



# Oracle Academy

10:10 a 11:10h

## Inteligencia Artificial con Machine Learning en Java

Jordi Ariño | Software Developer Manager at PUE

# Inteligencia Artificial con Machine Learning en Java

Madrid, 8 de mayo





## Jordi Ariño

Software Developer Manager at PUE  
Agile Software Developer

[jordi.arino@pue.es](mailto:jordi.arino@pue.es)  
[@jordiAS2K](https://twitter.com/jordiAS2K)



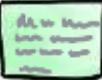
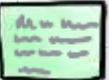
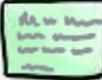
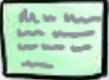
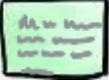
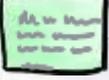
#PUEAcademyDay19

# Introducción

## Inteligencia Artificial con Machine Learning en Java





	To do	Doing	Done
			
			
			
			
			
			

# Agenda

- 1.- Introducción
- 2.- Programa Oracle Academy
- 3.- Oracle Academy: Plan de estudios
- 4.- AiML: Artificial Intelligence with ML
- 5.- Demo: Plataforma Oracle iLearning
- 6.- Hands-On Labs



Esta **workshop** se enmarca dentro del programa educativo **Oracle Academy**.

Oracle Academy ofrece una solución completa de **recursos para la educación** en TI, con el objetivo de ayudar a los estudiantes a prepararse para su futuro profesional.

**PUE** es el **partner** escogido por Oracle para la difusión y gestión de su iniciativa **Oracle Academy en España**.

Son ya más de 125 centros que participan activamente en este proyecto y reciben **soporte activo** por parte de PUE para la correcta **implantación** de los recursos docentes que tienen a su disposición.



## Objetivo:

Mostrar el **nuevo curso disponible** en Oracle Academy, **Artificial Intelligence with Machine Learning in Java**.

Disponible dentro de la plataforma **Oracle iLearning** para las instituciones educativas homologadas en el programa Oracle Academy.

El curso ofrece una introducción o iniciación a los conceptos base del proceso de *Aprendizaje Automático* dentro del campo de la Inteligencia Artificial, mientras se diseña un sencillo modelo o solución de "Machine Learning" con Java.



Con la inscripción a este workshop habréis recibido acceso gratuito a *formación online en formato de autoaprendizaje* a una serie de **cursos oficiales de Java y bases de datos Oracle**.

**Objetivo:**

Poder evaluar algunos de los recursos e-learning que Oracle Academy pone a disposición de centros y profesores para la formación de sus alumnos, de manera oficial, en desarrollo en Java y diseño y programación de Bases de Datos Oracle.

# Programa Oracle Academy

## Inteligencia Artificial con Machine Learning en Java





	To do	Doing	Done

# Agenda

- 1.- Introducción
- 2.- Programa Oracle Academy**
- 3.- Oracle Academy: Plan de estudios
- 4.- AiML: Artificial Intelligence with ML
- 5.- Demo: Plataforma Oracle iLearning
- 6.- Hands-On Labs

# Programa Oracle Academy

<b>Community</b>  <b>Certification</b>  <b>Training</b>  <b>Learning Resources</b>  <b>Technology</b>	<b>BADGES, LOGOS &amp; MERCHANDISE</b> 		<b>ENGAGE WITH EXPERTS</b>  		<b>ORACLE OPEN WORLD &amp; JAVA ONE</b>  	
	<b>CERTIFICATION PREPARATION &amp; EXAMS</b>					
	<b>50% OFF Preparation</b>		 		<b>25% OFF Exams</b>	
	<b>FACULTY PROFESSIONAL DEVELOPMENT</b>			<b>INDIVIDUAL LEARNING</b>		
	 <b>IN-CLASS TRAINING</b>		 <b>VIRTUAL + IN-CLASS TRAINING</b>	 <b>VIRTUAL INSTRUCTOR LED</b>	 <b>WORKSHOPS IN A BOX</b>	
<b>CURRICULUM</b> 		<b>ORACLE PRESS BOOKS</b> 	<b>LECTURE SERIES</b> 	<b>TECHNICAL ARTICLES</b> 	<b>WEBCASTS &amp; PODCASTS</b> 	
<b>CLOUD ENVIRONMENTS</b> 		<b>JAVA DEVELOPMENT ENVIRONMENTS</b>     			<b>ORACLE SOFTWARE</b>   	



Miembro institucional

Inicio

Bienvenida

Membresía

Plan de estudios

Capacitación

Recursos

Descuentos

Página de inicio de Oracle Academy



Bienvenida



Membresía



Encuesta



Plan de estudios



Capacitación



Recursos



Descuentos

Integrated Cloud Applications & Platform Services

[Contáctenos](#) | [Avisos legales](#) | [Términos de uso](#) | [Privacidad](#) | [Acerca de Oracle](#)



<https://academy.oracle.com>



## ¿Cómo darme de alta?

[www.pue.es/oracle-academy](http://www.pue.es/oracle-academy)  
[pueacademy@pue.es](mailto:pueacademy@pue.es)



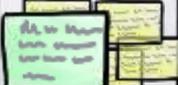
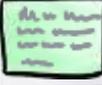
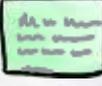
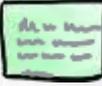
#PUEAcademyDay19

# Oracle Academy: Plan de estudios

## Inteligencia Artificial con Machine Learning en Java





	To do	Doing	Done
			
			
			
			
			
			

# Agenda

- 1.- Introducción
- 2.- Programa Oracle Academy
- 3.- Oracle Academy: Plan de estudios**
- 4.- AiML: Artificial Intelligence with ML
- 5.- Demo: Plataforma Oracle iLearning
- 6.- Hands-On Labs

# Oracle Academy: Plan de estudios

## Workshops disponibles



Getting Started with Java Using Alice



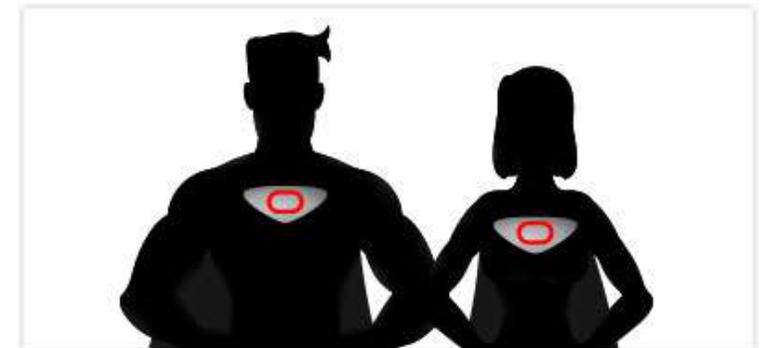
Creating Java Programs with Greenfoot



Programming the Finch Robot in Greenfoot



Programming the Finch Robot in Java



Solve it with SQL



Undo    Redo

handle style    DEFAULT    ROTATION    TRANSLATION    RESIZE

use snap    Snap details

this.witch

one shots

**this.witch's Properties**

Witch    witch    ←    new Witch

Paint =

Opacity =

Vehicle =

Position = ( x: -0.01    y: -0.00    z: -1.82 )

Width: 1.37

Size = Height: 1.49   

Depth: 1.25

Show Joints:

**Object Markers (0)**

Browse Gallery By Class Hierarchy    Browse Gallery By Theme    Browse Gallery By Group    Search Gallery    Shapes/Text

all themes    fantasy    cauldron





Undo Redo

handle style: DEFAULT ROTATION TRANSLATION RESIZ

use snap ▶ Snap details

this.MyCar ▼

one shots ▼

▼ this.MyCar's Properties

SportsCar MyCar ← new SportsCar resourc

Paint =  WHITE

Opacity =

Vehicle =  this

Position = (x: 0.57 ,y: 0.00 ,z: -0.34 )

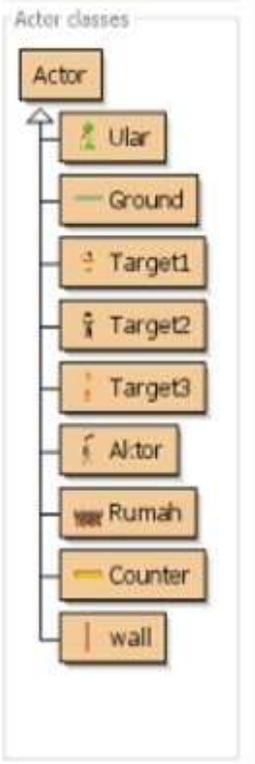
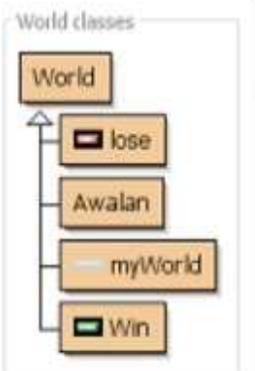
Browse Gallery By Class Hierarchy Browse Gallery By Theme Browse Gallery By Group Search Gallery Shapes/Text My Classes

all classes ▼ Transport classes ▼ Automobile classes ▼



Share...

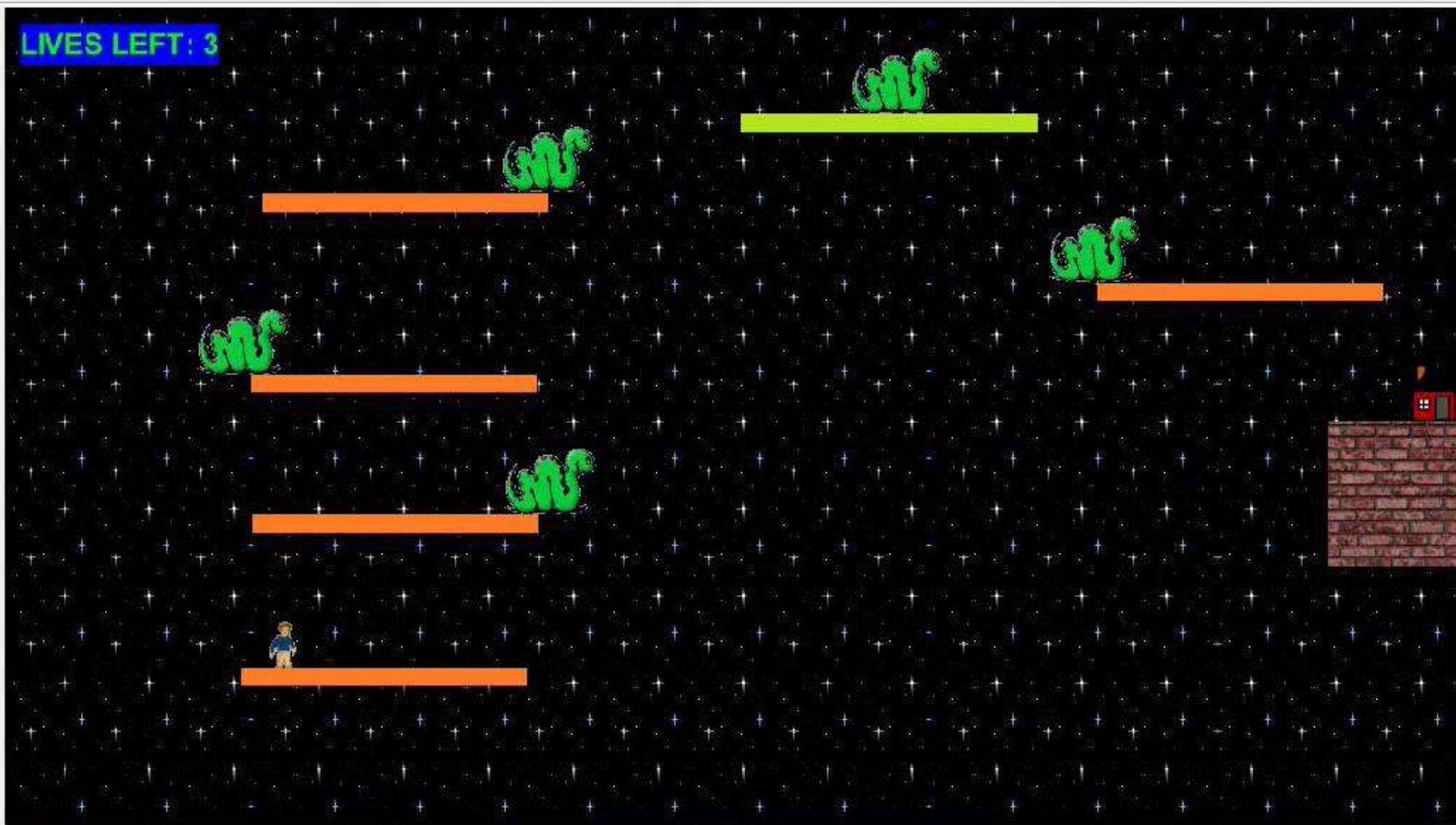
Skor; 0



> Act   || Pause   ↻ Reset

Speed:

LIVES LEFT: 3



Share...

- GameOver
- Complete
- EndPoint:
- Counter
- Enemy
  - Enemy1
  - Enemy2
- Laser
  - LaserLeft
  - LaserRight
- Objects
  - Ground
  - Mover1
  - Mover2
  - Stable
  - Brick:
- Person

> Act

|| Pause

↺ Reset

Speed:



Compile



# Recording Criminal's Details

Back at the secret Lair...

When we catch a criminal we record all this information about them.

I have created a database to store the known details of all the criminals in the city.

## Criminal Properties:

- Name
- Sex
- Age
- Height
- Hair\_Color
- Eye\_Color
- Facial\_Hair
- Tattoos
- Glasses
- Scars
- Feet\_Size



# Suspect Examples



We will take the information and add it to our SQL database system so that there will be no escape for them in the future.



Name : Clayton Lara  
Sex : Female  
Age : 29  
Height : Tall  
Hair\_Color : Blonde  
Eye\_Color : Brown  
Facial\_Hair : No  
Tattoos : No  
Glasses : No  
Scars : Yes  
Feet\_Size : Large



Name : Josh Stone  
Sex : Male  
Age : 42  
Height : Medium  
Hair\_Color : Black  
Eye\_Color : Blue  
Facial\_Hair : Yes  
Tattoos : Yes  
Glasses : Yes  
Scars : No  
Feet\_Size : Medium

It's the hotline from police headquarters...

Ring! Ring!



Hello SQLman,  
we have a  
third clue.



Excellent, added to our  
existing clues we can  
really narrow down the  
suspect list!!



The first thief  
is not only Male  
with scars on  
his hands but in  
addition he has  
either Black or  
Brown Hair



Thank you officer I will  
have my team narrow  
down the list of  
suspects even more.

It looks like we  
now have three  
clues!

For this we need  
to learn more  
about Conditions  
using Logical  
Operators.



# Running SQL Commands



These are the 3 main components of APEX that we will be working with.

Execute them in the given order to return the data you asked for from the table.

2

Click the Run button.

1

Enter the command in the command editor.

3

View the output on the Results table.

ORACLE Application Express

Application Builder | SQL Workshop | Team Development | Packaged Apps

SQL Commands | Schema: WMCRAE\_SQL\_16

Rows: 1000 | Clear Command | Find Tables | Save | Run

```
SELECT *
FROM suspects;
```

SUSPECT_ID	NAME	SEX	AGE	HEIGHT	HAIR_COLOR	EYE_COLOR	FACIAL_HAIR	TATTOOS	GLASSES	SCARS
210	Nasim Jennings	Female	21	Short	Blonde	Blue	No	Yes	No	Yes
211	Mia Greer	Female	78	Short	Black	Brown	Yes	No	No	Yes
212	Byron	Male	18	Short	Black	Green	Yes	No	Yes	Yes

# Oracle Academy: Plan de estudios

## Cursos disponibles



Java Foundations



Java Fundamentals



Java Programming



Artificial Intelligence with  
Machine Learning in Java



Database Foundations



Database Design and  
Programming with SQL



Programming with PL/SQL



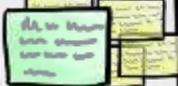
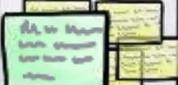
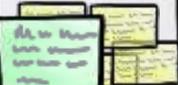
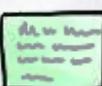
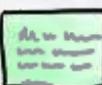
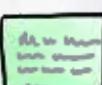
APEX  
Application Development  
Foundations

# Curso AiML: Artificial Intelligence with ML in Java

Inteligencia Artificial con Machine Learning en Java





	To do	Doing	Done
			
			
			
			
			
			

# Agenda

- 1.- Introducción
- 2.- Programa Oracle Academy
- 3.- Oracle Academy: Plan de estudios
- 4.- AiML: Artificial Intelligence with ML**
- 5.- Demo: Plataforma Oracle iLearning
- 6.- Hands-On Labs

## Curso AiML

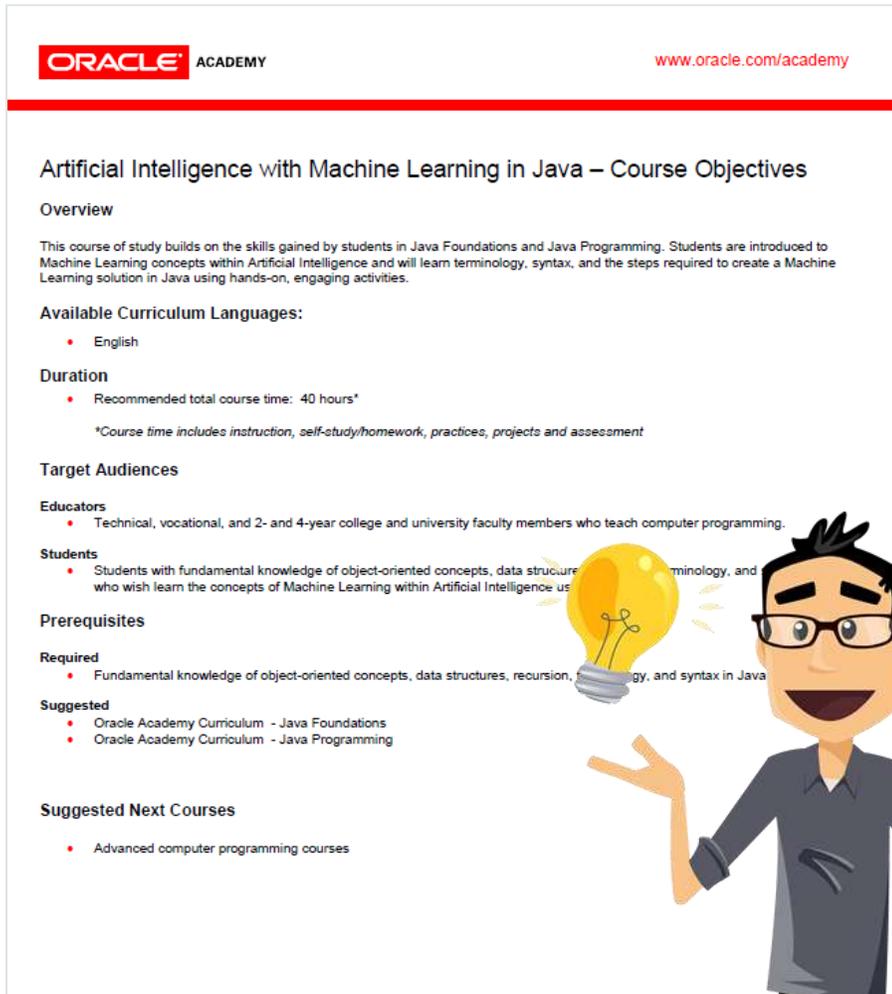
Este curso **amplía las habilidades** que adquieren los estudiantes en los cursos de Java Foundations, Java Fundamentals y Java Programming.

Se introduce a los estudiantes en los conceptos básicos de aprendizaje automático (**Machine Learning**) dentro de la IA.

Los alumnos aprenden terminología y conceptos básicos de ML, además de los pasos necesarios para crear desde cero una solución o modelo simple de Machine Learning.

**Idioma:** Inglés

**Tiempo:** 40 horas (recomendado)



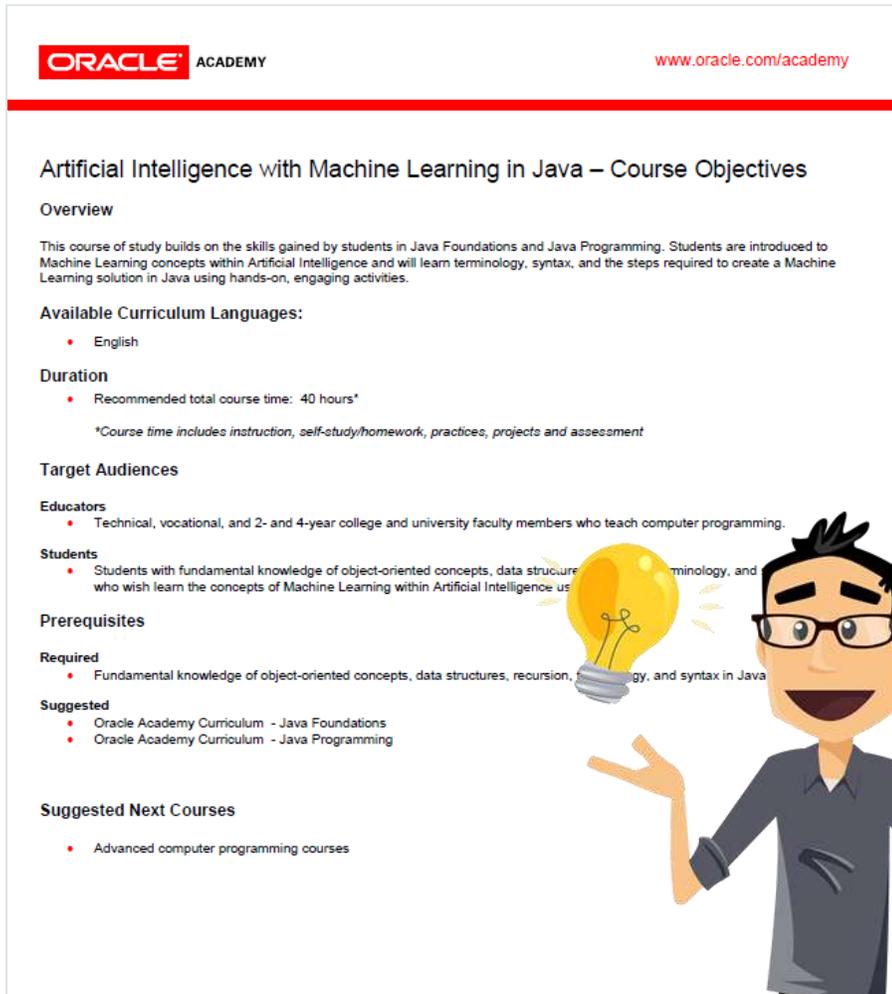
The screenshot shows the Oracle Academy course page for 'Artificial Intelligence with Machine Learning in Java'. The page includes the Oracle Academy logo and website URL at the top. The main heading is 'Artificial Intelligence with Machine Learning in Java – Course Objectives'. Below this, there is an 'Overview' section, followed by 'Available Curriculum Languages' (English), 'Duration' (40 hours), 'Target Audiences' (Educators and Students), 'Prerequisites' (Required and Suggested), and 'Suggested Next Courses'. A cartoon character with glasses and a lightbulb above his head is overlaid on the bottom right of the screenshot.

## Curso AiML

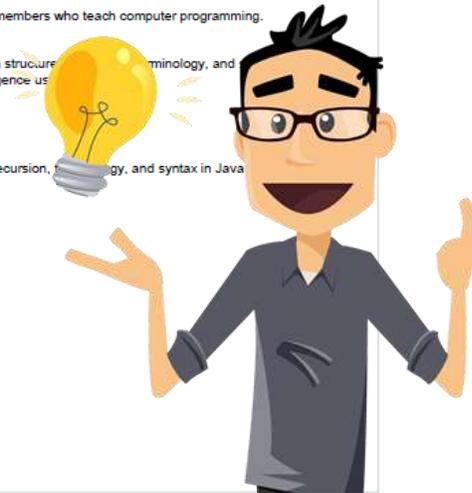
El curso no requiere ningún conocimiento previo de Inteligencia Artificial o Machine Learning.

Se requieren conocimientos previos de programación en Java, y se recomienda estar familiarizado –aunque no es obligatorio- con el uso de **estructuras de datos** y **recursividad**.

El objetivo final del curso es entender e implementar desde cero un modelo sencillo de Machine Learning utilizando un algoritmo de tipo **árbol de decisión**.



The screenshot shows the Oracle Academy website for the course 'Artificial Intelligence with Machine Learning in Java'. The page includes the Oracle Academy logo and the URL www.oracle.com/academy. The course objectives, overview, available curriculum languages (English), duration (40 hours), target audiences (educators and students), prerequisites (fundamental knowledge of object-oriented concepts, data structures, recursion, and syntax in Java), suggested courses (Oracle Academy Curriculum - Java Foundations and Java Programming), and suggested next courses (advanced computer programming courses) are listed.



## Course Syllabus

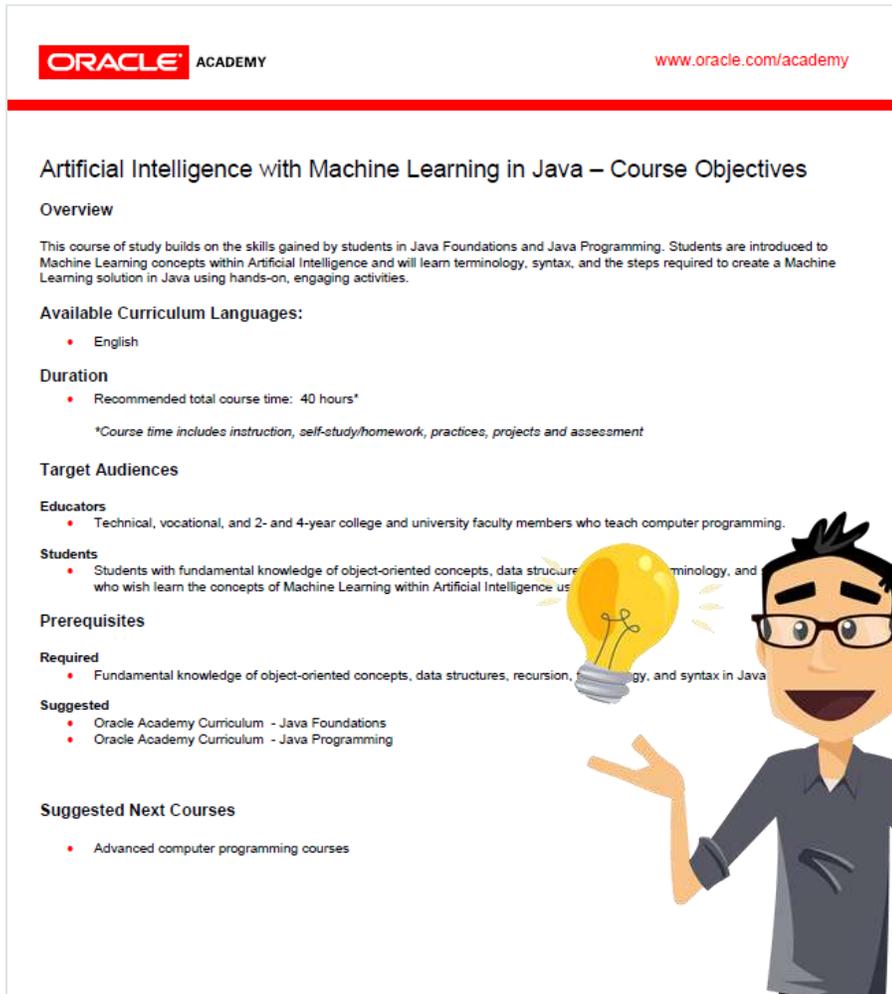
El curso está formado por **4 módulos o secciones** con contenido interactivo de autoaprendizaje y pequeñas prácticas relacionadas para construir un proyecto final.

**Section 1: Introduction**

**Section 2: Machine Learning**

**Section 3: Trees and Recursion**

**Section 4: Entropy and the ID3 Algorithm**



**ORACLE** ACADEMY [www.oracle.com/academy](http://www.oracle.com/academy)

### Artificial Intelligence with Machine Learning in Java – Course Objectives

**Overview**

This course of study builds on the skills gained by students in Java Foundations and Java Programming. Students are introduced to Machine Learning concepts within Artificial Intelligence and will learn terminology, syntax, and the steps required to create a Machine Learning solution in Java using hands-on, engaging activities.

**Available Curriculum Languages:**

- English

**Duration**

- Recommended total course time: 40 hours\*

*\*Course time includes instruction, self-study/homework, practices, projects and assessment*

**Target Audiences**

**Educators**

- Technical, vocational, and 2- and 4-year college and university faculty members who teach computer programming.

**Students**

- Students with fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java who wish learn the concepts of Machine Learning within Artificial Intelligence using Java.

**Prerequisites**

**Required**

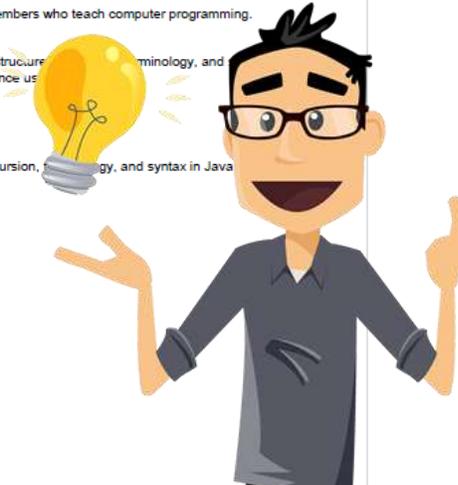
- Fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java.

