PREDICTION OF COLOMBIAN STUDENTS' ACADEMIC SUCCESS USING DECISION TREES ALGORITHMS

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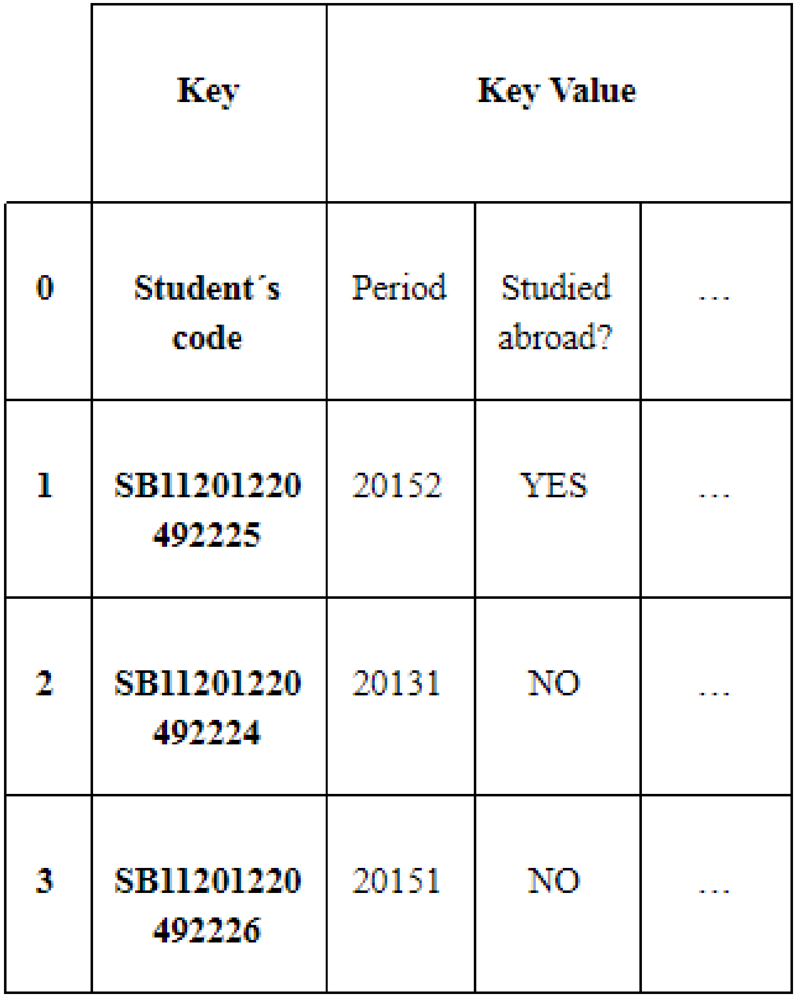
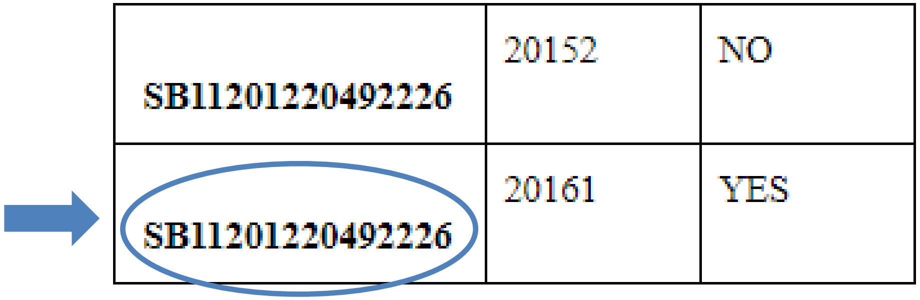
Designed Data Structure
1. Data Frame

Figure 1: Data Frame of students and their information. The student’s code is the key and all information such as ID, age, genre is they key value.



