Feature selection using Recursive Feature Elimination

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Feature selection

Feature selection is an important step in the machine learning workflow. It is process of identifying important predictors and remove unnecessary features.

Why needed:

- Feature selection useful to prevent overfitting
- Reduce dimensions
- Helps to understand the data

Feature selection in Machine learning workflow

- Typically applied between data-preprocessing and model building.

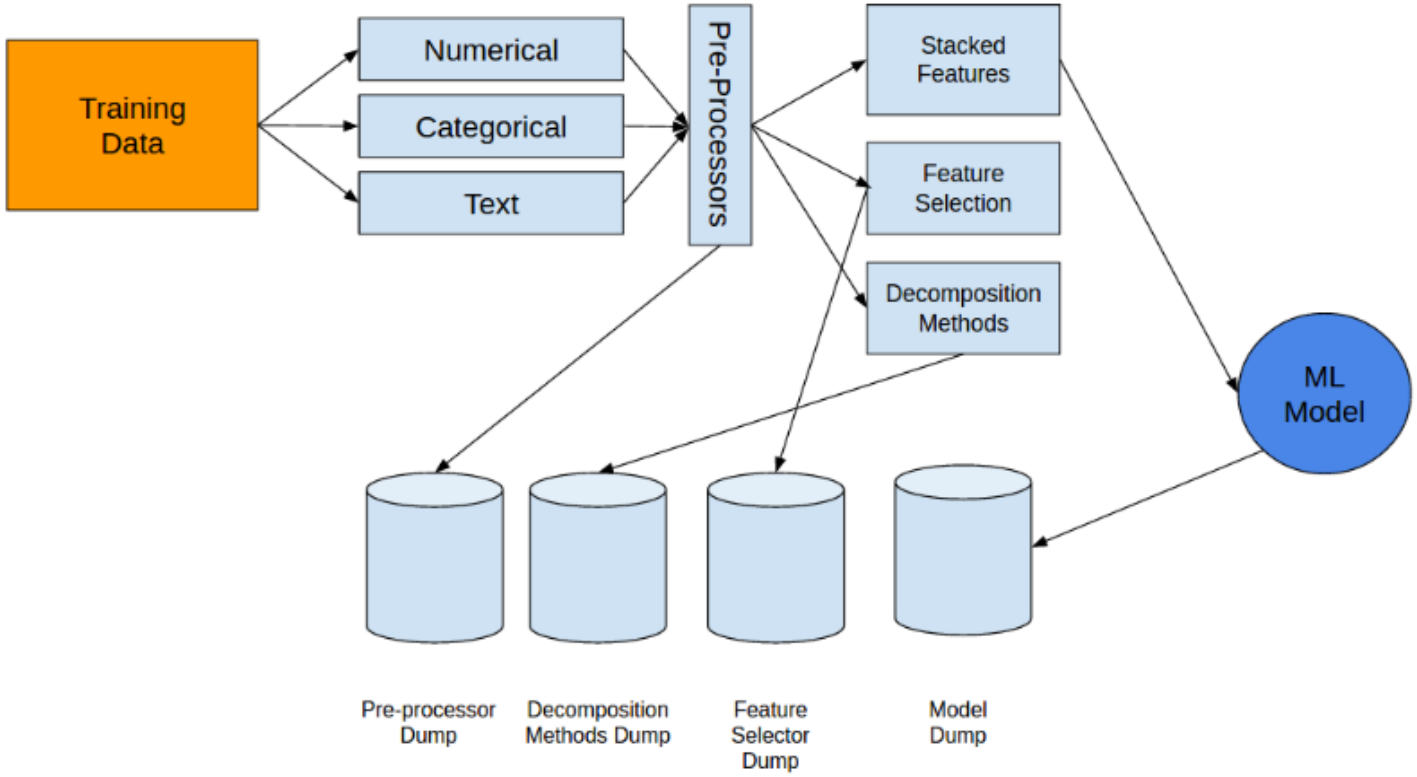


Image courtesy: http://s5047.pcdn.co/wp-content/uploads/2016/07/abhishek_25.png

Feature selection algorithm

- Univariate feature selection
  - Example: Correlation-based selection
- Multivariate feature selection
  - Example: Recursive feature elimination using Cross-Validation (RFECV)

Recursive feature elimination using Cross-Validation (RFECV)

- RFECV applies RFE on k-fold cross-validation of the training dataset
  - RFE stands for Recursive feature elimination
  - RFE recursively removes features by m features at a time. Default m = 1. It repeats the process until all the features are exhausted or number of features reached the threshold of minimum number of features to select