**Suggested**

- Oracle Academy Curriculum - Java Foundations
- Oracle Academy Curriculum - Java Programming

**Suggested Next Courses**

- Advanced computer programming courses



## Course Syllabus

### Section 1: Introduction

#### 1.1 Course Overview

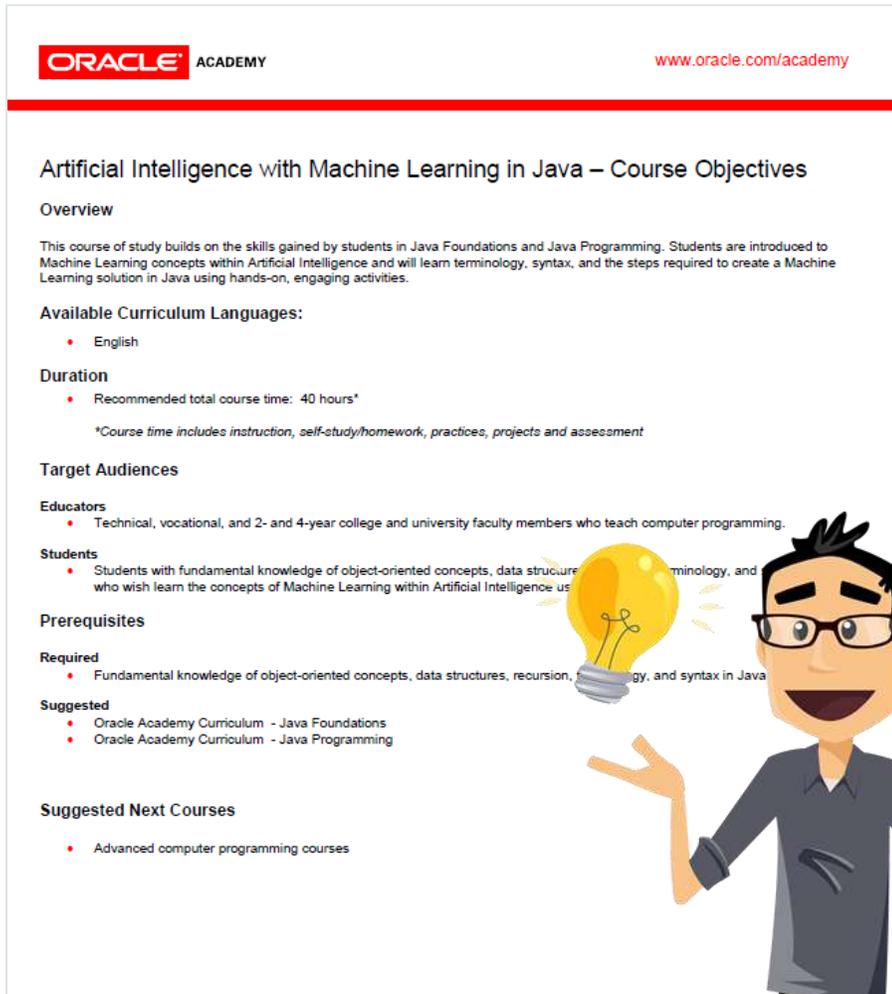
- Understand the nature of the course
- Understand the delivery mechanism

#### 1.2 Introduction to AI

- Define artificial intelligence
- Define machine learning
- Give examples of using artificial intelligence
- Define data exhaust

#### 1.3 Data and Information

- Define data
- Define information
- Differentiate between data and information



**ORACLE** ACADEMY [www.oracle.com/academy](http://www.oracle.com/academy)

### Artificial Intelligence with Machine Learning in Java – Course Objectives

**Overview**

This course of study builds on the skills gained by students in Java Foundations and Java Programming. Students are introduced to Machine Learning concepts within Artificial Intelligence and will learn terminology, syntax, and the steps required to create a Machine Learning solution in Java using hands-on, engaging activities.

**Available Curriculum Languages:**

- English

**Duration**

- Recommended total course time: 40 hours\*

*\*Course time includes instruction, self-study/homework, practices, projects and assessment*

**Target Audiences**

**Educators**

- Technical, vocational, and 2- and 4-year college and university faculty members who teach computer programming.

**Students**

- Students with fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java who wish learn the concepts of Machine Learning within Artificial Intelligence using hands-on, engaging activities.

**Prerequisites**

**Required**

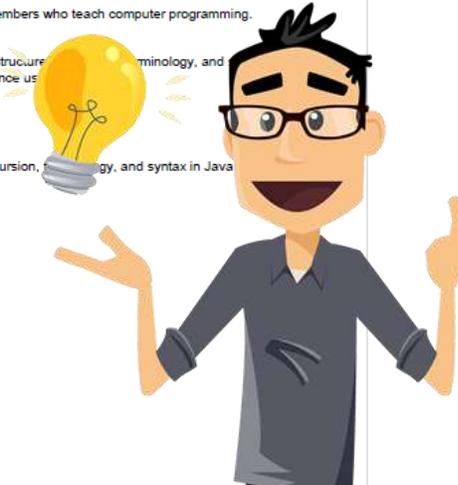
- Fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java

**Suggested**

- Oracle Academy Curriculum - Java Foundations
- Oracle Academy Curriculum - Java Programming

**Suggested Next Courses**

- Advanced computer programming courses

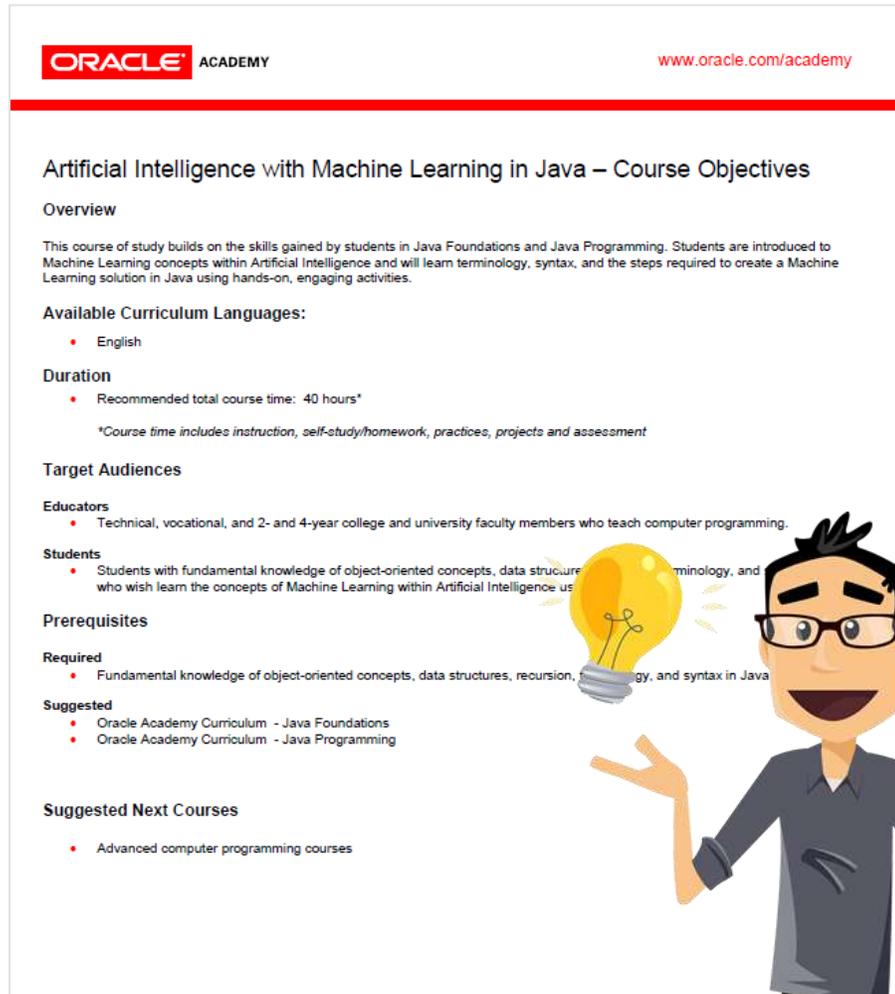


## Course Syllabus

### Section 1: Introduction

#### 1.4 Categorizing Data

- Define supervised learning
- Define unsupervised learning
- Define classification
- Define regression
- Define structured and unstructured data



**ORACLE** ACADEMY [www.oracle.com/academy](http://www.oracle.com/academy)

### Artificial Intelligence with Machine Learning in Java – Course Objectives

**Overview**

This course of study builds on the skills gained by students in Java Foundations and Java Programming. Students are introduced to Machine Learning concepts within Artificial Intelligence and will learn terminology, syntax, and the steps required to create a Machine Learning solution in Java using hands-on, engaging activities.

**Available Curriculum Languages:**

- English

**Duration**

- Recommended total course time: 40 hours\*

*\*Course time includes instruction, self-study/homework, practices, projects and assessment*

**Target Audiences**

**Educators**

- Technical, vocational, and 2- and 4-year college and university faculty members who teach computer programming.

**Students**

- Students with fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java who wish learn the concepts of Machine Learning within Artificial Intelligence using hands-on, engaging activities.

**Prerequisites**

**Required**

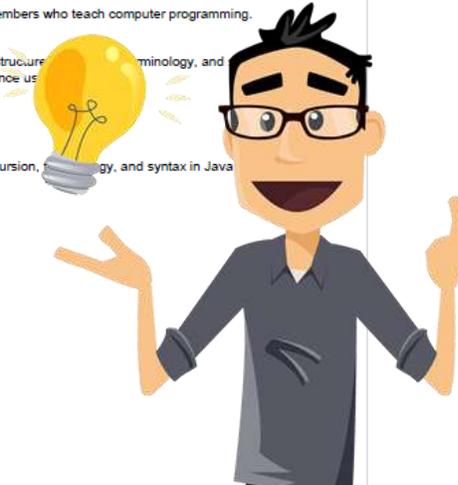
- Fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java

**Suggested**

- Oracle Academy Curriculum - Java Foundations
- Oracle Academy Curriculum - Java Programming

**Suggested Next Courses**

- Advanced computer programming courses



## Course Syllabus

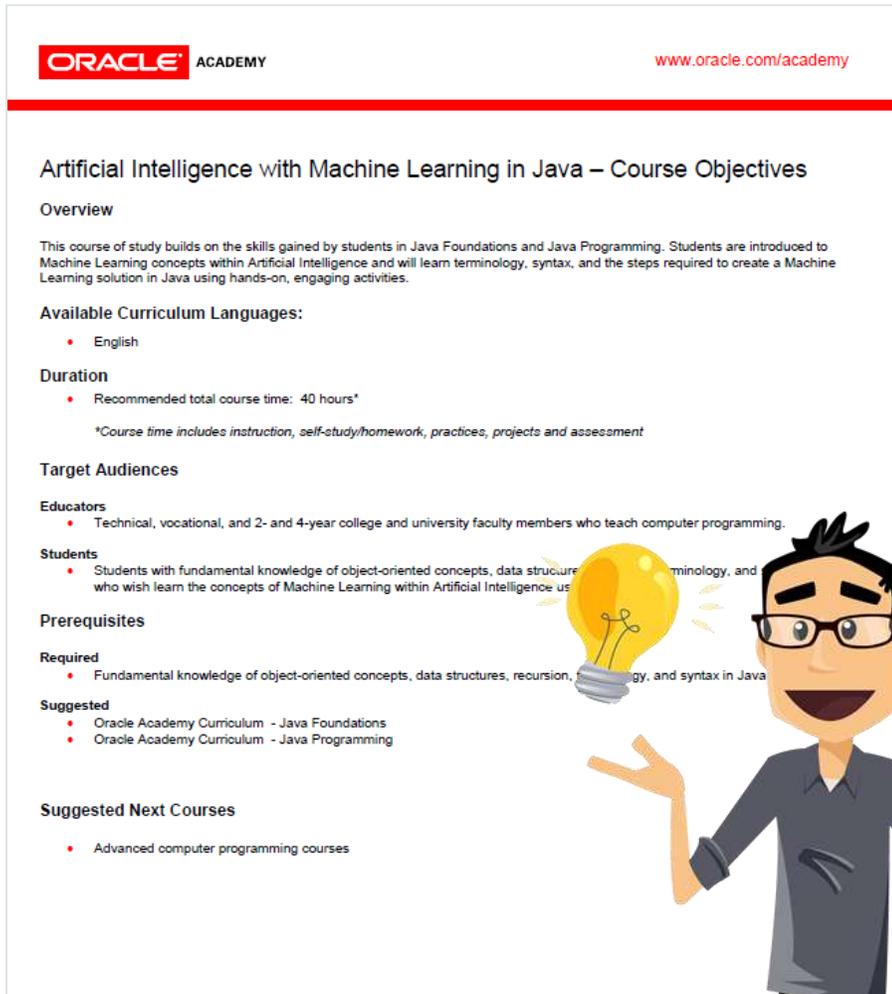
### Section 2: Machine Learning

#### 2.1 Why now?

- State the reasons behind the growth in AI
- Understand the growth in processing power

#### 2.2 Machine Learning Workflow

- Understand the use of models within machine learning
- Understand the CRISP-DM Model



**ORACLE** ACADEMY [www.oracle.com/academy](http://www.oracle.com/academy)

### Artificial Intelligence with Machine Learning in Java – Course Objectives

**Overview**

This course of study builds on the skills gained by students in Java Foundations and Java Programming. Students are introduced to Machine Learning concepts within Artificial Intelligence and will learn terminology, syntax, and the steps required to create a Machine Learning solution in Java using hands-on, engaging activities.

**Available Curriculum Languages:**

- English

**Duration**

- Recommended total course time: 40 hours\*

*\*Course time includes instruction, self-study/homework, practices, projects and assessment*

**Target Audiences**

**Educators**

- Technical, vocational, and 2- and 4-year college and university faculty members who teach computer programming.

**Students**

- Students with fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java who wish learn the concepts of Machine Learning within Artificial Intelligence using hands-on, engaging activities.

**Prerequisites**

**Required**

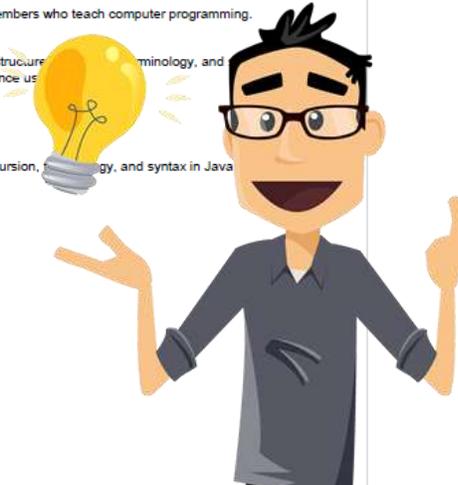
- Fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java

**Suggested**

- Oracle Academy Curriculum - Java Foundations
- Oracle Academy Curriculum - Java Programming

**Suggested Next Courses**

- Advanced computer programming courses



## Course Syllabus

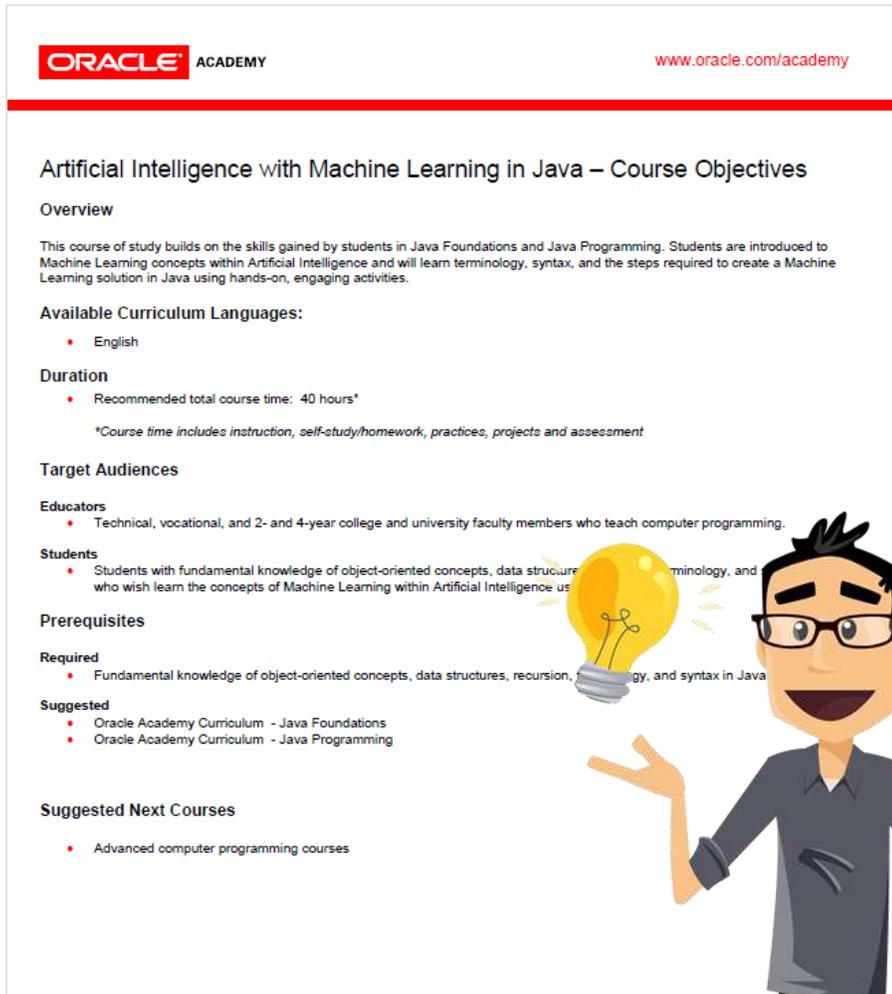
### Section 3: Trees and Recursion

#### 3.1 Binary Trees

- Understand a node
- Understand a binary tree
- Create a Node class

#### 3.2 Recursion

- Define recursion
- Understand recursive methods
- State the advantages and disadvantages of recursion



**ORACLE** ACADEMY [www.oracle.com/academy](http://www.oracle.com/academy)

### Artificial Intelligence with Machine Learning in Java – Course Objectives

**Overview**

This course of study builds on the skills gained by students in Java Foundations and Java Programming. Students are introduced to Machine Learning concepts within Artificial Intelligence and will learn terminology, syntax, and the steps required to create a Machine Learning solution in Java using hands-on, engaging activities.

**Available Curriculum Languages:**

- English

**Duration**

- Recommended total course time: 40 hours\*

*\*Course time includes instruction, self-study/homework, practices, projects and assessment*

**Target Audiences**

**Educators**

- Technical, vocational, and 2- and 4-year college and university faculty members who teach computer programming.

**Students**

- Students with fundamental knowledge of object-oriented concepts, data structures, terminology, and syntax in Java who wish learn the concepts of Machine Learning within Artificial Intelligence using Java.

**Prerequisites**

**Required**

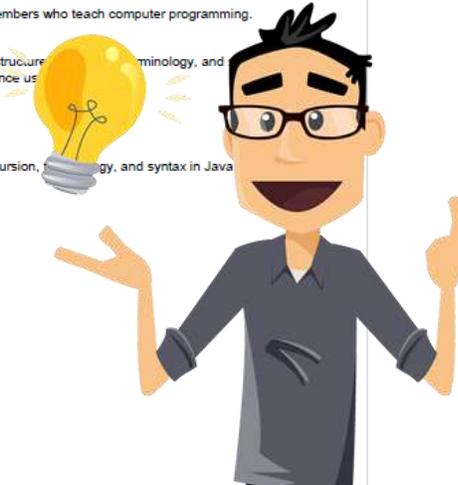
- Fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java

**Suggested**

- Oracle Academy Curriculum - Java Foundations
- Oracle Academy Curriculum - Java Programming

**Suggested Next Courses**

- Advanced computer programming courses



## Course Syllabus

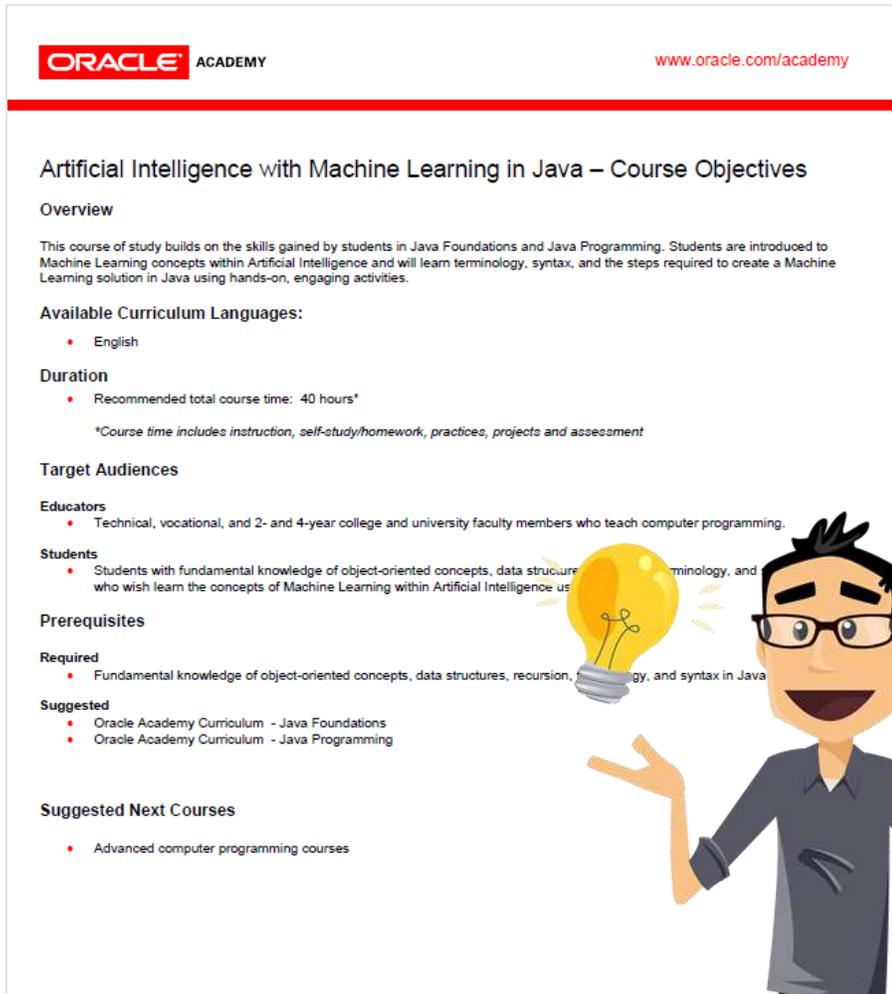
### Section 3: Trees and Recursion

#### 3.3 Tree Traversal

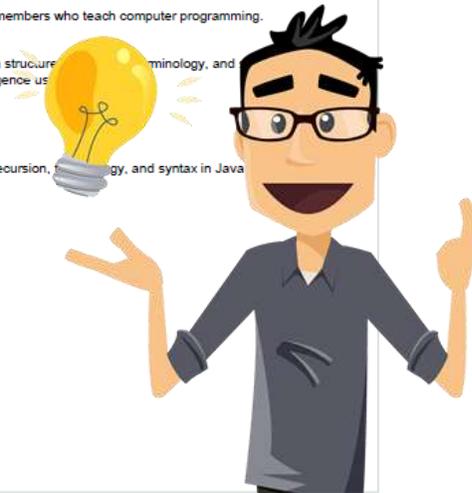
- Describe tree traversal
- Define pre-order traversal
- Define post-order traversal
- Define in-order traversal
- Create methods for Btree

#### 3.4 Yes/No Game

- Describe the use of decision trees
- Create a yes/no game
- State the problems of creating a manual decision tree



The screenshot shows the Oracle Academy course page for 'Artificial Intelligence with Machine Learning in Java'. The page includes the Oracle Academy logo and website URL (www.oracle.com/academy). The course title is 'Artificial Intelligence with Machine Learning in Java – Course Objectives'. The overview states that the course builds on skills from Java Foundations and Java Programming, introducing Machine Learning concepts. Available curriculum languages include English. The duration is 40 hours, including instruction, self-study, homework, practices, projects, and assessment. Target audiences are educators (technical, vocational, and college/university faculty) and students with fundamental knowledge of object-oriented concepts, data structures, recursion, and syntax in Java. Prerequisites include fundamental knowledge of these topics. Suggested prerequisites are Oracle Academy Curriculum - Java Foundations and Oracle Academy Curriculum - Java Programming. Suggested next courses are advanced computer programming courses.



## Course Syllabus

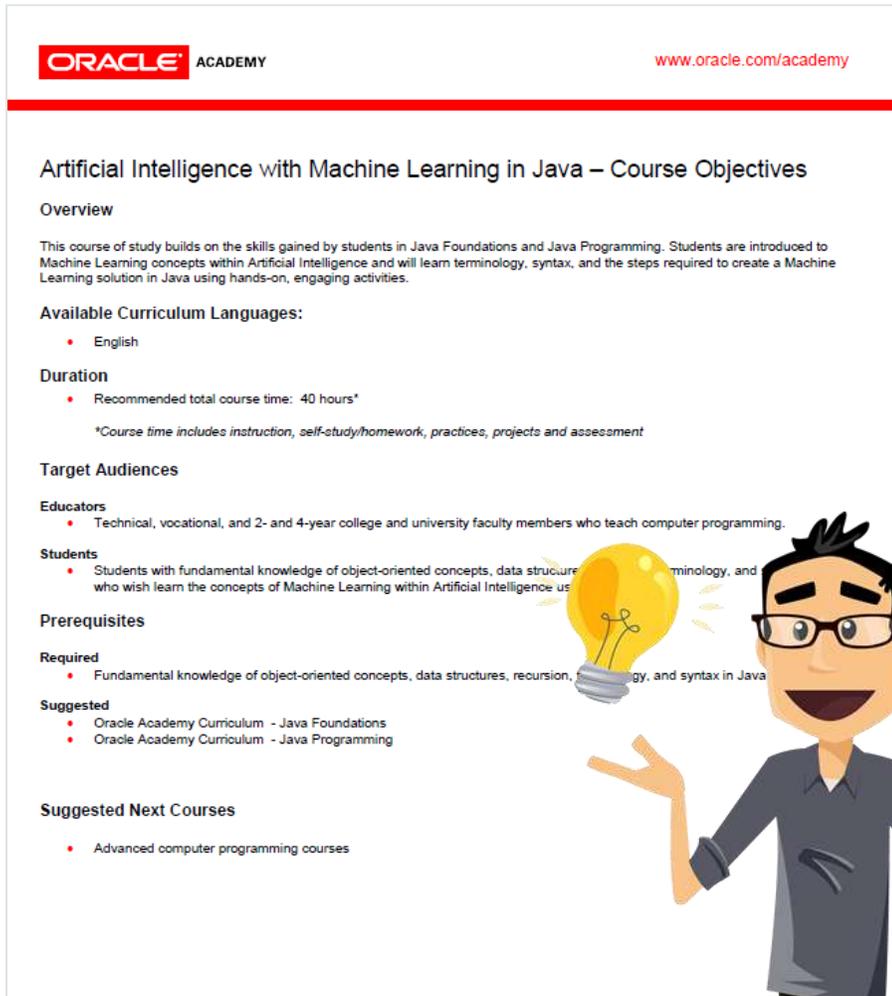
### Section 4: Entropy and the ID3 Algorithm

#### 4.1 Decision Tree Algorithms

- State a number of decision tree algorithms
- Identify the ID3 algorithm

#### 4.2 Information Entropy

- Define information entropy
- Understand variance
- Calculate information entropy
- Understand information entropy



**ORACLE** ACADEMY [www.oracle.com/academy](http://www.oracle.com/academy)

### Artificial Intelligence with Machine Learning in Java – Course Objectives

**Overview**

This course of study builds on the skills gained by students in Java Foundations and Java Programming. Students are introduced to Machine Learning concepts within Artificial Intelligence and will learn terminology, syntax, and the steps required to create a Machine Learning solution in Java using hands-on, engaging activities.

**Available Curriculum Languages:**

- English

**Duration**

- Recommended total course time: 40 hours\*

*\*Course time includes instruction, self-study/homework, practices, projects and assessment*

**Target Audiences**

**Educators**

- Technical, vocational, and 2- and 4-year college and university faculty members who teach computer programming.

**Students**

- Students with fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java who wish learn the concepts of Machine Learning within Artificial Intelligence using hands-on, engaging activities.

**Prerequisites**

**Required**

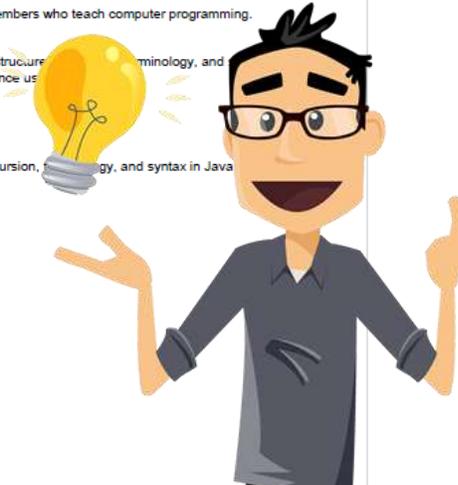
- Fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java

**Suggested**

- Oracle Academy Curriculum - Java Foundations
- Oracle Academy Curriculum - Java Programming

**Suggested Next Courses**

- Advanced computer programming courses



## Course Syllabus

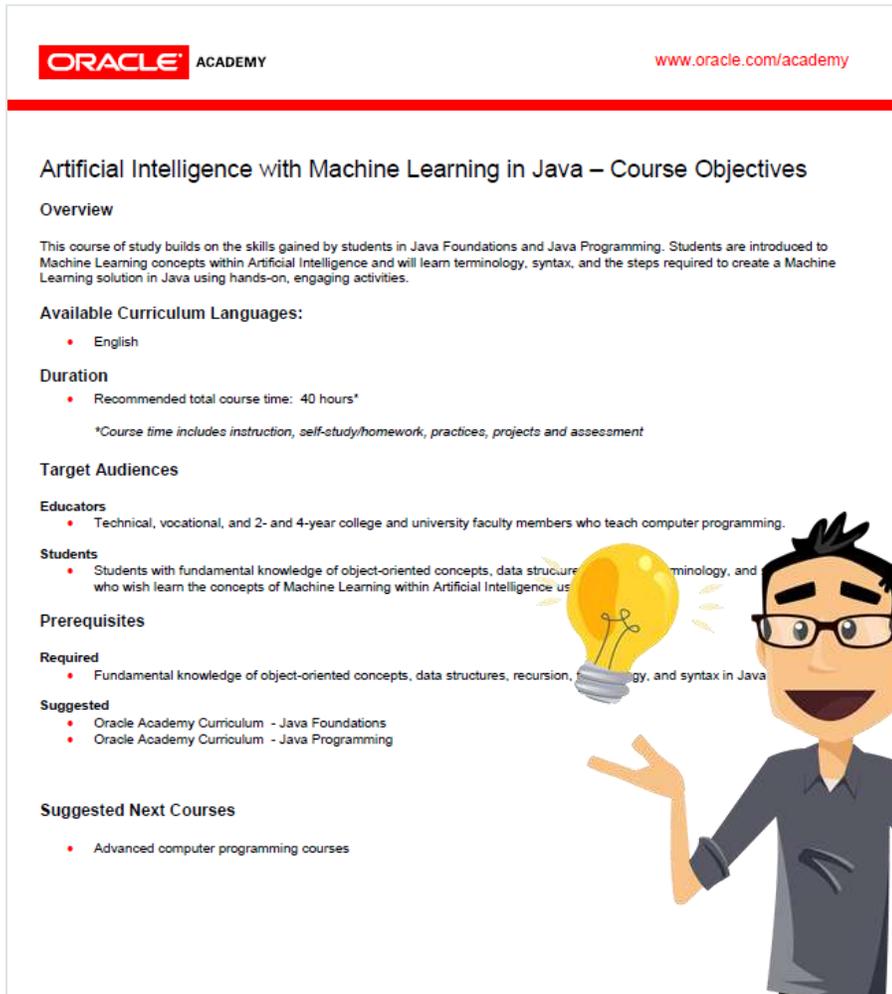
### Section 4: Entropy and the ID3 Algorithm

#### 4.3 ID3 Worked Example

- Calculate entropy
- Calculate gain
- Manually work through the ID3 algorithm

#### 4.4 Create an ID3 Tree

- Understand non binary tree structure
- Create a non-binary tree structure



**ORACLE** ACADEMY [www.oracle.com/academy](http://www.oracle.com/academy)

### Artificial Intelligence with Machine Learning in Java – Course Objectives

**Overview**

This course of study builds on the skills gained by students in Java Foundations and Java Programming. Students are introduced to Machine Learning concepts within Artificial Intelligence and will learn terminology, syntax, and the steps required to create a Machine Learning solution in Java using hands-on, engaging activities.

