Small data technique I

Lecture 14

Changho Suh

October 1, 2021

Challenge of DTs & ensemble learning

Outline

1. Investigate a challenge that arises in DTs.

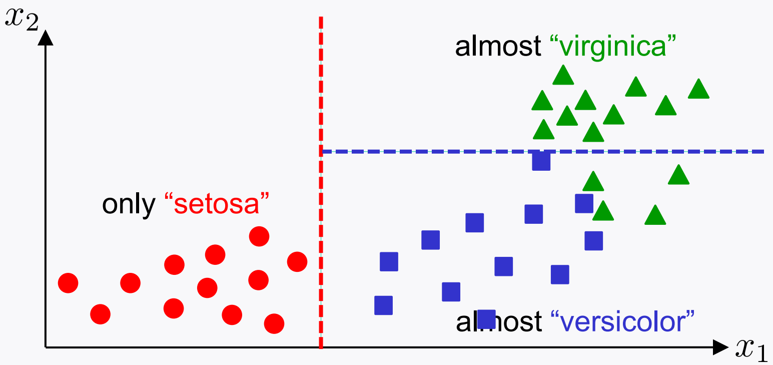
2. Explore a way to address the challenge:

Ensemble learning

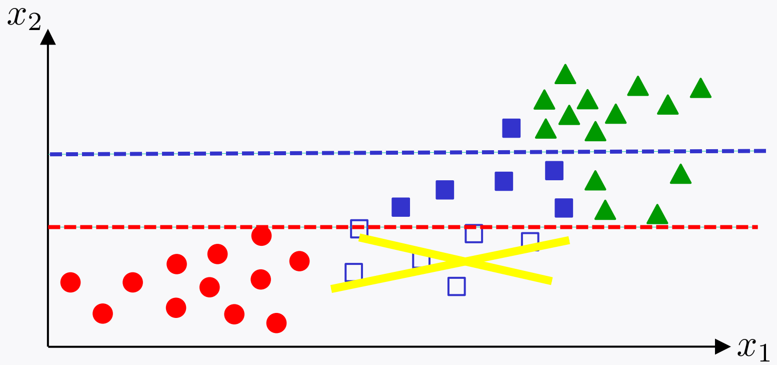
Challenge

Very sensitive to **small variations** of training data.

Example:



remove very long versicolor



A solution to address variation sensitivity

Turns out:

Ensemble learning is a solution.

For the rest:

1. Study what **ensemble learning** is.

2. Study ond powerful ensemble method:

Random forests (RFs)

Ensemble learning

Debate on a decision

How to decide when we have *diverse* opinions?

Often rely on **majority voting**.

Wisdom of the crowd: An aggregated decision is often better than even an expert's answer.

Can expect in the predictor context:

An aggregating prediction based on many predictors

→ A better prediction relative to the best predictor.

Ensemble learning

Ensemble: A *group* of predictors

Ensemble learning:
A technique that aggregates predictions of the ensemble.

Hard voting: Declare the one that gets **most votes**.

Soft voting: Declare the one with **highest probability** averaged over predictors

A way to obtain ensemble

Train each predictor on a **different subset** of the training set.

How to construct different subsets?

