

<https://doi.org/10.23913/ride.v14i28.1872>

*Scientific articles*

## **El uso del prompt de ChatGPT como asistente en la educación**

*The use of Chat GPT prompt as an assistant in education*

*Usando o prompt ChatGPT como asistente educacional*

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## Resumen

La inteligencia artificial (IA) ha emergido como una tecnología revolucionaria que ha transformado muchos aspectos de nuestra vida diaria, incluso de la educación. Por ello, la presente investigación tiene como objetivo proponer una sintaxis de aplicación detallada del *prompt* y de los comandos que se deben proporcionar a ChatGPT para la realización de diferentes actividades académicas. Para este fin, se ha concebido a ChatGPT como una herramienta de asistencia en la educación, ya que se encuentra estrechamente vinculada con distintos lenguajes de programación, como lo son C y Python. Además, se presentan ejemplos concretos que muestran la aplicación de estos comandos, los cuales han sido explicados de manera minuciosa para disminuir el margen de error en los resultados obtenidos. En relación con los programas que ChatGPT ha proporcionado junto con los ejemplos, se ha realizado una verificación de su correcto funcionamiento para asegurar la adecuada representación de los conceptos requeridos en cada actividad académica.

**Palabras clave:** inteligencia artificial, interacción, guion, lenguaje de programación, educación.

## Abstract

In recent years, artificial intelligence has emerged as a innovative technology with far-reaching impacts on various aspects of our daily lives, including its role in education. Hence, the aim of this study is to propose a comprehensive guide on how to interact with ChatGPT for performing different academic tasks. ChatGPT is envisioned as a tool for educational support, owing to its integration with various programming languages such as C and Python. To facilitate understanding, specific examples illustrating the application of commands are provided, accompanied by detailed explanations aimed at minimizing errors in outcomes. Moreover, an assessment of the functionality of ChatGPT-provided programs and examples has been conducted to ensure accurate representation of the requisite academic concepts for each task.

**Keywords:** artificial intelligence, interaction, script, programming language, education.

## Resumo

A inteligência artificial (IA) emergiu como uma tecnologia revolucionária que transformou muitos aspectos da nossa vida cotidiana, incluindo a educação. Portanto, o objetivo desta pesquisa é propor uma sintaxe de aplicação detalhada do prompt e dos comandos que devem ser fornecidos ao ChatGPT para a realização de diferentes atividades acadêmicas. Para tanto, o ChatGPT foi concebido como uma ferramenta de assistência educacional, pois está intimamente ligado a diversas linguagens de programação, como C e Python. Além disso, são apresentados exemplos específicos que mostram a aplicação destes comandos, os quais foram explicados detalhadamente para reduzir a margem de erro nos resultados obtidos. Em relação aos programas que o ChatGPT disponibiliza juntamente com os exemplos, foi realizada uma verificação do seu correto funcionamento para garantir a representação adequada dos conceitos exigidos em cada atividade acadêmica.

**Palavras-chave:** inteligência artificial, interação, roteiro, linguagem de programação, educação.

**Reception date:** March 2023

**Acceptance Date:** April 2024

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## Introduction

Artificial intelligence (AI) is a branch of computer science that has attracted much interest due to its wide field of application. The concept of *artificial intelligence* arose from the ideas of Alan Turing, although this term was proposed by McCarthy in a conference at Dartmouth. College in which renowned researchers of the time participated. However, since its origin, AI has had to deal with the conflict of not having a clear and single definition (Ponce *et al.* , 2014).

Some applications of AI are in bioengineering, a field that applies engineering techniques and concepts to human biology, specifically medicine. For its part, biomedical engineering is a branch of bioengineering that focuses on the medicine of prevention, diagnosis and treatment of diseases for healthcare and biomedical research. Some examples of AI applications within bioengineering include intelligent control of prostheses, intelligent surgical equipment, brain-computer interfaces, pattern recognition in digital images of human organs, and biomedical signals (Rangel *et al.* , 2015).

When it comes to everyday life, AI applications are diverse and constantly evolving. Some of them are image processing, since, currently, you can find smart cameras with automated systems that are used for surveillance, crime prevention, transportation, logistics,

identification of people, among others. Another application is found in natural language processing ( *chatbots* ), which, although they do not have total intelligence , are evolving rapidly and their dialogue is expected to be increasingly similar to a person-to-person interaction, especially in areas of service. Likewise, in industry, the application of AI in business sectors such as agriculture, livestock, among others, allows for greater efficiency and profitability (González, October 15, 2020). Therefore, it can be said that AI is rapidly transforming our daily lives and even different areas such as health, education, science and technology.

