Wood classification

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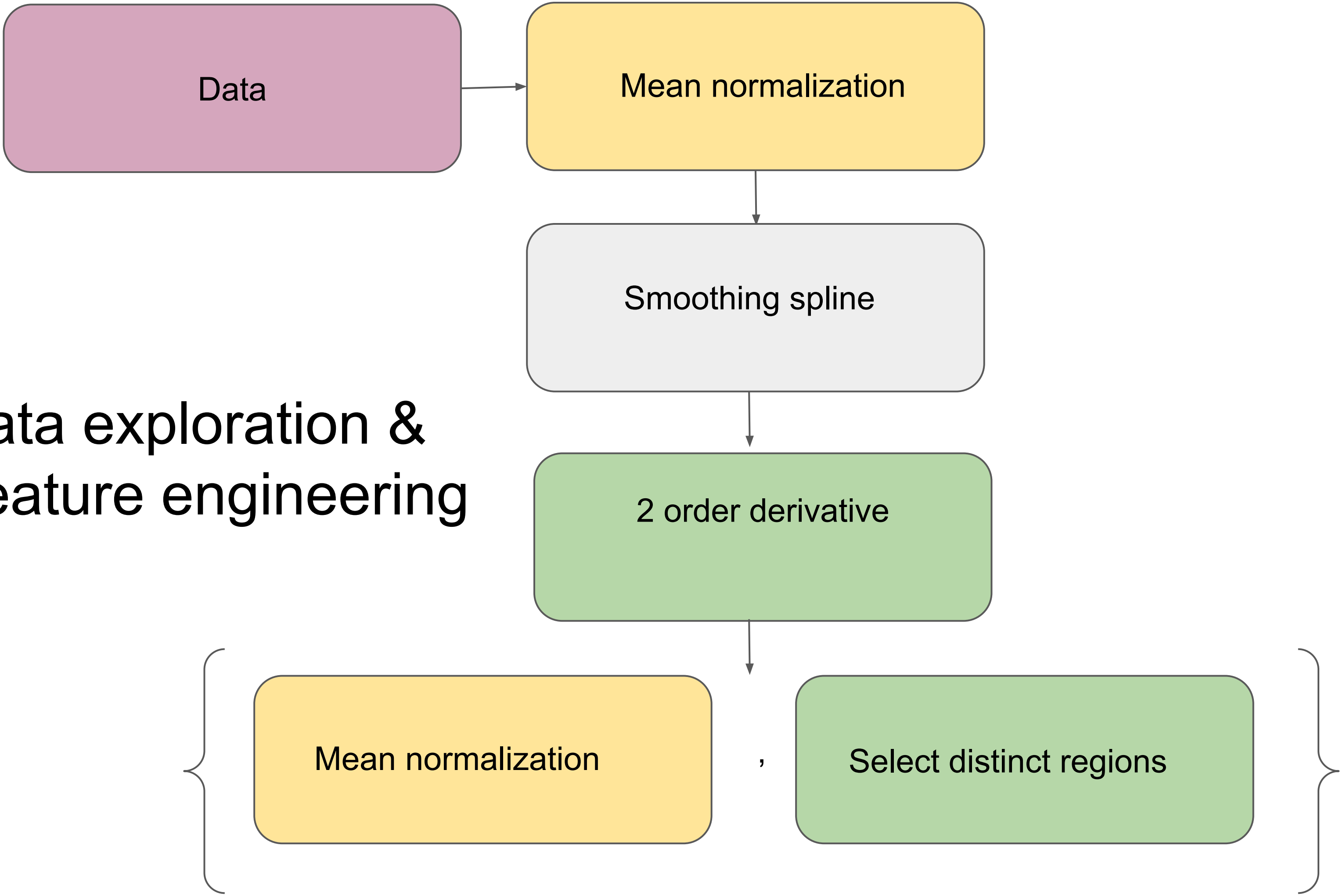
Data exploration & Feature engineering



