Lecture 13: Feature selection

ohie Robe

Introduction

Definition

Filter-based

Wrapper based selection

# Lecture 13: Feature selection Introduction to Machine Learning

Sophie Robert

L3 MIASHS — Semestre 2

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Filter-based approaches

Wrapper based selection

- 1 Introduction
- 2 Definition
- 3 Filter-based approaches
- 4 Wrapper based selection

Lecture 13: Feature selection

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#### Introduction

Definition

Filter-based approaches

Wrapper based

### Question

Do you remember what is the definition of feature reduction ?

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#### Introduction

Definition

Filter-based

Wrapper based

#### 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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#### Introduction

Definition

Filter-based approaches

Wrapper based selection

#### 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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### Introduction

Definition

Filter-based

Wrapper

### Question

Why do we want to perform feature reduction ?

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# Introduction

Definition

Filter-based approaches

Wrapper based selection

### Question

Why do we want to perform feature reduction ?

 Simplification of models to make them easier to interpret by users

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### Introduction

Definition

Filter-based approaches

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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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### Introduction

Definition

approaches

Wrapper based

#### 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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#### Introduction

Definition

Filter-based approaches

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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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#### Introduction

Definitio

Filter-based approaches

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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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#### Introduction

Definition

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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)

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Definition

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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

Definition

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**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:

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Feature selection can be done using:

Field specific insight

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Filter-based approaches

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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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#### Definition

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Approaches can be:

# Possible approaches

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#### Definition

Filter-based 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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#### Definition

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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.

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#### Variance threshold selection

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

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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.

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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?

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#### Advantages:

- Model independant
- Limitted risk of overfitting

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#### Advantages:

- Model independant
- Limitted risk of overfitting

#### Limits:

■ Does not take into account correlation between variables

### 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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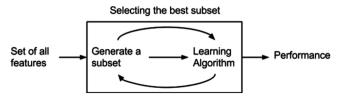
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### Wrapper based selection

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

### 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
- **Backward**: Start with every set of feature and remove at each round the one which maximizes the score.

### 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
- **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.

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Wrapper based selection Advantages:

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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:

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#### Advantages:

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

#### Limits:

Model dependent

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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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Introduction

Definition

Filter-based approaches

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