1. A way to choose *partial examples*:

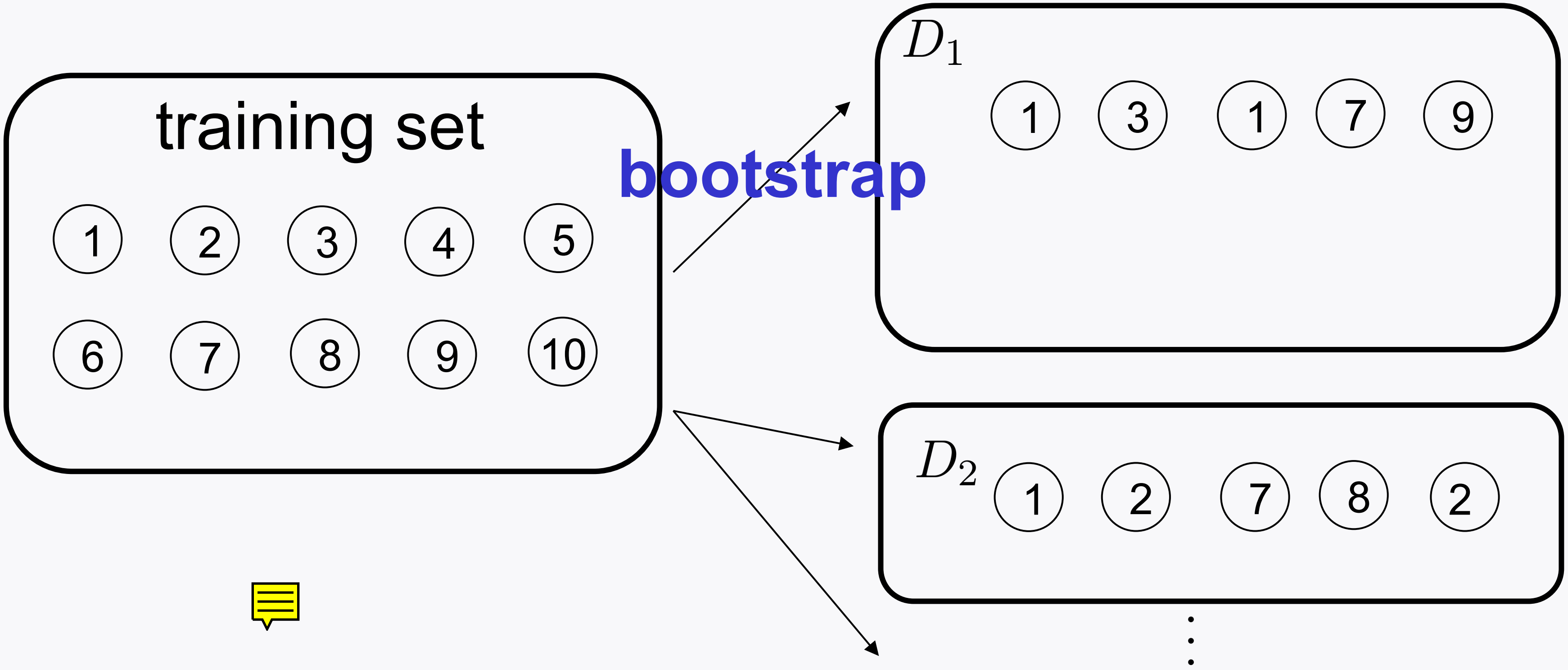
   Bootstrap

2. A way to choose *partial features*:

   Random subspace method

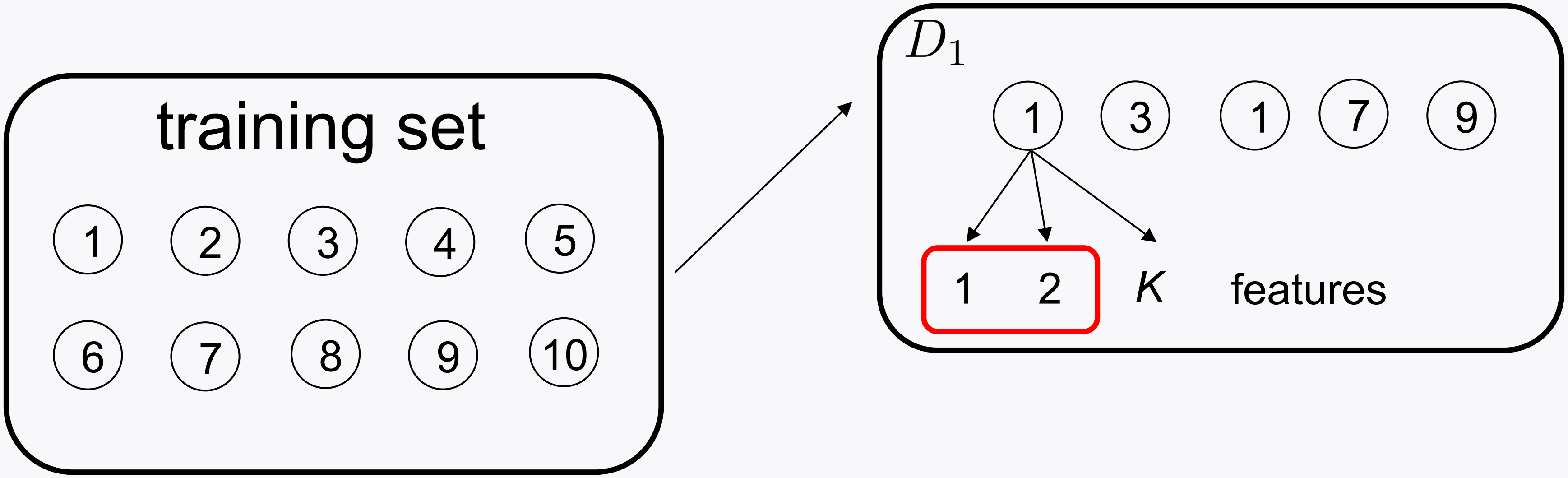
RF=Bootstrap+random subspace

Sampled uniformly at random *w/ replacement*

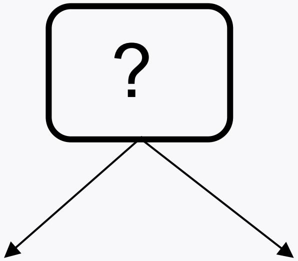


RF=Bootstrap+random subspace