Data

Mean normalization

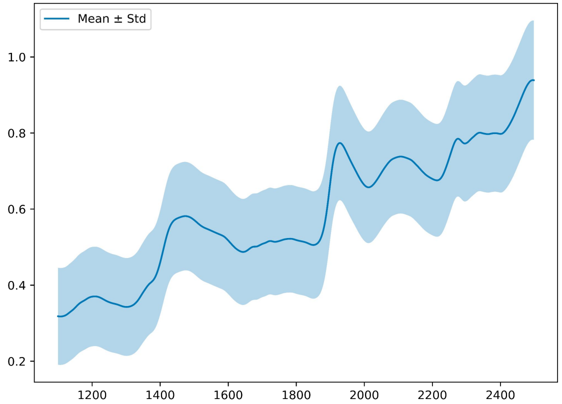
Smoothing spline

2 order derivative

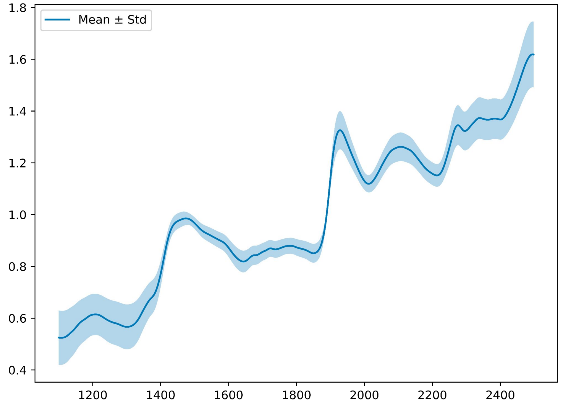
Mean normalization , Select distinct regions

