

Lecture 13: Feature selection

Introduction to Machine Learning

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L3 MIASHS — Semestre 2

2023-2024

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Introduction

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Question

Do you remember what is the definition of feature reduction ?

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Question

Do you remember what is the definition of feature reduction ?

- Find the subset of variables which bears the most information

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Question

Do you remember what is the definition of feature reduction ?

- Find the subset of variables which bears the most information
- Use only these variables to perform the learning task

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Question

Why do we want to perform feature reduction ?

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Question

Why do we want to perform feature reduction ?

- Simplification of models to make them easier to interpret by users

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Question

Why do we want to perform feature reduction ?

- Simplification of models to make them easier to interpret by users
- Shorter training times

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Question

Why do we want to perform feature reduction ?

- Simplification of models to make them easier to interpret by users
- Shorter training times
- Avoid the curse of dimensionality

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Question

Why do we want to perform feature reduction ?

- Simplification of models to make them easier to interpret by users
- Shorter training times
- Avoid the curse of dimensionality
- Drop variables that do not respect models hypothesis

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Features can be either:

- **Redundant**: the information is already given by other features (highly correlated) (for example, late arrival and late departure).

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Features can be either:

- **Redundant**: the information is already given by other features (highly correlated) (for example, late arrival and late departure).
- **Unrelevant**: the feature does not bring any information (for example, the weather for image recognition)

Definition

Feature selection

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Feature selection

Feature selection consists in finding the subset of variables which bear the most information for the learning task and only using those for problem solving.

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Feature selection

Feature selection consists in finding the subset of variables which bear the most information for the learning task and only using those for problem solving.

Feature selection can be done using:

Feature selection

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Feature selection

Feature selection consists in finding the subset of variables which bear the most information for the learning task and only using those for problem solving.

Feature selection can be done using:

- Field specific insight

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Feature selection

Feature selection consists in finding the subset of variables which bear the most information for the learning task and only using those for problem solving.

Feature selection can be done using:

- Field specific insight
- Automatic rules based on objective metrics

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Feature selection

Feature selection consists in finding the subset of variables which bear the most information for the learning task and only using those for problem solving.

Feature selection can be done using:

- Field specific insight
- Automatic rules based on objective metrics
- Embedded within the algorithm itself (can be used as part of the data processing step)

Possible approaches

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Approaches can be:

Possible approaches

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Approaches can be:

- **Filter based:** ignore the learning model and select a subset of variables.

Possible approaches

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Approaches can be:

- **Filter based:** ignore the learning model and select a subset of variables.
- **Wrapper based:** iteratively build a model with a subset of feature and select the best performing one according to a learning score.

Filter-based approaches

Variance analysis

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Variance threshold selection

Variance based selection consists in **removing features with low variance.**

Variance analysis

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Variance threshold selection

Variance based selection consists in **removing features with low variance**.

In practice:

- Set a minimum variance threshold (careful about bias !)

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Variance threshold selection

Variance based selection consists in **removing features with low variance**.

In practice:

- Set a minimum variance threshold (careful about bias !)
- Remove all features not matching this criterion.

Variance analysis

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Variance threshold selection

Variance based selection consists in **removing features with low variance**.

In practice:

- Set a minimum variance threshold (careful about bias !)
- Remove all features not matching this criterion.

Question

Is this a filter-based or wrapper based approach ?

Advantages and limits

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Filter-based
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Advantages:

- Model independent
- Limited risk of overfitting

Advantages and limits

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Filter-based
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Advantages:

- Model independant
- Limited risk of overfitting

Limits:

- Does not take into account correlation between variables

Wrapper based selection

Wrapper based selection

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Wrapper based selection

Wrapper based selection (or model-based selection)

consists in iteratively building a model on a subset of features and selecting the best performing subset of features.

Wrapper based selection

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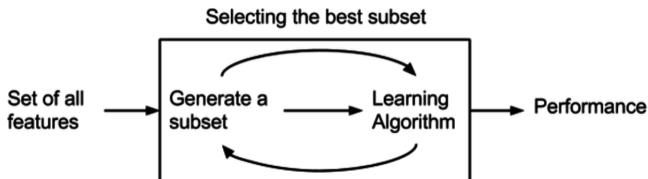
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Wrapper based selection

Wrapper based selection (or model-based selection)

consists in iteratively building a model on a subset of features and selecting the best performing subset of features.



Wrapper-based selection

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Selection can be:

- **Forward:** Start without any feature and add at each round the one which maximizes the score

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Selection can be:

- **Forward:** Start without any feature and add at each round the one which maximizes the score
- **Backward:** Start with every set of feature and remove at each round the one which maximizes the score.

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Selection can be:

- **Forward:** Start without any feature and add at each round the one which maximizes the score
- **Backward:** Start with every set of feature and remove at each round the one which maximizes the score.

...and stop algorithm once a threshold is reached.

Advantages and limits

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Advantages:

Advantages and limits

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Advantages:

- Takes into account the specificity of the learning task

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Advantages:

- Takes into account the specificity of the learning task
- Takes into account correlation between variables

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Advantages:

- Takes into account the specificity of the learning task
- Takes into account correlation between variables

Limits:

Advantages and limits

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Advantages:

- Takes into account the specificity of the learning task
- Takes into account correlation between variables

Limits:

- Model dependent

Advantages and limits

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Advantages:

- Takes into account the specificity of the learning task
- Takes into account correlation between variables

Limits:

- Model dependent
- Correlation depends on subset

Questions

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Questions ?