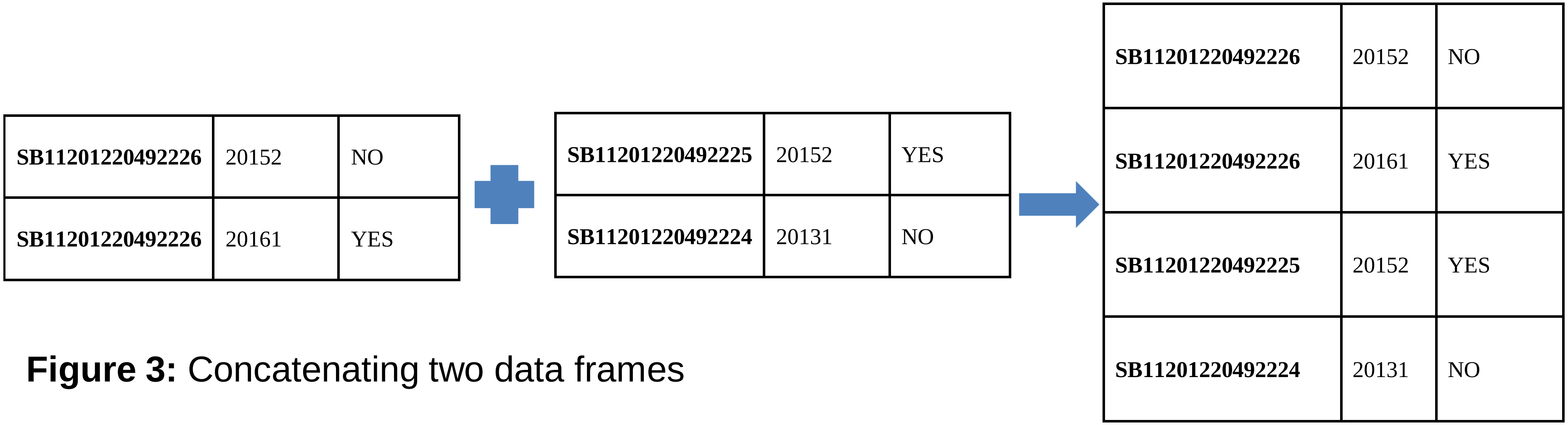
	Key	**Key Value**		
0	**Student´s code**	Period	Studied abroad?	…
1	**SB11201220 492225**	20152	YES	…
2	**SB11201220 492224**	20131	NO	…
3	**SB11201220 492226**	20151	NO	…

Operations



SB11201220492226	20152	NO
SB11201220492226	20161	YES

Figure 2: Information access operation



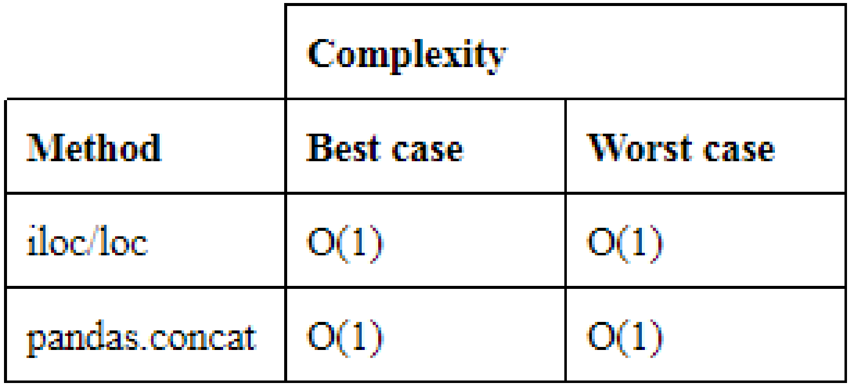
SB11201220492226	20152	NO
SB11201220492226	20161	YES