Data Exploration

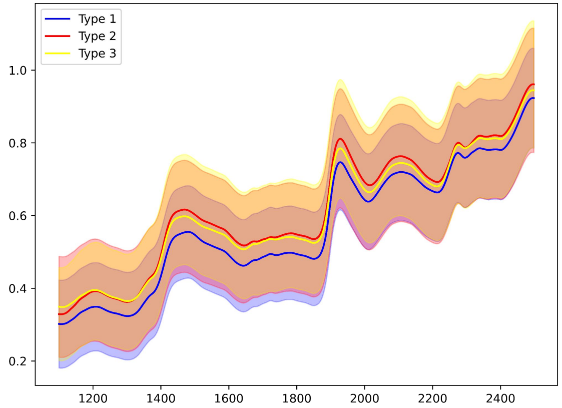
Overall

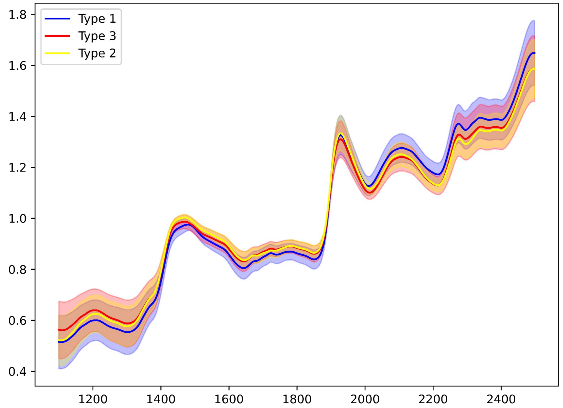


Mean Normalization

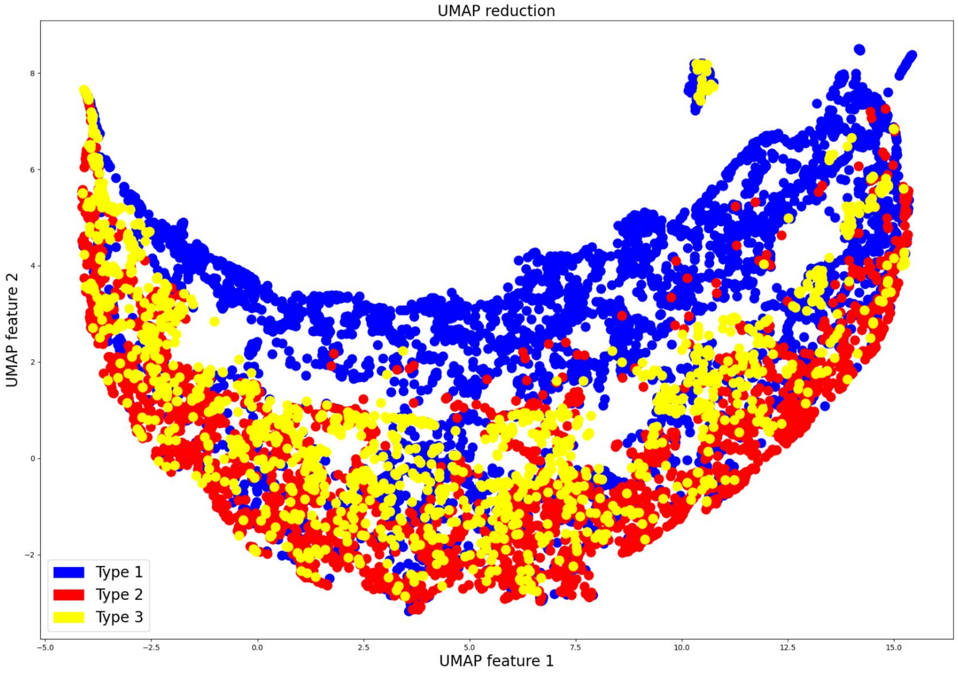


3 types



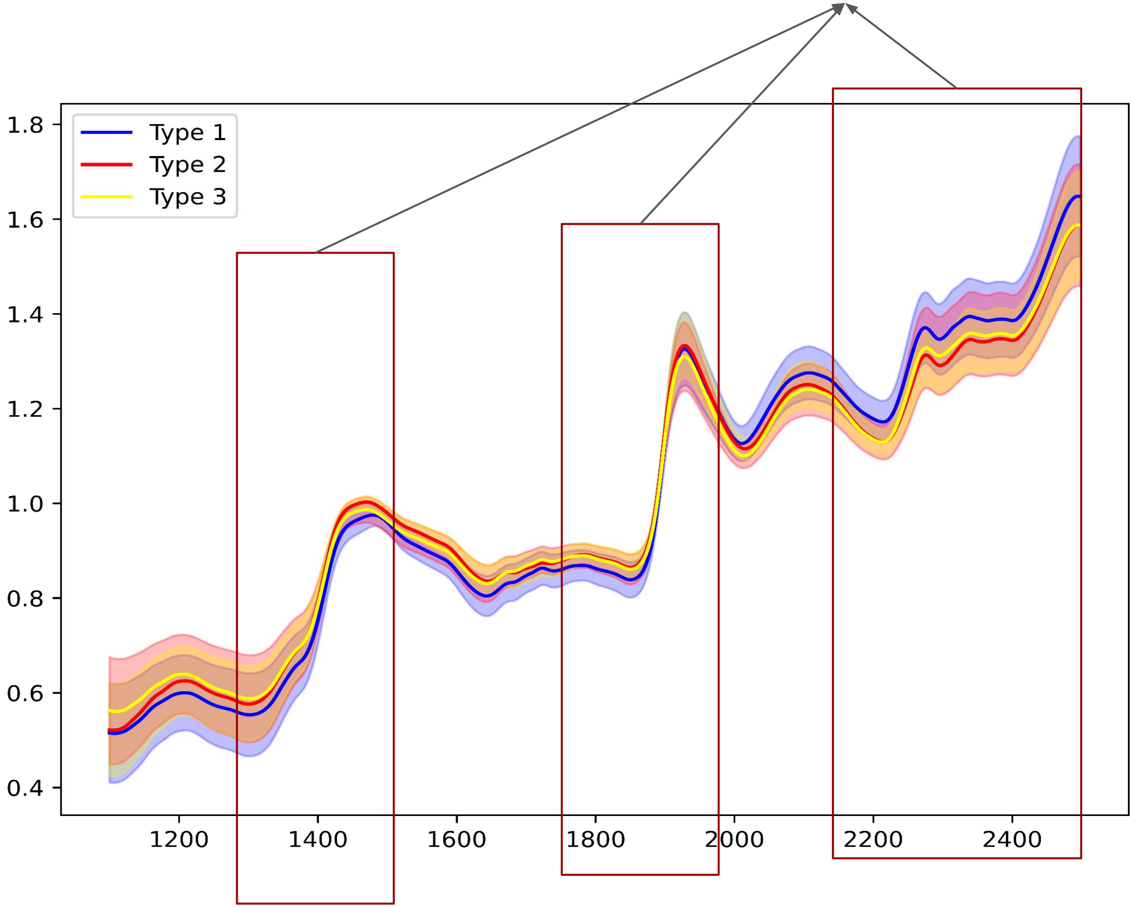


Data Exploration



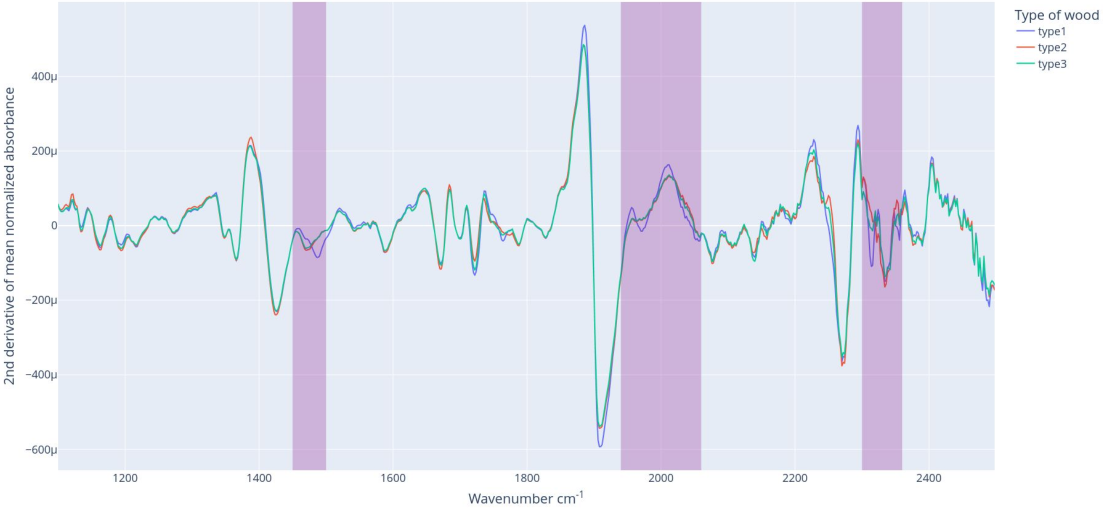