Recursive feature elimination (rfe)

X

Y

# bedrooms	Area	Age	Price (1k)
3	1200	10	560
3	980	13	520
3	1200	20	410
5	1600	4	880

Model fit on Train set

Train

Test

Program flow of rfe (_rfe_single_fit)

Scores (r-squared on Test set)

.78		

ranking

# bedrooms	Area	Age
1	1	1

model.feature_importance

# bedrooms	Area	Age
.6	.3	.1

Task: Calculate scores of the feature set

X

Y

# bedrooms	Area	Age	Price (1k)
3	1200	10	560
3	980	13	520
3	1200	20	410
5	1600	4	880

Program flow of rfe (_rfe_single_fit)

Scores (r-squared on Test set)

.78	.88 (delayed unitll next round)	

ranking

# bedrooms	Area	Age
1	1	2

Model fit on Train set

Train

Test

model.feature_importance

# bedrooms	Area	Age
.6	.3	.1

# bedrooms	Area	Age
.6	.3	...

Task: Remove worst performing feature

X

Y

# bedrooms	Area	Age	Price (1k)
3	1200	10	560
3	980	13	520
3	1200	20	410
5	1600	4	880

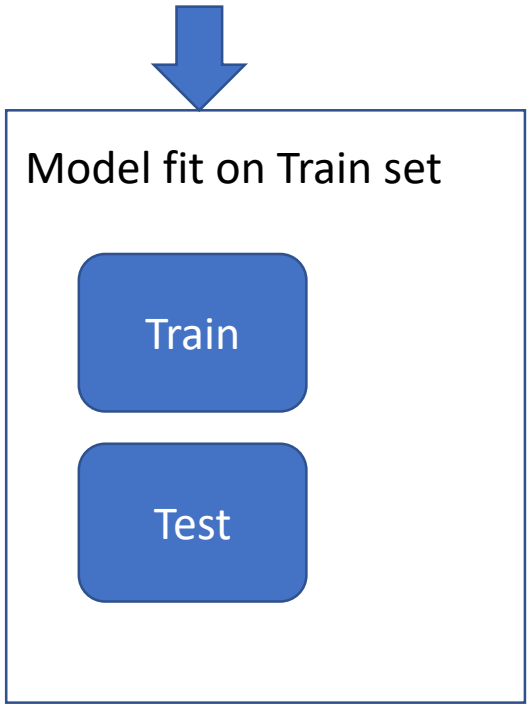
Program flow of rfe (_rfe_single_fit)

Scores (r-squared on Test set)

.78	.88	.6 (delayed unitll next round)

ranking

# bedrooms	Area	Age
1	2	3



model.feature_importance

# bedrooms	Area
.56	.44

# bedrooms	Area
.56	.44

Task: Remove worst performing feature

- Recursive feature elimination (rfe) is repeated until

  #(remaining features) >= n_features_to_select

  where n_features_to_select is a parameter passed during runtime

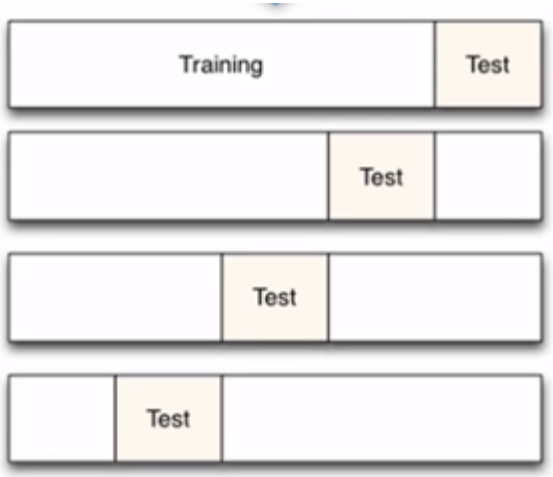
- When n_features_to_select is None, then

  n_features_to_select = Total number of features / 2

Recursive feature elimination using cross-validation (rfecv)