**Available Curriculum Languages:**

- English

**Duration**

- Recommended total course time: 40 hours\*

*\*Course time includes instruction, self-study/homework, practices, projects and assessment*

**Target Audiences**

**Educators**

- Technical, vocational, and 2- and 4-year college and university faculty members who teach computer programming.

**Students**

- Students with fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java who wish learn the concepts of Machine Learning within Artificial Intelligence using hands-on, engaging activities.

**Prerequisites**

**Required**

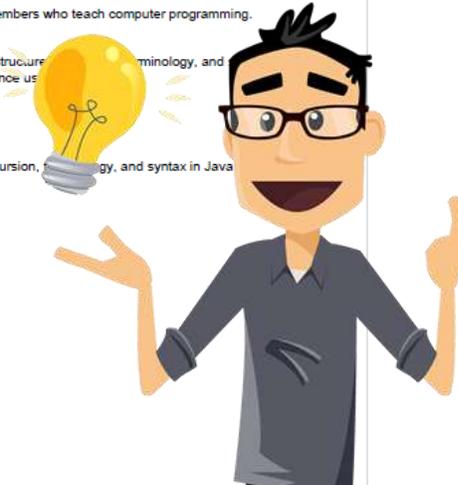
- Fundamental knowledge of object-oriented concepts, data structures, recursion, terminology, and syntax in Java

**Suggested**

- Oracle Academy Curriculum - Java Foundations
- Oracle Academy Curriculum - Java Programming

**Suggested Next Courses**

- Advanced computer programming courses



# AiML: Artificial Intelligence with ML

#PUEAcademyDay19

**ORACLE** Academy

## AWARD *of* COURSE COMPLETION

Artificial Intelligence with Machine Learning in Java

PRESENTED TO

«Name»

FOR SATISFACTORY COMPLETION OF ALL  
COURSEWORK AND TRAINING

«Date»

\_\_\_\_\_  
Oracle Academy Instructor

**ORACLE** Academy

## AWARD *of* ACHIEVEMENT

PRESENTED TO

«Name»

FOR SUCCESSFULLY COMPLETING THE ORACLE ACADEMY

Artificial Intelligence with Machine Learning in Java

FINAL EXAM

«Date»

\_\_\_\_\_  
Oracle Academy Instructor

**Certificados de finalización para estudiantes**

Tenemos el agrado de ofrecerle certificados de Oracle Academy que puede entregarles a los alumnos que completen los cursos y exámenes finales de Oracle Academy. Los certificados de finalización de curso están pensados para entregárselos a los alumnos que aprueben exitosamente el curso correspondiente. Los certificados de examen final se deben entregar a los alumnos que aprueben exitosamente el examen final. Los alumnos que aprueben ambos pueden recibir los dos certificados.

Para crear los certificados:

- Descargue el archivo zip correspondiente aquí abajo.
- Lea las instrucciones de otorgamiento.
- Imprima los certificados en el papel de su elección.

Curso	Certificado de finalización de curso	Certificado de examen final
Oracle Application Express - Application Development	Descargar	Descargar
Database Design and Programming with PL/SQL	Descargar	Descargar
Database Design and Programming with SQL	Descargar	Descargar
Database Foundations	Descargar	Descargar
Java Foundations	Descargar	Descargar
Java Fundamentals	Descargar	Descargar
Java Programming	Descargar	Descargar
Artificial Intelligence with Machine Learning in Java	Descargar	Descargar

# AiML: Artificial Intelligence with ML

# AiML: Artificial Intelligence with ML

	Session1	Session2	Session3	Session4	Session5
Week 1	Introduction				
Week 2	Machine Learning				
Week 3	Trees and Recursion				
Week 4					
Week 5	Yes/No Game				
Week 6	Entropy and the ID3 Algorithm				
Week 7					
Week 8	Create an ID3 Tree				
Week 9	Final Exam Review			Final Exam	

# Demo: Plataforma Oracle iLearning

## Inteligencia Artificial con Machine Learning en Java





To do	Doing	Done

# Agenda

- 1.- Introducción
- 2.- Programa Oracle Academy
- 3.- Oracle Academy: Plan de estudios
- 4.- AiML: Artificial Intelligence with ML
- 5.- Demo: Plataforma Oracle iLearning**
- 6.- Hands-On Labs

## Conexión

Usuario:

Contraseña:

Recordar Contraseña

[¿Contraseña Olvidada?](#)

## Bienvenido a Oracle iLearning



Oracle iLearning es un sistema de gestión de formación (LMS) de empresas y un componente principal de Oracle E-Business Suite. Oracle iLearning proporciona una infraestructura completa para que las organizaciones gestionen, proporcionen y realicen un seguimiento de la formación en entornos basados en clases y en línea. Utilice Oracle iLearning para:

- Consolidar las iniciativas de formación en un sistema de gestión de formación escalable y asequible
- Diseñar y entregar contenido de formación con rapidez
- Proporcionar la mezcla óptima de formación en clase y en línea
- Medir la eficacia de las iniciativas de formación
- Realizar una integración con una solución global de E-Business

## Anuncios

- ❏ **\*\*NEW\*\***  
**APEX UPDATE**  
command known issue  
resolution
- ❏ **January 7, 2019: New**  
**Language Release -**  
**Java Fundamentals -**  
**Indonesian**
- ❏ **\*\*NEW\*\***  
**Be sure to check**  
**"Include Completed**  
**Offerings" and Select**  
**"All" Items Per Page on**  
**this Oracle iLearning**  
**Home page**
- ❏ **\*\*NEW\*\***  
**Member Resource**  
**Center including Oracle**  
**Academy Education**  
**Bytes now available!**
- ❏ **2018 - 2019 Curriculum**  
**Release Information**

<http://ilearning.oracle.com/ilearn/en/learner/jsp/login.jsp?site=OracleAcad>

## Buscar Catálogo



Frase Exacta  
[Búsqueda Avanzada...](#)

[Examinar Catálogo](#)



## Mi Formación

Reanudar Última

Jordi Anífo Santos



Ya está inscrito en las ofertas que aparecen a continuación. La oferta puede ser una oferta autónoma o formar parte de una ruta de formación o de una formación integrada.

Filtro   Incluir Ofertas Terminadas

Elementos por Página: [5](#) | [10](#) | [20](#) | [Todo](#)

[Anterior](#)
[1 - 13 de 13](#)
[Siguiente](#)

Oferta	Fecha de Inicio	Estado	Reproducir
<a href="#">Java Fundamentals 2018 - Alumno - Español (Java Fundamentals 2018 - Student - Spanish)</a>	04-ago-2018	1 de 29 Terminado	
<a href="#">Java Foundations 2018 - Student - English</a>	04-ago-2018	4 de 36 Terminado	
<a href="#">Java Foundations 2018 - Teacher - English</a>	04-ago-2018	No Intentado	
<a href="#">Java Foundations 2018 - Alumno - Español (Java Foundations 2018 - Student - Spanish)</a>	04-ago-2018	1 de 36 Terminado	
<a href="#">Member Resource Center</a>	06-dic-2018	No Intentado	
<a href="#">How to Assign Yourself Curriculum</a>	14-mar-2019	No Intentado	
<a href="#">Java Fundamentals 2018 - Student - English</a>	02-abr-2019	1 de 29 Terminado	
<a href="#">Java Programming 2018 - Student - English</a>	02-abr-2019	1 de 35 Terminado	
<a href="#">Artificial Intelligence with Machine Learning in Java 2018 - Student - English</a>	02-abr-2019	1 de 14 Terminado	
<a href="#">Artificial Intelligence with Machine Learning in Java 2018 - Teacher - English</a>	02-abr-2019	6 de 14 Terminado	
<a href="#">Java Foundations 2018 - Profesor - Español (Java Foundations 2018 - Teacher - Spanish)</a>	02-abr-2019	No Intentado	
<a href="#">Java Fundamentals 2018 - Teacher - English</a>	02-abr-2019	No Intentado	
<a href="#">Java Programming 2018 - Teacher - English</a>	02-abr-2019	No Intentado	

## Anuncios

- \*\*NEW\*\***  
**APEX UPDATE**  
**command known issue resolution**
- January 7, 2019: New Language Release - Java Fundamentals - Indonesian**
- \*\*NEW\*\***  
**Be sure to check "Include Completed Offerings" and Select "All" Items Per Page on this Oracle iLearning Home page**
- \*\*NEW\*\***  
**Member Resource Center including Oracle Academy Education Bytes now available!**
- 2018 - 2019 Curriculum Release Information**

[Inicio](#) > [Detalles sobre la Oferta](#)

## **Aviso** : Estado de la Inscripción

Inscripción obligatoria.

## **eStudy** Artificial Intelligence with Machine Learning in Java 2018 - Teacher - English

Reproducir

Anular Inscripción

Atrás

**Idioma:** English | **Estado de la Inscripción:** Reservado | **Versión:** 1.0

### Anuncios de Ofertas

 **Semester Exam Option**



Recomendar Este Curso

### Estructura del Curso

- [-]  [Artificial Intelligence with Machine Learning in Java 2018 - Teacher - English](#) [Estado: No Terminado | Hora: 00:34:12]
- [-]  [Artificial Intelligence with Machine Learning in Java 2018 English Teacher Curriculum](#) [Estado: Terminado | Hora: 00:31:41]
  - [-]  [Section 0 - Course Resources - Teacher](#) [Estado: Terminado | Hora: 00:15:47]
  - [-]  [Section 1 - Introduction - Teacher](#) [Estado: Terminado | Hora: 00:04:14]
  - [-]  [Section 2 - Machine Learning - Teacher](#) [Estado: Terminado | Hora: 00:01:45]
  - [-]  [Section 3 - Trees and Recursion - Teacher](#) [Estado: Terminado | Hora: 00:01:03]
  -  **Section 4 - Entropy and the ID3 Algorithm - Teacher** [Estado: Terminado | Hora: 00:08:52]
  - [-]  [Artificial Intelligence with Machine Learning in Java 2018 English Quizzes and Exams](#) [Estado: No Terminado | Hora: 00:02:31]
    - [-]  [Sections 1 & 2 Quiz](#) [Estado: No Terminado | Hora: 00:00:54]
    - [-]  [Sections 3 & 4 Quiz](#) [Estado: No Terminado | Hora: 00:00:44]
    - [-]  [AiML Final Exam](#) [Estado: No Terminado | Hora: 00:00:53]

### Estudiantes Inscritos

Se han inscrito en esta oferta más de 100 estudiantes, por lo que no se muestran los nombres de cada uno de ellos

Reproducir

Anular Inscripción

Atrás

Estructura del Curso

- Artificial Intelligence with Machine Learning in Java
- Artificial Intelligence with Machine Learning in Java
  - Section 0 - Course Resources - Teacher**
  - Section 1 - Introduction - Teacher
  - Section 2 - Machine Learning - Teacher
  - Section 3 - Trees and Recursion - Teacher
  - Section 4 - Entropy and the ID3 Algorithm - Teacher
- Artificial Intelligence with Machine Learning in Java
  - Sections 1 & 2 Quiz
  - Sections 3 & 4 Quiz
  - AIML Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 0 - Course Resources



Home



Course Information



Course Download Center

Estructura del Curso

- Artificial Intelligence with Machine Learning in
- Artificial Intelligence with Machine Learning
  - Section 0 - Course Resources - Teacher**
  - Section 1 - Introduction - Teacher
  - Section 2 - Machine Learning - Teacher
  - Section 3 - Trees and Recursion - Teacher
  - Section 4 - Entropy and the ID3 Algorithm
- Artificial Intelligence with Machine Learning
  - Sections 1 & 2 Quiz
  - Sections 3 & 4 Quiz
  - AIML Final Exam

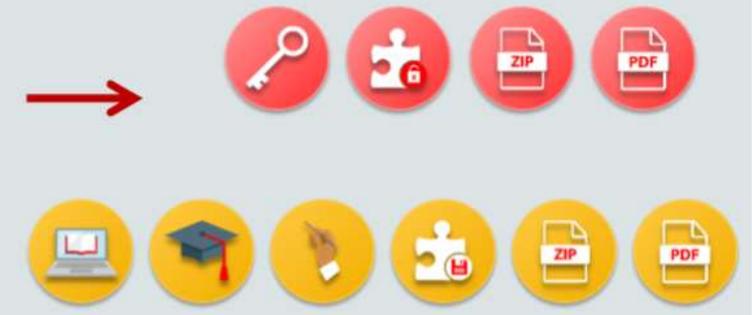
# Artificial Intelligence with Machine Learning in Java

## Section 0 - Course Resources

Course Icons used in all Sections for Online Resources.

Teacher only icons are displayed with red background  
Student icons (available for teachers also) are displayed in yellow

Click an icon to see more information.



Home



Course Information



Course Download Center



Estructura del Curso

- Artificial Intelligence with Machine Learning in
- Artificial Intelligence with Machine Learning
  - Section 0 - Course Resources - Teacher**
  - Section 1 - Introduction - Teacher
  - Section 2 - Machine Learning - Teacher
  - Section 3 - Trees and Recursion - Teacher
  - Section 4 - Entropy and the ID3 Algorithm
- Artificial Intelligence with Machine Learning
  - Sections 1 & 2 Quiz
  - Sections 3 & 4 Quiz
  - AiML Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 0 - Course Resources

### Course Download Center



Course Resources



Oracle iLearning Resources



Course Documents (Offline)



Interactive Lessons (Offline)

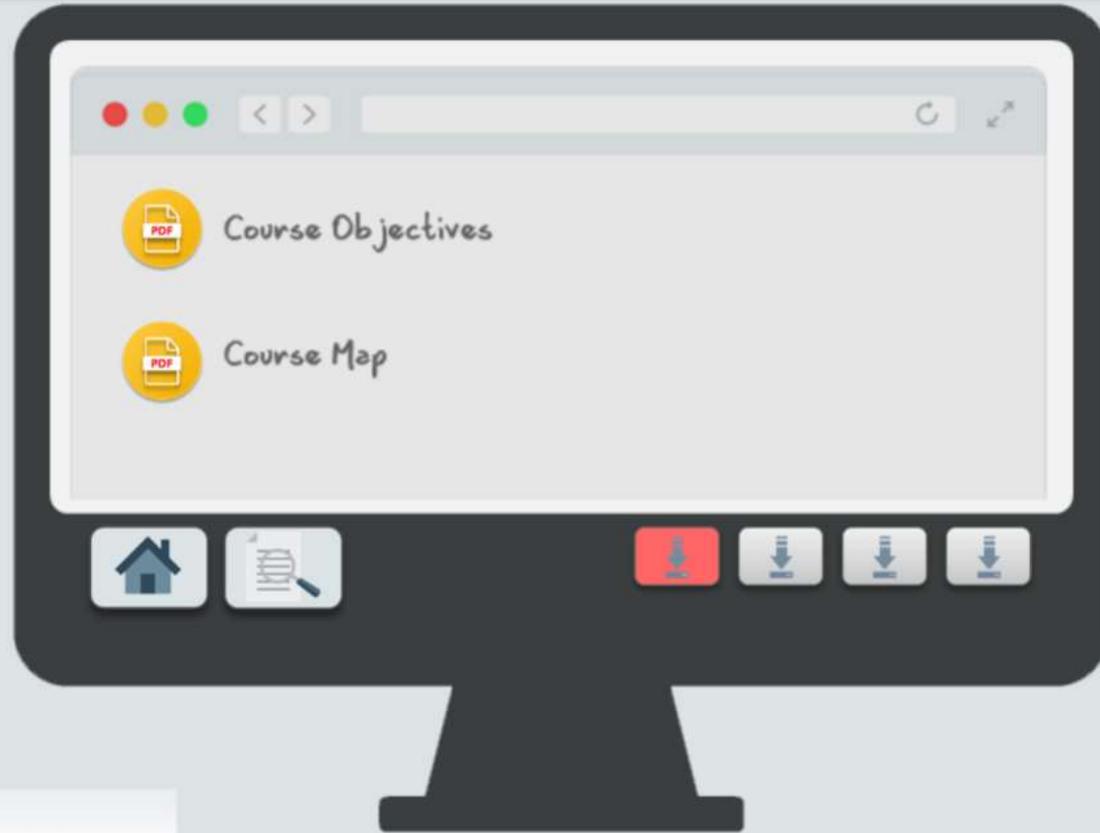


Estructura del Curso

- Artificial Intelligence with Machine Learning in
- Artificial Intelligence with Machine Learning
  - Section 0 - Course Resources - Teacher**
  - Section 1 - Introduction - Teacher
  - Section 2 - Machine Learning - Teacher
  - Section 3 - Trees and Recursion - Teacher
  - Section 4 - Entropy and the ID3 Algorithm
- Artificial Intelligence with Machine Learning
  - Sections 1 & 2 Quiz
  - Sections 3 & 4 Quiz
  - AIML Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 0 - Course Resources

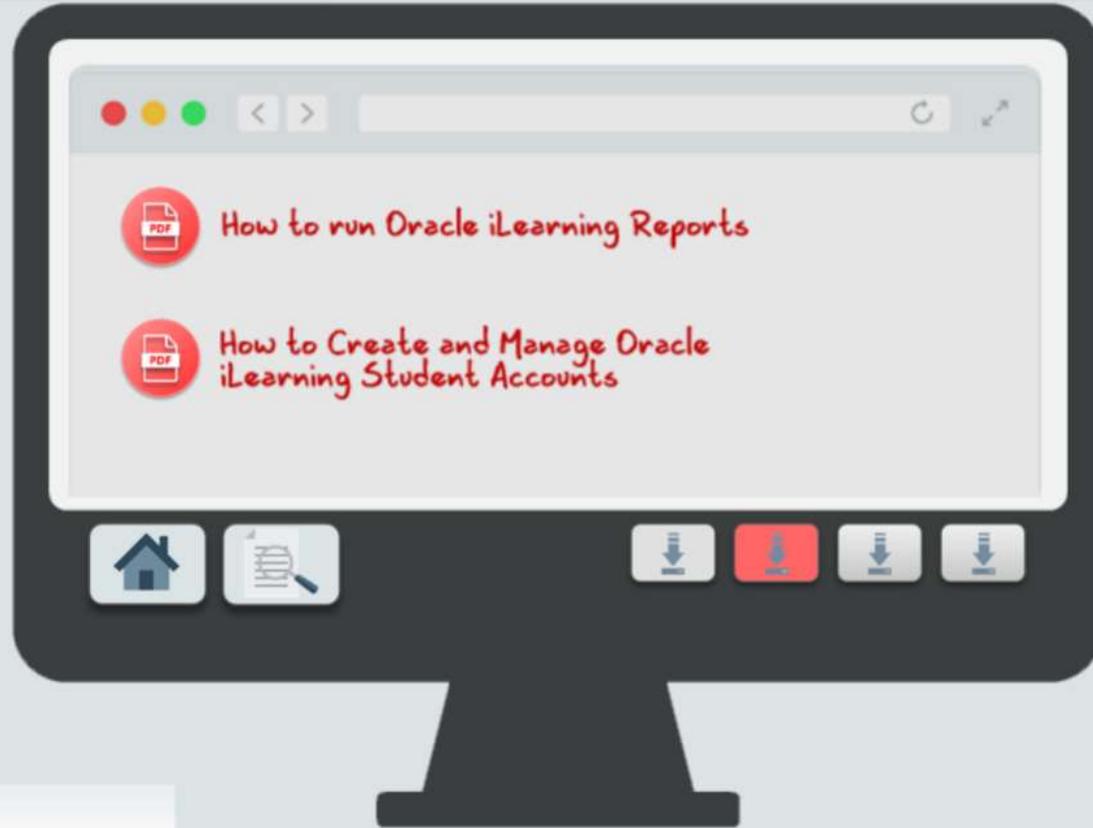


Estructura del Curso

- Artificial Intelligence with Machine Learning in
- Artificial Intelligence with Machine Learning
  - Section 0 - Course Resources - Teacher**
  - Section 1 - Introduction - Teacher
  - Section 2 - Machine Learning - Teacher
  - Section 3 - Trees and Recursion - Teacher
  - Section 4 - Entropy and the ID3 Algorithm
- Artificial Intelligence with Machine Learning
  - Sections 1 & 2 Quiz
  - Sections 3 & 4 Quiz
  - AIWL Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 0 - Course Resources

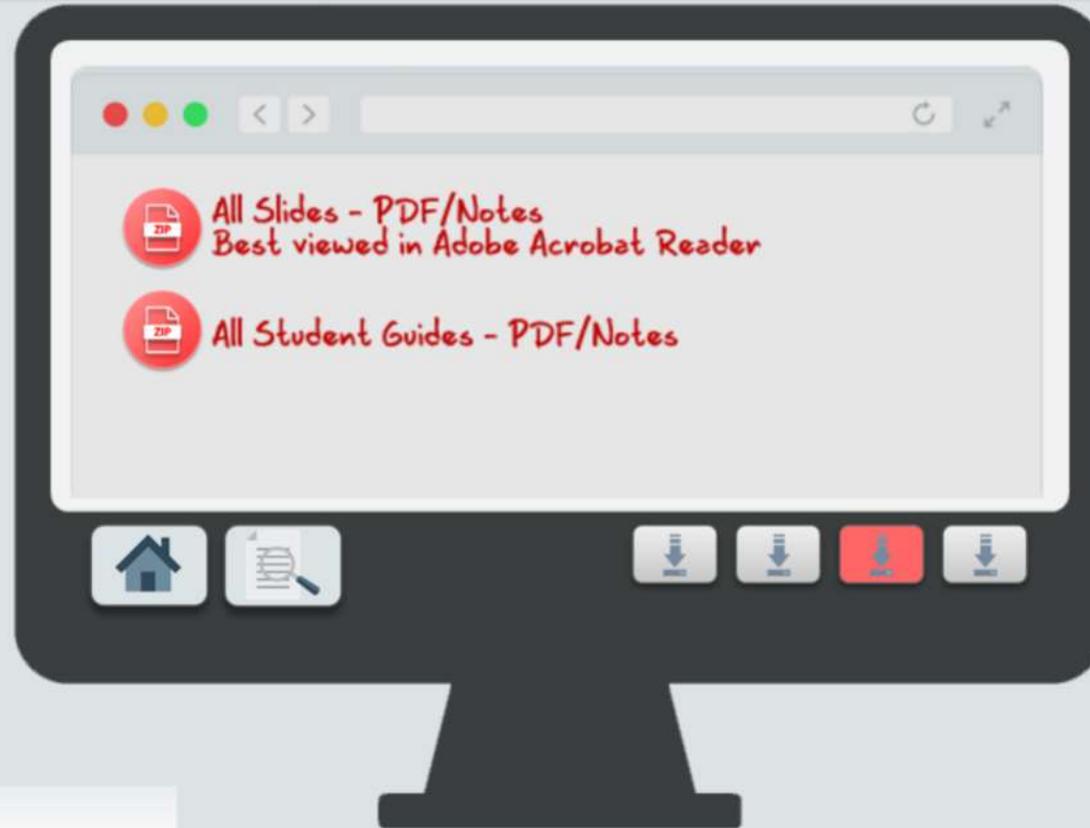


Estructura del Curso

- Artificial Intelligence with Machine Learning in Java
- Artificial Intelligence with Machine Learning in Java
  - Section 0 - Course Resources - Teacher
  - Section 1 - Introduction - Teacher
  - Section 2 - Machine Learning - Teacher
  - Section 3 - Trees and Recursion - Teacher
  - Section 4 - Entropy and the ID3 Algorithm
- Artificial Intelligence with Machine Learning in Java
  - Sections 1 & 2 Quiz
  - Sections 3 & 4 Quiz
  - AIML Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 0 - Course Resources

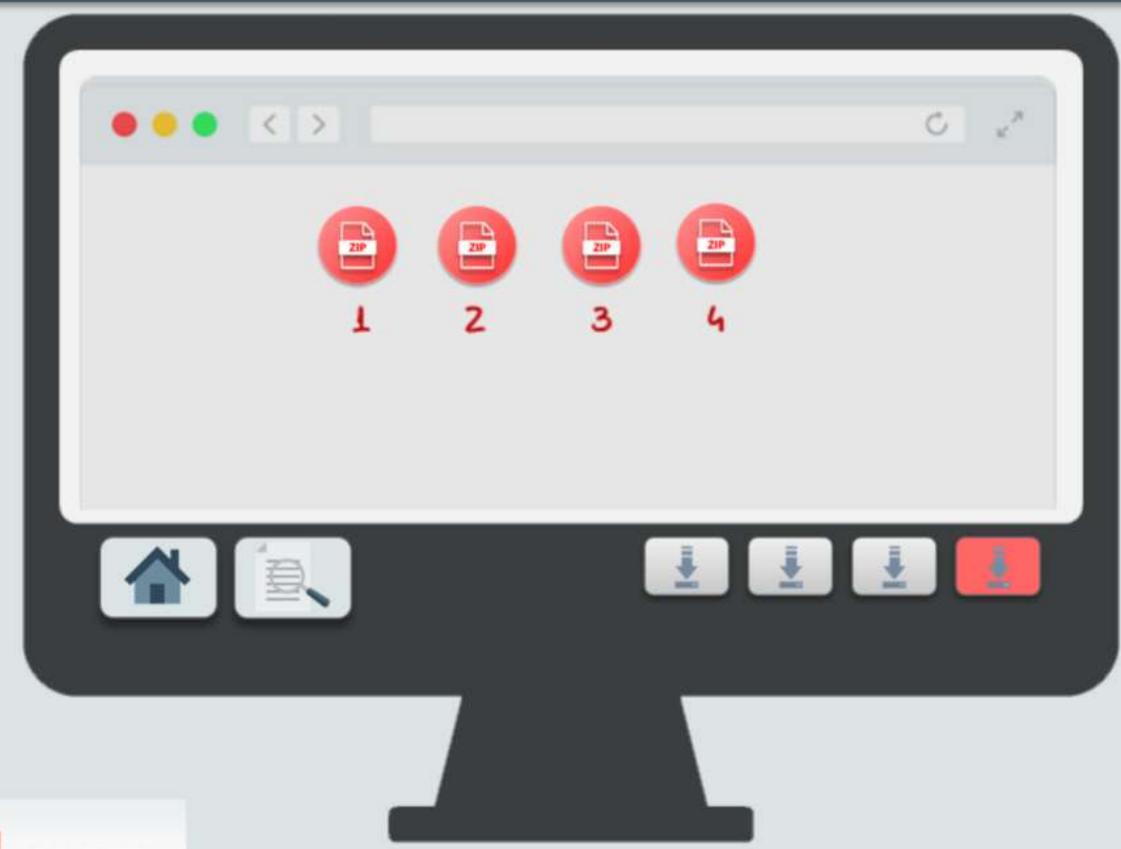


Estructura del Curso

- Artificial Intelligence with Machine Learning in
- Artificial Intelligence with Machine Learning
- Section 0 - Course Resources - Teacher**
- Section 1 - Introduction - Teacher
- Section 2 - Machine Learning - Teacher
- Section 3 - Trees and Recursion - Teacher
- Section 4 - Entropy and the ID3 Algorithm
- Artificial Intelligence with Machine Learning
- Sections 1 & 2 Quiz
- Sections 3 & 4 Quiz
- AiML Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 0 - Course Resources



*Interactive Lessons  
for Offline Viewing*

- 1. Choose a Section*
- 2. Download Zip*
- 3. Unzip*
- 4. View in Adobe Acrobat Reader*



Estructura del Curso

- Artificial Intelligence with Machin
- Artificial Intelligence with Mac
- Section 0 - Course Resource
- Section 1 - Introduction - Tr
- Section 2 - Machine Learnir
- Section 3 - Trees and Recu**
- Section 4 - Entropy and the
- Artificial Intelligence with Mac
- Sections 1 & 2 Quiz
- Sections 3 & 4 Quiz
- AIML Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 3 - Trees and Recursion



To get started, select a lesson or an icon

- 1
- 2
- 3
- 4



Estructura del Curso

- Artificial Intelligence with Machine Learning
- Artificial Intelligence with Machine Learning
  - Section 0 - Course Resources
  - Section 1 - Introduction to Machine Learning
  - Section 2 - Machine Learning
  - Section 3 - Trees and Recursion**
  - Section 4 - Entropy and the Decision Tree
- Artificial Intelligence with Machine Learning
  - Sections 1 & 2 Quiz
  - Sections 3 & 4 Quiz
  - AIML Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 3 - Trees and Recursion

Section Information - Click an icon to see information about this section's practices, projects, and quizzes.



Section Practices



Section Projects



Section Quizzes and Exams



Estructura del Curso

- Artificial Intelligence with Machin
- Artificial Intelligence with Mac
- Section 0 - Course Resource
- Section 1 - Introduction - Tr
- Section 2 - Machine Learnir
- Section 3 - Trees and Recu**
- Section 4 - Entropy and the
- Artificial Intelligence with Mac
- Sections 1 & 2 Quiz
- Sections 3 & 4 Quiz
- AIML Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 3 - Trees and Recursion

### Section Information



Section Practices



Section Projects



Section Quizzes and Exams

**Practice Activities are included in Lesson Slides**

- Lesson 1: Trace Binary Trees  
Create a Node class in Java for Binary Trees
- Lesson 2: Create Recursive Methods for Factorials and Fibonacci Numbers
- Lesson 3: Create Code for Recursive Tree Traversal  
Create Code to Print Output for Tree Traversal
- Lesson 4: Create a Yes/No Game  
Create a Manual Decision Tree





Estructura del Curso

- Artificial Intelligence with Machin
- Artificial Intelligence with Mac
- Section 0 - Course Resource
- Section 1 - Introduction - Tr
- Section 2 - Machine Learnin
- Section 3 - Trees and Recu**
- Section 4 - Entropy and the
- Artificial Intelligence with Mac
- Sections 1 & 2 Quiz
- Sections 3 & 4 Quiz
- AIML Final Exam

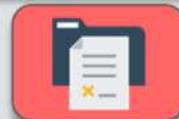
# Artificial Intelligence with Machine Learning in Java

## Section 3 - Trees and Recursion

### Lesson Topics:

#### Section 3 - Trees and Recursion

- Lesson 1 - Binary Trees
- Lesson 2 - Recursion
- Lesson 3 - Tree Traversal
- Lesson 4 - Yes/No Game





Estructura del Curso

- Artificial Intelligence with Machin
- Artificial Intelligence with Mac
- Section 0 - Course Resource
- Section 1 - Introduction - Tr
- Section 2 - Machine Learnir
- Section 3 - Trees and Rect**
- Section 4 - Entropy and the
- Artificial Intelligence with Mac
- Sections 1 & 2 Quiz
- Sections 3 & 4 Quiz
- AIML Final Exam

# Artificial Intelligence with Machine Learning in Java

## Section 3 - Trees and Recursion

### Teacher Resources



### Student Resources



### 3-4 Yes/No Game

- 1
- 2
- 3
- 4





Slide Title

- Oracle Academy
- Artificial Intelligence with Ma...
- Objectives
- Decision Tree Algorithms
- Binary Trees
- Binary Trees Structure
- Task - Binary Tree Creation
- Solution - Node Class

# Artificial Intelligence with Machine Learning

## 3-1 Binary Trees





## Slide Title

- Oracle Academy
- Artificial Intelligence with Ma...
- Objectives
- Decision Tree Algorithms
- Binary Trees
- Binary Trees Structure
- Task - Binary Tree Creation
- Solution - Node Class

# Objectives

This lesson covers the following objectives:

- Understand a node
- Understand a binary tree
- Create a Node class



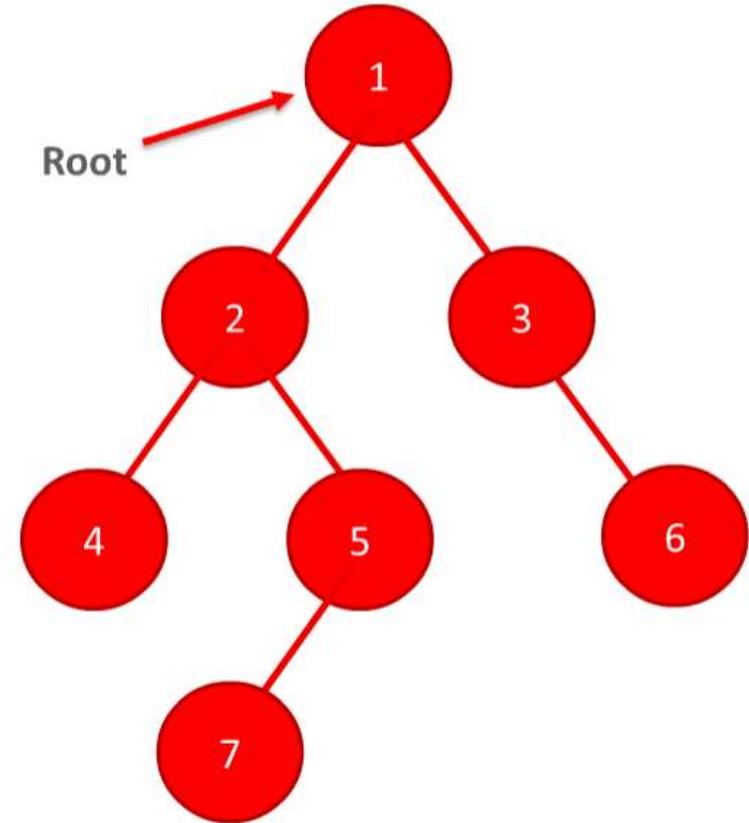


## Slide Title

- Oracle Academy
- Artificial Intelligence with Ma...
- Objectives
- Decision Tree Algorithms
- Binary Trees
- Binary Trees Structure
- Task - Binary Tree Creation
- Solution - Node Class

# Binary Trees

- The first node is called the root node, and is the building block of all other nodes.
- Apart from the root node every other node must be directly connected to a parent node.