Data Exploration

Spectrums' trends are different for wood types in some regions



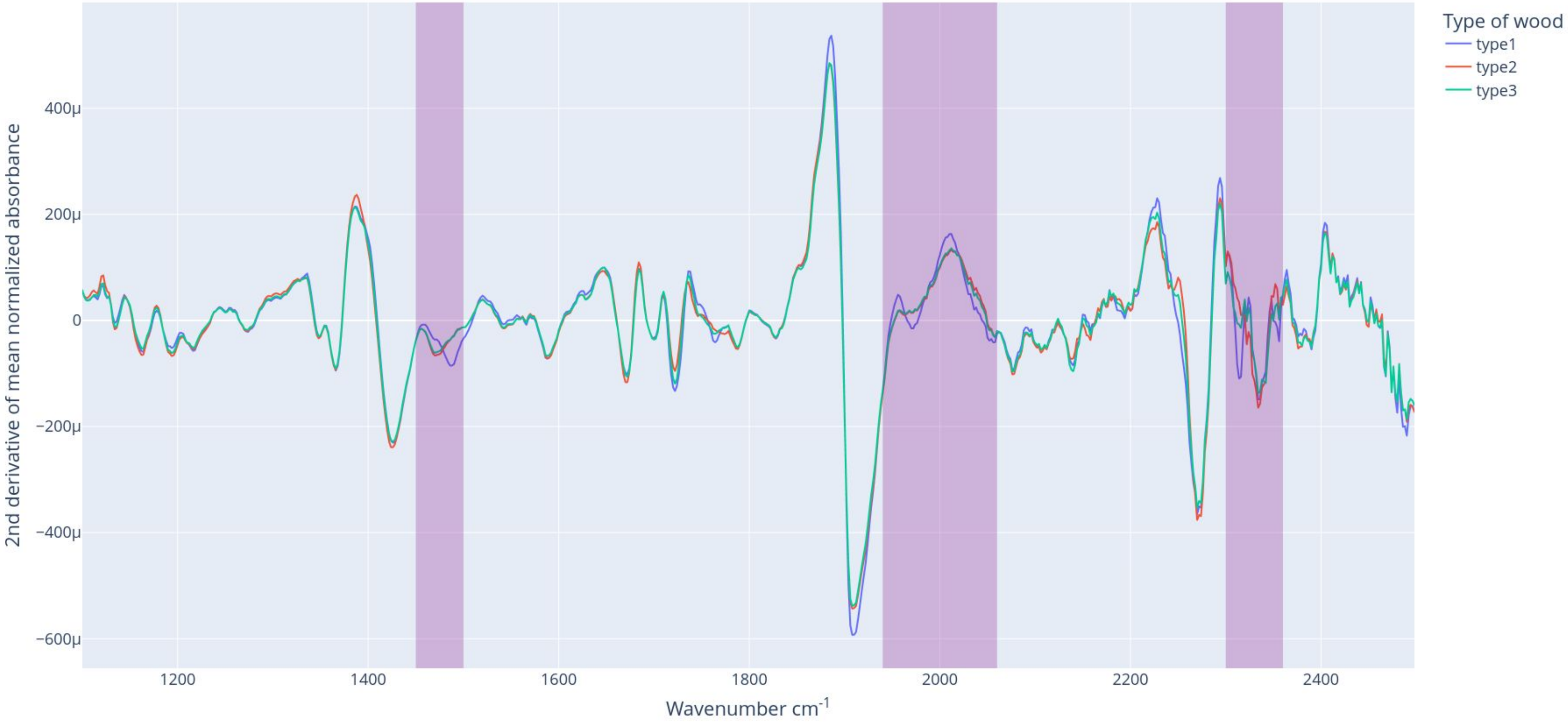
Feature Engineering

- Take the 2nd derivative of spectra.
- Type 1 is easy to be distinguished.
- Type 2 and 3 are very similar.

