Sun, Li, et al. "Brain Tumor Segmentation and Survival Prediction Using Multimodal MRI Scans With Deep Learning." Frontiers in neuroscience 13 (2019): 810.