Classification Using Tree Based Models

BUILDING DECISION TREES

Overview

Recognize classification problems

Understand how decision trees are used to solve classification problems

Understand how machine learning can be used to build decision trees

Gender Detection

Given the first name of a user

or

Weather Forecasting

Given a time of day

or

or

Quant Trading

Given a trading day

or

Fraud Detection

Given a transaction

or

Classification Problems

Classifying something into predefined set of categories

Gender Detection
- Male, Female

Weather Forecasting
- Cloudy, Sunny, Rainy

Quant Trading
- Up day, Down day

Fraud Detection
- Fraud, Not fraud

Classification Problems

We are given a **problem instance**

A name

A time of day

A trading day

A transaction

Classification Problems

We need to assign a **label** to the problem instance

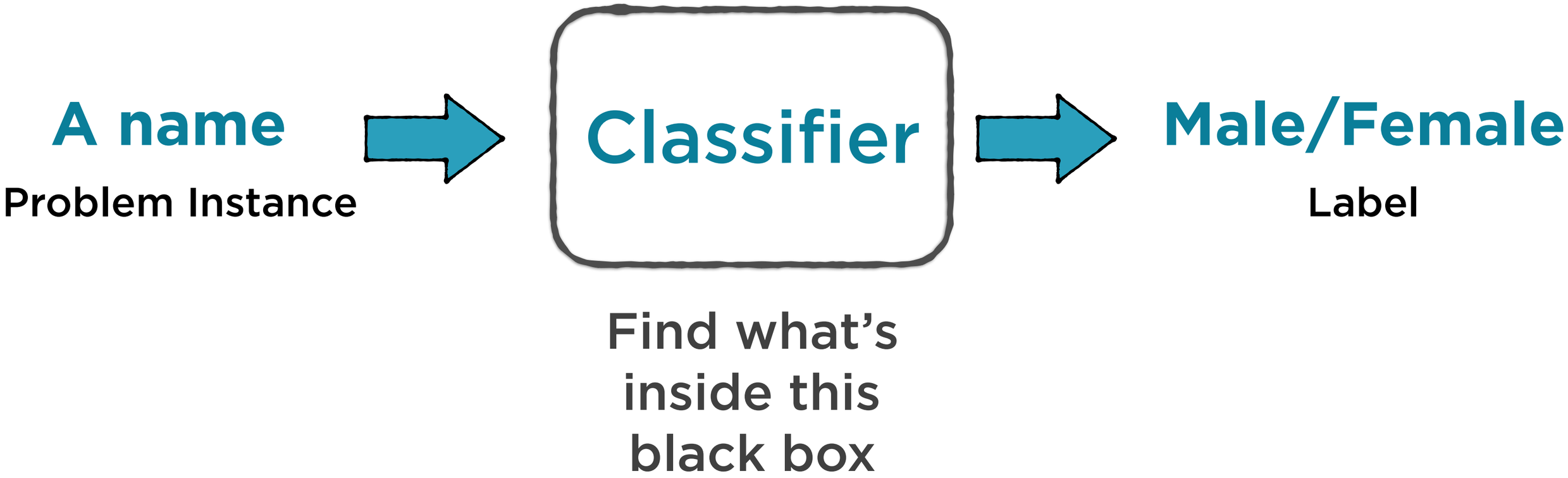
Male or **female**?

Cloudy or **rainy** or **sunny**?

Up-day or **down-day**?

Fraud or **Not fraud**?