SB11201220492225	20152	YES
SB11201220492224	20131	NO

SB11201220492226	20152	NO
SB11201220492226	20161	YES
SB11201220492225	20152	YES
SB11201220492224	20131	NO

Figure 3: Concatenating two data frames

Time and Complexity Analysis



	Complexity	
Method	Best case	Worst case
iloc/loc	O(1)	O(1)
pandas.concat	O(1)	O(1)

Table 1: Complexity of some operations in Data Frame

Structure	Data Frame
Space	59869502 bytes-539116653 bytes
Time of creation	0.41s-4.43s
Time of access	0.000216s-0.000648s
Time of concatenation	0.75s-0.80s

Table 2: Results analysis

Design Criteria

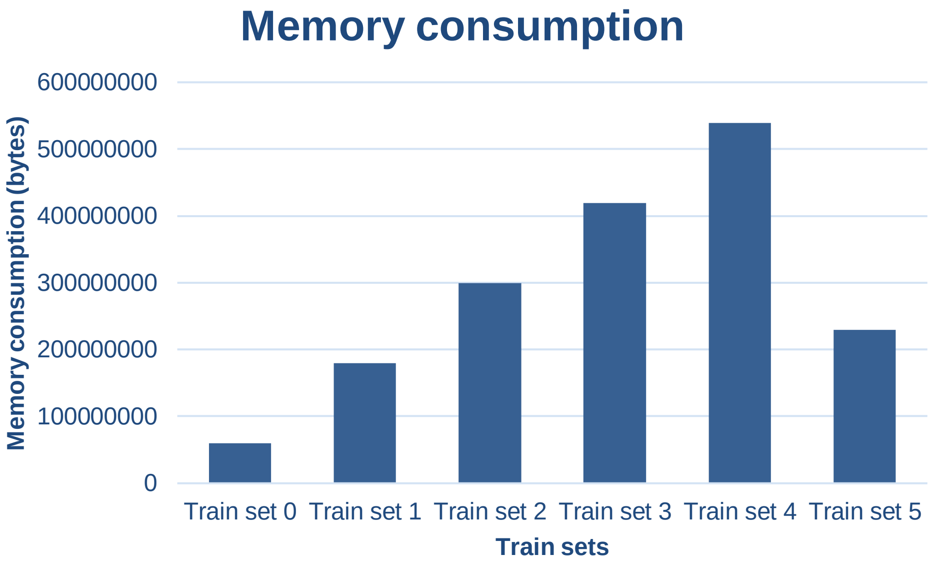
- Since the format of the input data is a matrix, it is very convenient to store it in a table-like structure.

- Data frames allow storing different data types.

- One of the most used data structures when working with big data and AI.

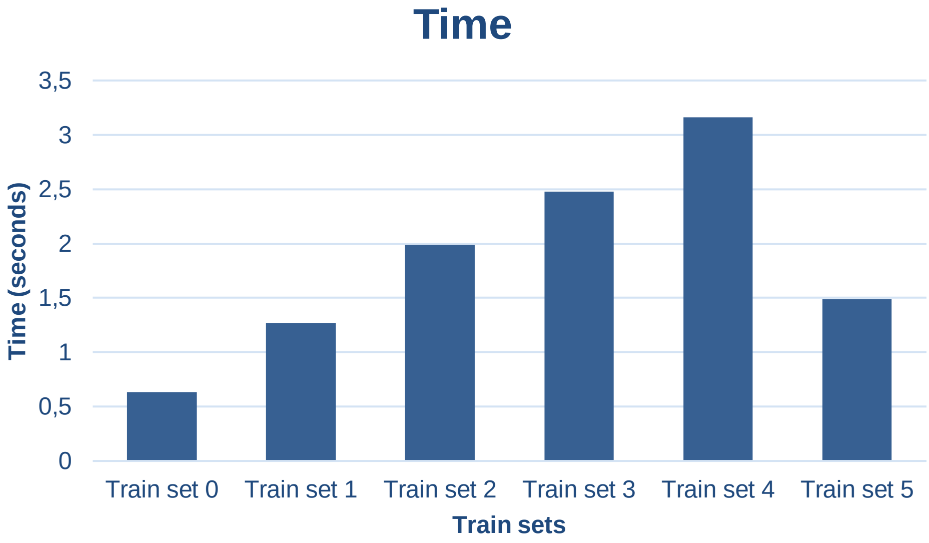
- Efficient and easy way of organizing and managing a large volume of information.