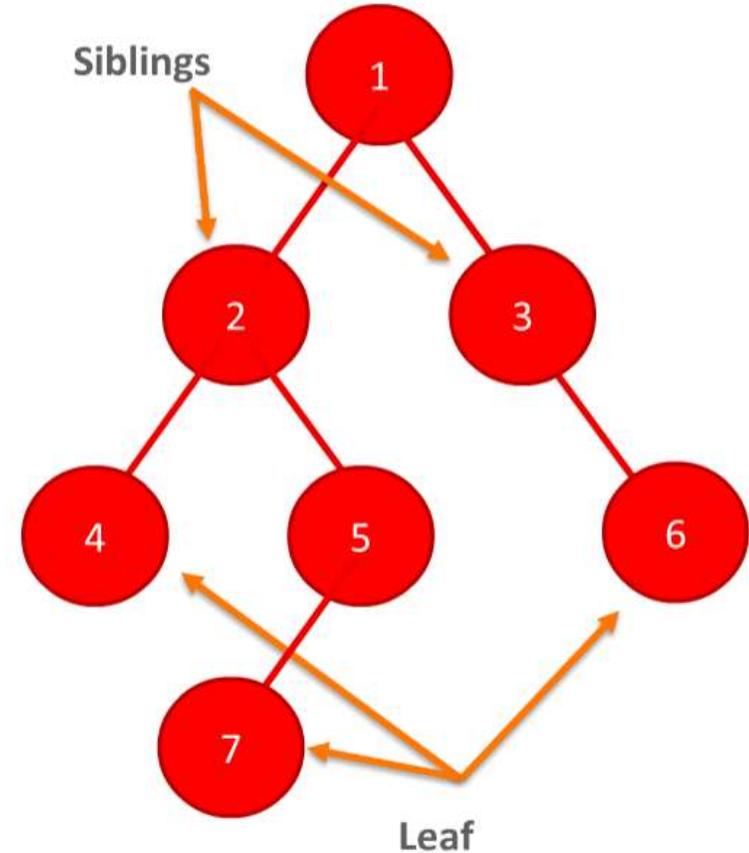


## Slide Title

- Oracle Academy
- Artificial Intelligence with Ma...
- Objectives
- Decision Tree Algorithms
- Binary Trees
- Binary Trees Structure
- Task - Binary Tree Creation
- Solution - Node Class

# Binary Trees

- Each node can have 0, 1 or 2 child nodes.
- If a node has no children, it is called a leaf.
- Two nodes that have the same parent are called siblings.





## Slide Title

- Oracle Academy
- Artificial Intelligence with Ma...
- Objectives
- Decision Tree Algorithms
- Binary Trees
- Binary Trees Structure
- Task - Binary Tree Creation
- Solution - Node Class

## Solution – Node Class

```
public class Node {  
    int data;  
    Node left;  
    Node right;  
  
    public Node(int data) {  
        this.data = data;  
        left = null;  
        right = null;  
    }  
}
```



## Slide Title

- Binary Trees
- Binary Trees Structure
- Task - Binary Tree Creation
- Solution - Node Class
- Tree Methods
- Task - Define Methods
- Solution - Methods
- Solution - Methods
- Summary
- Oracle Academy

# Summary

In this lesson, you should have learned how to:

- Understand a node
- Understand a binary tree
- Create a Node class



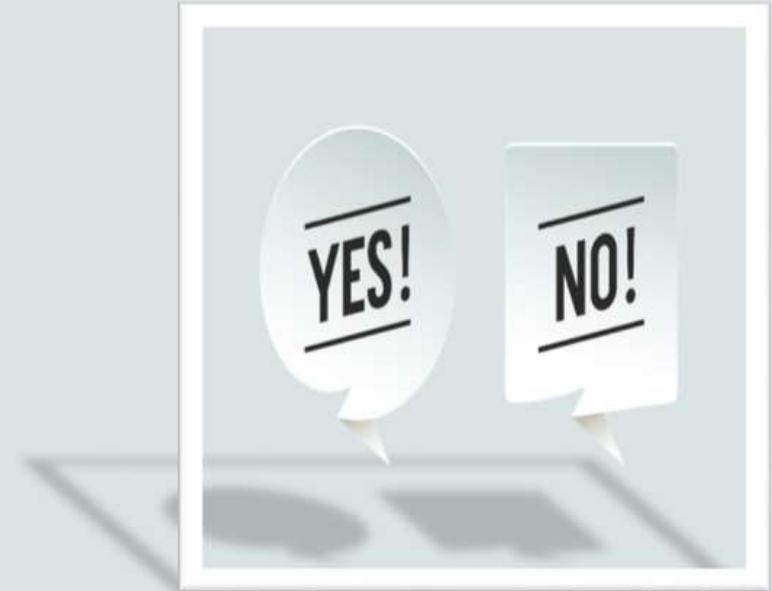


Slide Title

- Oracle Academy
- Artificial Intelligence with Ma...
- Objectives
- Decision Trees Revisited
- Task - Yes or No Game
- Yes/No Game Flow
- Task - Create Yes/No Game
- Decision Trees Continued
- Task - Manual Decision Trees P...
- Manual Decision Trees
- Decision Trees Data Set
- Play Outdoor Sport

# Artificial Intelligence with Machine Learning in Java

## 3-4 Yes/No Game





## Slide Title

- Oracle Academy
- Artificial Intelligence with Ma...
- Objectives
- Decision Trees Revisited
- Task - Yes or No Game
- Yes/No Game Flow
- Task - Create Yes/No Game
- Decision Trees Continued
- Task - Manual Decision Trees P...
- Manual Decision Trees
- Decision Trees Data Set
- Play Outdoor Sport

# Objectives

This lesson covers the following objectives:

- Describe the use of decision trees
- Create a yes/no game
- State the problems of creating a manual decision tree





## Slide Title

- Oracle Academy
- Artificial Intelligence with Ma...
- Objectives
- Decision Trees Revisited
- Task - Yes or No Game
- Yes/No Game Flow
- Task - Create Yes/No Game
- Decision Trees Continued
- Task - Manual Decision Trees P...
- Manual Decision Trees
- Decision Trees Data Set
- Play Outdoor Sport

## Task – Create Yes/No Game

- As more users play, the program "learns" more about animals.
- Your task is to write this game. Good luck.





## Slide Title

- Yes/No Game Flow
- Yes/No Game Flow
- Yes/No Game Flow
- Task - Create Yes/No Game
- Decision Trees Continued
- Task - Manual Decision Trees P...
- Manual Decision Trees
- Decision Trees Data Set
- Play Outdoor Sport
- Play Sport
- Decision Trees
- Manual Decision Tree Creation
- Automatic Decision Trees
- Summary
- Oracle Academy

# Play Outdoor Sport

Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No



## Slide Title

- Yes/No Game Flow
- Yes/No Game Flow
- Yes/No Game Flow
- Task - Create Yes/No Game
- Decision Trees Continued
- Task - Manual Decision Trees P...
- Manual Decision Trees
- Decision Trees Data Set
- Play Outdoor Sport
- Play Sport
- Decision Trees
- Manual Decision Tree Creation
- Automatic Decision Trees
- Summary
- Oracle Academy

# Summary

In this lesson, you should have learned how to:

- Describe the use of decision trees
- Create a yes/no game
- State the problems of creating a manual decision tree

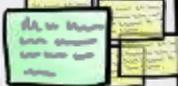
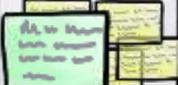
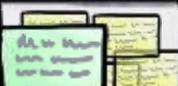
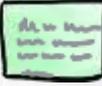


# Hands-On Labs

## Inteligencia Artificial con Machine Learning en Java





To do	Doing	Done
		
		
		
		
		
		

# Agenda

- 1.- Introducción
- 2.- Programa Oracle Academy
- 3.- Oracle Academy: Plan de estudios
- 4.- AiML: Artificial Intelligence with ML
- 5.- Demo: Plataforma Oracle iLearning
- 6.- Hands-On Labs**

# ¿Inteligencia Artificial, Machine Learning o Deep Learning?

## ¿Qué significa cada una?



### Inteligencia Artificial:

Máquinas simulando el comportamiento y razonamiento de los humanos. Para ello, usan diferentes técnicas, entre ellas, Machine Learning.

**Ejemplo:** los asistentes de voz **Siri** y **Alexa**.



### Machine Learning:

Es la capacidad de las computadoras para aprender por sí mismas a partir de datos y experiencia. En su uso más complejo utiliza Deep Learning.

**Ejemplo:** El análisis predictivo en los **vehículos autónomos** y la **personalización de contenidos** según patrones de comportamiento.



### Deep Learning:

Algoritmos que permiten clasificar y relacionar grandes volúmenes información imitando las redes neuronales.

**Ejemplo:** **Chatbots** y opciones avanzadas de **traducción**, incluso con **reconocimiento del dialecto**.

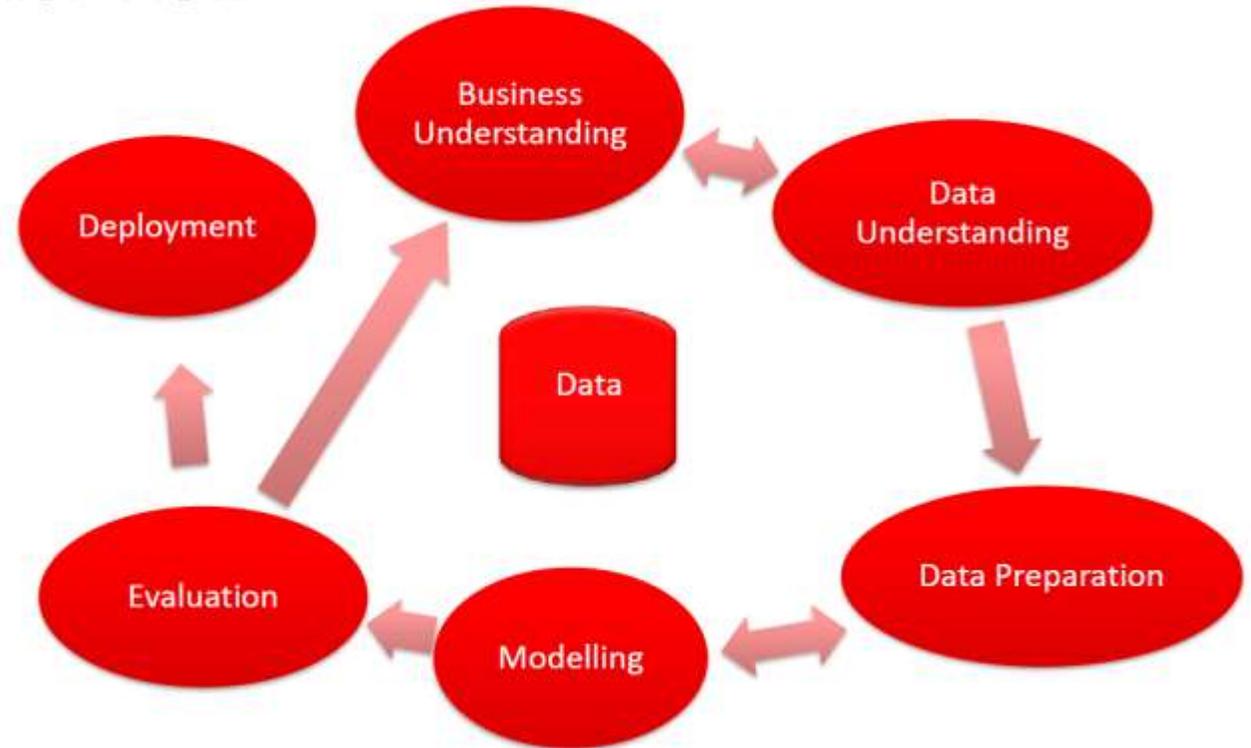
# Hands-On Labs



**ORACLE** ACADEMY

## Machine Learning Workflow

### CRISP Flow



CRISP-DM (Cross-Industry Standard Process for Data Mining)

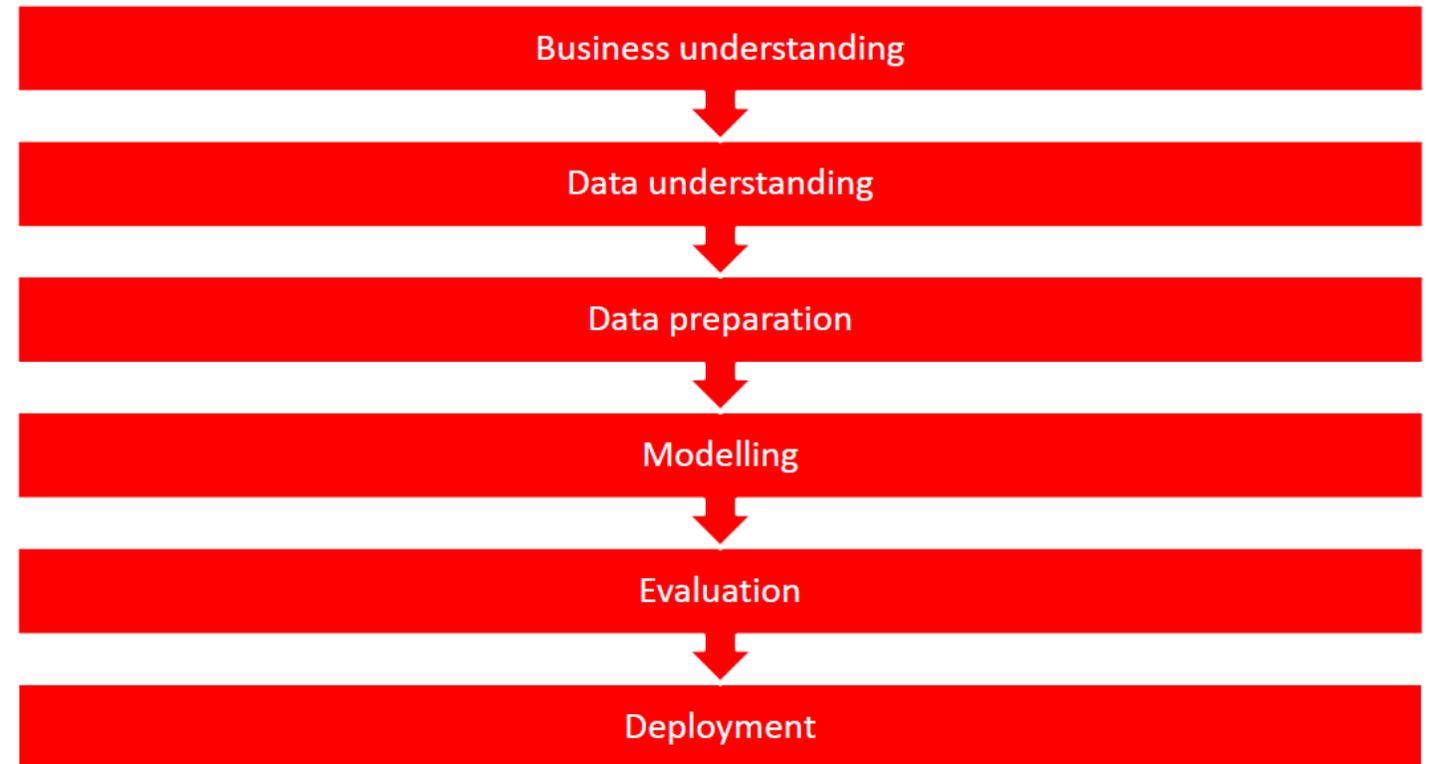
# Hands-On Labs



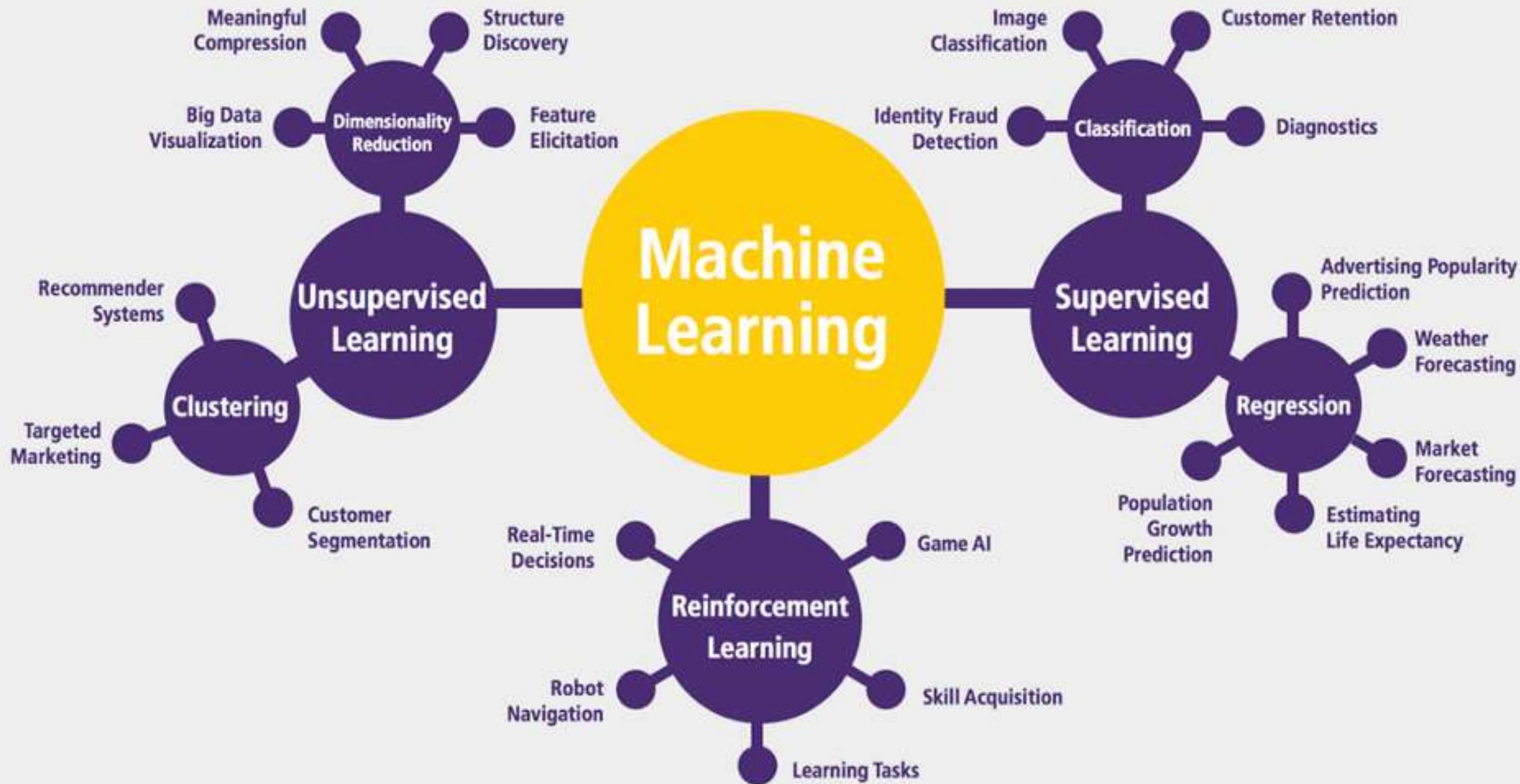
**ORACLE** ACADEMY

## Machine Learning Workflow

### CRISP - Overview



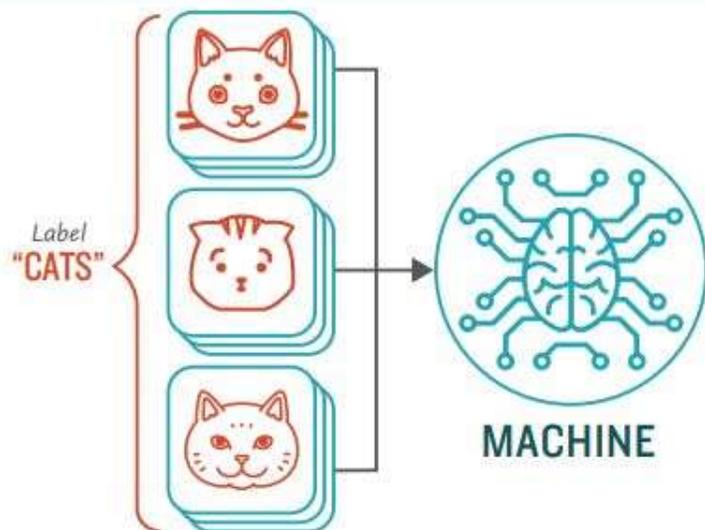
CRISP-DM (Cross-Industry Standard Process for Data Mining)



# How **Supervised** Machine Learning Works

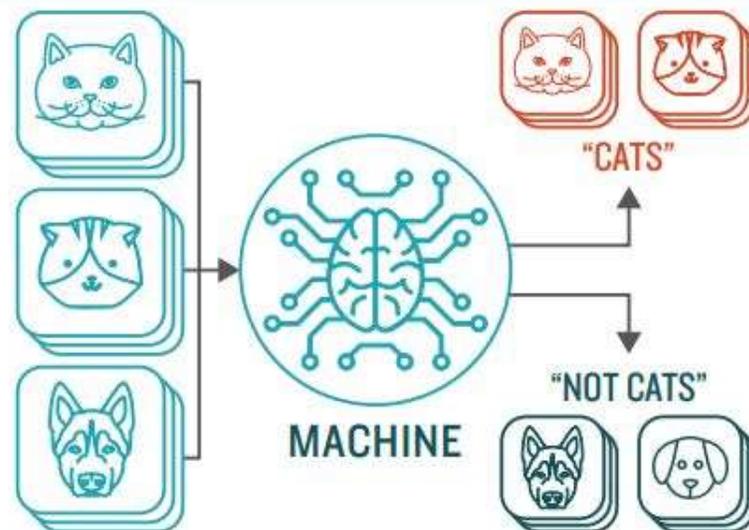
## STEP 1

Provide the machine learning algorithm categorized or "labeled" input and output data from to learn

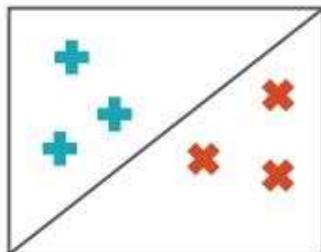


## STEP 2

Feed the machine new, unlabeled information to see if it tags new data appropriately. If not, continue refining the algorithm

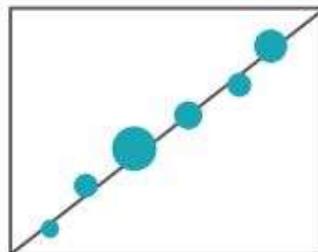


## TYPES OF PROBLEMS TO WHICH IT'S SUITED



### CLASSIFICATION

Sorting items into categories



### REGRESSION

Identifying real values (dollars, weight, etc.)

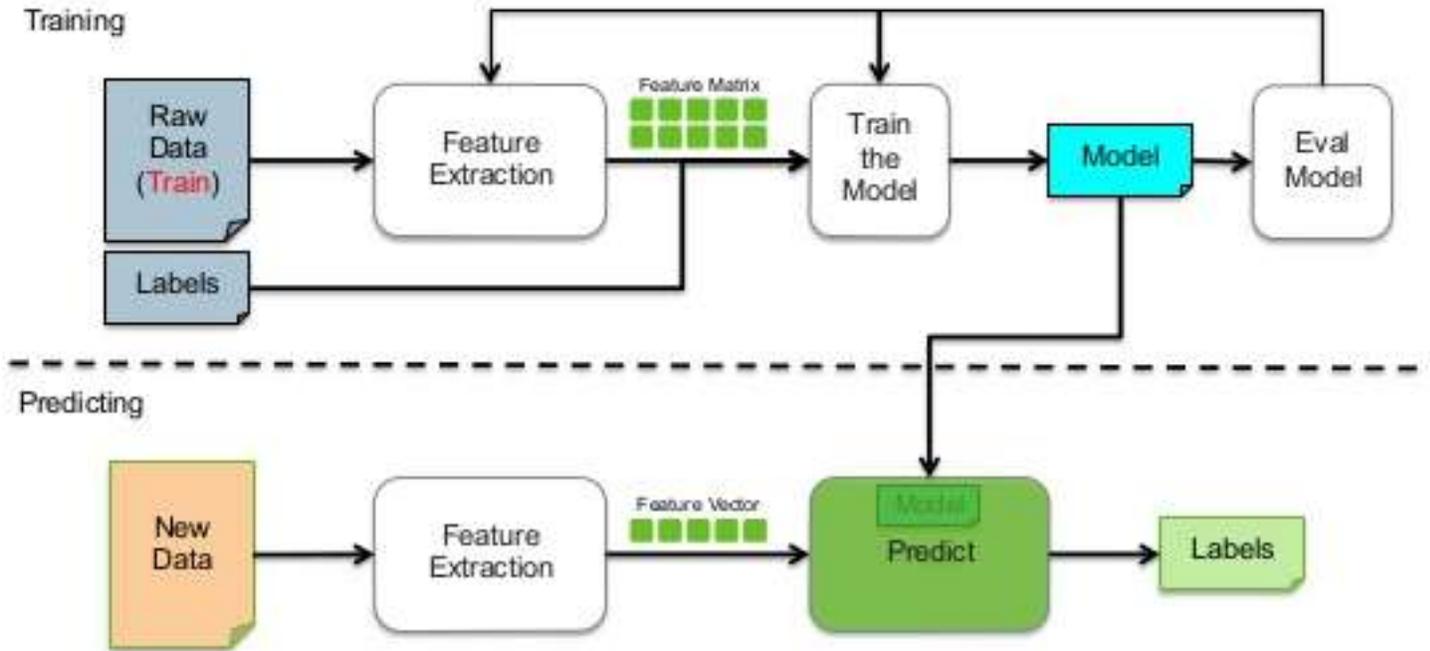
# Hands-On Labs



**ORACLE** ACADEMY

PUE ACADEMY  Day

## Machine Learning



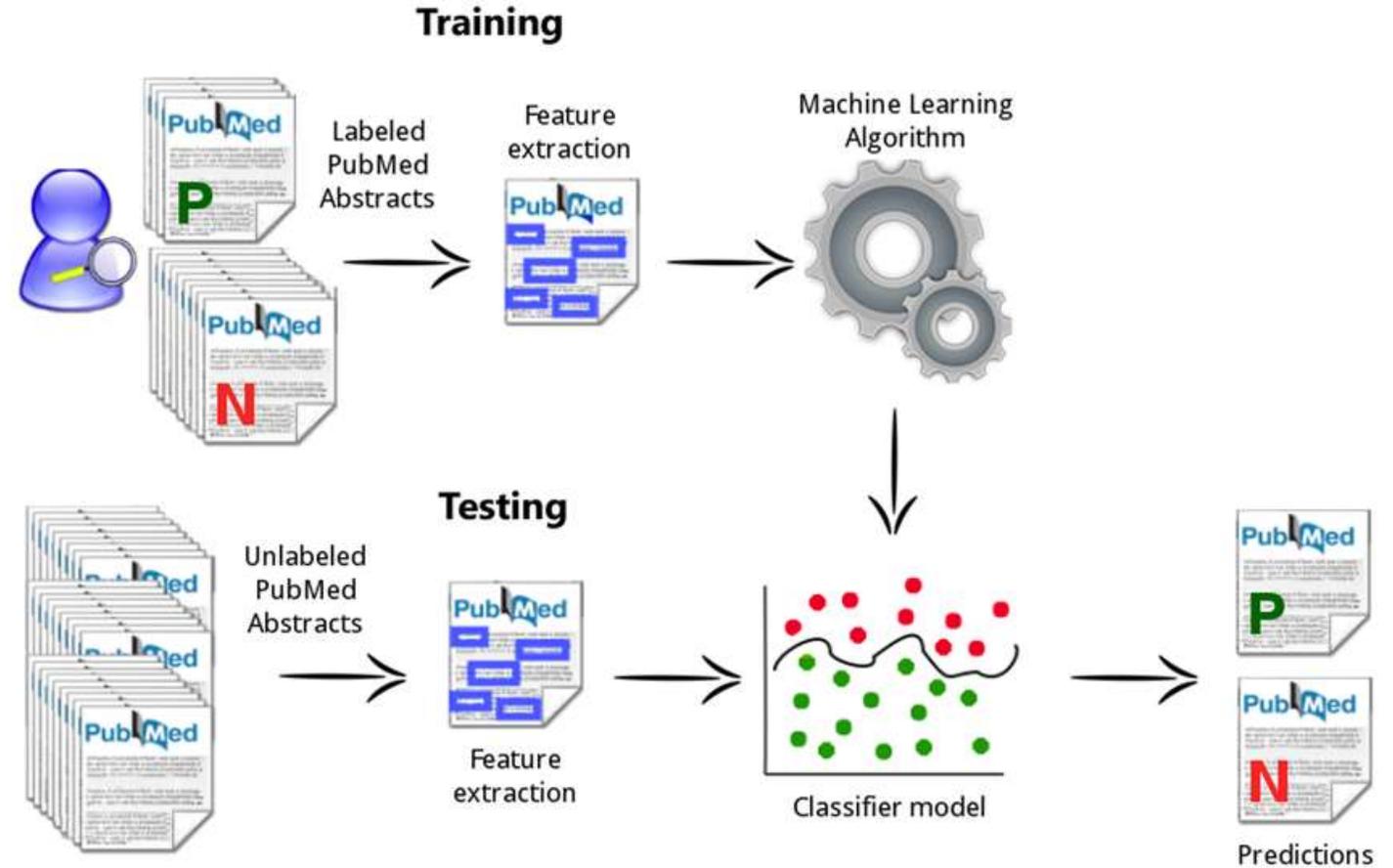
# Hands-On Labs



**ORACLE** ACADEMY

PUE ACADEMY  Day

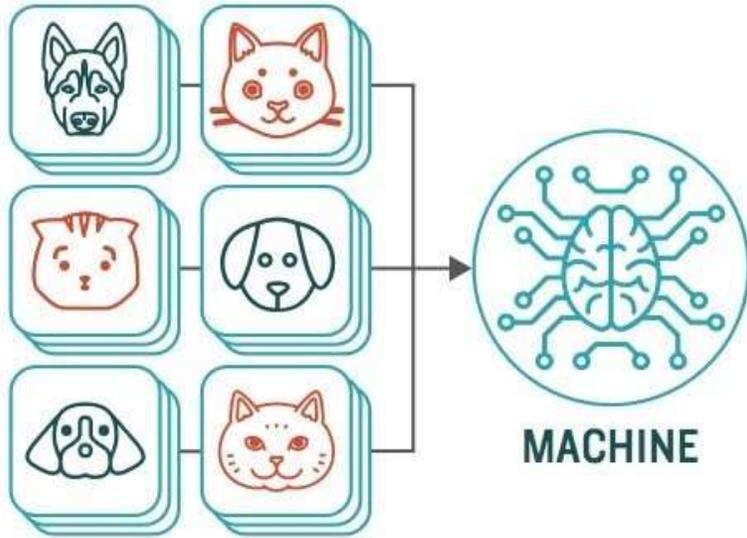
## Machine Learning



# How **Unsupervised** Machine Learning Works

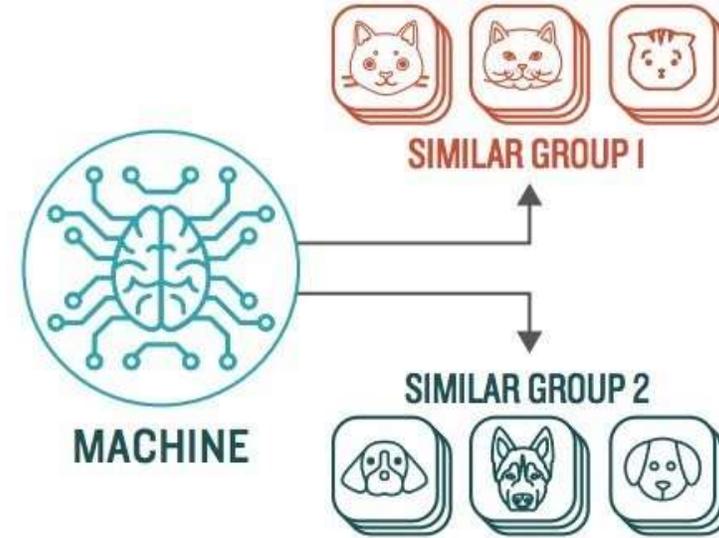
## STEP 1

Provide the machine learning algorithm uncategorized, unlabeled input data to see what patterns it finds

