Data Science

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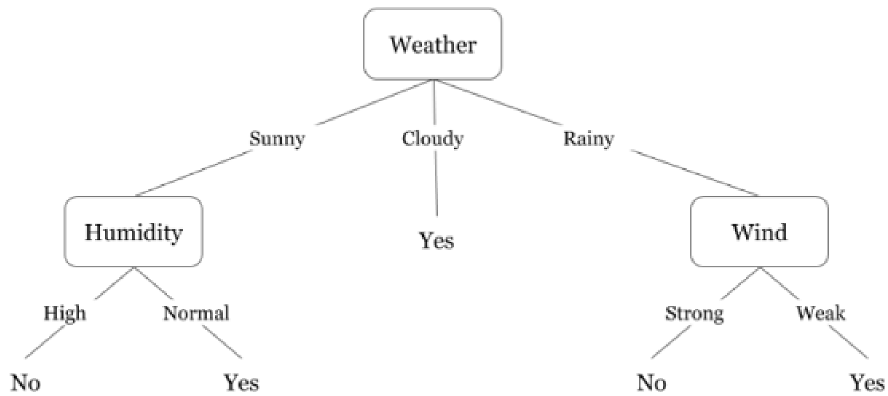
Assignment 1

Q_1 Explain the use of decision trees in data science.

Answer. Decision trees are a fundamental tool in the field of data science. They are versatile and intuitive machine learning algorithms used for both *classification* and *regression* tasks. Decision trees work by recursively splitting the dataset into subsets based on the most significant attribute at each node. These splits create a tree-like structure of decisions, where each internal node represents a decision based on a specific feature, and each leaf node represents the predicted outcome.

- **Decision Making:** Decision trees are excellent for decision-making processes. They allow data scientists to visualize decisions and understand the implications of each choice.
- **Feature Importance:** By evaluating which features are used for splitting nodes, data scientists can prioritize features for further analysis.
- **Non-Linear Relationships:** Decision trees can capture non-linear relationships between features and the target variable. Unlike linear models, decision trees can model complex patterns in the data.
- **Handling Missing Values:** Decision trees can handle missing values in the dataset. They can make decisions even if some values are missing for certain features.
- **Interpretability:** Decision trees are easy to interpret and explain to non-experts. The visual representation of a tree structure simplifies complex decision-making processes.
- **Ensemble Methods:** Decision trees serve as the building blocks for powerful ensemble methods like Random Forest and Gradient Boosting. These methods combine multiple decision trees to improve predictive performance.

An example of a decision tree is shown below.



Q_2 Take any real-life problem related to data science and solve it using a decision tree to solve in *Python*.

Answer. We can use Decision Tree classification to predict the labels from the Pima Indians Diabetes Database[1].

Source Code:

```
# Load libraries
import pandas as pd
from sklearn.tree import DecisionTreeClassifier  # Decision Tree Classifier
from sklearn.model_selection import train_test_split  # train_test_split function
from sklearn import metrics # scikit-learn metrics module for accuracy calculation

# Loading the Dataset
col_names = [ "pregnant", "glucose", "bp", "skin", "insulin",
             "bmi", "pedigree", "age", "label" ]
pima = pd.read_csv("diabetes.csv", header=None, names=col_names)
pima.head()

# split dataset in features and target variable
feature_cols = ["pregnant", "insulin", "bmi", "age", "glucose", "bp", "pedigree"]
X = pima[feature_cols]  # Features
y = pima.label  # Target variable
```

[1] https://www.kaggle.com/datasets/uciml/pima-indians-diabetes-database

```
# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.3, random_state=1
)  # 70% training and 30% test

# Create Decision Tree classifer object
clf = DecisionTreeClassifier()

# Train Decision Tree Classifer
clf = clf.fit(X_train, y_train)

# Predict the response for test dataset
y_pred = clf.predict(X_test)

# Model Accuracy, how often is the classifier correct?
print("Accuracy:", metrics.accuracy_score(y_test, y_pred))
```

Output:

	pregnant	glucose	bp	skin	insulin	bmi	pedigree	age	label
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

```
Accuracy: 0.6753246753246753
```

Assignment 2

Q_1 Explain the use of prediction and classification in data science.

Answer. Prediction and **Classification** are two fundamental tasks used to extract meaningful insights from data and make informed decisions.

Prediction in Data Science:

Prediction involves estimating the value of an unknown variable based on the available data. It is widely used in various fields, including finance, weather forecasting, and sports analytics. In data science, predictive modeling helps in understanding patterns and trends within the data to forecast future outcomes.

Techniques for Prediction:

1. **Linear Regression:** It predicts a continuous numerical value based on the relationship between variables. *Example:* Predicting house prices based on features like area, number of bedrooms, and location.
2. **Decision Trees:** These are tree-like structures that make decisions based on asking a series of questions. *Example:* Predicting whether a customer will buy a product based on their demographic information and past purchase history.
3. **Neural Networks:** Deep learning algorithms that learn complex patterns in data. *Example:* Predicting stock prices based on historical market data and external factors.