Time and Memory Consumption



Graph 2: Memory consumption of the data

Graph 1: Time taken to create the data frame



Designed Data Structure
2. Binary Decision Tree

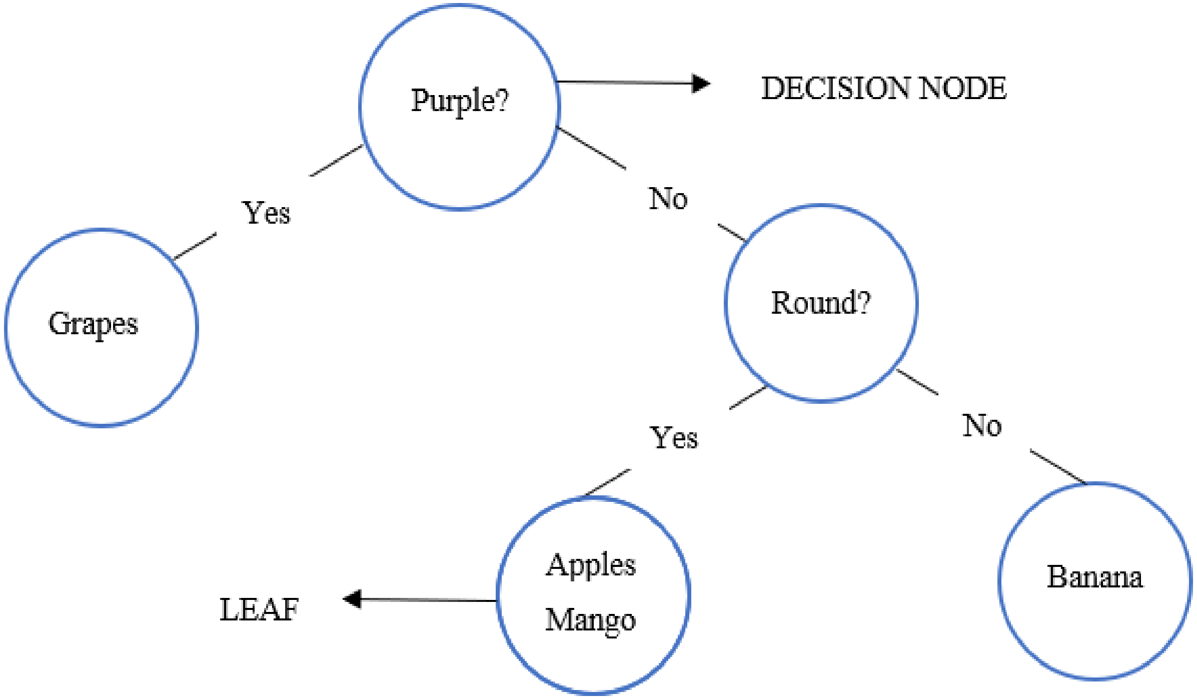


Figure 3: Binary Decision Tree.