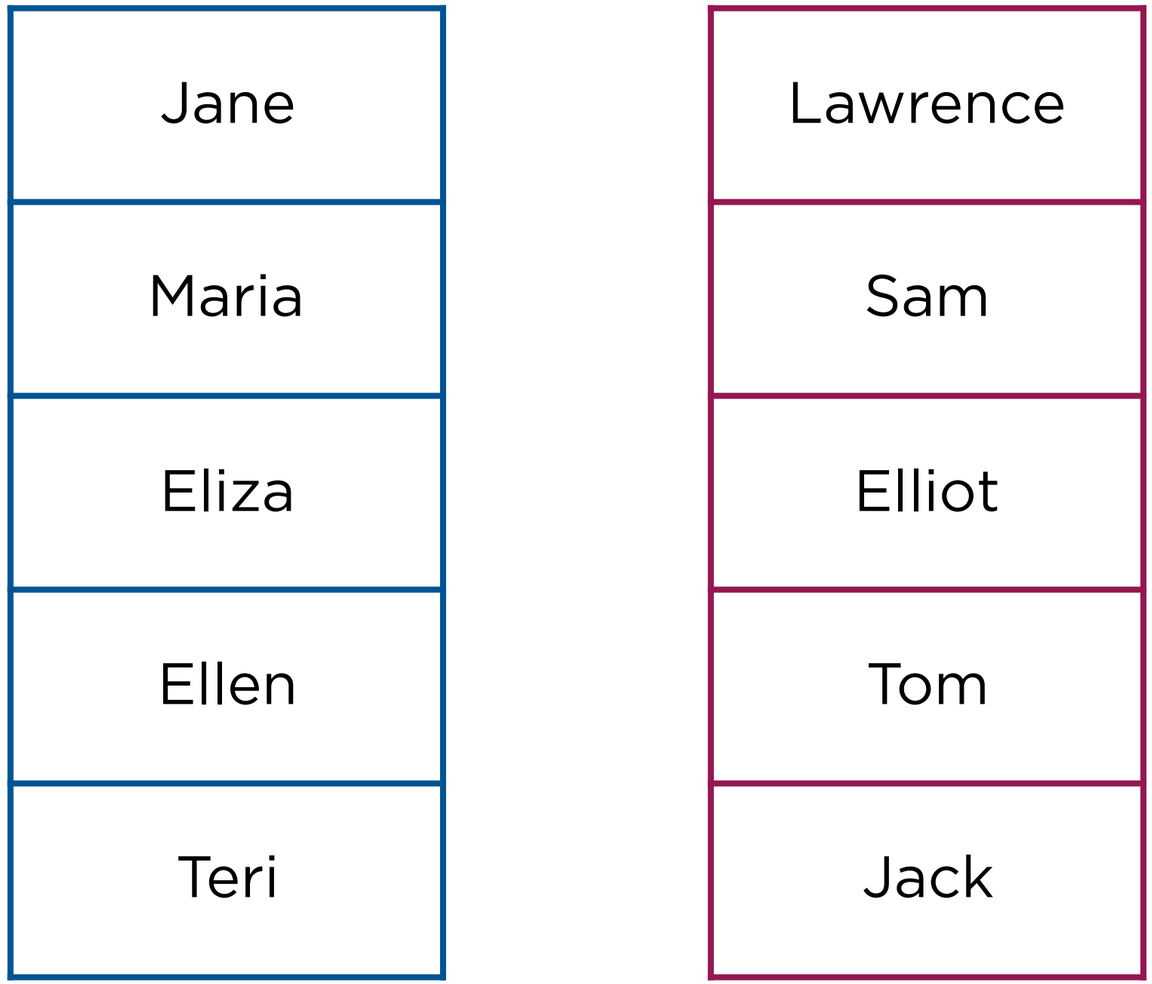
Solving Classification Problems



One way to solve
classification problems

Define a set of rules

Find the set of rules that can