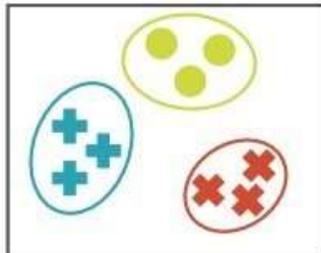


## STEP 2

Observe and learn from the patterns the machine identifies



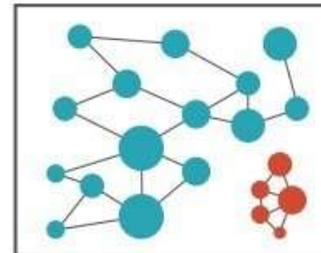
## TYPES OF PROBLEMS TO WHICH IT'S SUITED



### CLUSTERING

Identifying similarities in groups

*For Example:* Are there patterns in the data to indicate certain patients will respond better to this treatment than others?



### ANOMALY DETECTION

Identifying abnormalities in data

*For Example:* Is a hacker intruding in our network?

**INPUT RAW DATA**



- Unknown Output
- No Training Data Set



**Interpretation**

**Algorithm**

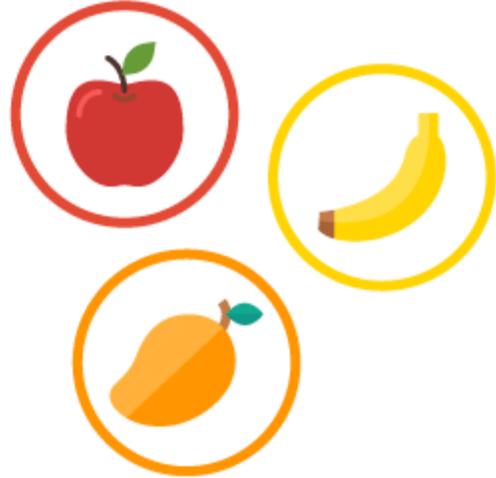


**Model Training**



**Processing**

**OUTPUT**



**Model Trained**

# The Home of Data Science & Machine Learning

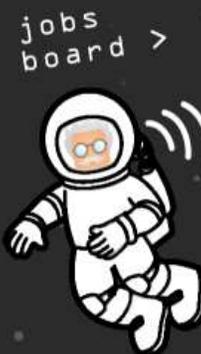
Kaggle helps you learn, work, and play



Create an account

or

Host a competition



## Competitions ›

Climb the world's most elite machine learning

## Datasets ›

Explore and analyze a collection of high quality

## Kernels ›

Run code in the cloud and receive community feedback

# Hands-On Labs



**ORACLE** ACADEMY

## Data Source

Labels



Age	Has Job	Owns House	Credit Rating	Approved?
Young	No	No	Fair	No
Young	No	No	Good	No
Young	Yes	No	Good	Yes
Middle	No	No	Good	No
Middle	Yes	Yes	Excellent	Yes
Old	Yes	No	Good	Yes
Old	No	No	Fair	No

Independent Data

Dependent Data



# Hands-On Labs

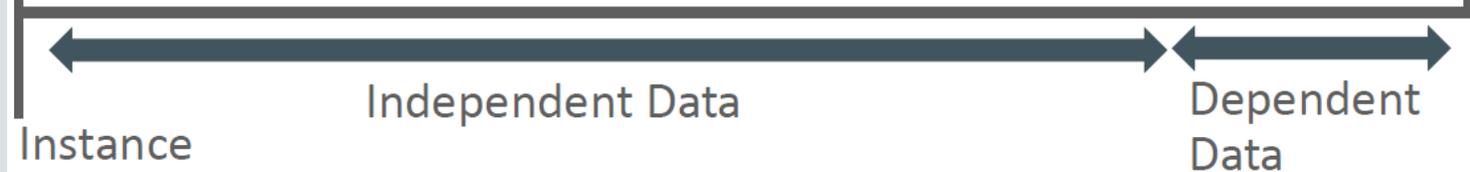


**ORACLE** ACADEMY

## Data Source

Labels (Classification)

Age	Has Job	Owns House	Credit Rating	Approved?
Young	No	No	Fair	No
Young	No	No	Good	No
Young	Yes	No	Good	Yes
Middle	No	No	Good	No
Middle	Yes	Yes	Excellent	Yes
Old	Yes	No	Good	Yes
Old	No	No	Fair	No



# Hands-On Labs



**ORACLE** ACADEMY

## Data Source

### Play Outdoor Sport

Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

# Hands-On Labs



**ORACLE** ACADEMY

## Weka 3: Machine Learning Software

```
@relation Weather
```

```
@attribute Outlook {Sunny, Overcast, Rain}
```

```
@attribute Temperature {Hot, Mild, Cold}
```

```
@attribute Humidity {High, Normal}
```

```
@attribute Wind {Weak, Strong}
```

```
@attribute Play {Yes, No}
```



weather.arff

```
@data
```

```
Sunny,Hot,High,Weak,No
```

```
Sunny,Hot,High,Strong,No
```

```
Overcast,Hot,High,Weak,Yes
```

```
Rain,Mild,High,Weak,Yes
```

```
Rain,Cold,Normal,Weak,Yes
```

```
Rain,Cold,Normal,Strong,No
```

```
Overcast,Cold,Normal,Strong,Yes
```

```
Sunny,Mild,High,Weak,No
```

```
Sunny,Cold,Normal,Weak,Yes
```

```
Rain,Mild,Normal,Weak,Yes
```

```
Sunny,Mild,Normal,Strong,Yes
```

```
Overcast,Mild,High,Strong,Yes
```

```
Overcast,Hot,Normal,Weak,Yes
```

```
Rain,Mild,High,Strong,No
```

# Hands-On Labs



## Weka 3: Machine Learning Software

```
@relation Titanic-Passengers
```

```
@attribute Class {"1st","2nd","3rd","crew"}
```

```
@attribute Age {"Adult","Child"}
```

```
@attribute Sex {"Male","Female"}
```

```
@attribute Survived {"Yes","No"}
```



titanic.arff

```
@data
```

```
1st,Adult,Male,Yes
```

```
1st,Adult,Male,No
```

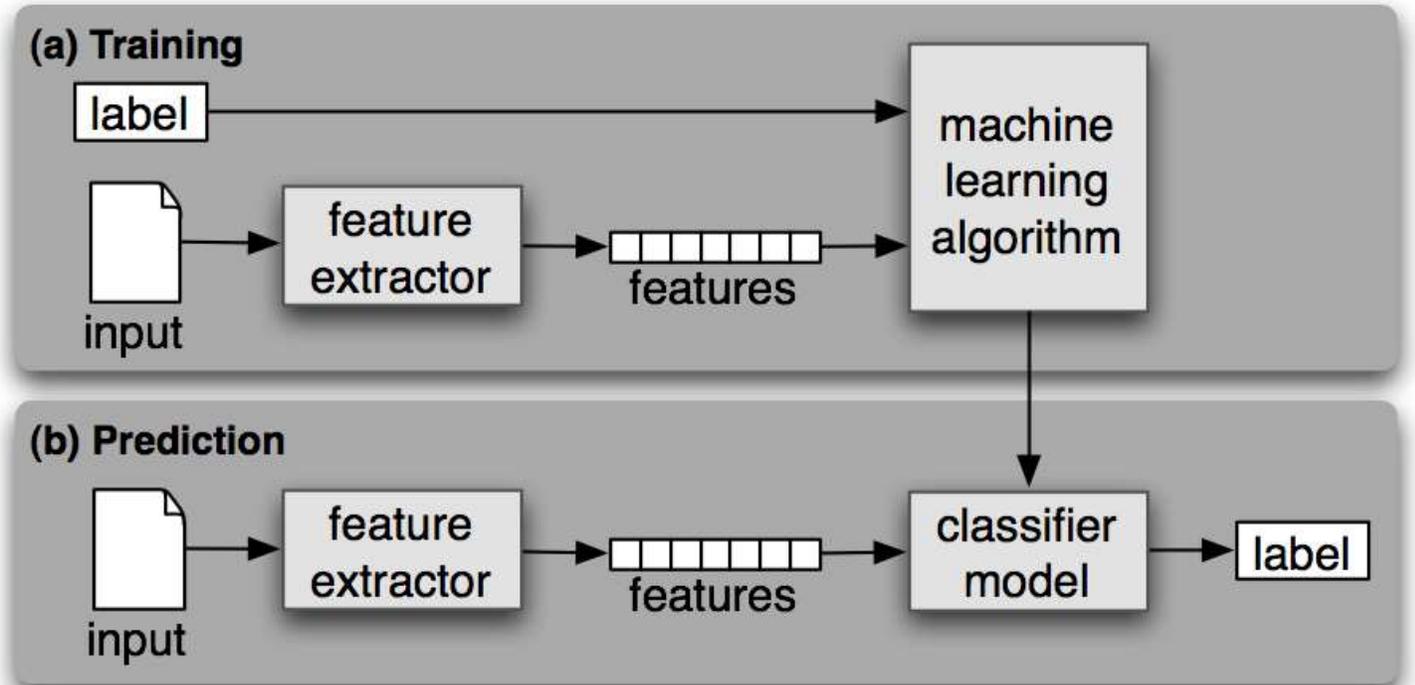
```
...
```

# Hands-On Labs



**ORACLE** ACADEMY

## Play Outdoor Sport



# Hands-On Labs



**ORACLE** ACADEMY

**PUE ACADEMY**  Day

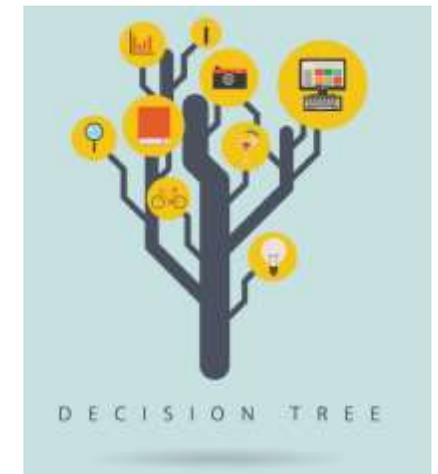
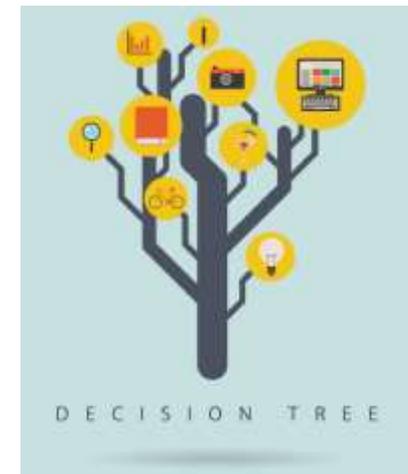
#PUEAcademyDay19

## Árboles de Decisión

Existen muchos **algoritmos** de tipo *Árbol de Decisión* (Decision Tree Algorithms) en Machine Learning.

Algunos de los más populares son:

- **Iterative Dichotomiser3 (ID3)**
- Classification and Regression Tree (CART)
- C4.5
- Chi-squared Automatic Interaction Detection (CHAID)
- Decision Stump
- Conditional Decision Trees



# Hands-On Labs



ORACLE ACADEMY

## Algoritmo ID3

### ID3



ID3 (Examples, Target\_Attribute, Attributes)

Create a root node for the tree

If all examples are positive, Return the single-node tree Root, with label = +.

If all examples are negative, Return the single-node tree Root, with label = -.

If number of predicting attributes is empty, then Return the single node tree Root, with label = most common value of the target attribute in the examples.

Otherwise Begin

$A \leftarrow$  The Attribute that best classifies examples.

Decision Tree attribute for Root = A.

For each possible value,  $v_i$ , of A,

Add a new tree branch below Root, corresponding to the test  $A = v_i$ .

Let Examples( $v_i$ ) be the subset of examples that have the value  $v_i$  for A

If Examples( $v_i$ ) is empty

Then below this new branch add a leaf node with label = most common target value in the examples

Else below this new branch add the subtree ID3 (Examples( $v_i$ ), Target\_Attribute, Attributes - {A})

End

Return Root

Se usará, como punto de partida, un pequeño dataset para recorrer paso a paso cada una de las fases del algoritmo ID3 y comprender todo el proceso de creación del árbol.



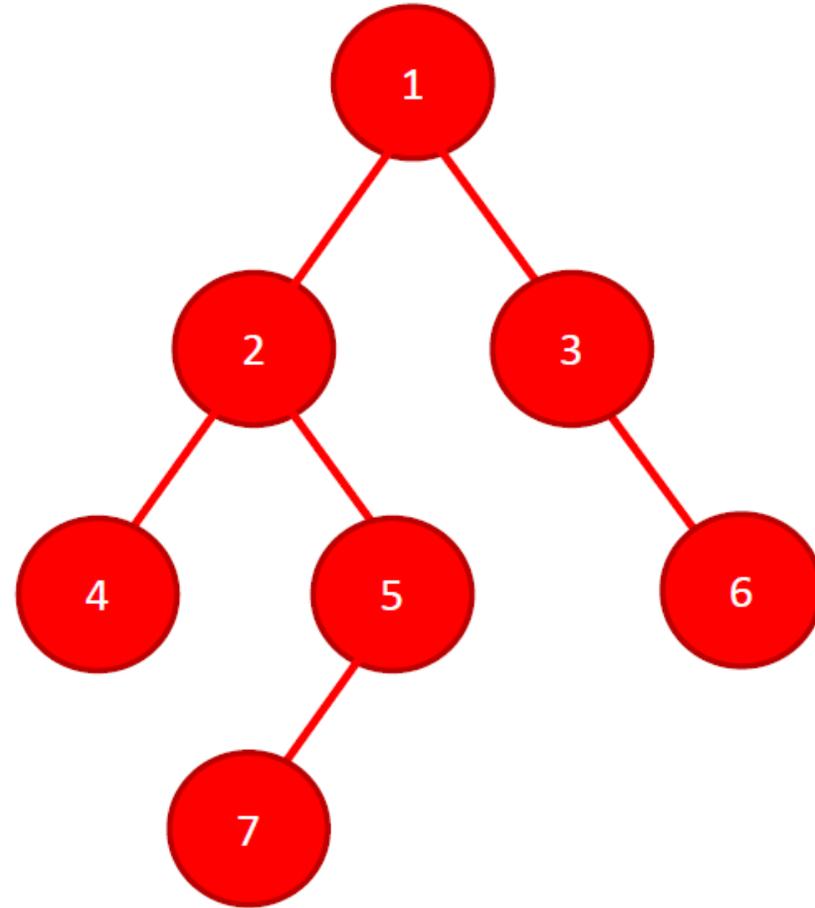
EasyEsL  
Games.com

# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game



**Árboles binarios**

# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game

Computer > File to read the knowledge base from?

Human > resources\kbs\got

---

Computer > Topic: 'Game of Thrones character'

---

Computer > Are you thinking in a 'Game of Thrones character'? (Y/N)

Human > Y

Computer > Is a man? (Y/N)

Human > Y

Computer > She/He/It is 'Tyrion Lannister'? (Y/N)

Human > N

---

Computer > You win, I loose!!!

---

---

Topic: Game of Thrones character

Computer: 0 wins

Human: 1 wins

---

Computer > Who/what were you thinking of?

Human > John Snow

Computer > Please enter a yes/no question that would distinguish 'John Snow' from 'Tyrion Lannister'

Human > Is a King?

Computer > For 'John Snow' the answer would be (Y/N)

Human > Y

# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game

-----  
Computer > Topic: 'Game of Thrones character'  
-----

Computer > Are you thinking in a 'Game of Thrones character'? (Y/N)

Human > Y

Computer > Is a man? (Y/N)

Human > Y

Computer > Is a King? (Y/N)

Human > Y

Computer > She/He/It is 'John Snow'? (Y/N)

Human > N

-----  
Computer > You win, I loose!!!  
-----  
-----

Topic: Game of Thrones character

Computer: 0 wins

Human: 2 wins

-----  
Computer > Who/what were you thinking of?

Human > Robert Baratheon

Computer > Please enter a yes/no question that would distinguish 'Robert Baratheon' from 'John Snow'

Human > Is alive?

Computer > For 'Robert Baratheon' the answer would be (Y/N)

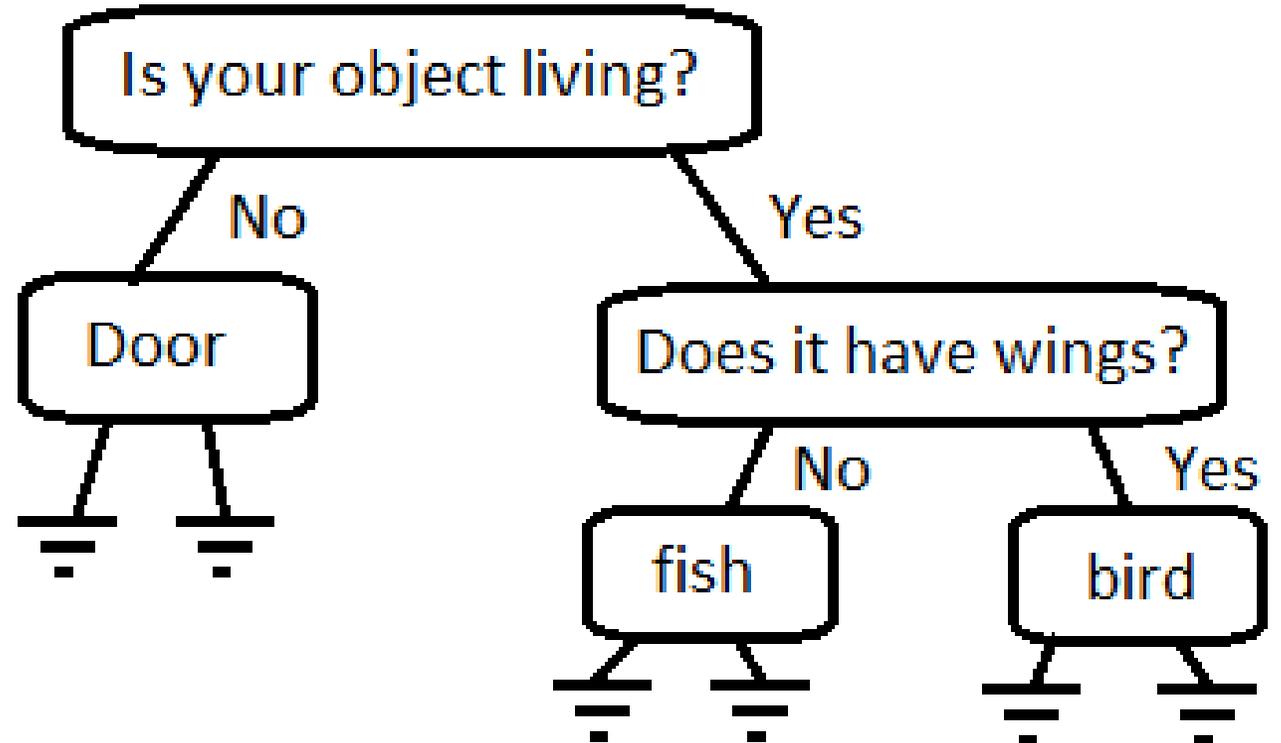
Human > N

# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game

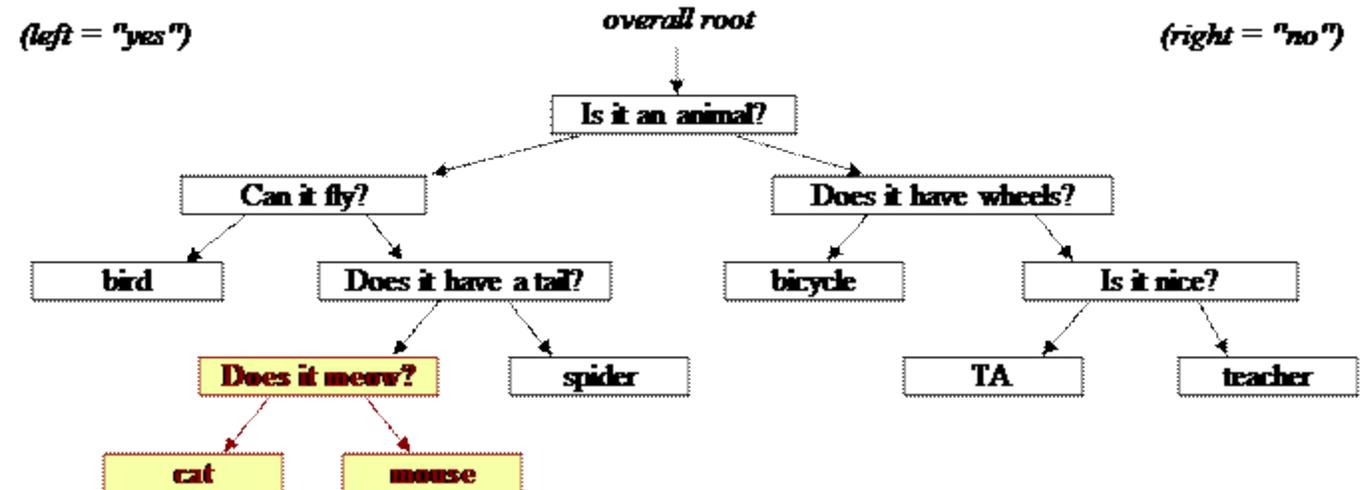
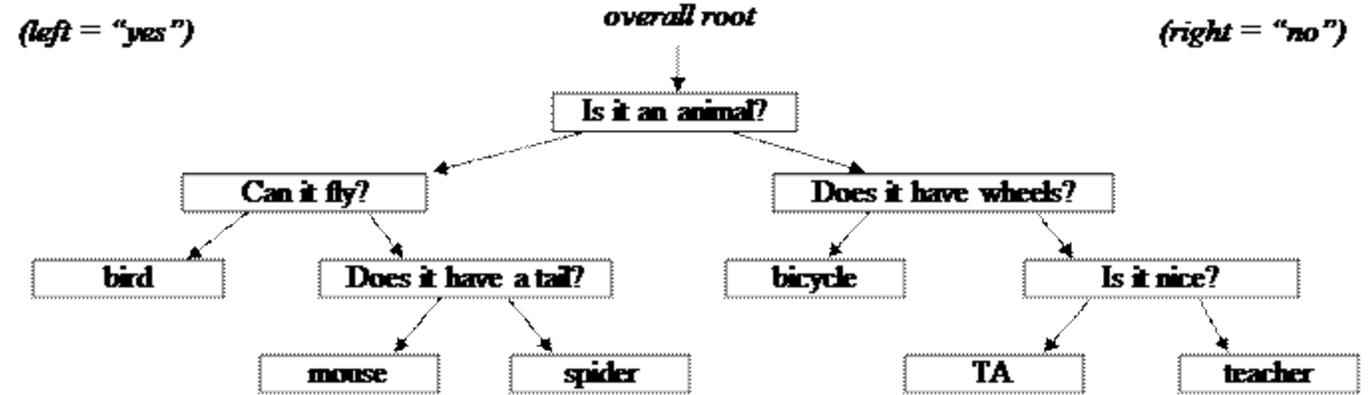


# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game



# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game

Animales

Q: Es un animal acuatico?

Q: Es un animal muy inteligente?

A: Delfin

Q: Es un animal muy peligroso?

Q: Tienen cuerpo gelatinoso?

A: Medusa

A: Tiburon

Q: Se alimentan de placton?

Q: Tiene la boca en forma de trompeta?

A: Caballito de mar

A: Pez

Q: Es un animal de rio?

A: Cocodrilo

A: Ballena

Q: Es un reptil?

Q: Cambia de color?

A: Camaleon

Q: Se arrastra por el suelo?

A: Serpiente

A: Lagarto

Q: Es un mamifero?

Q: Se cuelga por los arboles?

A: Mono

Q: Es de la familia de los felinos?

Q: Caza animales de tamano mediano o grande para comer?

# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game

Game of Thrones character

Q: Is a man?

A: John Nieve

A: Danerys

Game of Thrones character

Q: Is a man?

Q: Is a King?

Q: Is alive?

A: John Snow

A: Robert Baratheon

A: Tyrion Lannister

Q: Is youngth?