Data Structure Operations

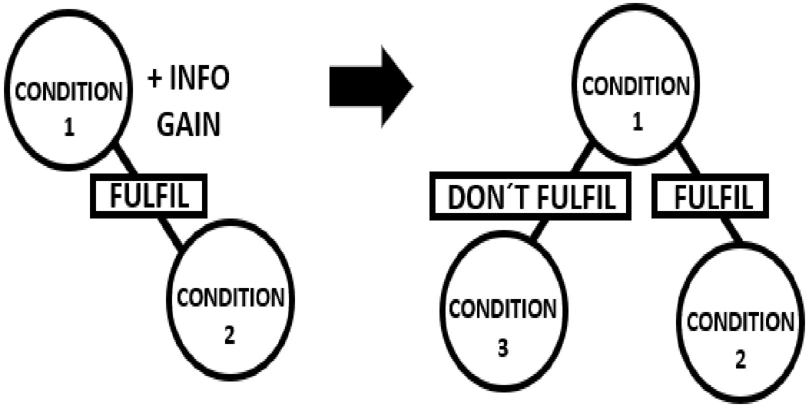


Figure 3: Creation of a binary decision tree

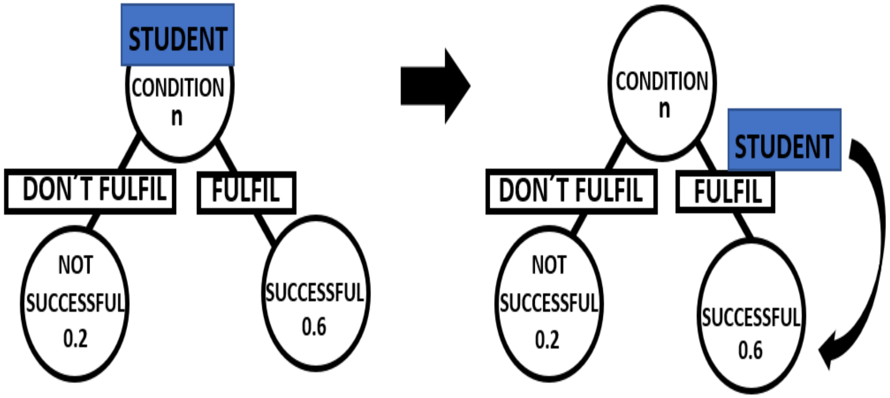


Figure 4: Classifying a student

Time and Complexity Analysis

	Complexity	
Operation	**Average case**	**Worst case**
Creation	$O(2^x * n * m)$	$O(2^x * n * m)$
Classify	$O(\log_2 n)$	$O(\log_2 n)$

Table 3: Complexity of the decision tree's operations.

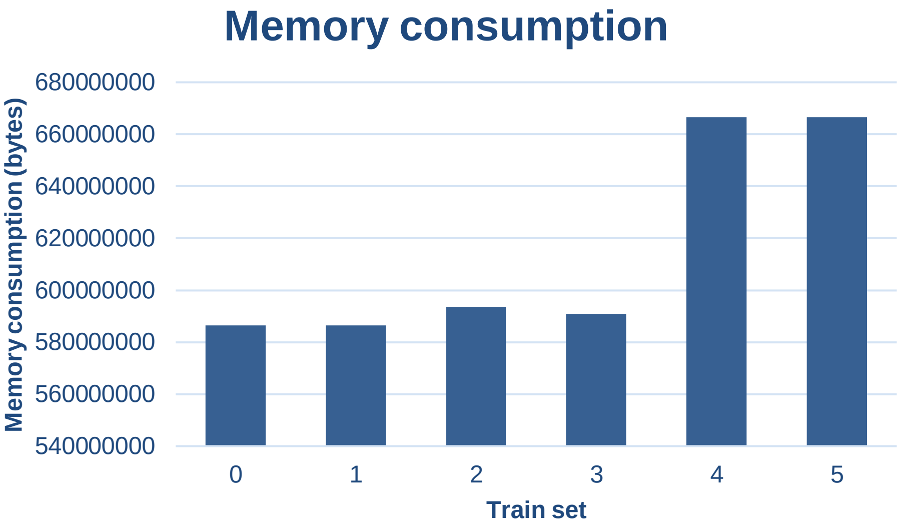
Structure	**Binary Decision Tree**
Space	586452992-666603520 bytes
Time of creation	253.796-813.418 s
Time of classifying	0.706-2.148s

Table 4: Results analysis.