classify these names correctly



Simply do a visual inspection

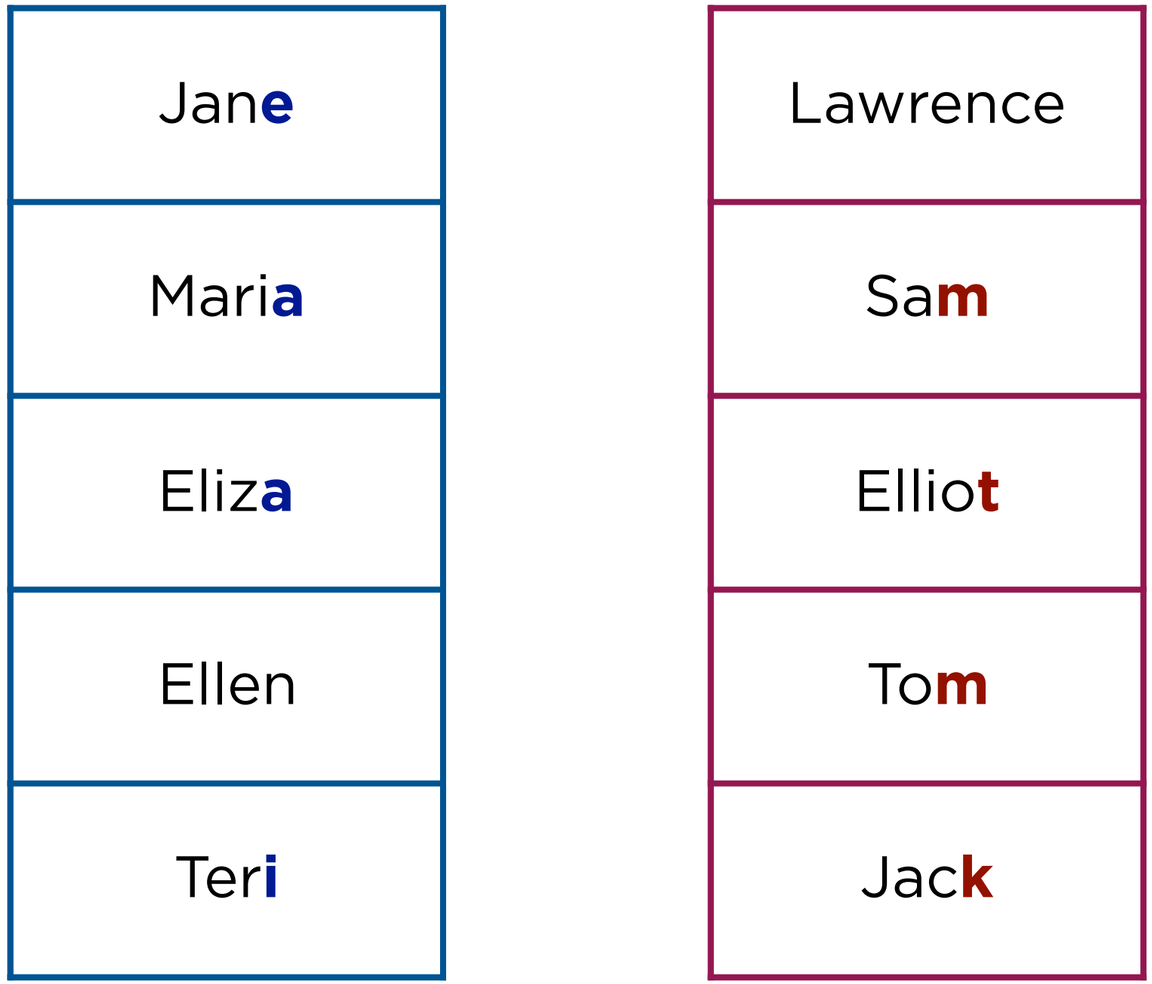
Jane
Maria
Eliza
Ellen
Teri

Lawrence
Sam
Elliot
Tom
Jack

In most cases