Classification in Data Science:

Classification involves assigning predefined labels or categories to data points based on their features. It is used in applications like spam email detection, image recognition, and sentiment analysis. Classification algorithms help in identifying patterns within the data to categorize new, unseen data points.

Techniques for Classification:

1. **Logistic Regression:** Despite its name, it is used for binary classification problems, predicting either of two classes. *Example:* Classifying emails as spam or non-spam based on their content and sender information.

2. **Random Forest:** An ensemble learning method that builds multiple decision trees and merges their predictions. *Example:* Classifying customer feedback into positive, negative, or neutral categories based on the text content.

3. **Support Vector Machines (SVM):** It finds the best hyperplane that separates different classes in high-dimensional space. *Example:* Classifying handwritten digits (0 to 9) in image recognition tasks.

Both prediction and classification techniques are crucial in data science and often overlap. For instance, in a customer churn prediction scenario for a tech company, you can use predictive modeling to estimate the likelihood of a customer leaving (prediction) and then classify them as 'churn' or 'no churn' based on a predefined threshold (classification).

Hence, **Prediction** focuses on estimating numerical values, while **classification** assigns labels or categories to data points. Understanding these concepts and employing appropriate techniques empower data scientists to make accurate predictions and informed decisions, making a significant impact on various fields, including technology and beyond.

Q_2 Write a program for text summarization using python.

Answer. We can use the NLTK[2] library for text summarization.

Source Code:

```
# Importing the libraries
import nltk

nltk.download("stopwords")
nltk.download("punkt")

from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize, sent_tokenize

# Input text - to summarize
text = """..."""

# Tokenizing the text
stopWords = set(stopwords.words("english"))
words = word_tokenize(text)

# Creating a frequency table to keep the score of each word
freqTable = dict()
for word in words:
    word = word.lower()
    if word in stopWords:
        continue
    if word in freqTable:
        freqTable[word] += 1
    else:
        freqTable[word] = 1

# Creating a dictionary to keep the score
# of each sentence
sentences = sent_tokenize(text)
sentenceValue = dict()

for sentence in sentences:
```

[2] https://www.nltk.org/

```
    for word, freq in freqTable.items():
        if word in sentence.lower():
            if sentence in sentenceValue:
                sentenceValue[sentence] += freq
            else:
                sentenceValue[sentence] = freq


sumValues = 0
for sentence in sentenceValue:
    sumValues += sentenceValue[sentence]

# Average value of a sentence from the original text
average = int(sumValues / len(sentenceValue))

# Storing sentences into our summary.
summary = ""
for sentence in sentences:
    if (sentence in sentenceValue) and (sentenceValue[sentence] > (1.2 * average)):
        summary += " " + sentence

# Logging the summary
print(summary)
```

Input Text:

Metroidvania is a sub-genre of action-adventure games and/or platformers focused on guided non-linearity and utility-gated exploration and progression. The term is a portmanteau of the names of the video game series Metroid and Castlevania, based on the template from Metroid (1986), Castlevania II (1987), Super Metroid (1994), and Castlevania: Symphony of the Night (1997).

These games usually feature a large interconnected world map the player can explore, although parts of the world will be inaccessible to the player until they acquire special items, tools, weapons, abilities, or knowledge within the game. Acquiring such improvements can also aid the player in defeating more difficult enemies and locating shortcuts and secret areas, and often includes retracing one's steps across the map. Through this, Metroidvania games include tighter integration of story and level design, careful design of levels and character controls to encourage exploration and experimentation, and a means for the player to become more invested in their player character through role-playing game elements. While early examples were usually two-dimensional side-scrolling platform games, the term has since been applied to top-down and 3D games.

The first Metroid game in 1986 established principles of the non-linear platformer that were refined through multiple iterations, with Super Metroid in 1994 considered to have polished the style of gameplay core to Metroidvanias. Castlevania: Symphony of the Night in 1997 is considered the defining Metroidvania game, incorporating role-playing game elements from The Legend of Zelda series with non-linear traversal within the Castlevania series; most subsequent Castlevania games followed its approach and refined the genre. Symphony of the Night's assistant director, Koji Igarashi, is credited with establishing key principles of Metroidvanias through his work on other Castlevania games. In the 2010s, a resurgence in Metroidvanias came about due to several critically praised, independently developed games.

Output Summary:

Castlevania: Symphony of the Night in 1997 is considered the defining Metroidvania game, incorporating role-playing game elements from The Legend of Zelda series with non-linear traversal within the Castlevania series; most subsequent Castlevania games followed its approach and refined the genre.