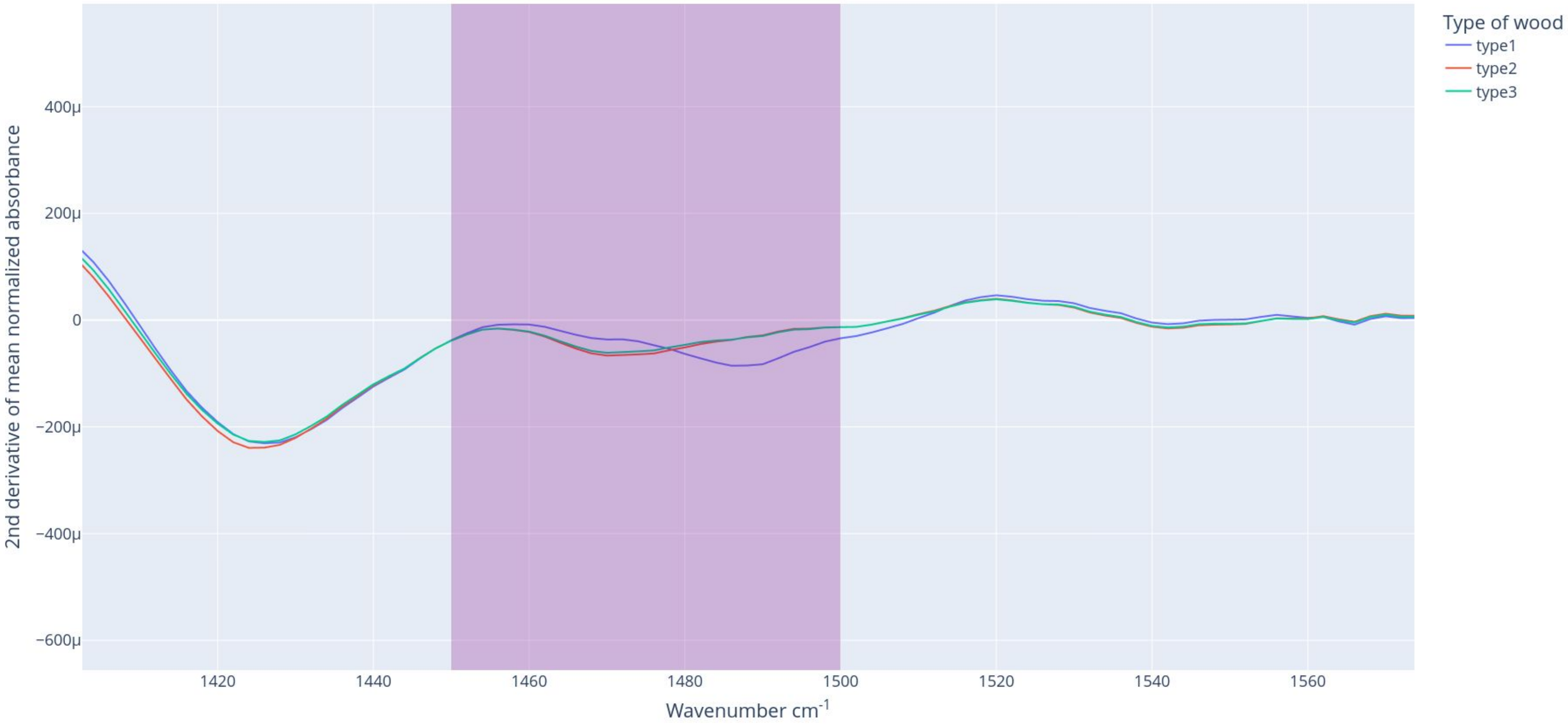


- The 2nd derivative implies the data difference clearly instead of just trends difference.

