![SHD 2020 logo]

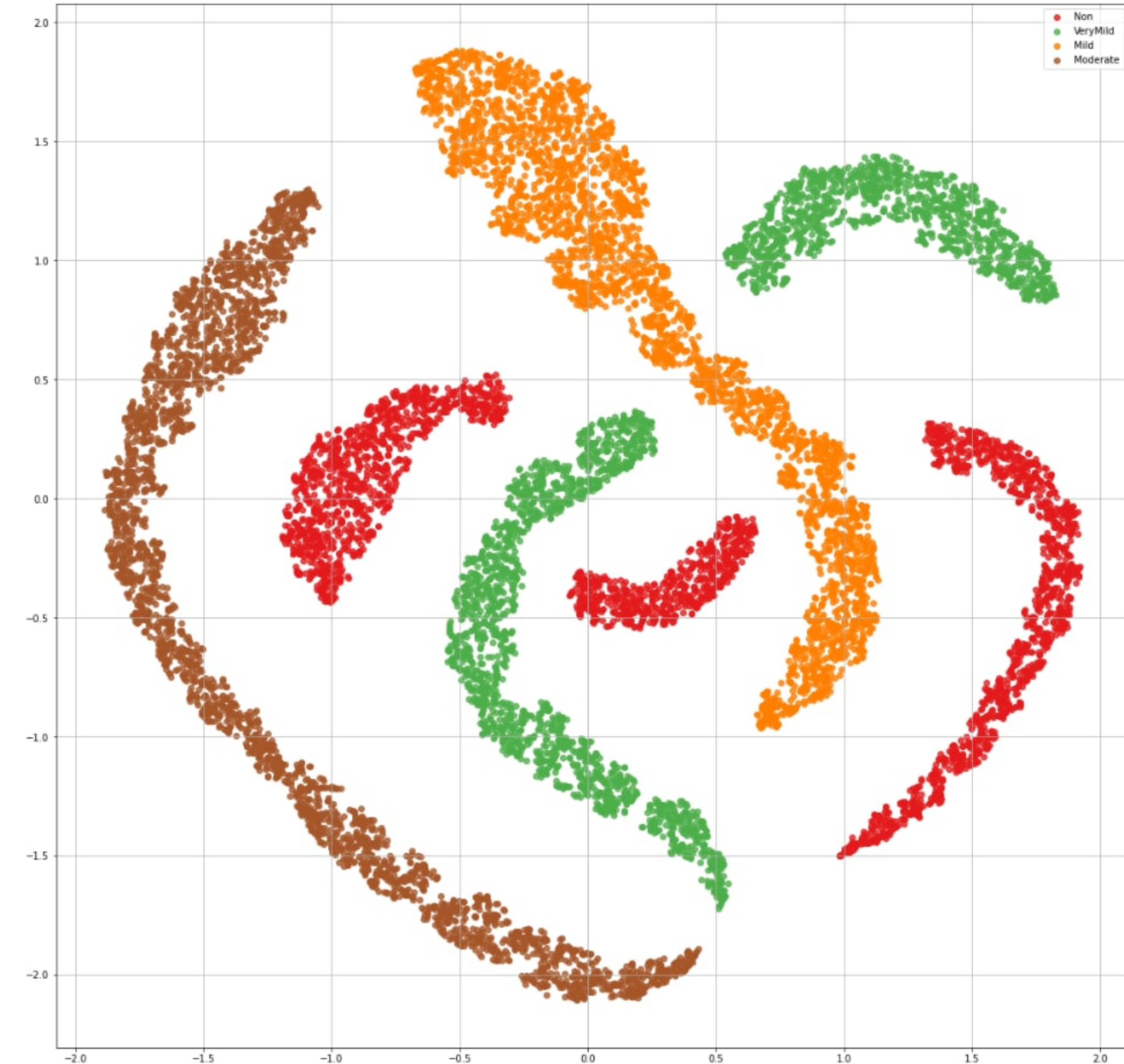# Gardariki-Hack

Alzheimer's MRI Image Analysis

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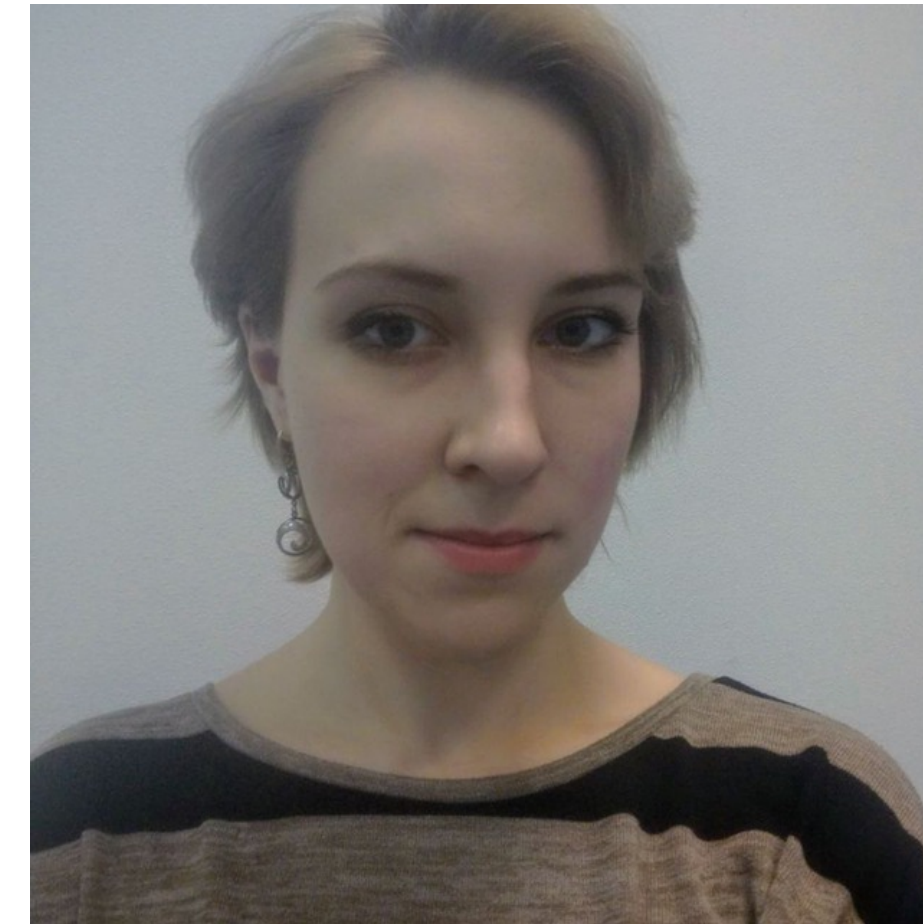
Our team

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Problem statement and data pre-processing

Train datasets: RealDataset, SyntheticDatasetV3

Test dataset: RealTestDataset

Labels: binarized («disease» and «non-disease»)

We try to resolve several tasks:

- synthetic train / synthetic validation

- real train / real validation

- synthetic train / real validation

NN architectures: CustomCNN, ResNet

- custom CNN (~170k params)
- pretrained / non-pretrained ResNet18 (~11M params)

synthetic train / synthetic validation

```
train accuracy: 0.9741

train metrics
              precision    recall  f1-score   support

           0       0.96      0.94      0.95      2391
           1       0.98      0.99      0.98      7209

    accuracy                           0.97      9600
   macro avg       0.97      0.96      0.97      9600
weighted avg       0.97      0.97      0.97      9600


val accuracy: 0.9917

val metrics
              precision    recall  f1-score   support

           0       0.98      0.98      0.98       656
           1       0.99      0.99      0.99      1744

    accuracy                           0.99      2400
   macro avg       0.99      0.99      0.99      2400
weighted avg       0.99      0.99      0.99      2400
```

real train / real validation

```
train accuracy: 0.9932

train metrics
              precision    recall  f1-score   support

           0       0.99      0.99      0.99      2049
           1       0.99      0.99      0.99      2047

    accuracy                           0.99      4096
   macro avg       0.99      0.99      0.99      4096
weighted avg       0.99      0.99      0.99      4096


val accuracy: 0.9785

val metrics
              precision    recall  f1-score   support

           0       0.96      1.00      0.98       511
           1       1.00      0.96      0.98       514

    accuracy                           0.98      1025
   macro avg       0.98      0.98      0.98      1025
weighted avg       0.98      0.98      0.98      1025
```