Sampled uniformly at random *w/ replacement*

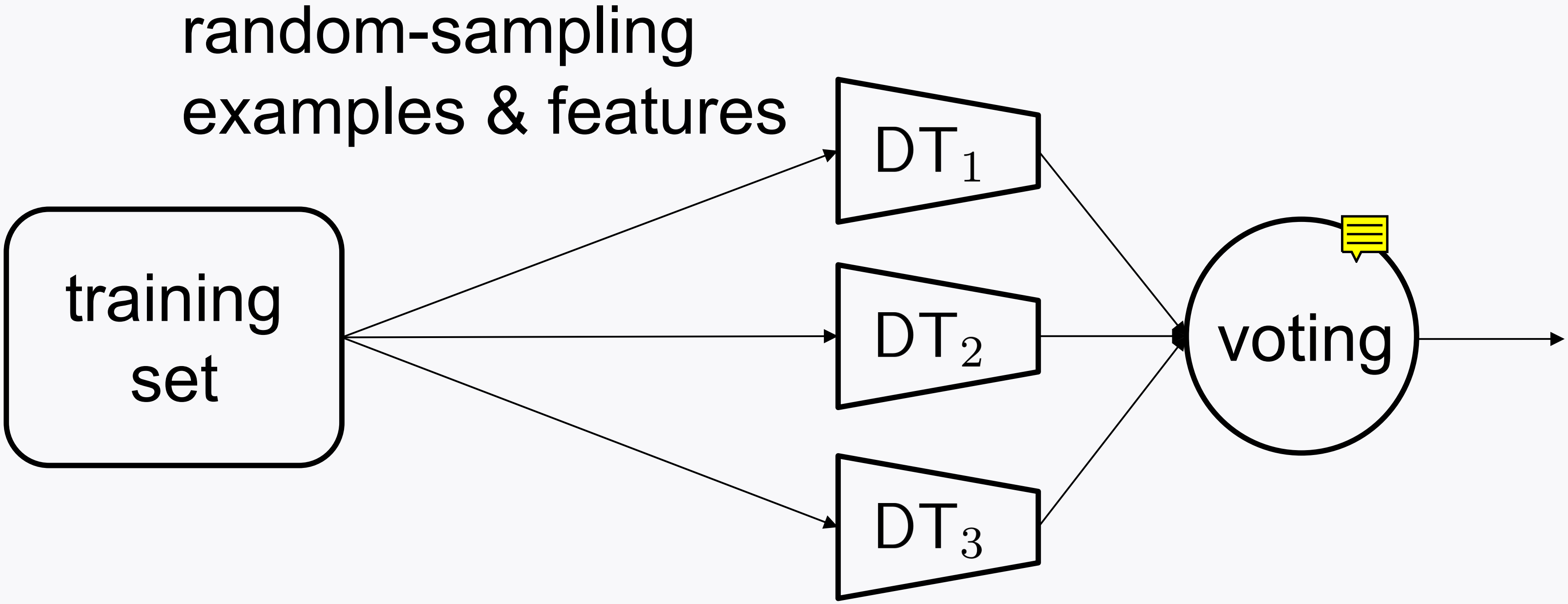


Decision Tree (DT) w/ D_1



Split a node considering a **random subset of features**.

RF in picture



Look ahead

Study **RF** in depth:

1. Investigate **hyperparameters**;

2. Study a measure for model *interpretation*:
   Feature Importance