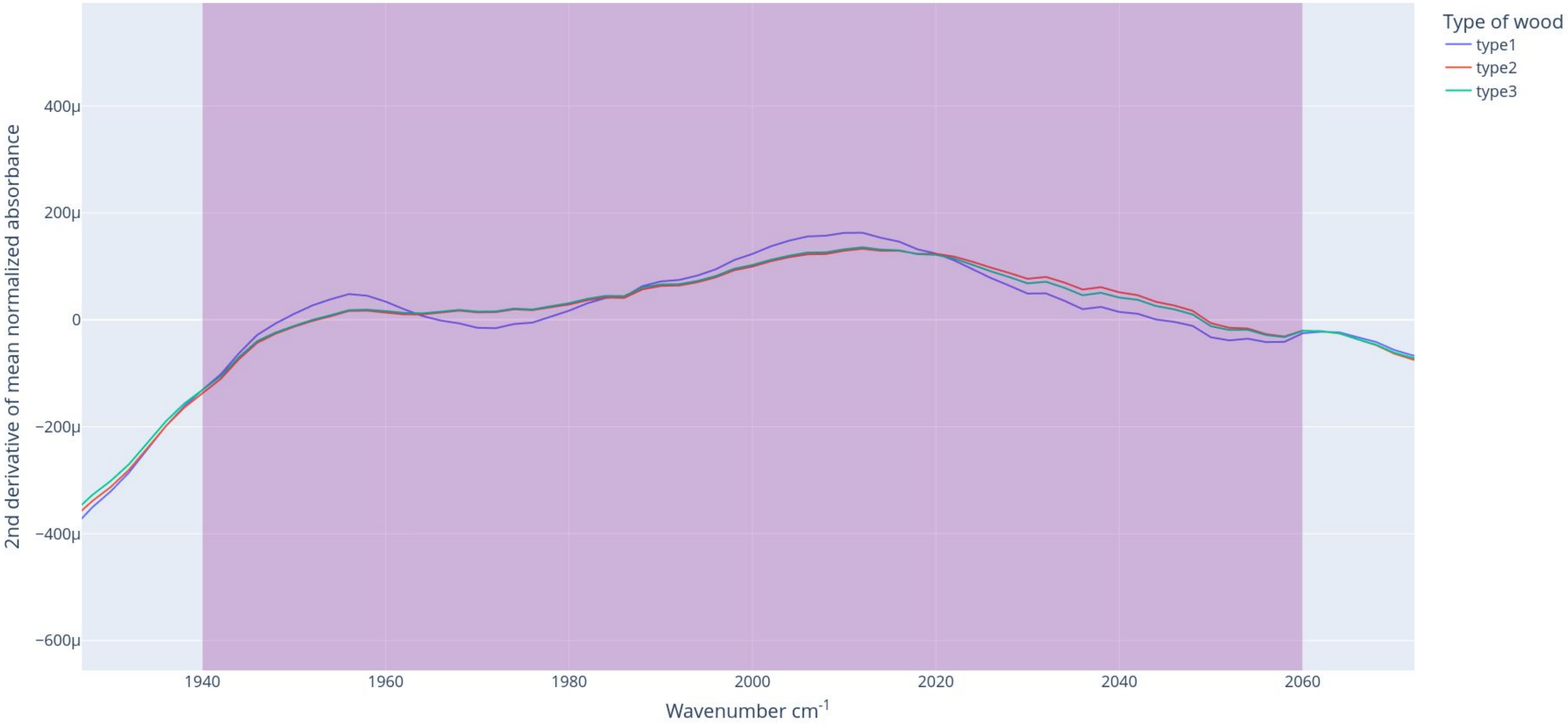
Feature Engineering - 2nd derivative



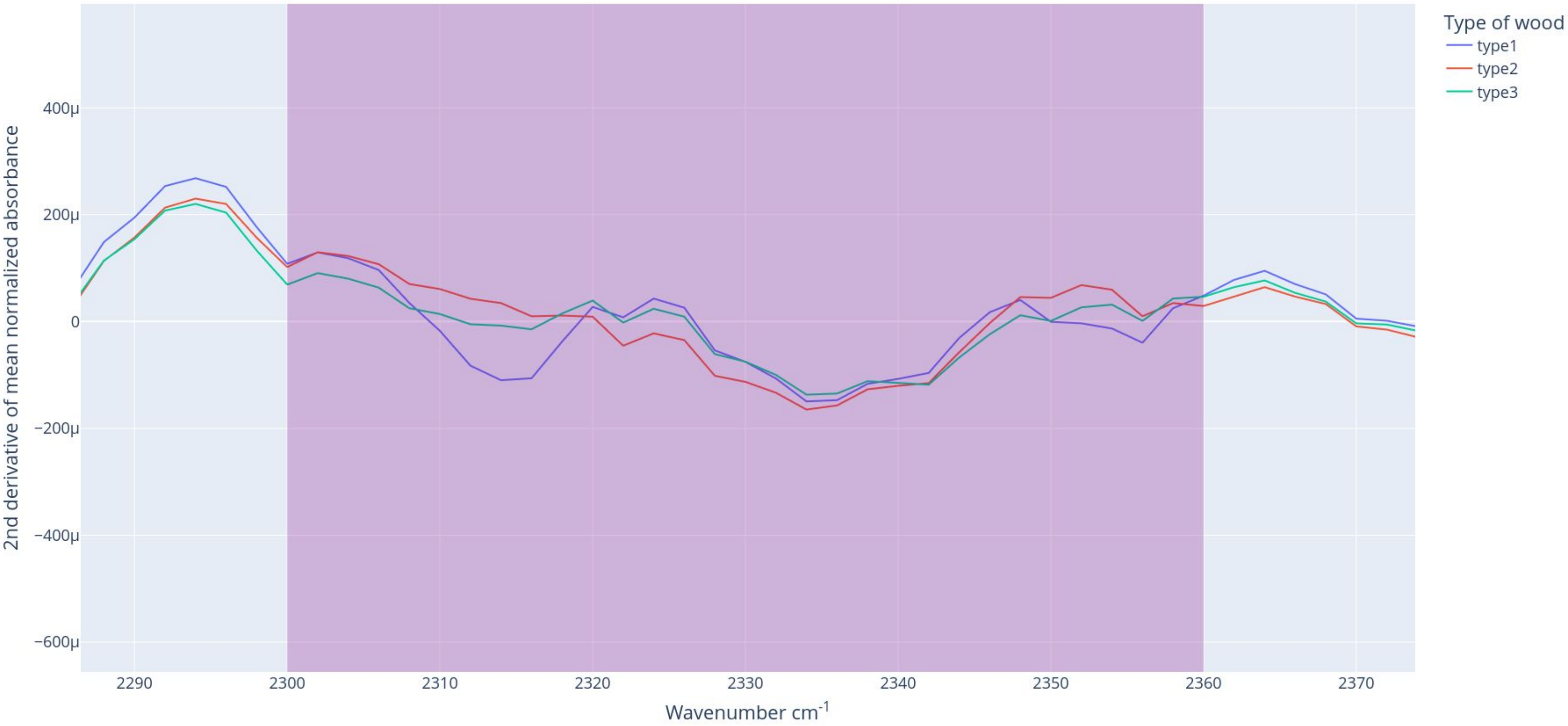
Feature Engineering - 2nd derivative