A: Danerys

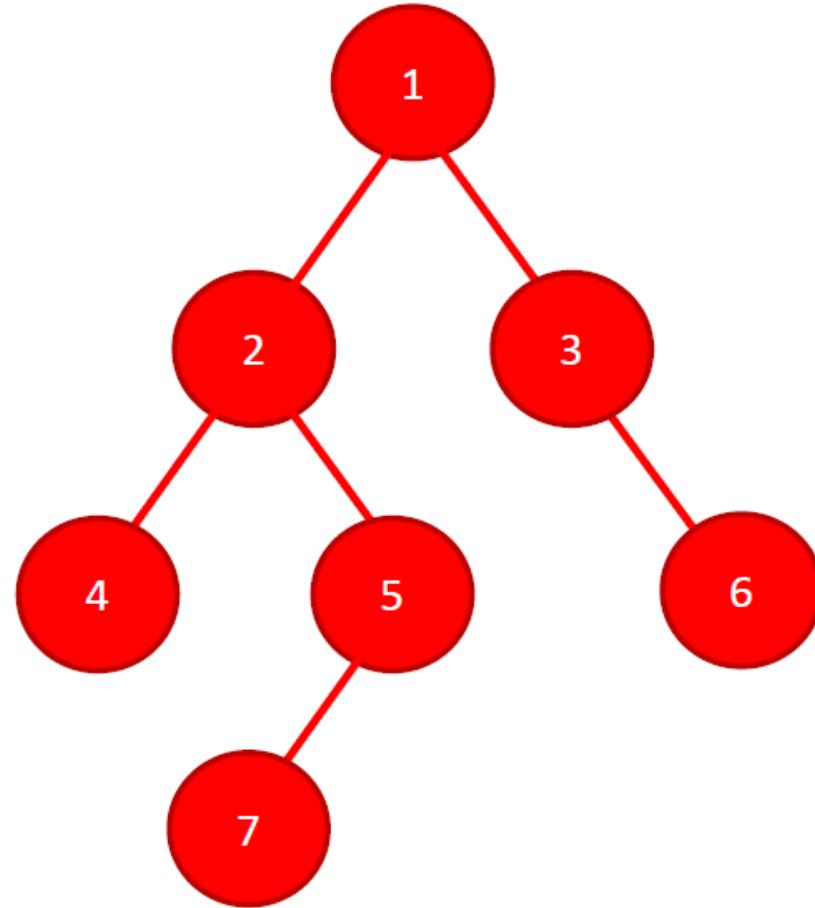
A: Cersei Lannister

# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game



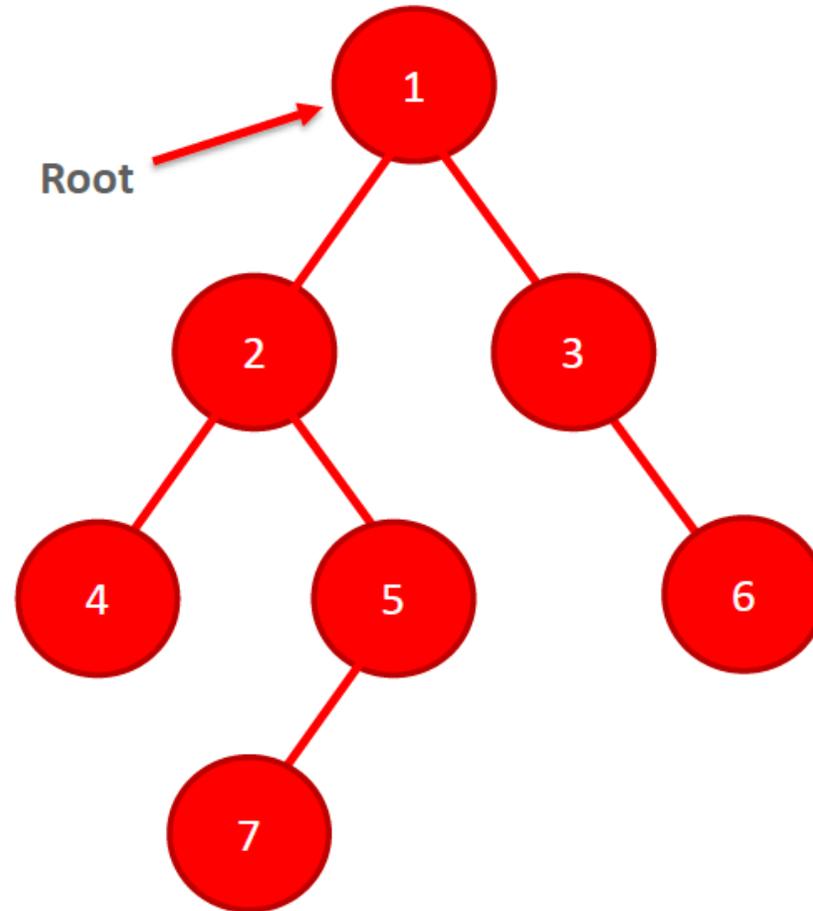
**Árboles binarios**

# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game



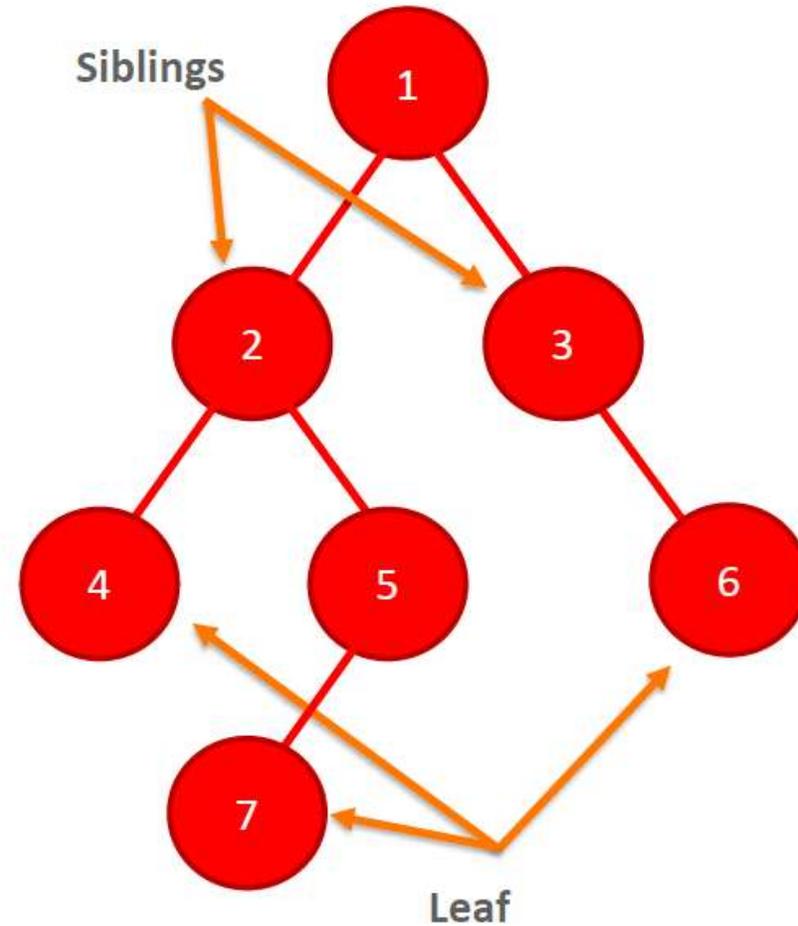
**Árboles binarios**

# Hands-On Labs



**ORACLE** ACADEMY

## Yes/No Game

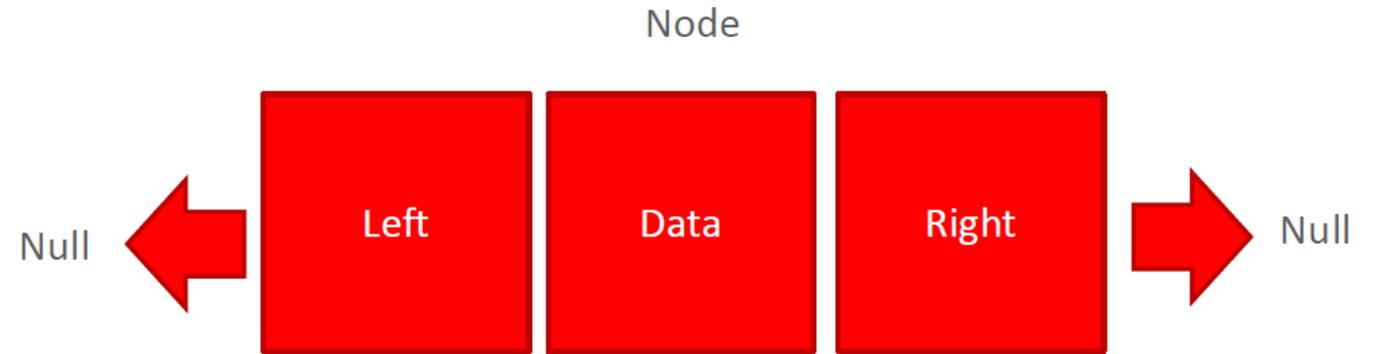


**Árboles binarios**

# Hands-On Labs



## Binary Tree Structure



```
public class TreeNode<T> {  
  
    private T content;  
    private TreeNode<T> leftNode;  
    private TreeNode<T> rightNode;  
  
    public TreeNode(T content, TreeNode<T> leftNode,  
                   TreeNode<T> rightNode) {  
        this.setContent(content);  
        this.setLeftNode(leftNode);  
        this.setRightNode(rightNode);  
    }  
  
    public TreeNode(T content) {  
        this(content, null, null);  
    }  
    ...  
}
```

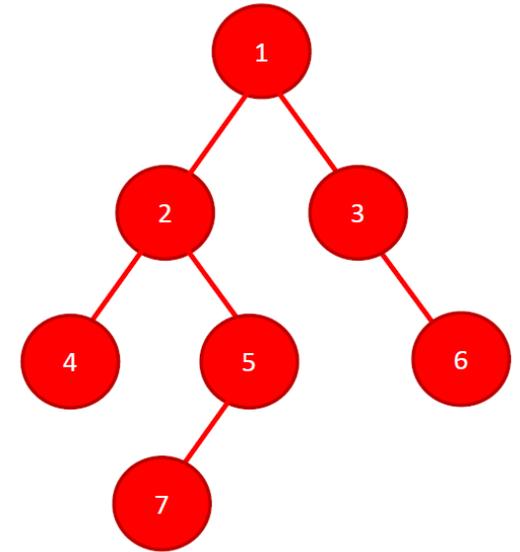
# Hands-On Labs



**ORACLE** ACADEMY

## Binary Tree Structure

```
public class BinaryTree<T> {  
  
    private TreeNode<T> root;  
    private TreeNode<T> current;  
  
    public BinaryTree(TreeNode<T> root) {  
        this.setRoot(root);  
        this.setCurrent(root);  
    }  
  
    public BinaryTree(T content) {  
        this(new TreeNode(content));  
    }  
  
    public String preOrder() {  
        return this.getRoot().preOrder();  
    }  
    public String postOrder() {  
        return this.getRoot().postOrder();  
    }  
  
    public String inOrder() {  
        return this.getRoot().inOrder();  
    }  
}
```



# Hands-On Labs

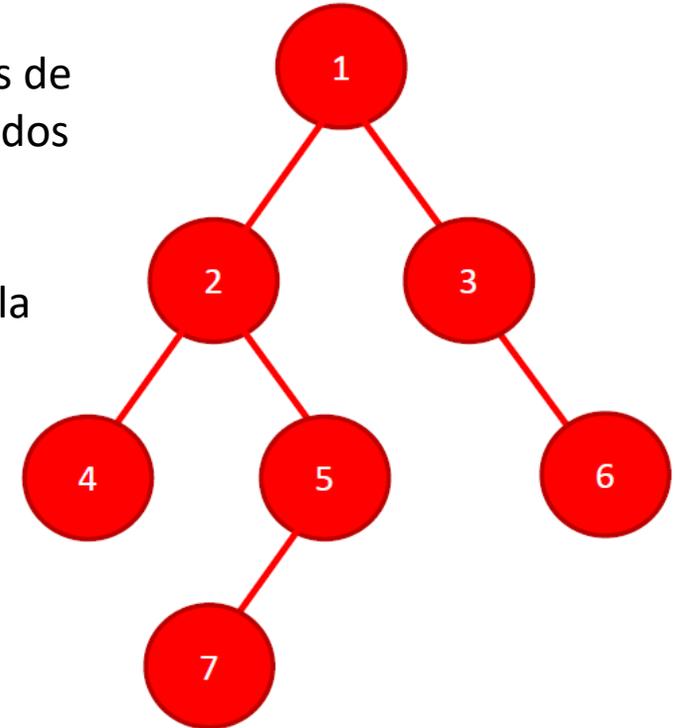


**ORACLE** ACADEMY

## Pre-Order Traversal

Se accede primero a un node antes de acceder a sus correspondientes nodos hijos.

Se procesan primero los nodos de la izquierda.



**1,2,4,5,7,3,6**

# Hands-On Labs

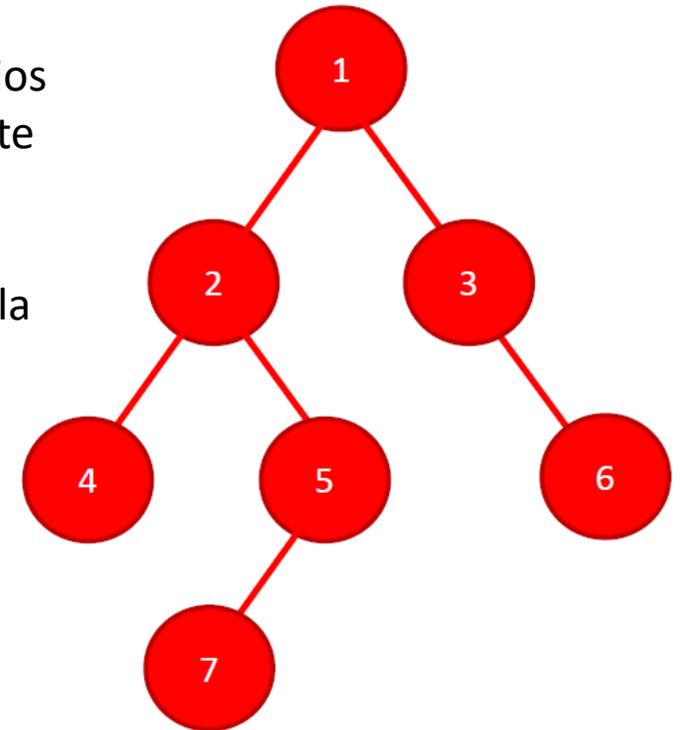


**ORACLE** ACADEMY

## Post-Order Traversal

Se acceden primero a los nodos hijos antes de acceder al correspondiente padre.

Se procesan primero los nodos de la izquierda.



**4,7,5,2,6,3,1**

# Hands-On Labs

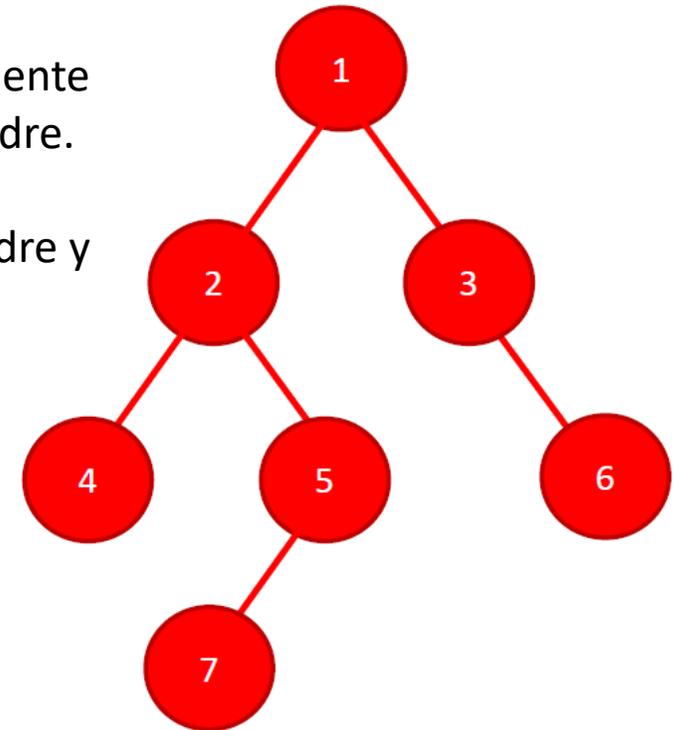


**ORACLE** ACADEMY

## In-Order Traversal

Se acceden primero al correspondiente sub-árbol izquierdo de un nodo padre.

Luego al correspondiente nodo padre y finalmente al sub-árbol derecho.



**4,2,7,5,1,3,6**

# Hands-On Labs



**ORACLE** ACADEMY

## Dataset o conjunto de datos

### Play Outdoor Sport

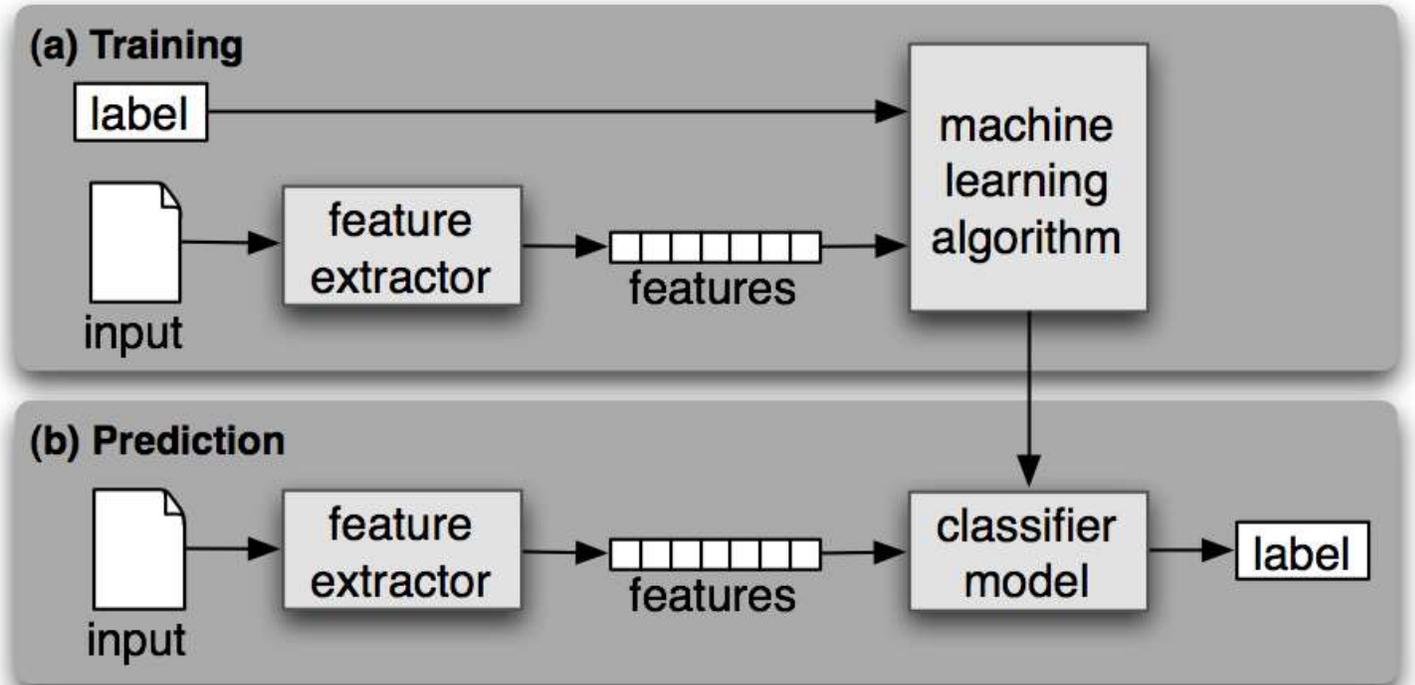
Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

# Hands-On Labs



**ORACLE** ACADEMY

## Play Outdoor Sport

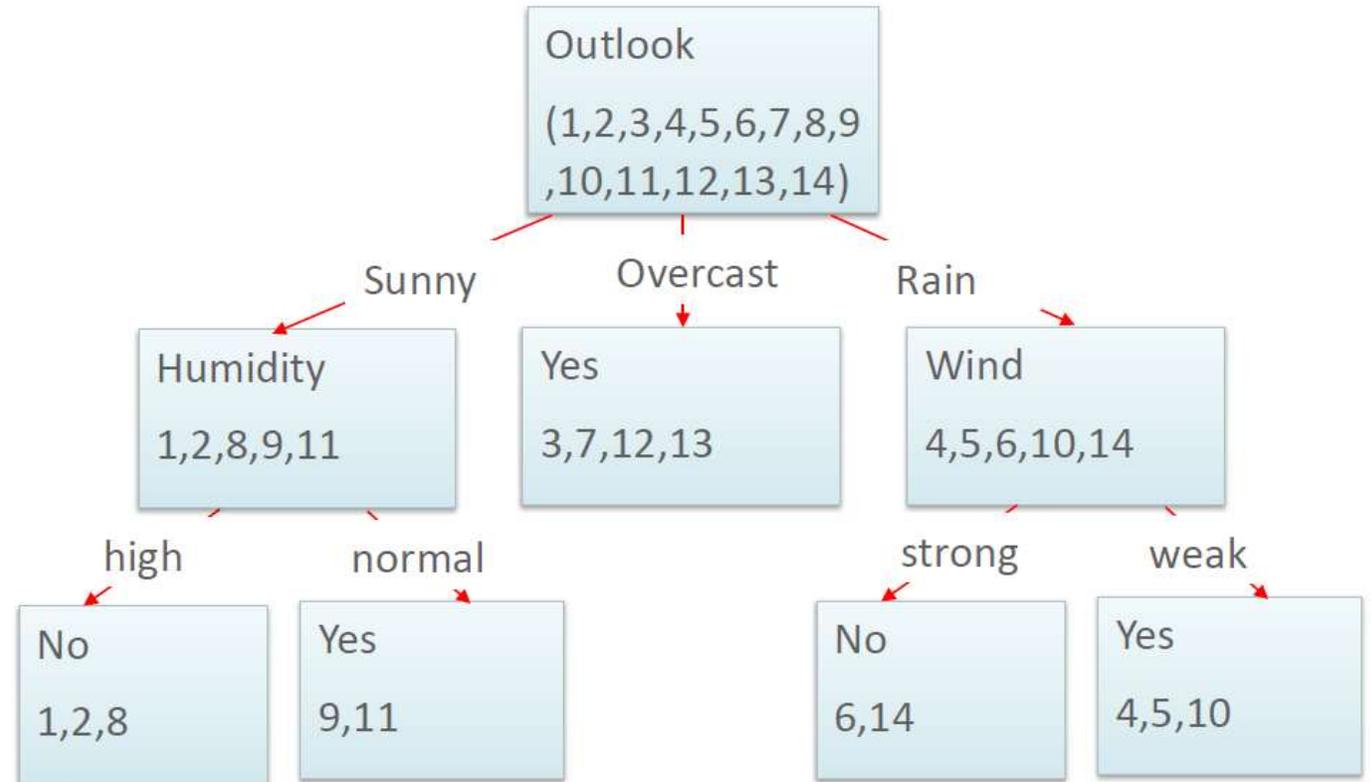


# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3



# Hands-On Labs



**ORACLE** ACADEMY

## Algoritmo ID3

### ID3



ID3 (Examples, Target\_Attribute, Attributes)

Create a root node for the tree

If all examples are positive, Return the single-node tree Root, with label = +.

If all examples are negative, Return the single-node tree Root, with label = -.

If number of predicting attributes is empty, then Return the single node tree Root, with label = most common value of the target attribute in the examples.

Otherwise Begin

A ← The Attribute that best classifies examples.

Decision Tree attribute for Root = A.

For each possible value,  $v_i$ , of A,

Add a new tree branch below Root, corresponding to the test  $A = v_i$ .

Let Examples( $v_i$ ) be the subset of examples that have the value  $v_i$  for A

If Examples( $v_i$ ) is empty

Then below this new branch add a leaf node with label = most common target value in the examples

Else below this new branch add the subtree ID3 (Examples( $v_i$ ), Target\_Attribute, Attributes – {A})

End

Return Root

# Hands-On Labs



## Entropía y ganancia

$$Entropy(S) = - \sum_{x=1}^n p(x) \log_2 p(x)$$

$$Gain(S, A) = Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

$$Entropy(S) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(S) = -\left(\frac{9}{14}\right) * \log_2\left(\frac{9}{14}\right) - \left(\frac{5}{14}\right) * \log_2\left(\frac{5}{14}\right)$$

$$Entropy(S) = -(0.643) * (-0.637) - (0.357) * (-1.485)$$

$$Entropy(S) = -(-0.410) - (-0.530)$$

$$Entropy(S) = (0.410) + (0.530)$$

$$Entropy(S) = 0.94$$



$$Gain(S, outlook) = 0.94 - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

$$Gain(S, outlook) = 0.94 - \left(\frac{|S_{Sunny}|}{14}\right) * Entropy(S_{Sunny}) - \left(\frac{|S_{Overcast}|}{14}\right) * Entropy(S_{Overcast}) - \left(\frac{|S_{Rain}|}{14}\right) * Entropy(S_{Rain})$$

$$Gain(S, outlook) = 0.94 - \left(\frac{|5|}{14}\right) * Entropy(S_{Sunny}) - \left(\frac{|4|}{14}\right) * Entropy(S_{Overcast}) - \left(\frac{|5|}{14}\right) * Entropy(S_{Rain})$$

$$Gain(S, outlook) = 0.94 - (0.357) * Entropy(S_{Sunny}) - (0.286) * Entropy(S_{Overcast}) - (0.357) * Entropy(S_{Rain})$$

$$Gain(S, outlook) = 0.94 - (0.357) * 0.971 - (0.286) * 0 - (0.357) * 0.971$$

$$Gain(S, outlook) = 0.94 - 0.347 - 0 - 0.347$$

$$Gain(S, outlook) = 0.246$$

# Hands-On Labs



ORACLE ACADEMY

## Entropía de la Información

La *entropía de la información* es un concepto definido por los matemáticos en 1949, y se refiere a la **incertidumbre** en los datos.

Los datos con un alto **nivel de incertidumbre** (o entropía) contendrán más información útil que podrá ser utilizada.

La **entropía** de la información se mide como:

$$Entropy(S) = - \sum_{x=1}^n p(x) \log_2 p(x)$$

Esta ecuación devolverá cuánta información se puede esperar de una acción dada.

Cuanto mayor sea el número, más información obtenemos.

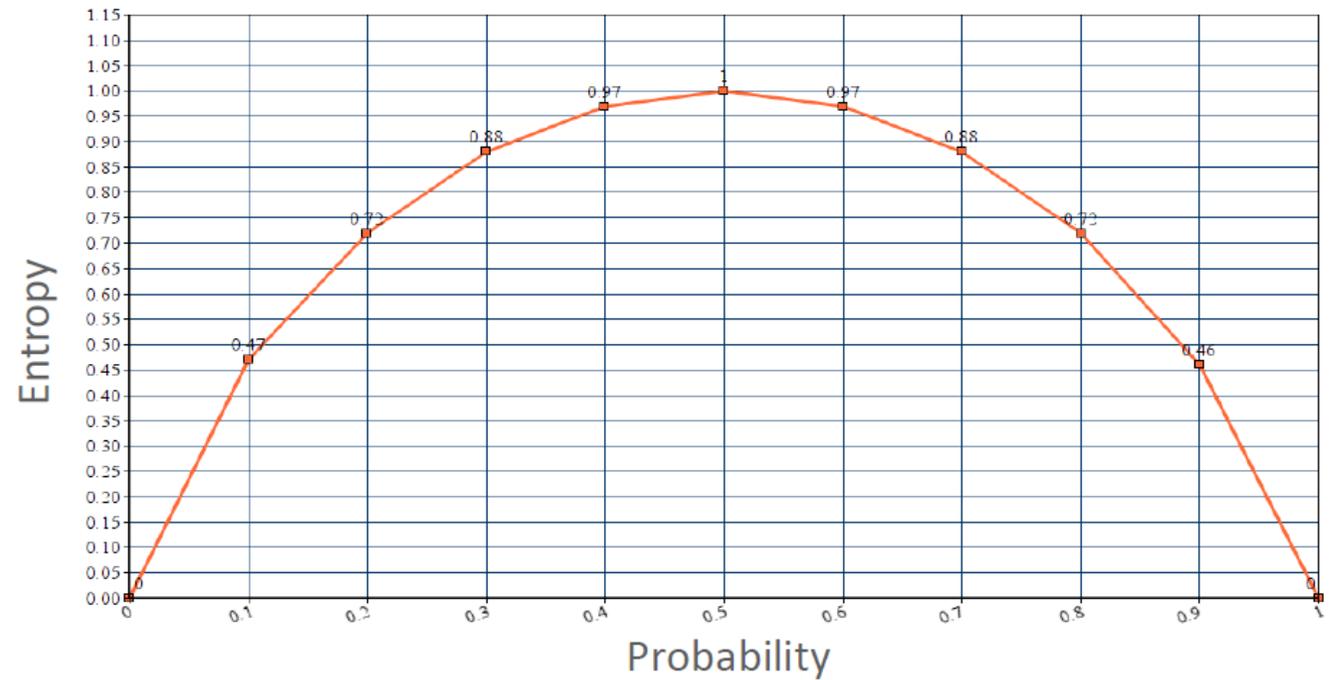


# Hands-On Labs



**ORACLE** ACADEMY

## Entropía de la Información



$$Entropy(S) = - \sum_{x=1}^n p(x) \log_2 p(x)$$

# Hands-On Labs



**ORACLE** ACADEMY

## Entropía de la Información

Tenemos **bolsa con 10 canicas verdes**

Calcular la entropía asociada a la acción de sacar una canica.

$$Entropy(S) = - \sum_{x=1}^n p(x) \log_2 p(x)$$

$$Entropy(S) = -p(x) \log_2 p(x)$$

$$Entropy(S) = -1 \log_2 1$$

$$Entropy(S) = -1 * 0$$

$$Entropy(S) = 0$$

Obtenemos una entropía de 0.

El nivel de incertidumbre es mínimo, por lo que podemos obtener poca información de este conjunto de datos. Por lo tanto, no es un buen conjunto de entrenamiento.



$n = 1$



**ORACLE** ACADEMY

## Entropía de la Información

Tenemos **bolsa con 5 canicas verdes y 5 cáncas rojas.**

Calcular la entropía asociada a la acción de sacar una canica.



$n = 2$

$$Entropy(S) = - \sum_{x=1}^n p(x) \log_2 p(x)$$

$$Entropy(S) = -p(\text{green}) \log_2 p(\text{green}) - p(\text{red}) \log_2 p(\text{red})$$

$$Entropy(S) = -\left(\frac{5}{10}\right) \log_2 \left(\frac{5}{10}\right) - \left(\frac{5}{10}\right) \log_2 \left(\frac{5}{10}\right)$$

$$Entropy(S) = -(0.5) * (-1) - (0.5) * (-1)$$

$$Entropy(S) = (0.5) + (0.5)$$

$$Entropy(S) = 1$$

Este es un valor de entropía más alto, por lo que tenemos un mejor conjunto de entrenamiento para el aprendizaje.

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

### Play Outdoor Sport

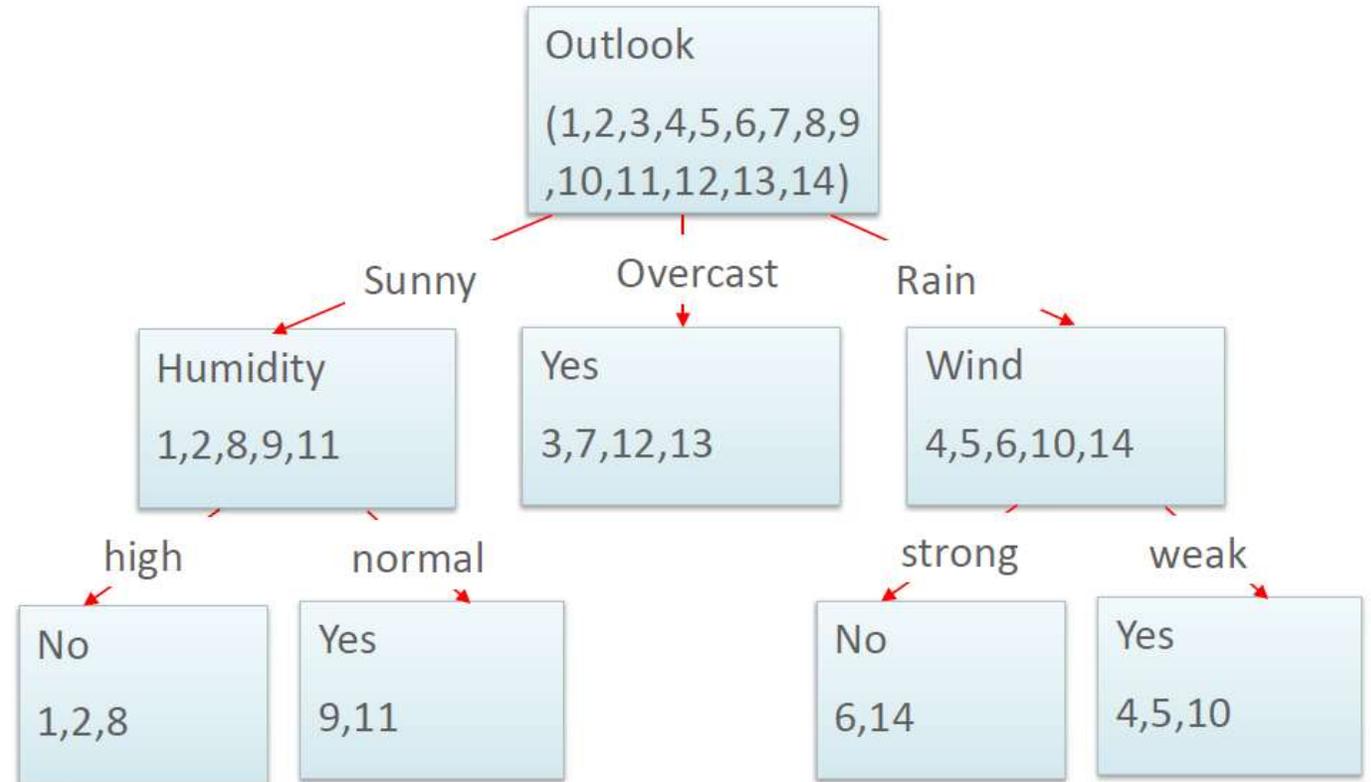
Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3



# Hands-On Labs

## Árbol de decisión ID3

### Paso 1

Calculamos la entropía asociada al atributo de salida: *Play*

$$Entropy(S) = - \sum_{x=1}^n p(x) \log_2 p(x)$$

Entropy (Play): 9-Yes, and 5-No

$$Entropy(S) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(S) = -\left(\frac{9}{14}\right) * \log_2\left(\frac{9}{14}\right) - \left(\frac{5}{14}\right) * \log_2\left(\frac{5}{14}\right)$$

$$Entropy(S) = -(0.643) * (-0.637) - (0.357) * (-1.485)$$

$$Entropy(S) = -(-0.410) - (-0.530)$$

$$Entropy(S) = (0.410) + (0.530)$$

$$Entropy(S) = 0.94$$

Play?
No
No
Yes
Yes
Yes
No
Yes
No
Yes
No



# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

### Paso 2

Ahora calculamos el valor de **ganancia de información** (*gain*) para cada uno de los atributos o features de nuestro conjunto de datos.