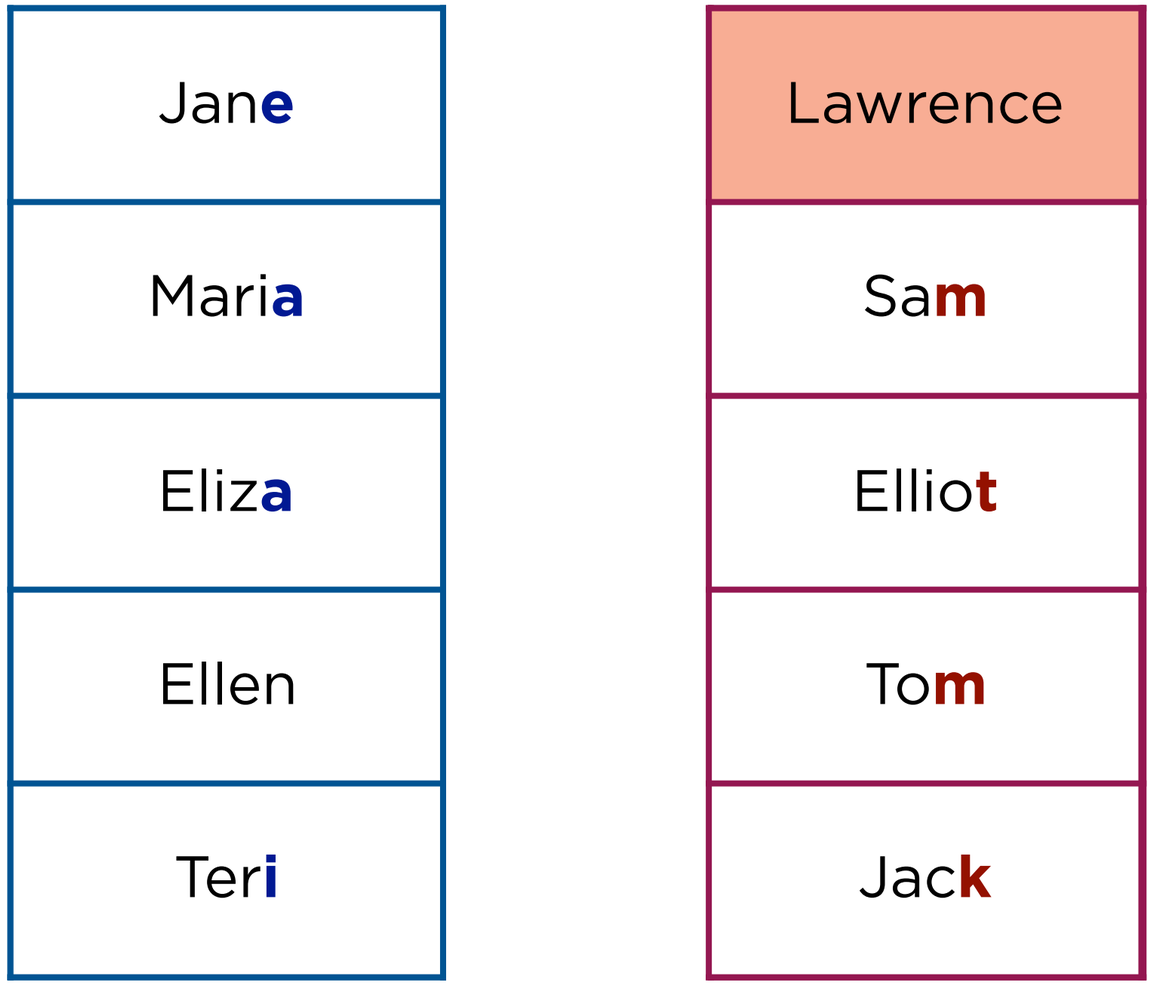
Female first names
end in **vowels**

Male first names
end in **consonants**



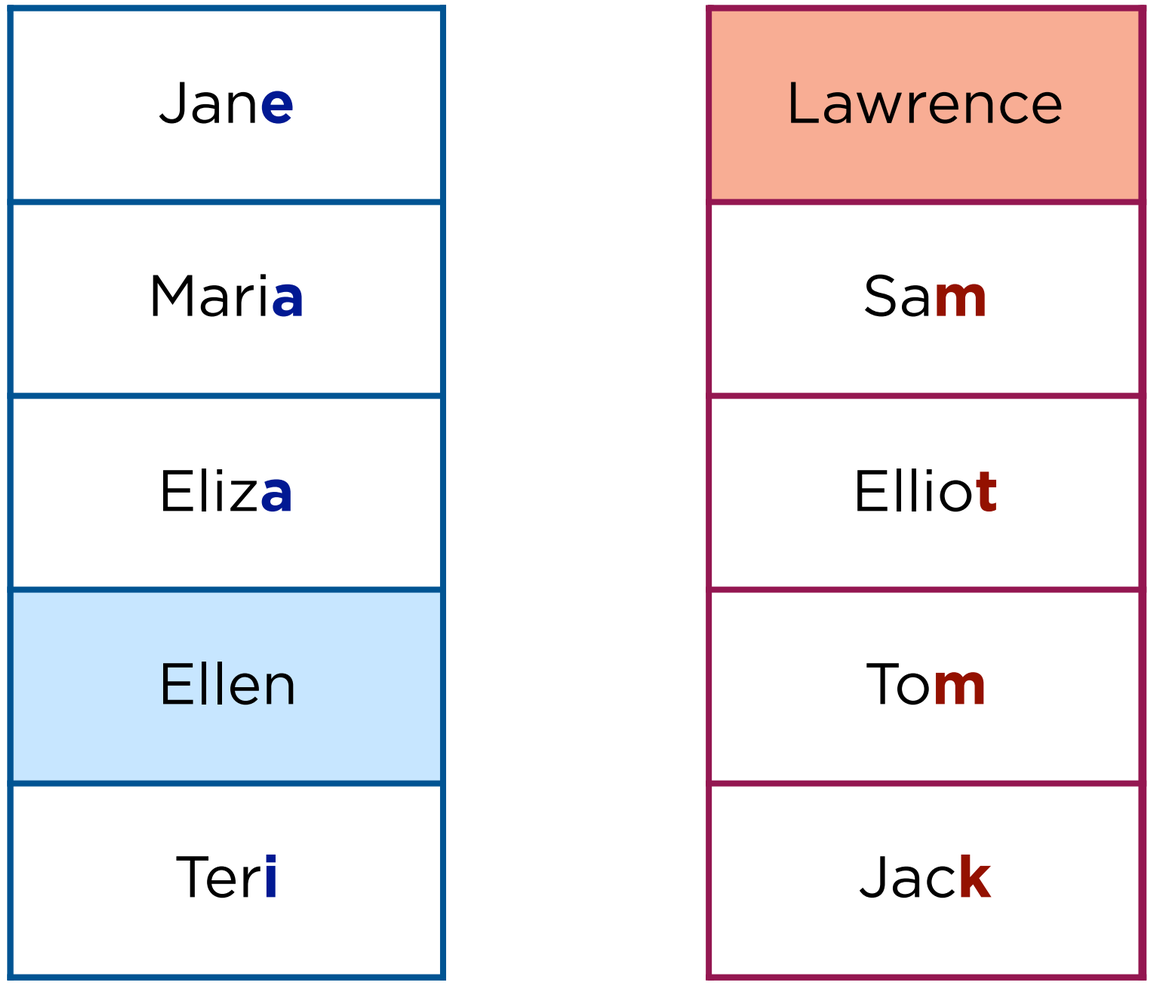
Except..