Program flow of rfecv.fit method

- rfecv repeats rfe with k-fold cross validation



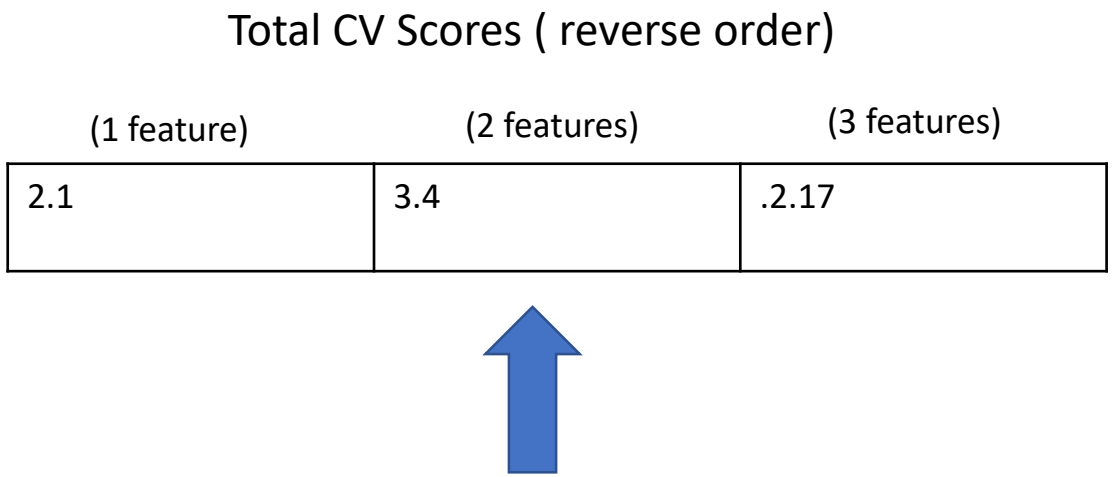
Scores (r-squared on Test set)

.56	.67	.4
.33	.8	.9
.78	.88	.2
.5	.79	.6

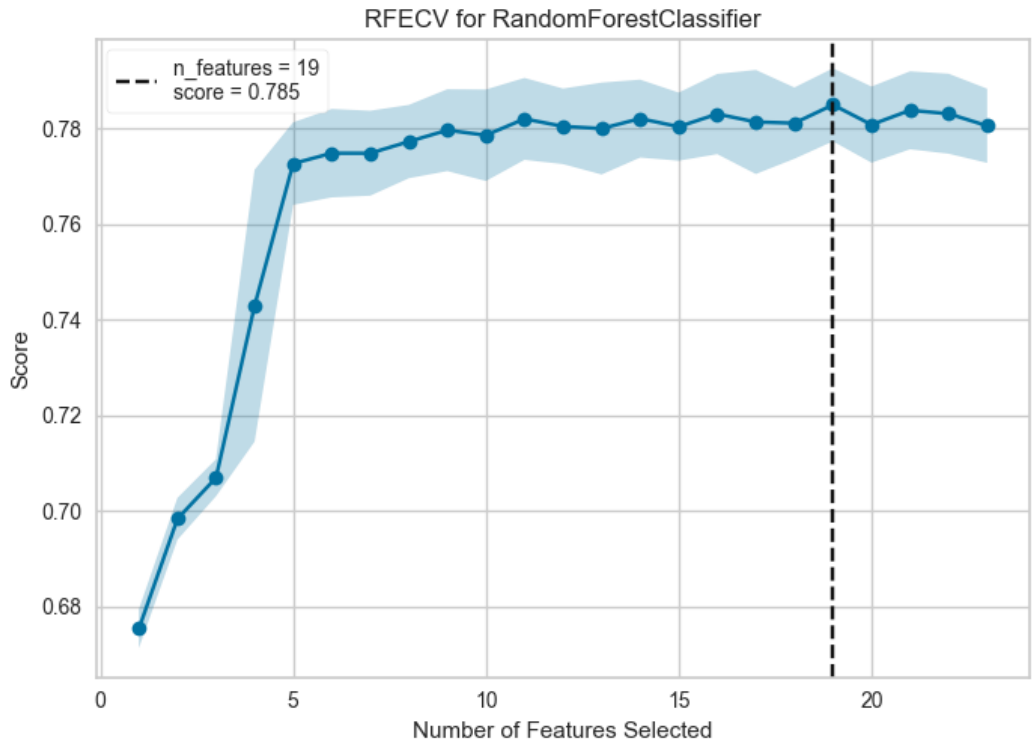
$\sum = 2.17$ $\sum = 3.14$ $\sum = 2.1$

Program flow of rfecv.fit method

- Position where cv scores reach its peak is selected as the optimal number of features (aka n_features_to_select)
- In the following example, number of optimal features is 2



- Example of CV scores plot where optimal number of features is 19



- Helps us to decide the minimum number of features needed
- Calls rfe one more time with n_features_to_select = (Total # f
  on the entire dataset.
- Last call changes ranking but not CV.scores