Así podremos elegir porqué atributo o feature se puede hacer un mejor split en nuestro árbol.

Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

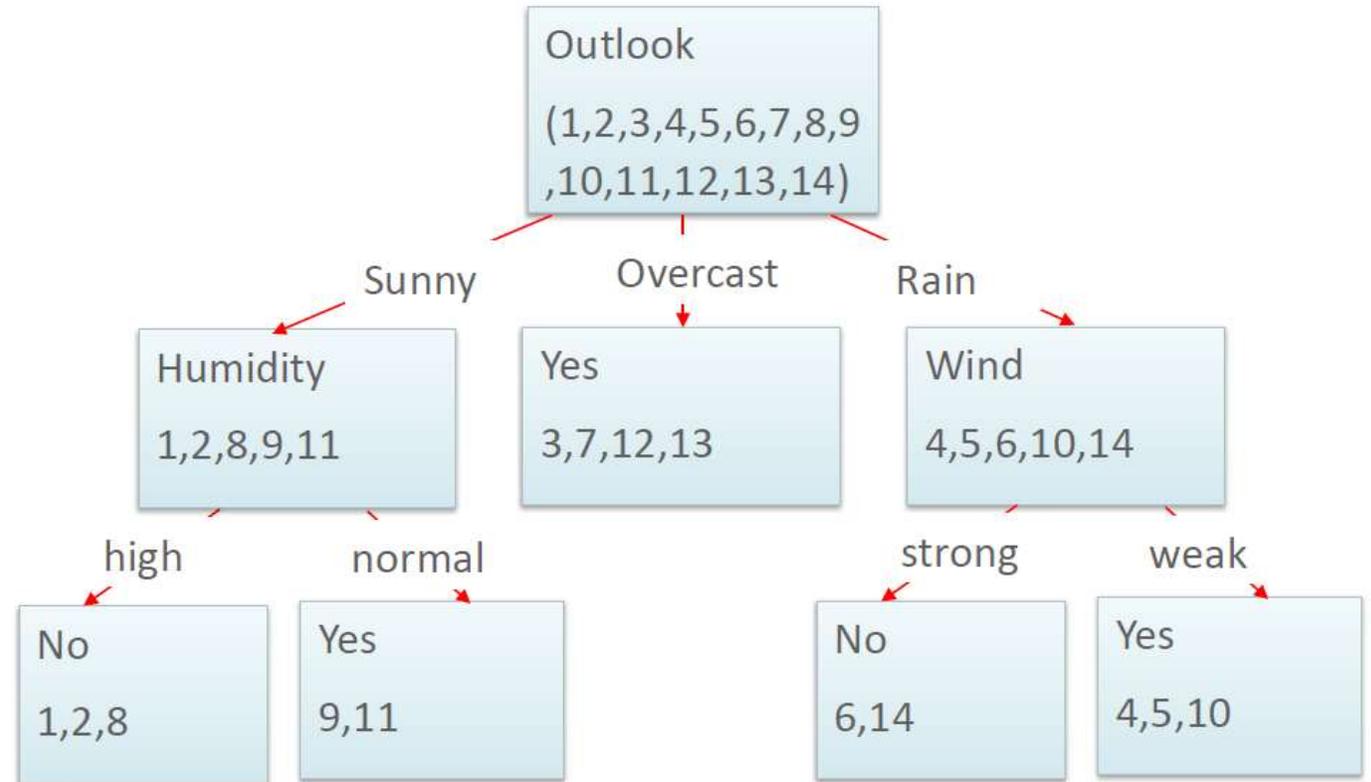
$$Entropy(S) = 0.94$$

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3



# Hands-On Labs



**ORACLE** ACADEMY

## Ganancia de la información

El cálculo de la ganancia de información -gain- mide la cantidad de entropía que se reduce en el dataset, al particionar o clasificar a partir de un atributo específico ( $A$ ).

$$Gain(S, A) = Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

Cuanto mayor sea el número de ganancia obtenido, mejor se clasificarán los datos a partir de ese atributo.

**Clave:** Calcular la entropía para cada posible valor del atributo y luego calcular la ganancia para ese atributo.

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

### Play Outdoor Sport

Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

$$Entropy(S) = 0.94$$

A: Outlook	#Play: Yes	# Play: No	Total
Sunny	2	3	5
Overcast	4	0	4
Rain	3	2	5

$$Entropy(Sunny) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(2+, 3-) = -\left(\frac{2}{5}\right) \log_2\left(\frac{2}{5}\right) - \left(\frac{3}{5}\right) \log_2\left(\frac{3}{5}\right)$$

$$Entropy(Overcast) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(4+, 0-) = -\left(\frac{4}{4}\right) \log_2\left(\frac{4}{4}\right) - \left(\frac{0}{4}\right) \log_2\left(\frac{0}{4}\right)$$

$$Entropy(Rain) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(3+, 2-) = -\left(\frac{3}{5}\right) \log_2\left(\frac{3}{5}\right) - \left(\frac{2}{5}\right) \log_2\left(\frac{2}{5}\right)$$

$$Entropy(Sunny) = 0.971$$

$$Entropy(Overcast) = 0$$

$$Entropy(Rain) = 0.971$$

Outlook
Sunny
Sunny
Overcast
Rain
Rain
Rain
Overcast
Sunny
Sunny
Rain
Sunny
Overcast
Overcast
Rain

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

$$Entropy(S) = 0.94$$

A: Outlook	#Play: Yes	# Play: No	Total
Sunny	2	3	5
Overcast	4	0	4
Rain	3	2	5

$$Gain(S, A) = Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

$$Gain(S, outlook) = 0.94 - \left(\frac{|5|}{14}\right) * Entropy(S_{Sunny}) - \left(\frac{|4|}{14}\right) * Entropy(S_{Overcast}) - \left(\frac{|5|}{14}\right) * Entropy(S_{Rain})$$

$$Gain(S, outlook) = 0.94 - (0.357) * 0.971 - (0.286) * 0 - (0.357) * 0.971$$

$$Gain(S, outlook) = 0.94 - 0.347 - 0 - 0.347$$

$$Gain(S, outlook) = 0.246$$

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

### Play Outdoor Sport

Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

$$Entropy(S) = 0.94$$

A: Temperature	#Play: Yes	# Play: No	Total
Cold	3	1	4
Mild	4	2	6
Hot	2	2	4

$$Entropy(cold) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(3+, 1-) = -\left(\frac{3}{4}\right) \log_2\left(\frac{3}{4}\right) - \left(\frac{1}{4}\right) \log_2\left(\frac{1}{4}\right)$$

$$Entropy(mild) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(4+, 2-) = -\left(\frac{4}{6}\right) \log_2\left(\frac{4}{6}\right) - \left(\frac{2}{6}\right) \log_2\left(\frac{2}{6}\right)$$

$$Entropy(hot) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(2+, 2-) = -\left(\frac{2}{4}\right) \log_2\left(\frac{2}{4}\right) - \left(\frac{2}{4}\right) \log_2\left(\frac{2}{4}\right)$$

$$Entropy(cold) = 0.811$$

$$Entropy(mild) = 0.918$$

$$Entropy(hot) = 1.0$$

# Hands-On Labs



## Árbol de decisión ID3

$$Entropy(S) = 0.94$$

A: Temperature	#Play: Yes	# Play: No	Total
Cold	3	1	4
Mild	4	2	6
Hot	2	2	4

$$Gain(S, A) = Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

$$Gain(S, temperature) = 0.94 - \left(\frac{|4|}{14}\right) * Entropy(S_{cold}) - \left(\frac{|6|}{14}\right) * Entropy(S_{mild}) - \left(\frac{|4|}{14}\right) * Entropy(S_{hot})$$

$$Gain(S, temperature) = 0.94 - (0.286) * 0.811 - (0.429) * 0.918 - (0.286) * 1.0$$

$$Gain(S, temperature) = 0.94 - 0.232 - 0.394 - 0.286$$

$$Gain(S, temperature) = 0.028$$

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

### Play Outdoor Sport

Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

$$Entropy(S) = 0.94$$

A: Humidity	#Play: Yes	# Play: No	Total
High	3	4	7
Normal	6	1	7

$$Entropy(high) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(3+, 4 -) = -\left(\frac{3}{7}\right) \log_2\left(\frac{3}{7}\right) - \left(\frac{4}{7}\right) \log_2\left(\frac{4}{7}\right)$$

$$Entropy(normal) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(5+, 2 -) = -\left(\frac{6}{7}\right) \log_2\left(\frac{6}{7}\right) - \left(\frac{1}{7}\right) \log_2\left(\frac{1}{7}\right)$$

$$Entropy(high) = 0.985$$

$$Entropy(normal) = 0.592$$

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

$$Entropy(S) = 0.94$$

A: Humidity	#Play: Yes	# Play: No	Total
High	3	4	7
Normal	6	1	7

$$Gain(S, A) = Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

$$Gain(S, humidity) = 0.94 - \left(\frac{|7|}{14}\right) * Entropy(S_{high}) - \left(\frac{|7|}{14}\right) * Entropy(S_{normal})$$

$$Gain(S, humidity) = 0.94 - (0.5) * (0.985) - (0.5) * (0.592)$$

$$Gain(S, humidity) = 0.94 - 0.493 - (0.296)$$

$$Gain(S, humidity) = 0.151$$

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

### Play Outdoor Sport

Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

$$Entropy(S) = 0.94$$

A: Wind	#Play: Yes	# Play: No	Total
Weak	6	2	8
Strong	3	3	6

$$Entropy(\text{weak}) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(6+, 2-) = -\left(\frac{6}{8}\right) \log_2\left(\frac{6}{8}\right) - \left(\frac{2}{8}\right) \log_2\left(\frac{2}{8}\right)$$

$$Entropy(\text{strong}) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(3+, 3-) = -\left(\frac{3}{6}\right) \log_2\left(\frac{3}{6}\right) - \left(\frac{3}{6}\right) \log_2\left(\frac{3}{6}\right)$$

$$Entropy(\text{strong}) = 1.0$$

$$Entropy(\text{weak}) = 0.811$$

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

$$Entropy(S) = 0.94$$

A: Wind	#Play: Yes	# Play: No	Total
Weak	6	2	8
Strong	3	3	6

$$Gain(S, A) = Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

$$Gain(S, wind) = 0.94 - \left(\frac{|8|}{14}\right) * Entropy(S_{weak}) - \left(\frac{|6|}{14}\right) * Entropy(S_{strong})$$

$$Gain(S, wind) = 0.94 - (0.571) * (0.811) - (0.429) * (1.0)$$

$$Gain(S, wind) = 0.94 - 0.463 - (0.429)$$

$$Gain(S, wind) = 0.048$$

# Hands-On Labs



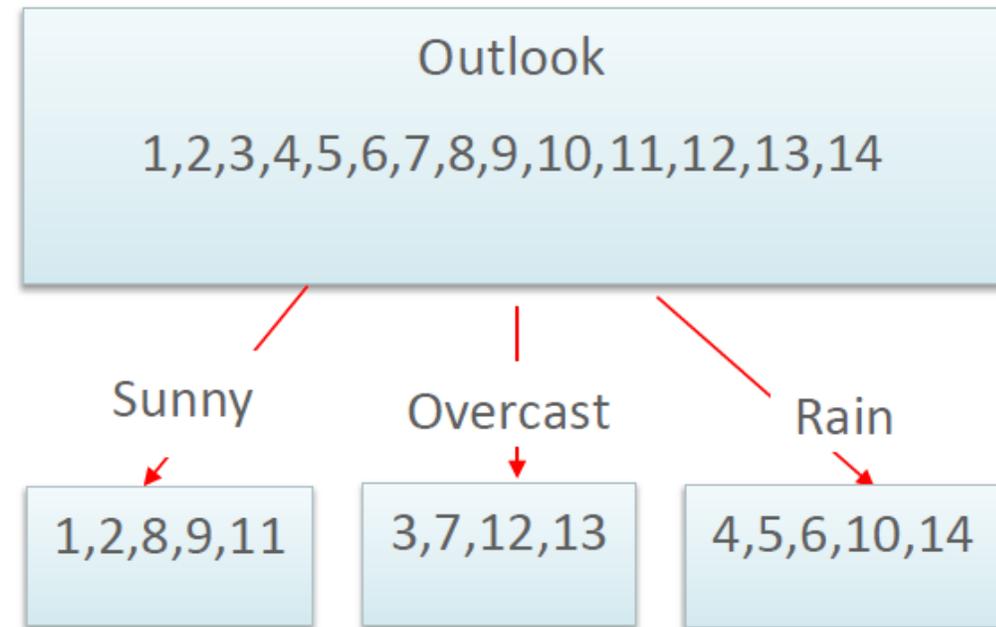
## Árbol de decisión ID3

Gain (S, Outlook)=0.246 ←

Gain (S, Temperature)=0.028

Gain (S, Humidity)=0.151

Gain (S, Wind)=0.048



# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

### Play Outdoor Sport

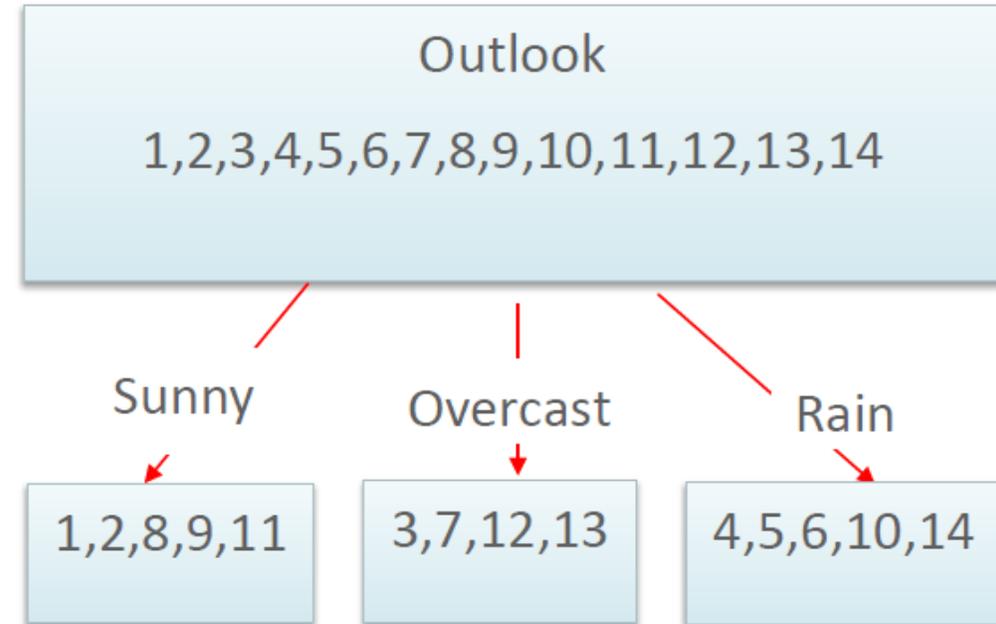
Num	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cold	Normal	Weak	Yes
6	Rain	Cold	Normal	Strong	No
7	Overcast	Cold	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

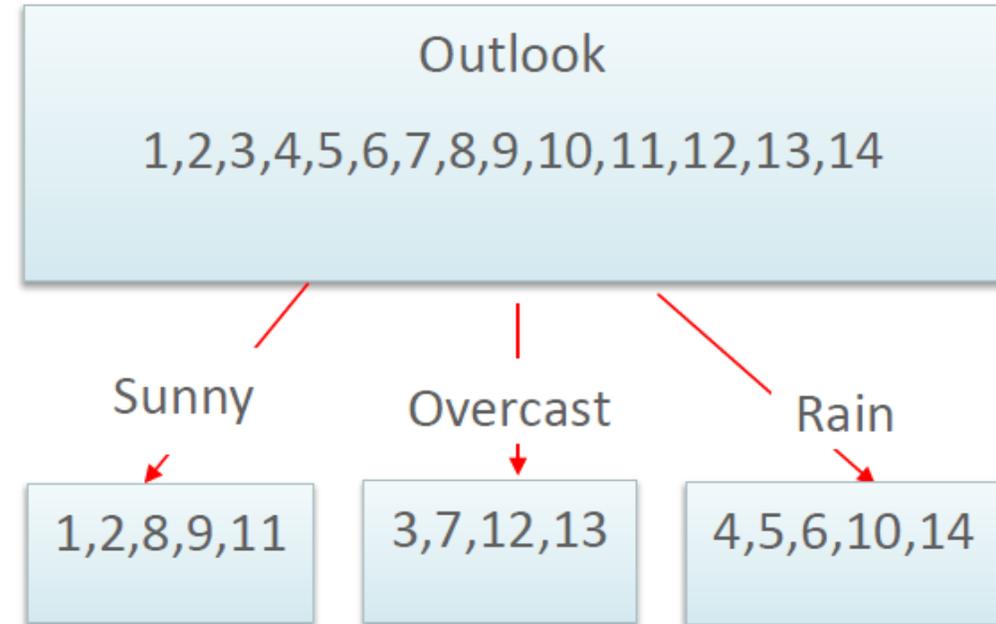


row	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes

# Hands-On Labs



## Árbol de decisión ID3



Row	Outlook	Temperature	Humidity	Wind	Play?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
8	Sunny	Mild	High	Weak	No
9	Sunny	Cold	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes

Row	Temperature	Humidity	Wind	Play?
1	Hot	High	Weak	No
2	Hot	High	Strong	No
8	Mild	High	Weak	No
9	Cold	Normal	Weak	Yes
11	Mild	Normal	Strong	Yes

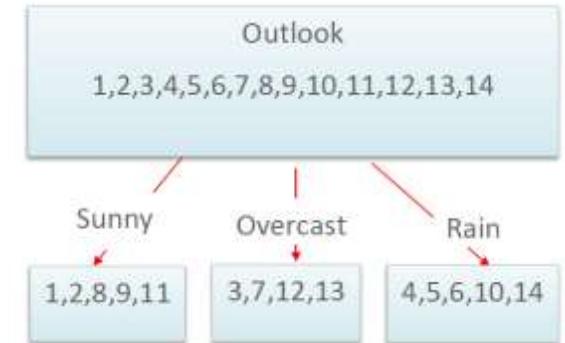
# Hands-On Labs



## Árbol de decisión ID3

¿Qué atributo seleccionamos ahora para continuar bajando por nuestro árbol?

Row	Temperature	Humidity	Wind	Play?
1	Hot	High	Weak	No
2	Hot	High	Strong	No
8	Mild	High	Weak	No
9	Cold	Normal	Weak	Yes
11	Mild	Normal	Strong	Yes



$$Entropy(S) = -p_{yes} \log_2(p_{yes}) - p_{no} \log_2(p_{no})$$

$$Entropy(S) = -\left(\frac{2}{5}\right) * \log_2\left(\frac{2}{5}\right) - \left(\frac{3}{5}\right) * \log_2\left(\frac{3}{5}\right)$$

$$Entropy(S) = 0.971$$

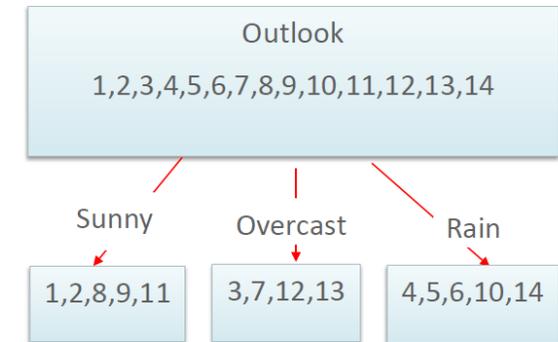
# Hands-On Labs



## Árbol de decisión ID3

¿Qué atributo seleccionamos ahora para continuar bajando por nuestro árbol?

Row	Temperature	Humidity	Wind	Play?
1	Hot	High	Weak	No
2	Hot	High	Strong	No
8	Mild	High	Weak	No
9	Cold	Normal	Weak	Yes
11	Mild	Normal	Strong	Yes



A: Temperature	#Play: Yes	# Play: No	Total
Cold	0	2	2
Mild	1	1	2
Hot	1	0	1

$$Gain(S, temperature) = 0.972 - \left(\frac{|S_{hot}|}{5}\right) * Entropy(S_{hot}) - \left(\frac{|S_{mild}|}{5}\right) * Entropy(S_{mild}) - \left(\frac{|S_{cold}|}{5}\right) * Entropy(S_{cold})$$

$$Gain(S, temperature) = 0.572$$

Y así para el resto de atributos ...