Vowel-ending names which begin with L are male names

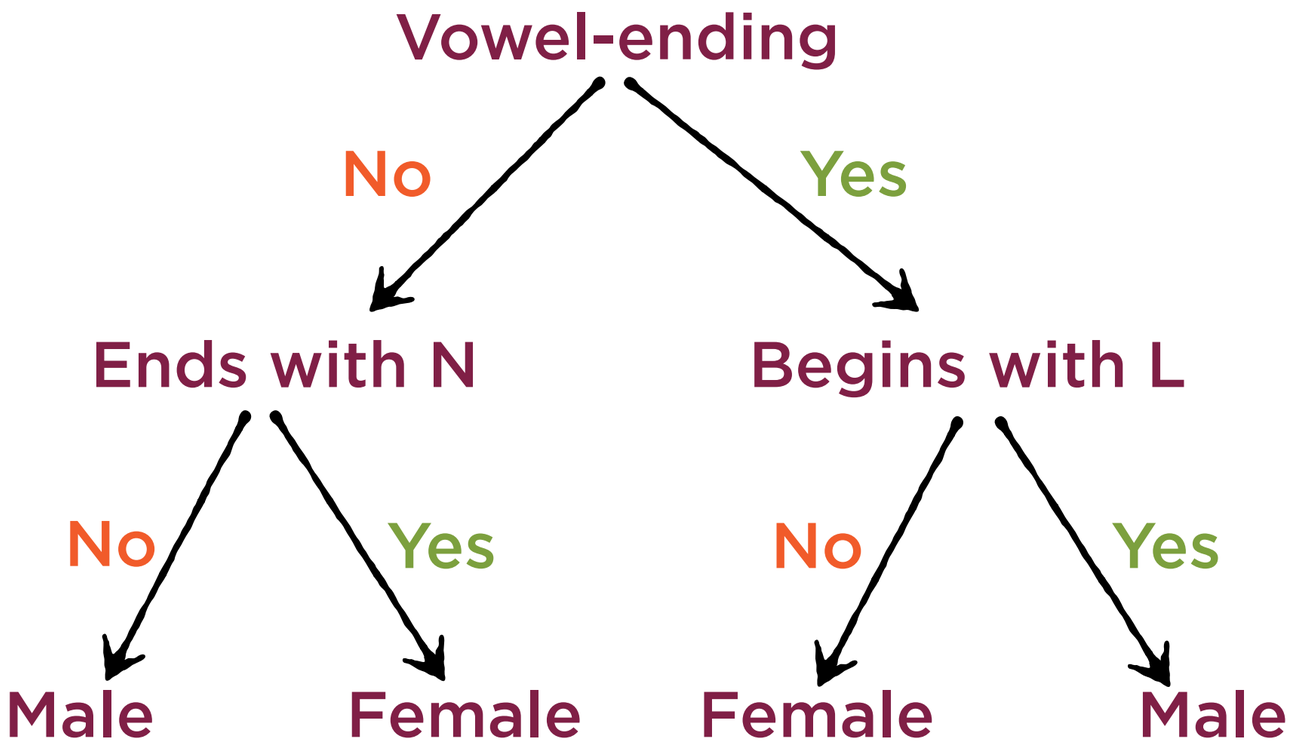


Except..

Consonant-ending names which end with N are female names



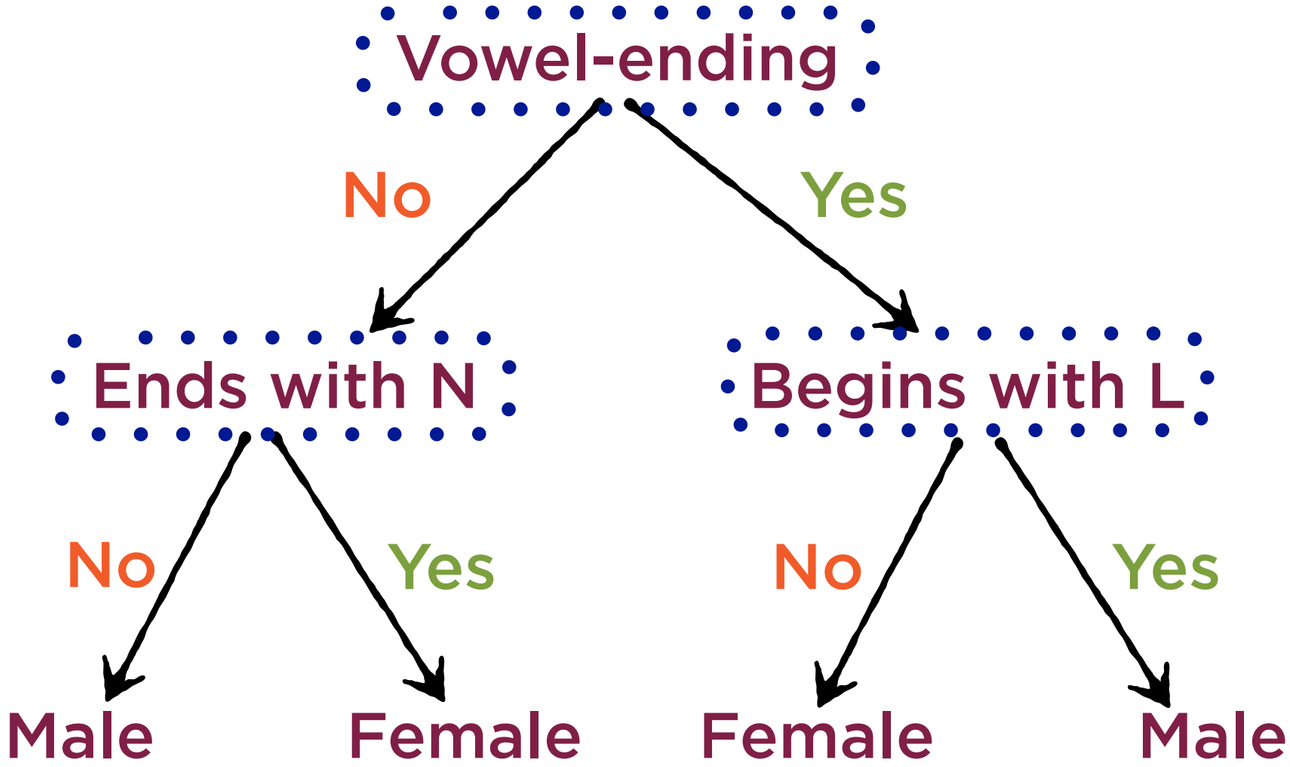
Visualize these rules using a tree representation