synthetic train / real validation

```
train accuracy: 0.9984

train metrics
              precision    recall  f1-score   support

           0       1.00      1.00      1.00      2391
           1       1.00      1.00      1.00      7209

    accuracy                           1.00      9600
   macro avg       1.00      1.00      1.00      9600
weighted avg       1.00      1.00      1.00      9600


val accuracy: 0.6479

val metrics
              precision    recall  f1-score   support

           0       0.64      0.68      0.66      2049
           1       0.66      0.62      0.64      2047

    accuracy                           0.65      4096
   macro avg       0.65      0.65      0.65      4096
weighted avg       0.65      0.65      0.65      4096
```
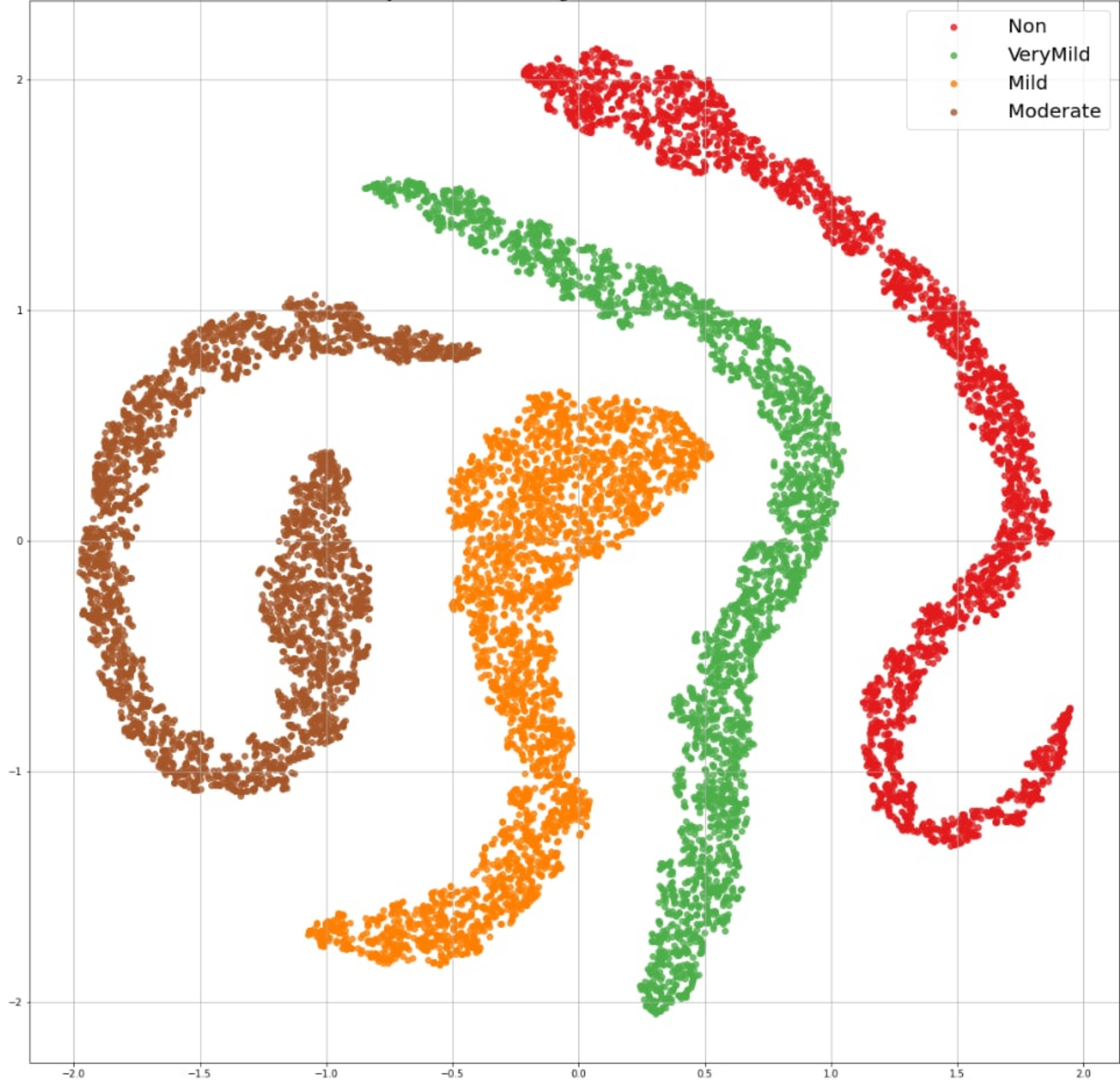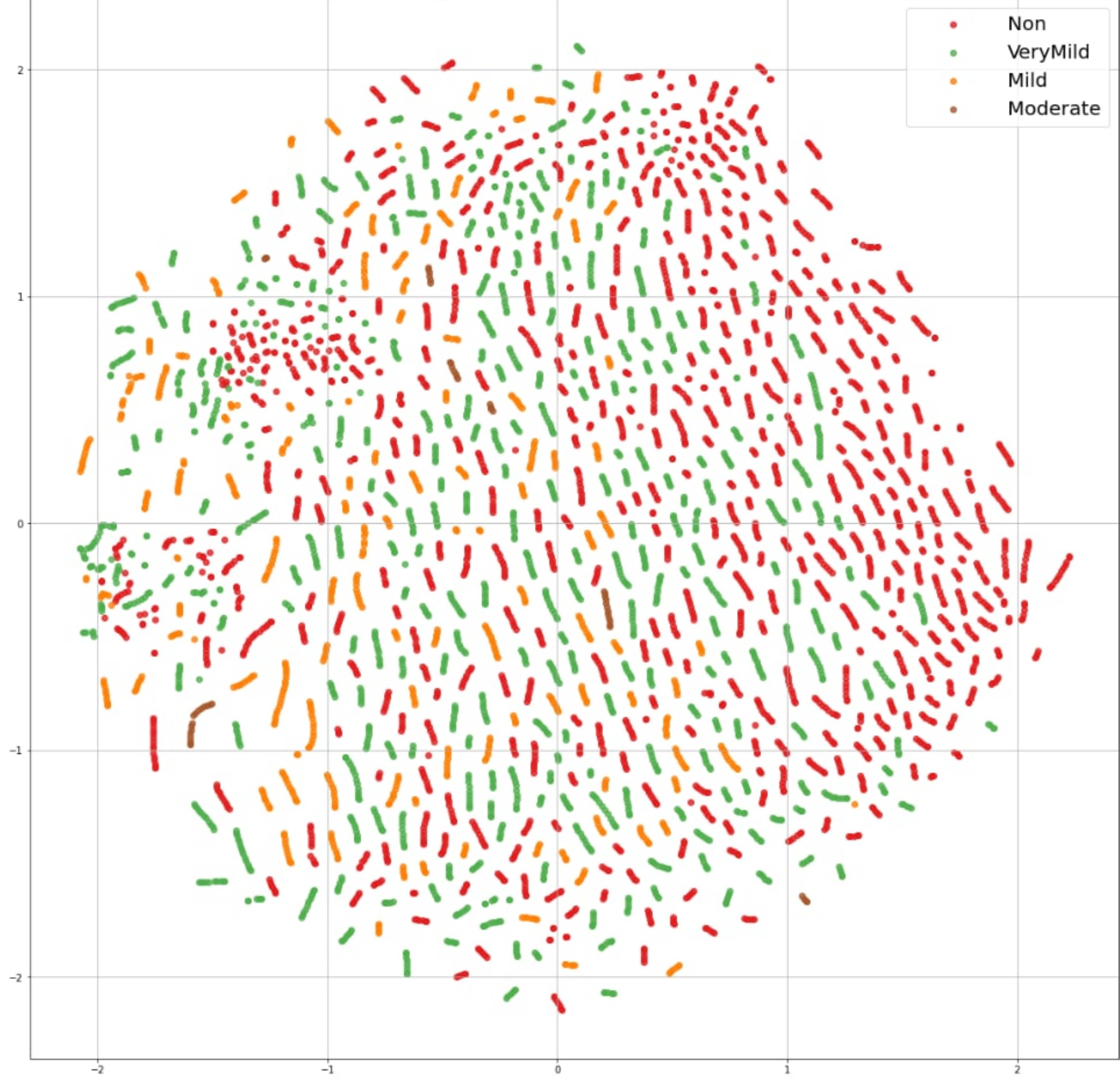
What is the reason for this difference in metrics?