# Hands-On Labs



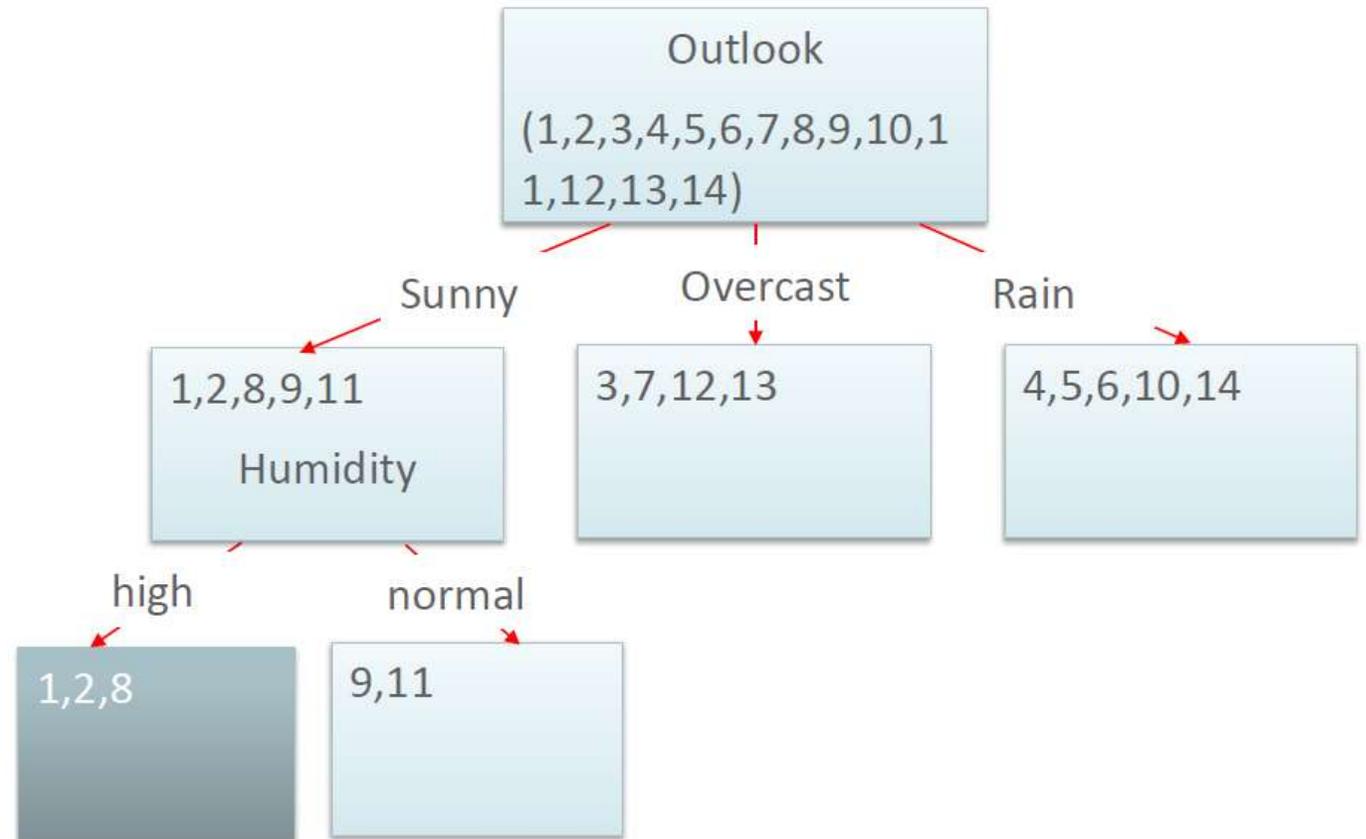
**ORACLE** ACADEMY

## Árbol de decisión ID3

$$\text{Gain}(S, \text{wind}) = 0.021$$

$$\text{Gain}(S, \text{humidity}) = 0.972 \leftarrow$$

$$\text{Gain}(S, \text{temperature}) = 0.572$$

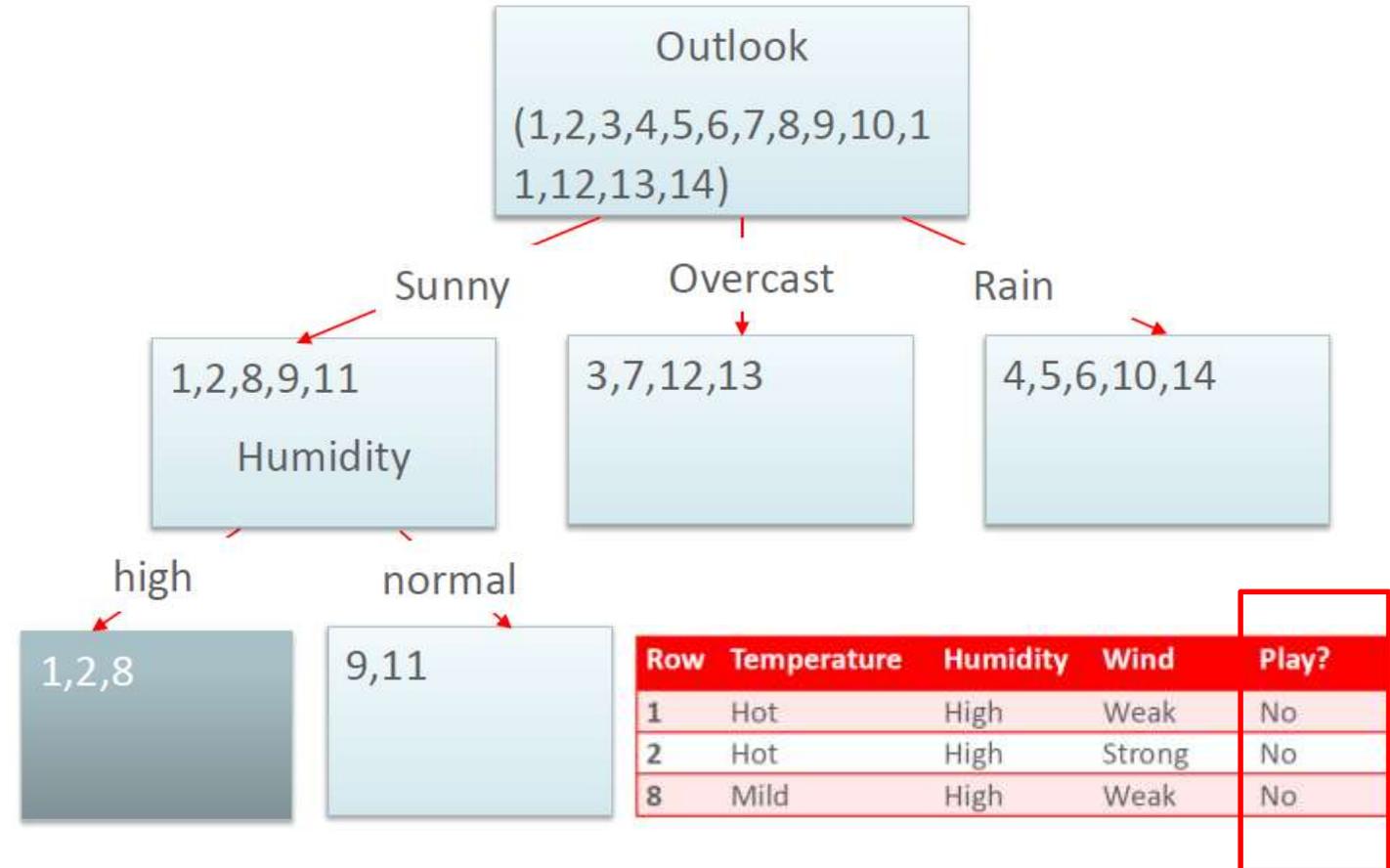


# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

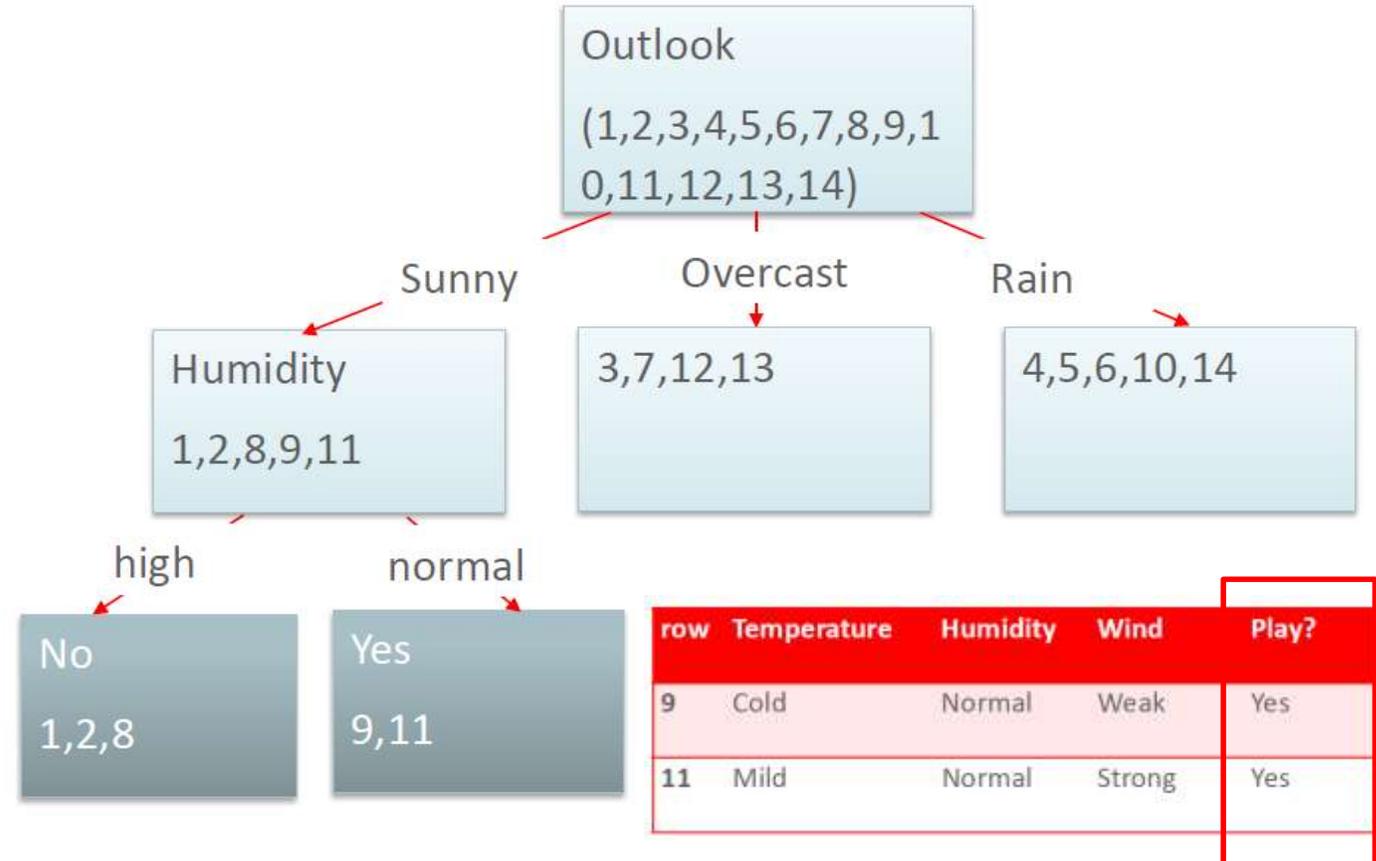


# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

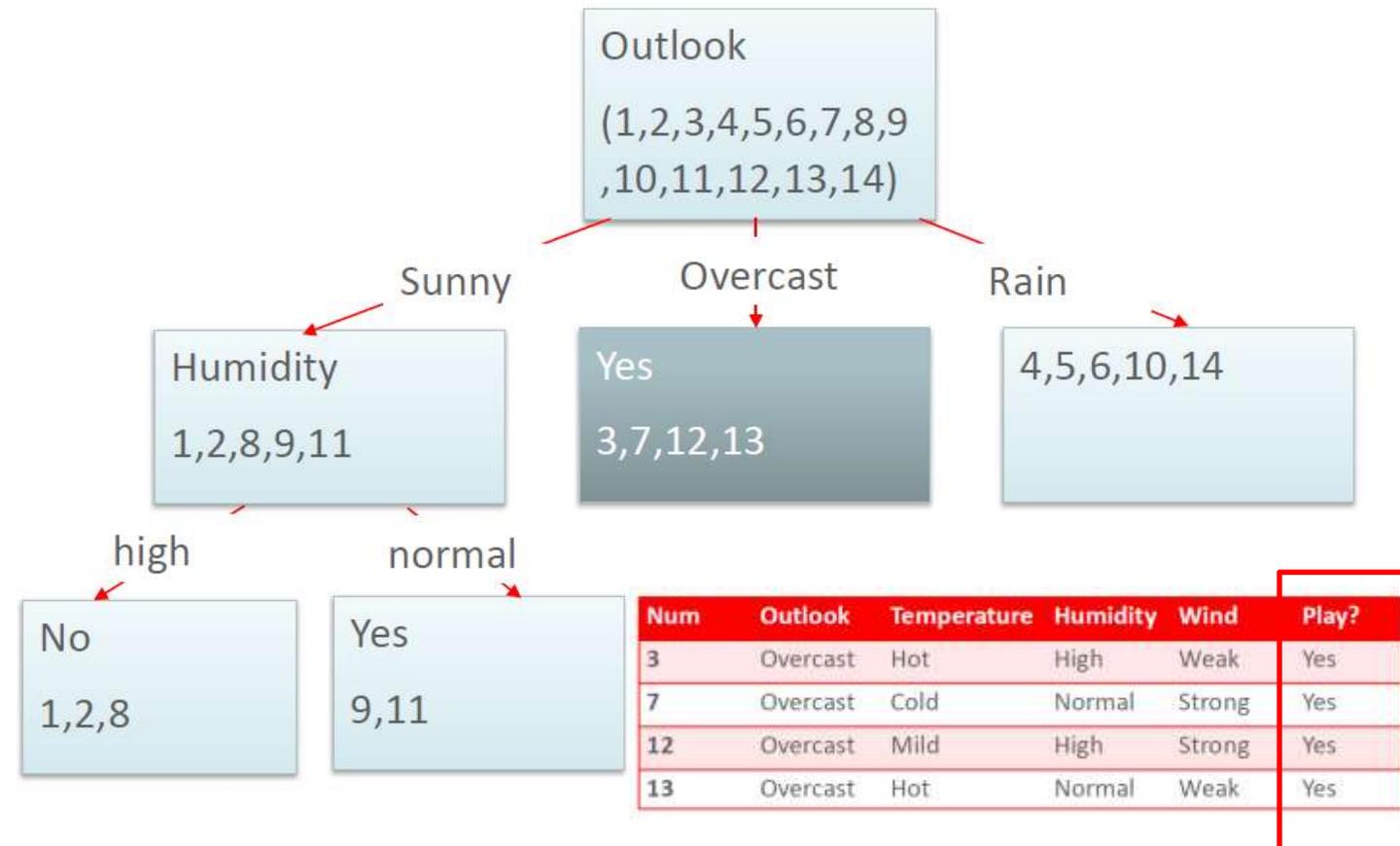


# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3

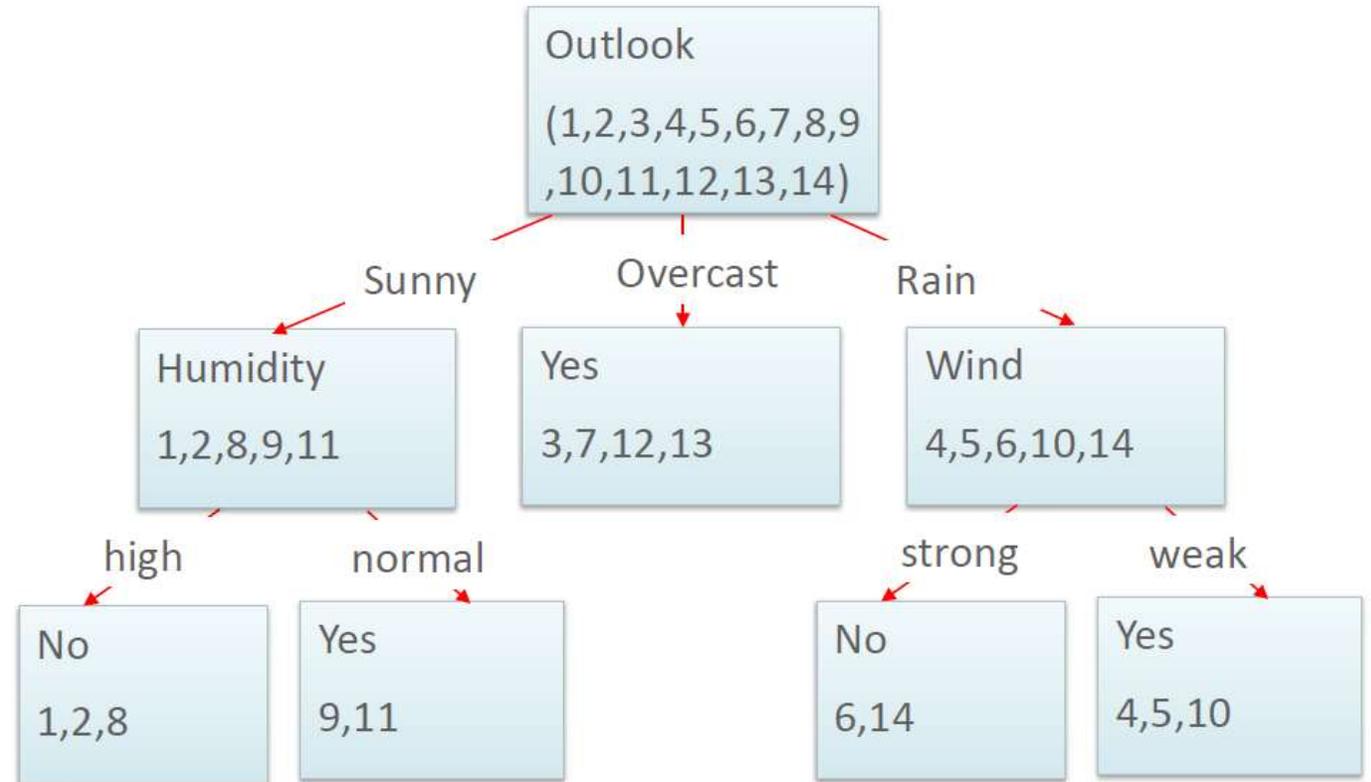


# Hands-On Labs



**ORACLE** ACADEMY

## Árbol de decisión ID3



# Hands-On Labs



ORACLE ACADEMY

## Algoritmo ID3

### ID3



ID3 (Examples, Target\_Attribute, Attributes)

Create a root node for the tree

If all examples are positive, Return the single-node tree Root, with label = +.

If all examples are negative, Return the single-node tree Root, with label = -.

If number of predicting attributes is empty, then Return the single node tree Root, with label = most common value of the target attribute in the examples.

Otherwise Begin

$A \leftarrow$  The Attribute that best classifies examples.

Decision Tree attribute for Root = A.

For each possible value,  $v_i$ , of A,

Add a new tree branch below Root, corresponding to the test  $A = v_i$ .

Let  $\text{Examples}(v_i)$  be the subset of examples that have the value  $v_i$  for A

If  $\text{Examples}(v_i)$  is empty

Then below this new branch add a leaf node with label = most common target value in the examples

Else below this new branch add the subtree ID3 ( $\text{Examples}(v_i)$ , Target\_Attribute, Attributes - {A})

End

Return Root

**No es tan complicado!! Ahora a implementarlo!!**

# Hands-On Labs



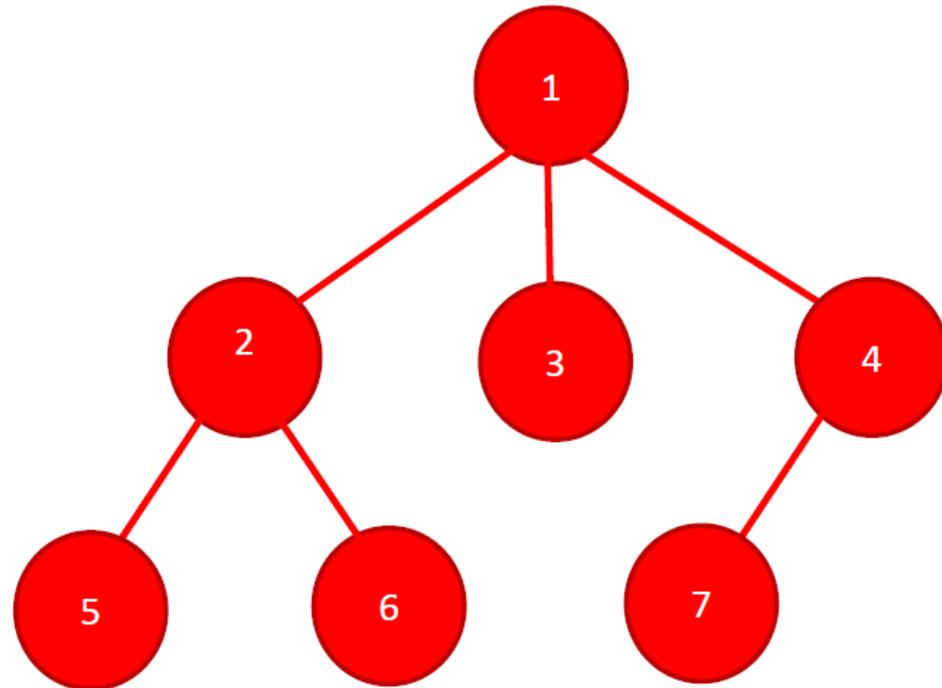
ORACLE ACADEMY

## Tarea final

Implementar el algoritmo de aprendizaje automático ID3.

El correspondiente árbol de decisión será almacenado en una estructura de tipo árbol, que habrá que implementar.

No se trata de un árbol binario, ya que un nodo podrá tener 2 o más nodos hijos.



# Hands-On Labs



**ORACLE** ACADEMY

## Implementar la clase Node

```
public class Node {  
    private List<Node> children = new ArrayList<Node>();  
    private Node parent;  
    private String data;  
    private NodeType type;  
  
    public Node() {  
    }  
  
    public Node(String data) {  
        setdata(data);  
    }  
}
```

```
public enum NodeType {  
    ROOTNODE,  
    LEAFNODE,  
    BRANCH  
}
```

# Hands-On Labs



**ORACLE** ACADEMY

## Implementar la clase Tree

```
public class Tree {
    private Node root;

    public Node getRoot() {
        return this.root;
    }

    public void setRoot(Node root) {
        this.root = root;
    }

    public boolean isEmpty() {
        return (root == null);
    }

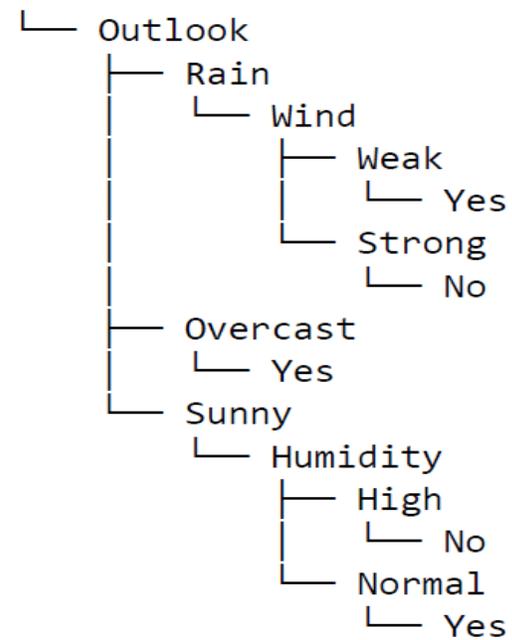
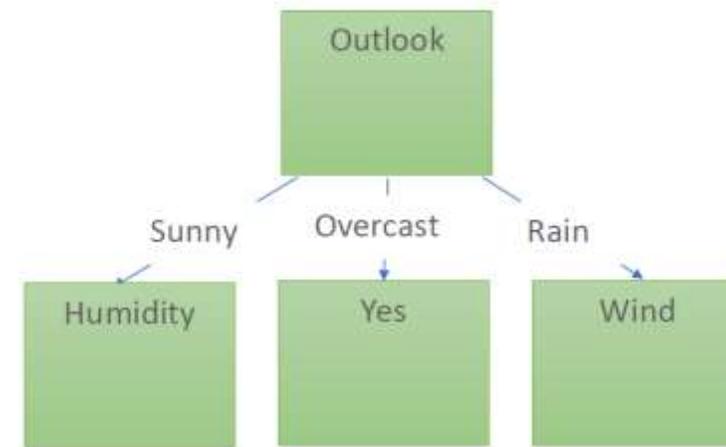
    public void print() {
        root.print("", true);
    }
}
```

# Hands-On Labs



**ORACLE** ACADEMY

## Implementar la clase Tree



# Hands-On Labs



**ORACLE** ACADEMY

## Weka 3: Machine Learning Software

```
@relation Weather
```

```
@attribute Outlook {Sunny, Overcast, Rain}
```

```
@attribute Temperature {Hot, Mild, Cold}
```

```
@attribute Humidity {High, Normal}
```

```
@attribute Wind {Weak, Strong}
```

```
@attribute Play {Yes, No}
```



weather.arff

```
@data
```

```
Sunny,Hot,High,Weak,No
```

```
Sunny,Hot,High,Strong,No
```

```
Overcast,Hot,High,Weak,Yes
```

```
Rain,Mild,High,Weak,Yes
```

```
Rain,Cold,Normal,Weak,Yes
```

```
Rain,Cold,Normal,Strong,No
```

```
Overcast,Cold,Normal,Strong,Yes
```

```
Sunny,Mild,High,Weak,No
```

```
Sunny,Cold,Normal,Weak,Yes
```

```
Rain,Mild,Normal,Weak,Yes
```

```
Sunny,Mild,Normal,Strong,Yes
```

```
Overcast,Mild,High,Strong,Yes
```

```
Overcast,Hot,Normal,Weak,Yes
```

```
Rain,Mild,High,Strong,No
```

# Hands-On Labs



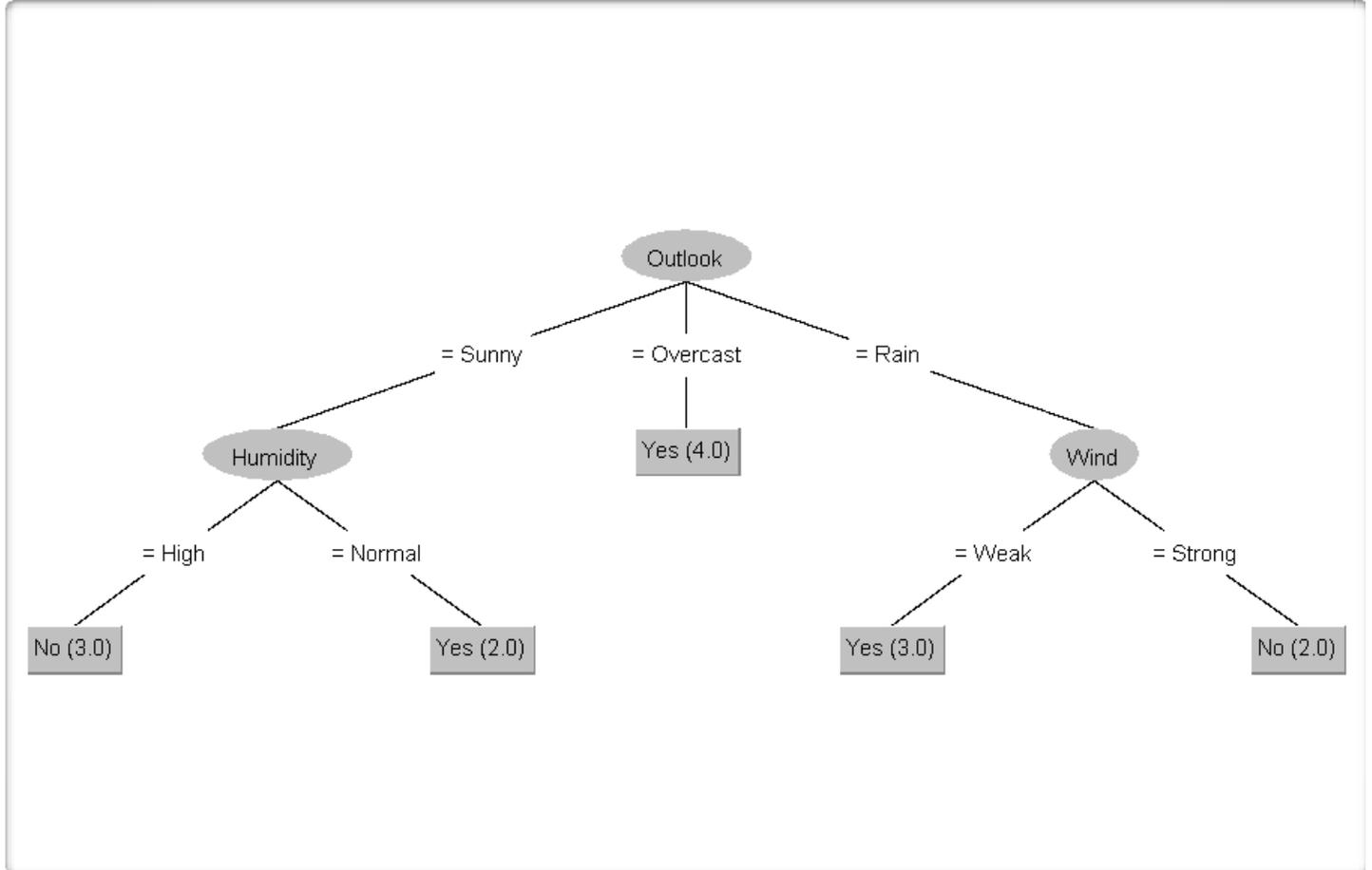
**ORACLE** ACADEMY

**PUE ACADEMY** Day

## Weka 3: Machine Learning Software

Weka Classifier Tree Visualizer: 16:32:27 - trees.J48 (weather)

Tree View



=== Summary ===

Correctly Classified Instances	14	100	%
Incorrectly Classified Instances	0	0	%

# Hands-On Labs



**ORACLE** ACADEMY

## Weka 3: Machine Learning Software

```
=== Run information ===
```

```
Scheme:      weka.classifiers.trees.J48 -C 0.25 -M 2
Relation:    weather
Instances:   14
Attributes:  5
```

```
Outlook
Temperature
Humidity
Wind
Play
```

```
Test mode:   evaluate on training data
```

```
Outlook = Sunny
| Humidity = High: No (3.0)
| Humidity = Normal: Yes (2.0)
Outlook = Overcast: Yes (4.0)
Outlook = Rain
| Wind = Weak: Yes (3.0)
| Wind = Strong: No (2.0)
```

```
Number of Leaves :      5
```

```
Size of the tree :      8
```

```
Time taken to build model: 0.01 seconds
```

# Hands-On Labs



## Weka 3: Machine Learning Software

```
@relation Titanic-Passengers
```

```
@attribute Class {"1st", "2nd", "3rd", "crew"}
```

```
@attribute Age {"Adult", "Child"}
```

```
@attribute Sex {"Male", "Female"}
```

```
@attribute Survived {"Yes", "No"}
```



titanic.arff

```
@data
```

```
1st,Adult,Male,Yes
```

```
1st,Adult,Male,No
```

```
...
```

# Hands-On Labs



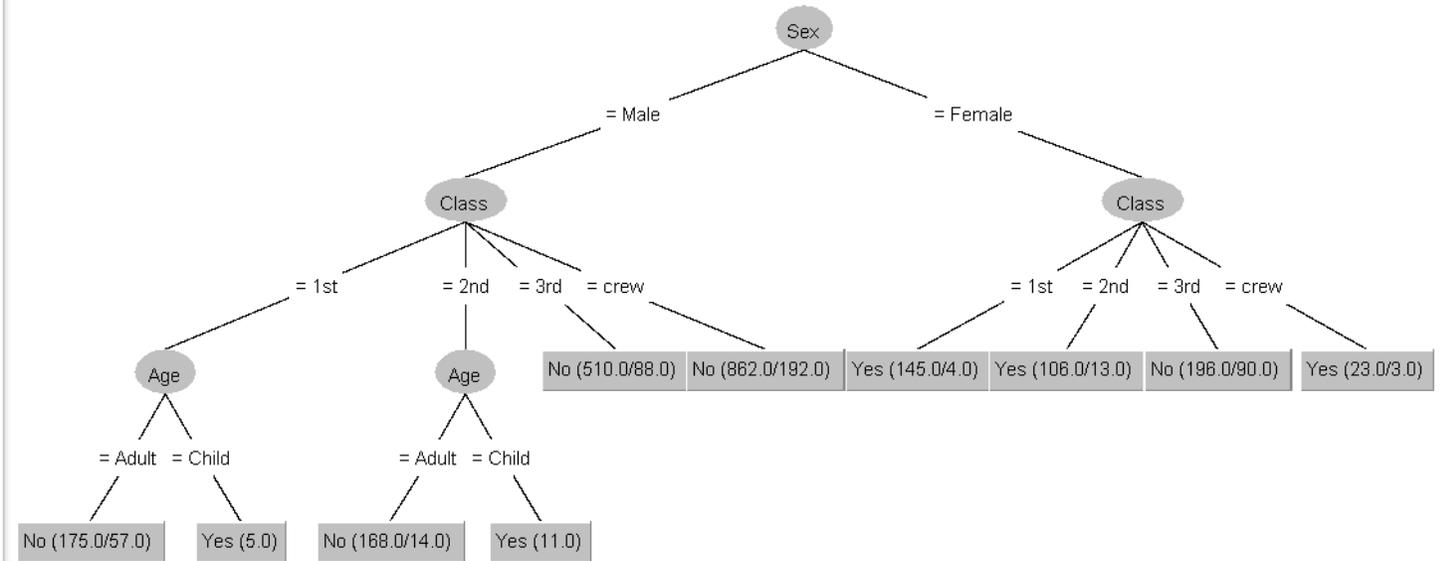
**ORACLE** ACADEMY

**PUE ACADEMY** Day

## Weka 3: Machine Learning Software

Weka Classifier Tree Visualizer: 16:48:26 - trees.J48 (Titanic-Passengers)

Tree View



=== Summary ===

Correctly Classified Instances	1740	79.055 %
Incorrectly Classified Instances	461	20.945 %

# Hands-On Labs



**ORACLE** ACADEMY

## Weka 3: Machine Learning Software

```
=== Run information ===
```

```
Scheme:          weka.classifiers.trees.J48 -C 0.25 -M 2
Relation:        Titanic-Passengers
Instances:       2201
Attributes:      4
                 Class
                 Age
                 Sex
                 Survived
Test mode:       evaluate on training data
```

```
Sex = Male
| Class = 1st
| | Age = Adult: No (175.0/57.0)
| | Age = Child: Yes (5.0)
| Class = 2nd
| | Age = Adult: No (168.0/14.0)
| | Age = Child: Yes (11.0)
| Class = 3rd: No (510.0/88.0)
| Class = crew: No (862.0/192.0)
Sex = Female
| Class = 1st: Yes (145.0/4.0)
| Class = 2nd: Yes (106.0/13.0)
| Class = 3rd: No (196.0/90.0)
| Class = crew: Yes (23.0/3.0)
```

```
Number of Leaves :    10
```

```
Size of the tree :    15
```

# Hands-On Labs



**ORACLE** ACADEMY

**PUE ACADEMY** Day

## Weka 3: Machine Learning Software



Test mode:      10-fold cross-validation

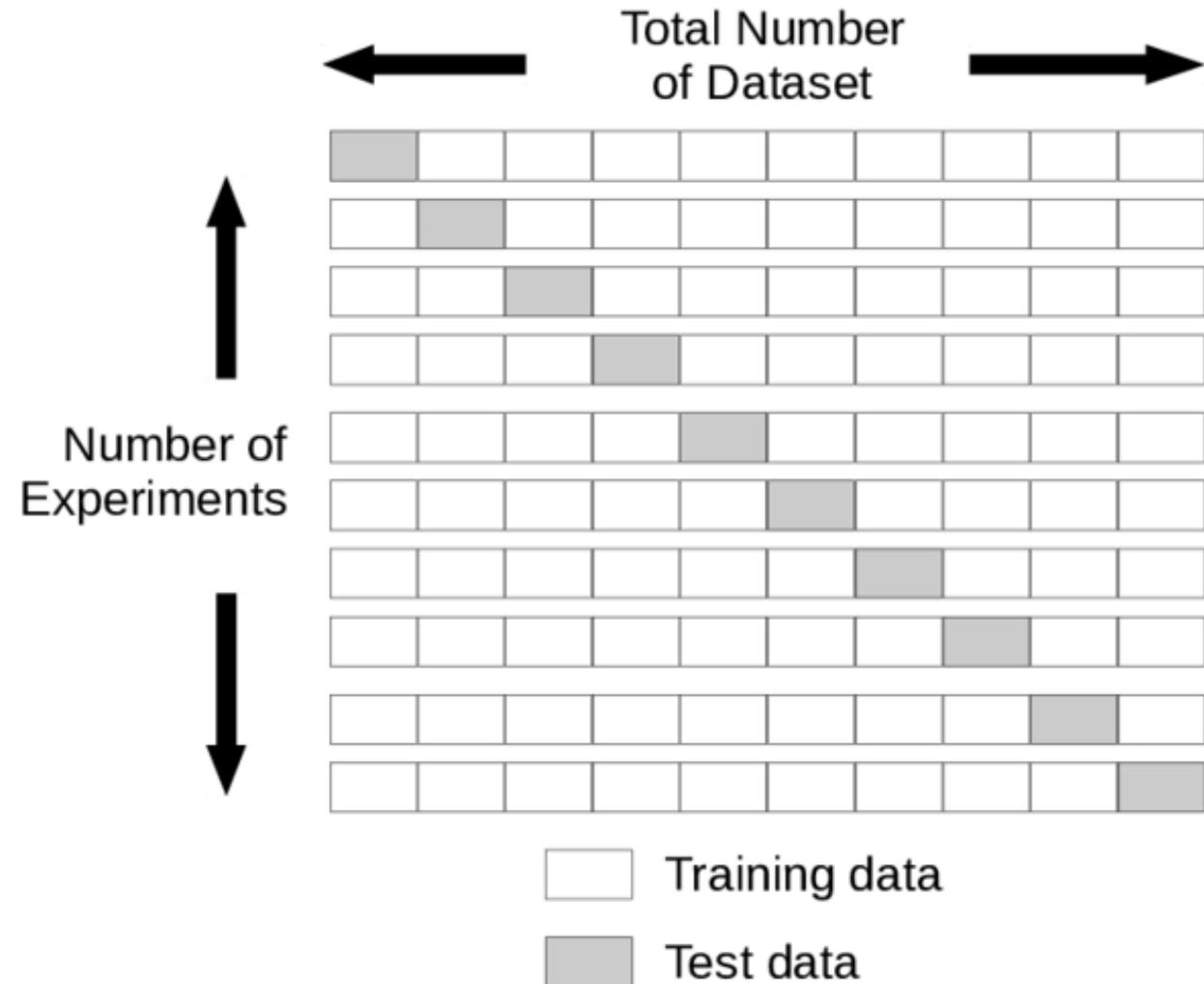
Correctly Classified Instances	9	64.2857 %
Incorrectly Classified Instances	5	35.7143 %

# Hands-On Labs



**ORACLE** ACADEMY

## Weka 3: Machine Learning Software





# ¡Muchas gracias!

[jordi.arino@pue.es](mailto:jordi.arino@pue.es)  
[@jordiAS2K](https://twitter.com/jordiAS2K)



#PUEAcademyDay19



# ¿Alguna pregunta?

[www.pue.es/oracle-academy](http://www.pue.es/oracle-academy)  
[pueacademy@pue.es](mailto:pueacademy@pue.es)



#PUEAcademyDay19

**ORACLE<sup>®</sup>**

**ACADEMY**

# PUE

## ACADEMY Day

[www.pue.es](http://www.pue.es)

# ¡Gracias!

 #PUEAcademyDay19

 pueacademy@pue.es

 BCN: 93 206 02 49

 MAD: 91 162 06 69



#### PROGRAMAS EDUCATIVOS



Microsoft Imagine Academy



#### PROGRAMAS DE CERTIFICACIÓN