The tree represents a series of choices

i.e. decisions

Decision Tree



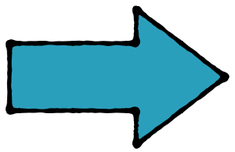
Decision Tree

A set of rules
used to classify
something

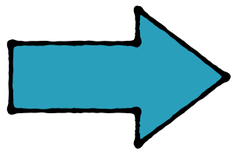
Building a Decision Tree

Training Data

Jane	Lawrence
Maria	Sam
Eliza	Elliot
Ellen	Tom
Teri	Jack



Machine Learning Algorithm



Decision Tree

Tree Based Models

Machine learning algorithms which build decision trees from training data

Tree Based Models

Decision Tree Learning Algorithms

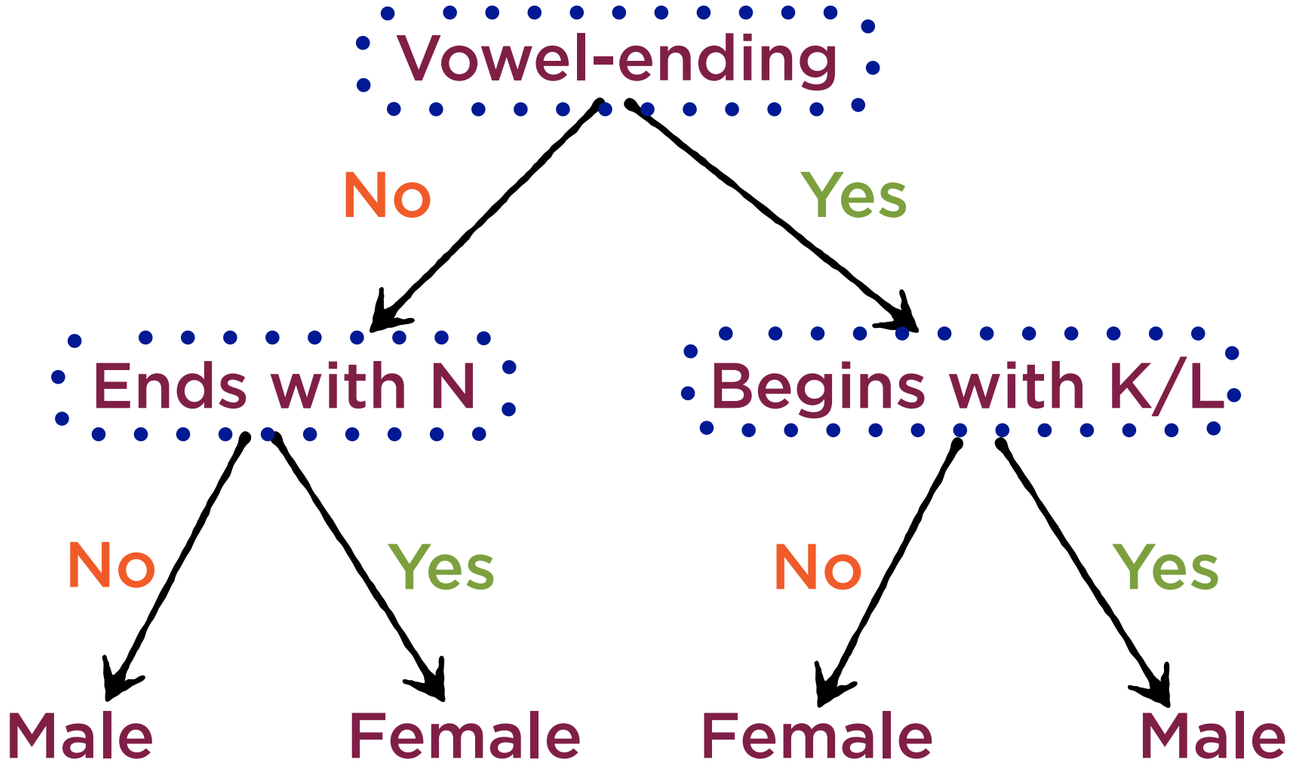
Build a single decision tree

Ensemble Learning Algorithms

Build multiple decision trees and combine their results

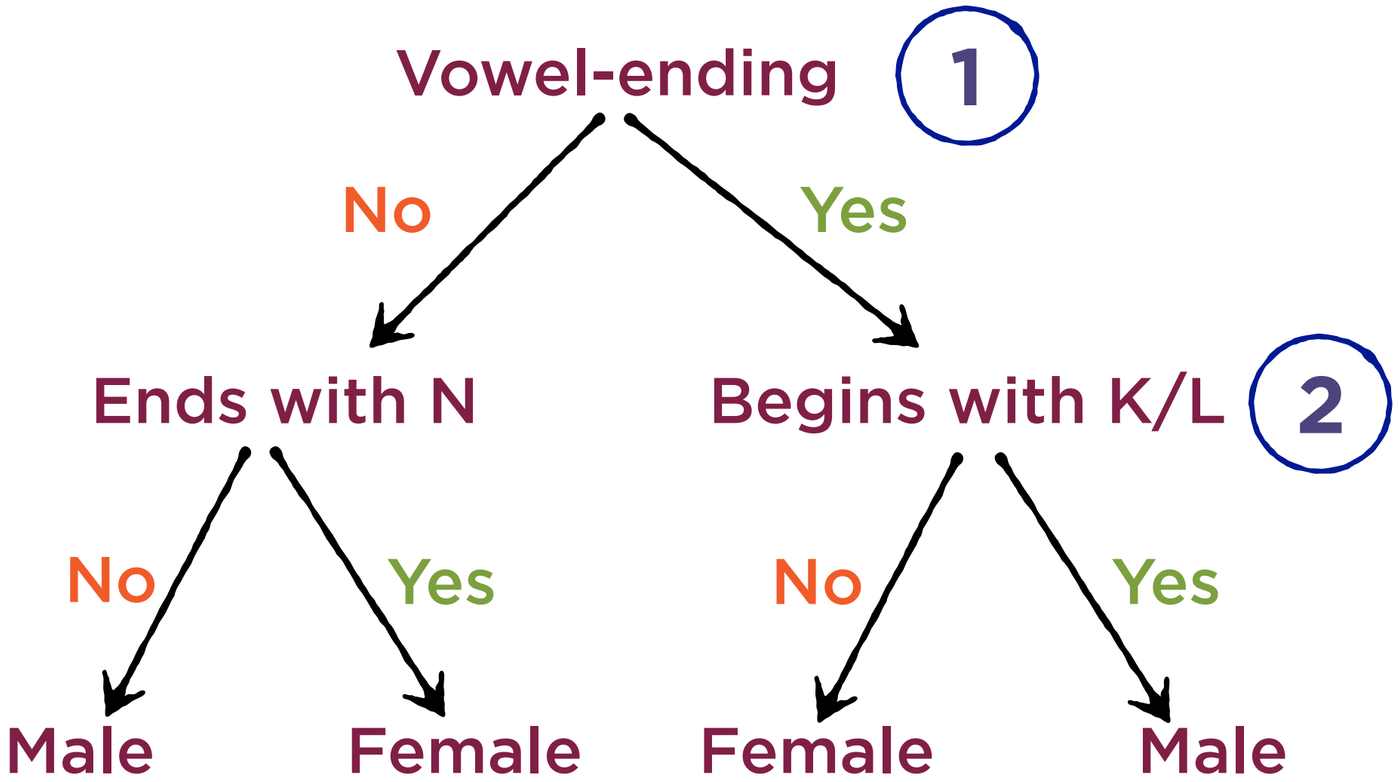
Each decision depends on the value of some attribute of the problem instance