We guess that the reason is in the synthetic/real data structure

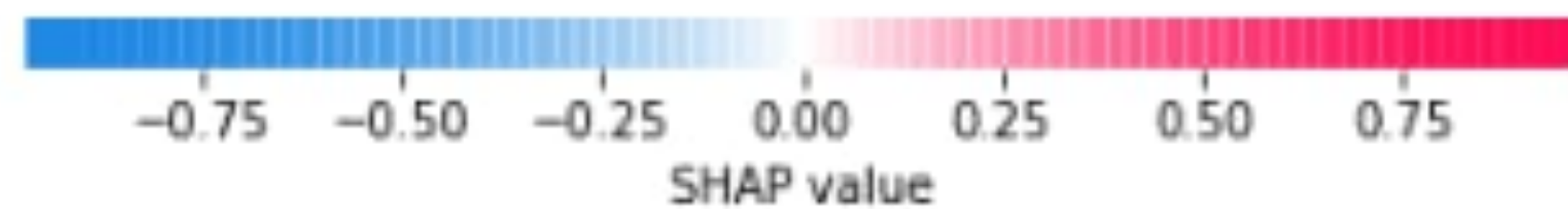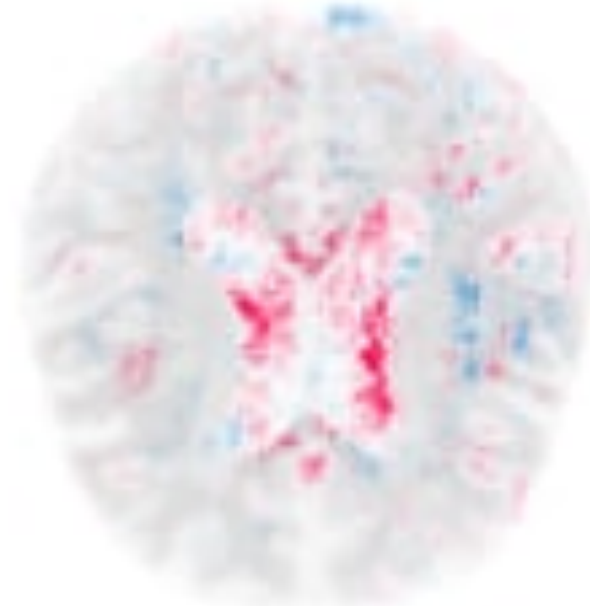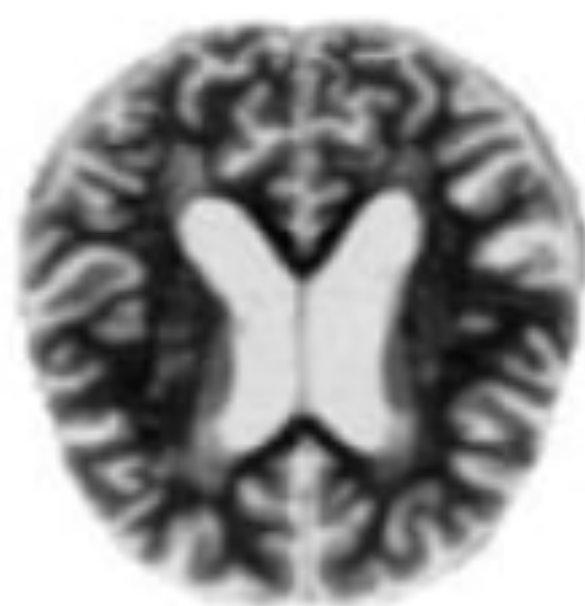# Find the most important regions of the brain for prediction

Our hypothesis: GAN failed to transmit the microstructure of the brain

We assume that some information about the microstructure of the brain is lost in the synthetic data

Adversarial validation

Train a model that will distinguish the synthetic data from the real one

```
train accuracy: 1.0000

train metrics
              precision    recall  f1-score   support

           0       1.00      1.00      1.00      9629
           1       1.00      1.00      1.00      4067

    accuracy                           1.00     13696
   macro avg       1.00      1.00      1.00     13696
weighted avg       1.00      1.00      1.00     13696


val accuracy: 0.9997

val metrics
              precision    recall  f1-score   support

           0       1.00      1.00      1.00      2371
           1       1.00      1.00      1.00      1054

    accuracy                           1.00      3425
   macro avg       1.00      1.00      1.00      3425
weighted avg       1.00      1.00      1.00      3425
```

Trying to improve the model

Select those synthetic data that are most similar to real ones

Model score

```
train accuracy: 0.9922

train metrics
              precision    recall  f1-score   support

           0       0.99      0.99      0.99      2100
           1       0.99      0.99      0.99      3900

    accuracy                           0.99      6000
   macro avg       0.99      0.99      0.99      6000
weighted avg       0.99      0.99      0.99      6000


val accuracy: 0.6717

val metrics
              precision    recall  f1-score   support

           0       0.68      0.66      0.67      2560
           1       0.67      0.69      0.68      2561

    accuracy                           0.67      5121
   macro avg       0.67      0.67      0.67      5121
weighted avg       0.67      0.67      0.67      5121
```

Final test on RealTestDataset

```
final accuracy: 0.4855

final metrics
              precision    recall  f1-score   support

           0       0.48      0.11      0.17       653
           1       0.49      0.88      0.63       626

    accuracy                           0.49      1279
   macro avg       0.48      0.49      0.40      1279
weighted avg       0.48      0.49      0.40      1279
```

Thanks for your attention!