Design Criteria

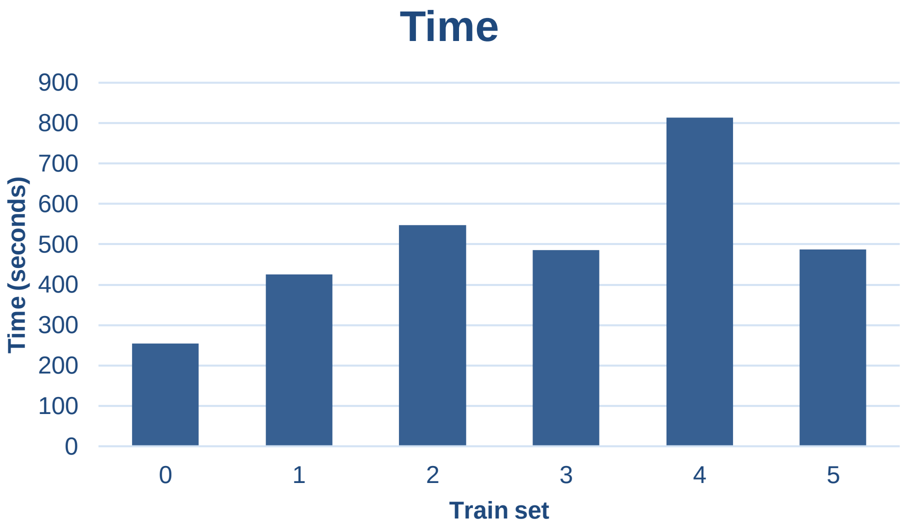
- CART is the latest, most used decision tree algorithm with C5.
- Consumes less memory and has a lower probability of misclassification than C5.0.