Decision Tree



The order in which we look at the attributes is important

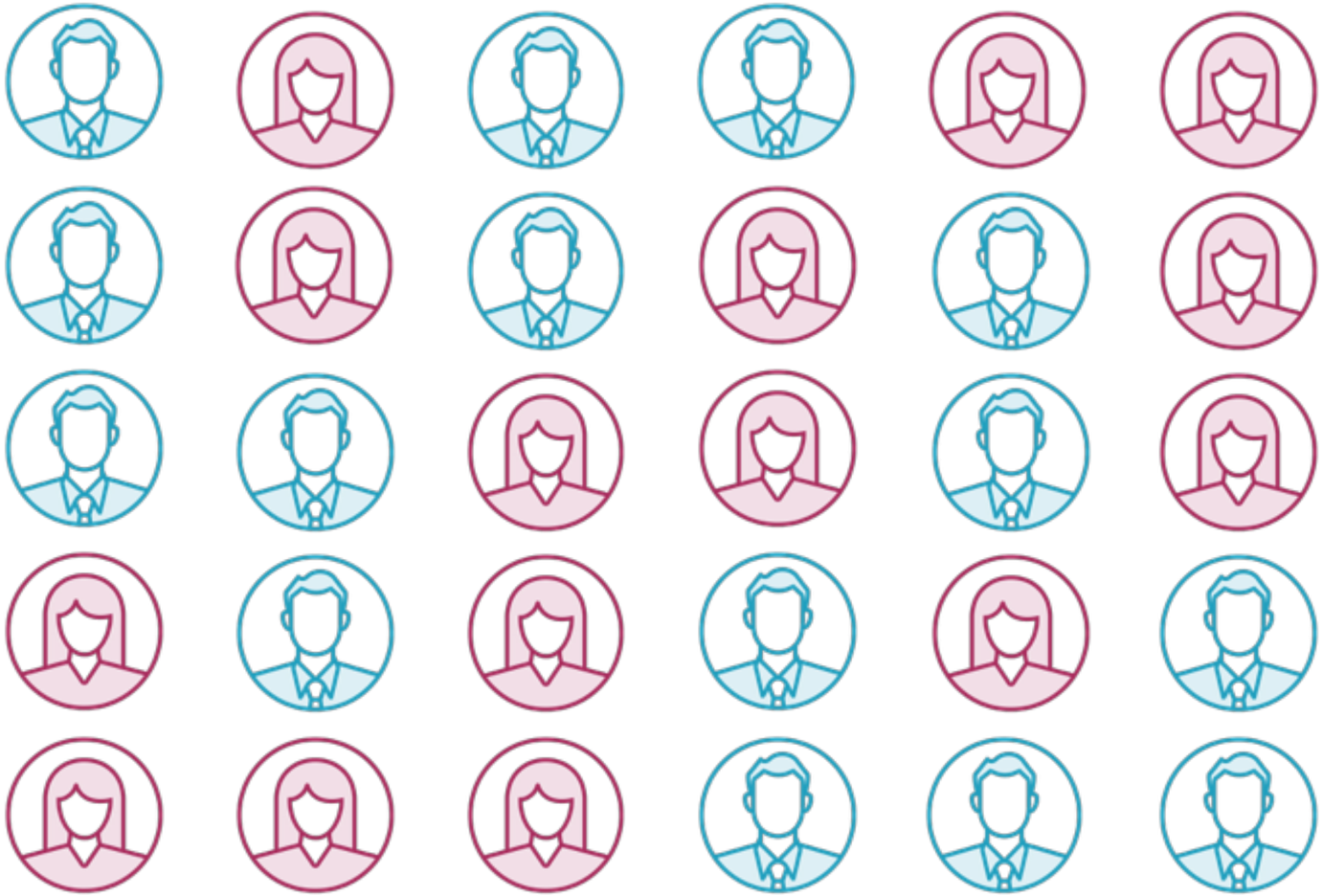
Decision Tree



How Decision Tree Learning Works

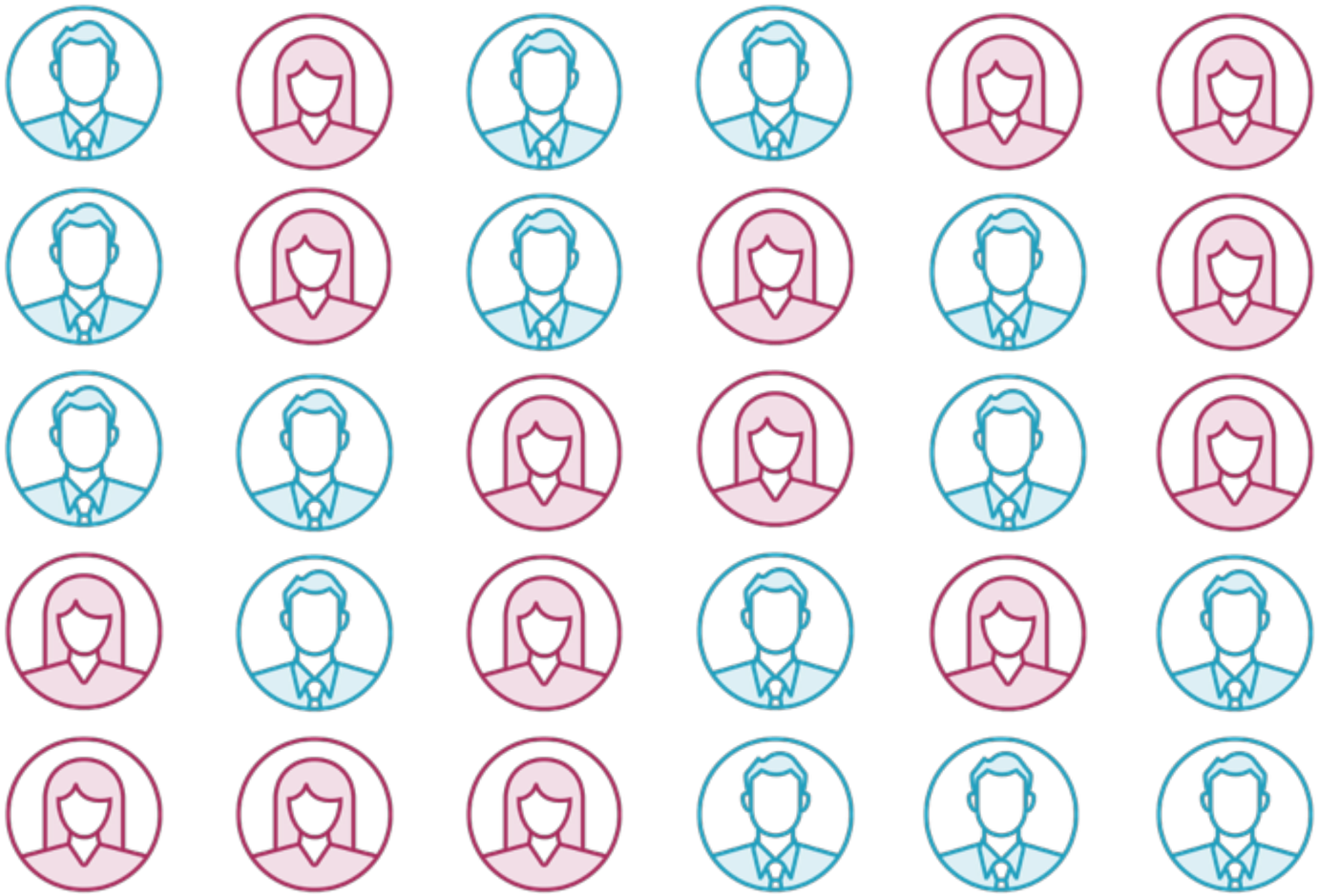
Choose an attribute/ feature that divides the training data into homogenous subsets