Feature Engineering - 2nd derivative



Feature Engineering - 2nd derivative



Unbalanced data

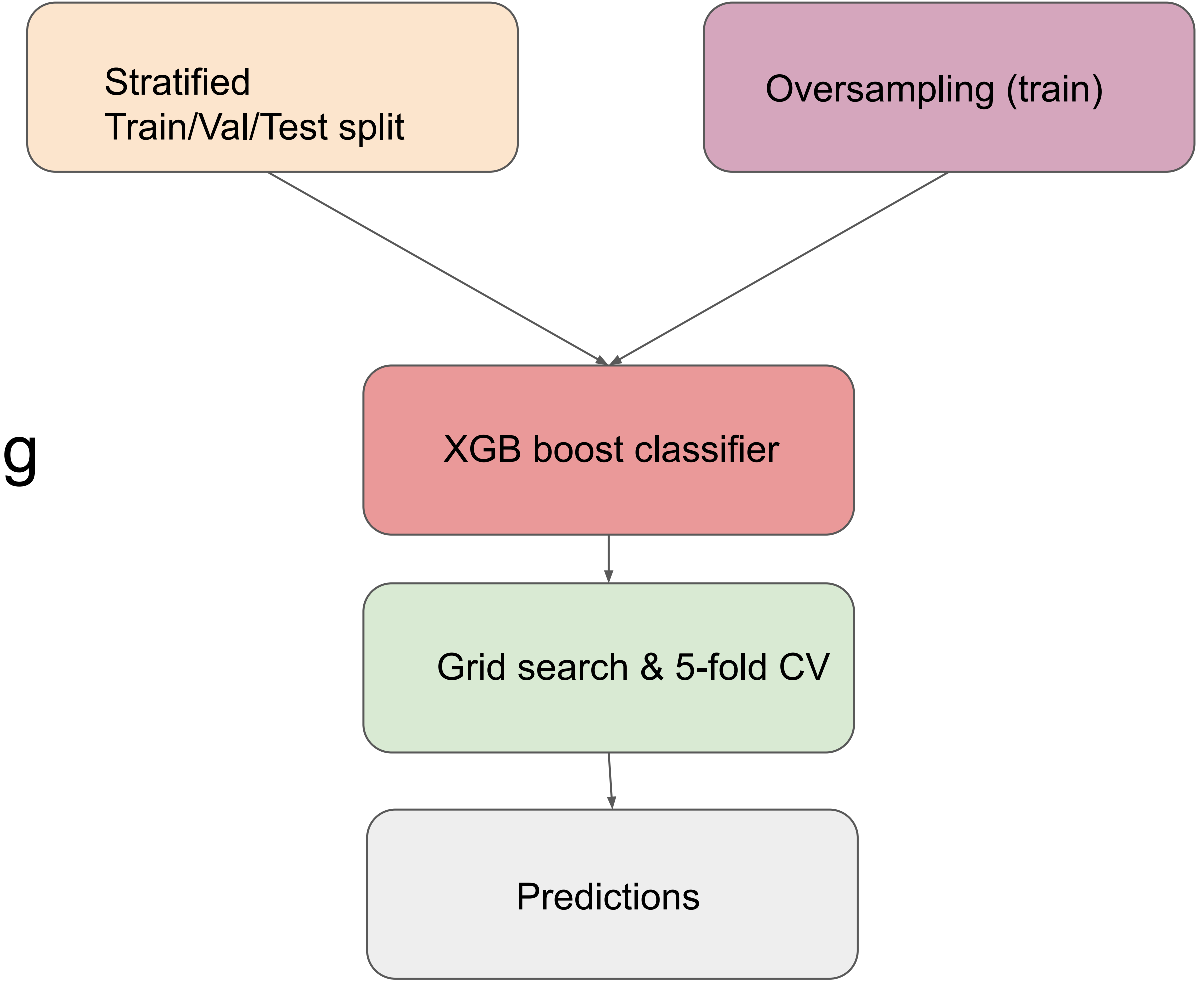
- Unbalanced data set:

Type 1	Type 2	Type 3
4416	2784	1344

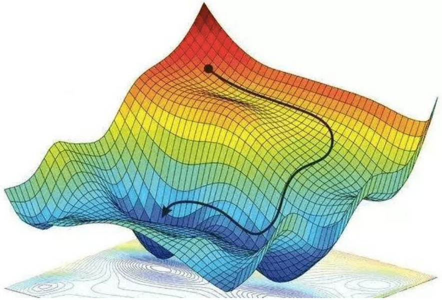
- Solution - Upsampling!
  - Synthesize new samples for the minority classes to obtain a balanced data set.
  - SMOTE (Synthetic Minority Oversampling Technique).
  - Choose a random sample from the minority class and compute its 5 nearest neighbors.
  - Randomly selected a neighbor from 5-nearest neighbors and generate a synthetic sample between these two samples in feature space.
- After upsampling we obtain a balanced data set for classification task:

Type 1	Type 2	Type 3
4416	4416	4416

Modelling

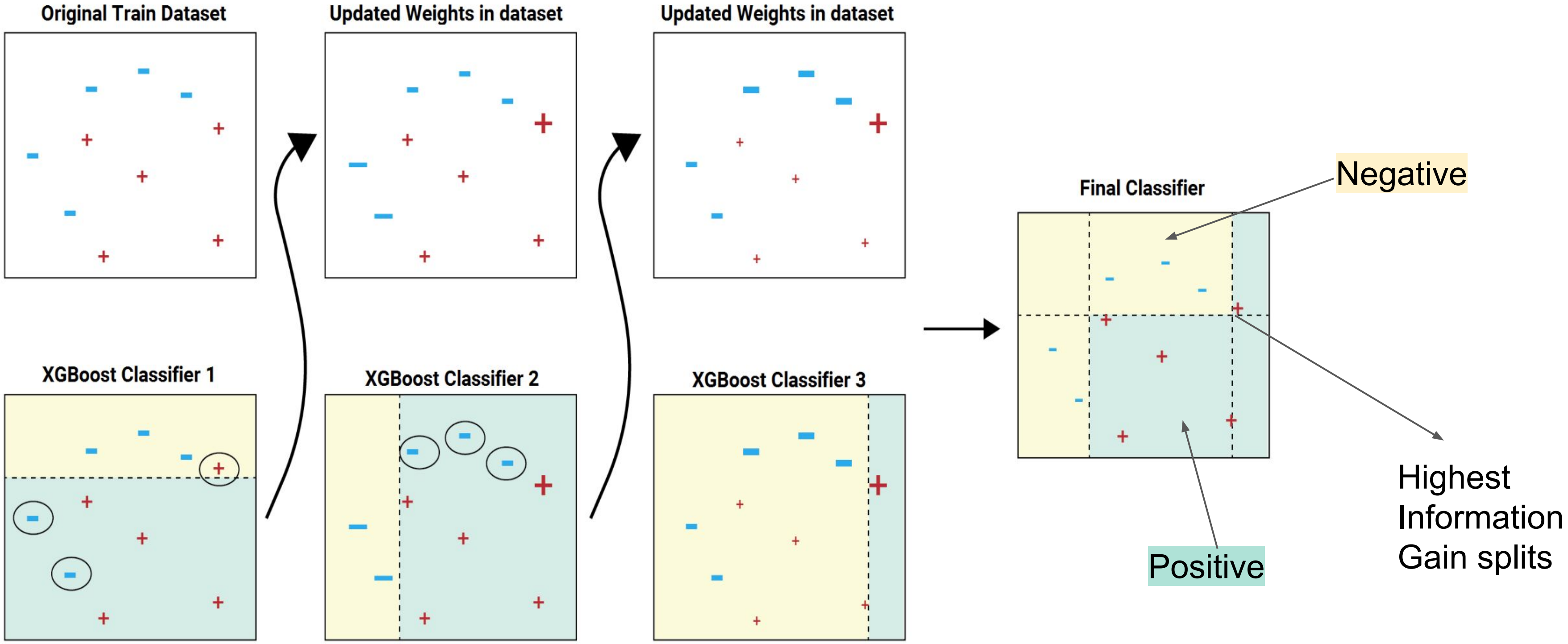

Stratified
Train/Val/Test split
Oversampling (train)
XGB boost classifier
Grid search & 5-fold CV
Predictions

XGB Boost Classifier



- **Extreme Gradient Boosting Decision tree.**
- Minimizes error loss function using **gradient descent**
- Makes use of **gradient boosting.** Trees are trained sequentially
- **Parallelized tree building** for extreme computational performance.
- Many hyperparameters: tree depth, number of trees, regularization,...

XGB Boost Classifier



Results

Class	Precision	Recall	F1-score	Support
1	0.90	0.78	0.84	36
2	0.73	1.00	0.84	27
3	0.94	0.71	0.81	21
average	**0.86**	**0.83**	**0.83**	
accuracy				**0.83**

Future work

- Consistency: Model not very consistent across scans/replicates within same sample

- Try different model types

- Time limitation: Comprehensive Hyperparameter search

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