Time and Memory Consumption

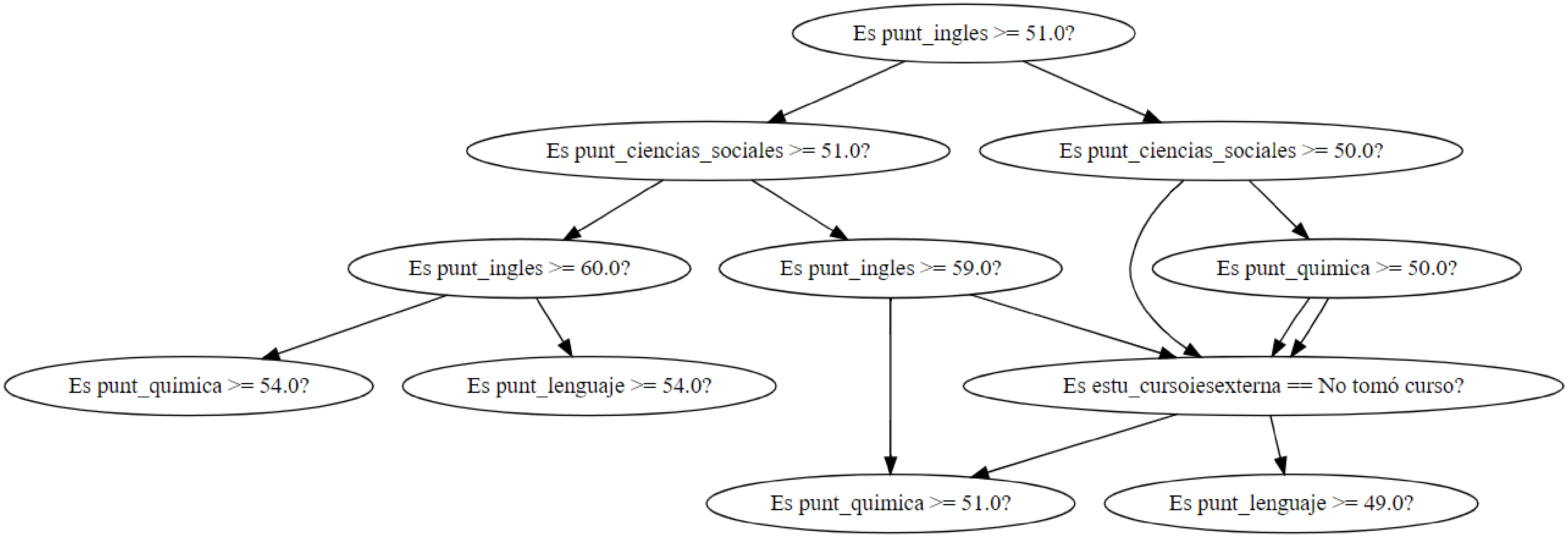


Graph 4: Memory consumption of the data

Graph 3: Time taken to create the decision tree



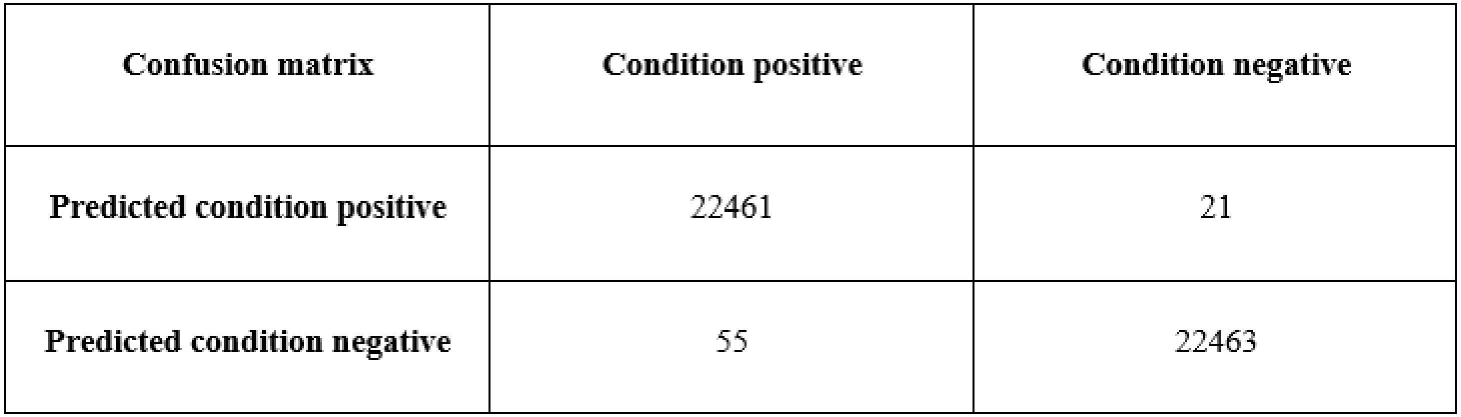
Implementation


Es punt_ingles >= 51.0?
Es punt_ciencias_sociales >= 51.0?
Es punt_ciencias_sociales >= 50.0?
Es punt_ingles >= 60.0?
Es punt_ingles >= 59.0?
Es punt_quimica >= 50.0?
Es punt_quimica >= 54.0?
Es punt_lenguaje >= 54.0?
Es estu_cursoiesexterna == No tomó curso?
Es punt_quimica >= 51.0?
Es punt_lenguaje >= 49.0?

Implementation

GitHub link: https://github.com/jrestrepot/ST0245-032/blob/master/proyecto/codigo/proyecto_final_datos1.py

Accuracy percentage: 99.8%



Confusion matrix	Condition positive	Condition negative
Predicted condition positive	22461	21
Predicted condition negative	55	22463

Table 5 : Time taken to create the decision tree

Applications

- Universities can use it to easily recognize excellent students and contact them for admission or scholarship processes.

- Also can be used to predict which active students are more likely to have a low score on their exam so they can provide them with special attention.

- Can be applied by the government to reinforce aspects in the educational system.