How Decision Tree Learning Works



Training Data

How Decision Tree Learning Works

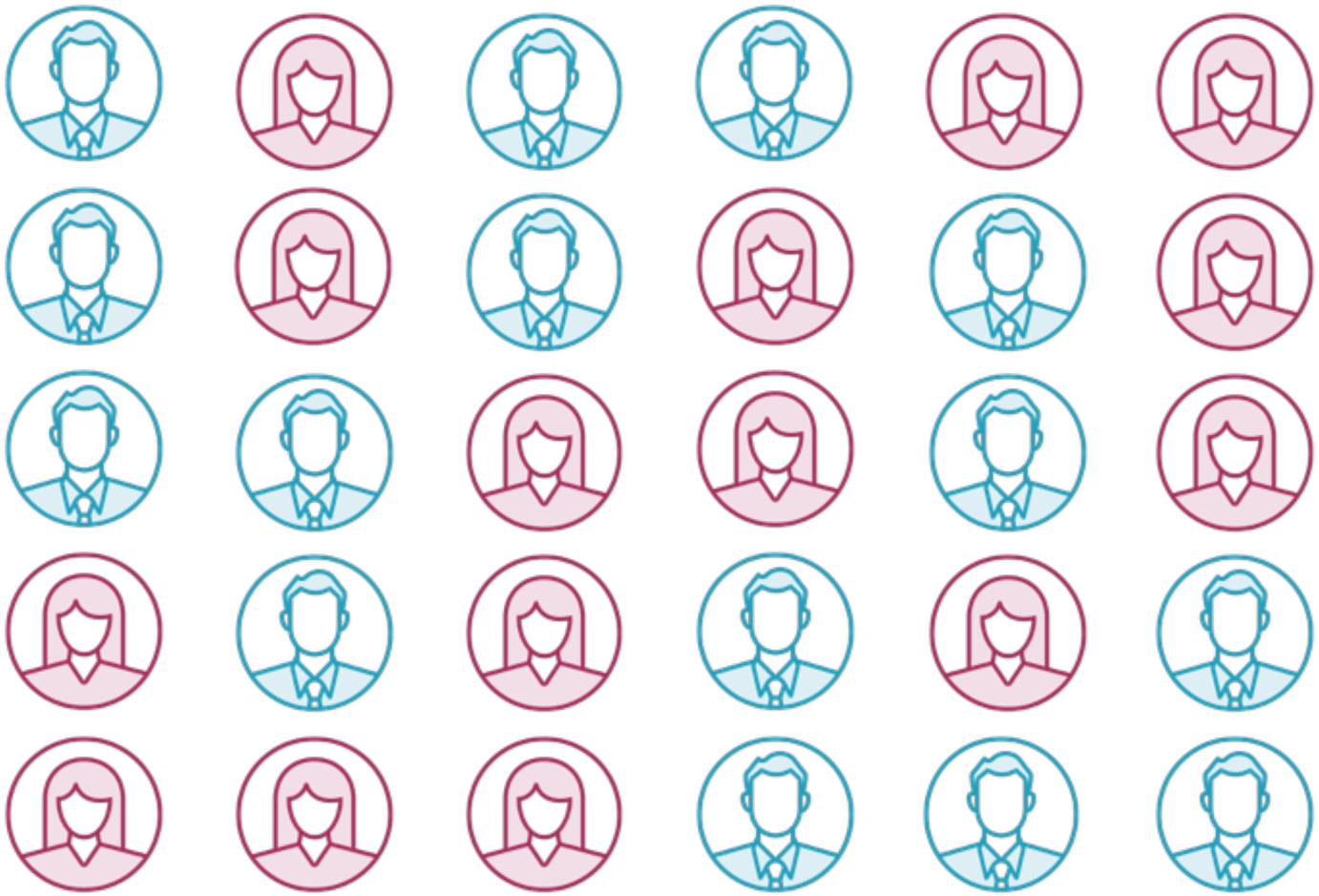


Attributes are

Vowel-ending?

Begins with K?

How Decision Tree Learning Works



Attributes are

Vowel-ending?

Begins with K?

How Decision Tree Learning Works

Yes

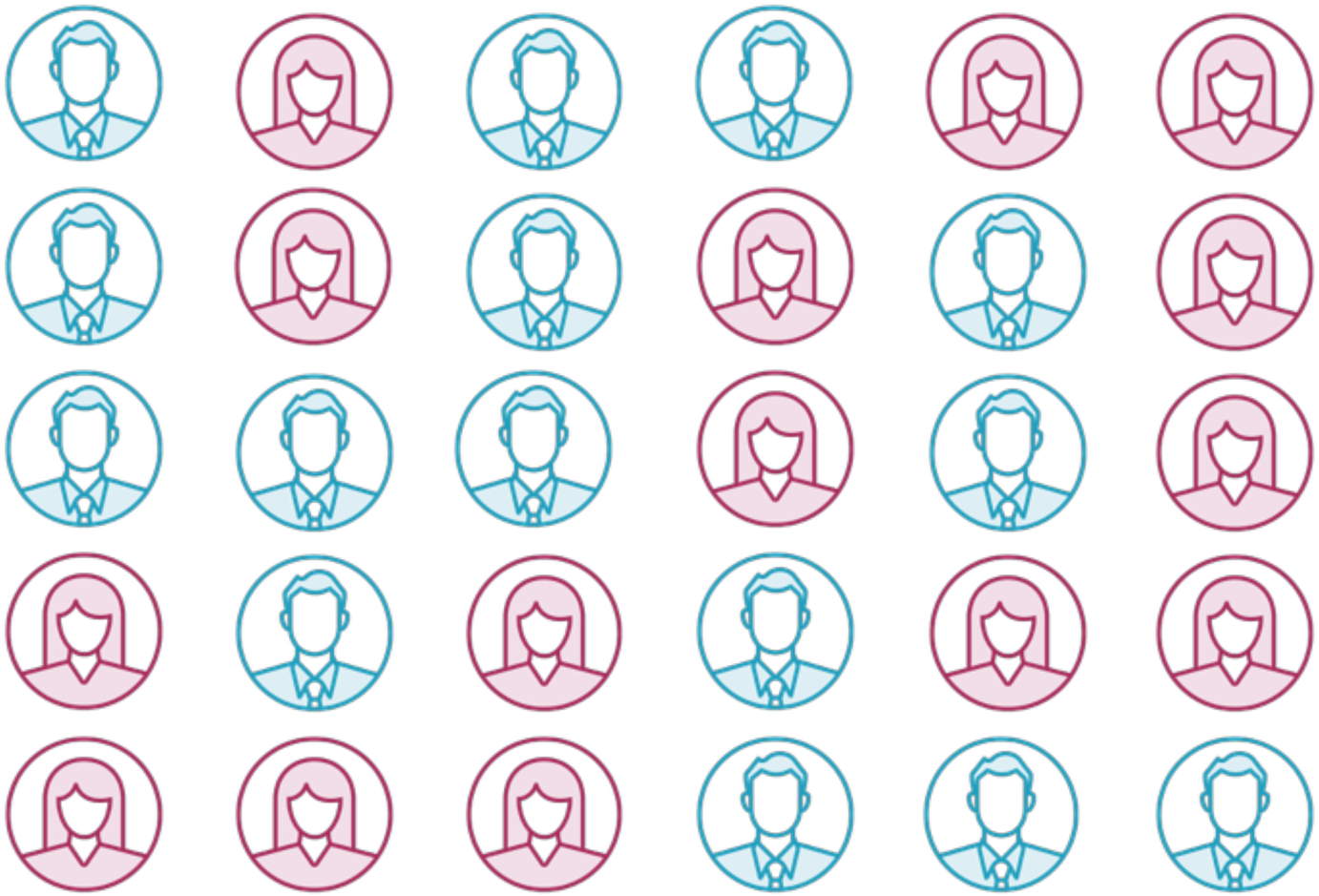
No

Attributes are

Vowel-ending?

Begins with K?

How Decision Tree Learning Works



Attributes are

Vowel-ending?

Begins with K?

How Decision Tree Learning Works

Yes

No

Attributes are

Vowel-ending?

Begins with K?

How Decision Tree Learning Works

Vowel-ending?

Leads to more homogenous subsets

Begins with K?

Leads to non-homogenous subsets

How Decision Tree Learning Works

Vowel-ending?

Gives us more information

Begins with K?

Gives comparatively less information

How Decision Tree Learning Works

Vowel-ending?

First attribute in the decision tree

Begins with K?

Next attribute in the decision tree

How Decision Tree Learning Works

Vowel-ending?

Begins with K?

Ends with N?

If there are more attributes, repeat this process within each subset using the remaining attributes

How Decision Tree Learning Works

Information Gain

Gini Impurity

Ways to measure homogeneity of the subsets formed

Summary

Recognize classification problems

Understand how decision trees are used to solve classification problems

Understand how machine learning can be used to build decision trees