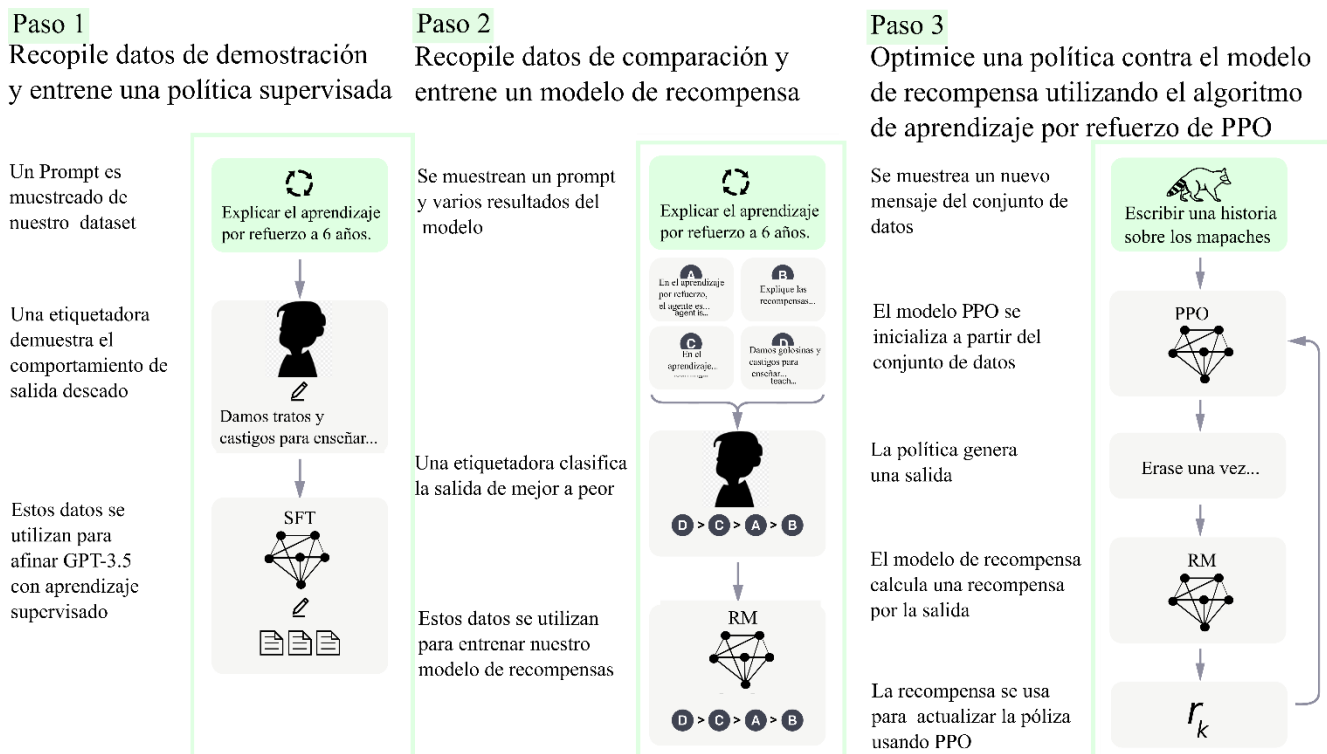
Currently, we have many applications on the internet, among which ChatGPT stands out , developed in 2022 by OpenAI . This chatbot is a large language model fine-tuned with both supervised and reinforcement learning techniques and is based on OpenAI 's GPT-3.5 model , an improved version of GPT-3 ( Deutsche Welle, December 9, 2022). ChatGPT is well known for its ability to hold conversations. Its operation consists of a transformer, while its pre-training is done through reinforcement learning through human feedback. This pre-training uses a data set that mixes conversations between users and an AI assistant, which serves to provide written responses to human trainers.

The main steps of ChatGPT training are to combine supervised learning with reinforcement learning. In the first step, demonstration data is collected to train a supervised policy. In the second step, comparison data is collected and a reward model is trained. Finally, a policy is optimized against the reward model using the reinforcement learning algorithm ( Gozalo -Brizuela and Garrido- Merchan , 2023). Figure 1 shows the ChatGPT training process <sup>1</sup>.

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<sup>1</sup> In Vaswani *et al* . (2017) details of the construction and training of Chat GPT are presented.

**Figure 1. GPT Chat Training**



Source: Gozalo -Brizuela y Garrido- Merchan (2023) with translation and own modifications

When ChatGPT-2 was introduced it attracted a lot of attention in different sectors of knowledge, as ChatGPT was able to effectively answer a wide range of human questions and offer smooth and complete answers that significantly outperformed previous public *chatbots* in terms of security and usefulness ( Guo *et al.* , 2023). This resulted in a debate between the advantages and disadvantages of using this AI tool, hence the different media outlets are in the dilemma of banning it or implementing it in educational settings, since there is a doubt as to whether its use will help. to reduce or increase the digital divide ( Ginger , February 9, 2023).

Indeed, in academia, the use of ChatGPT has sparked passionate controversy among educators, who range between fear that students will use AI tools to avoid learning and excitement about the new educational opportunities that could arise. However, we still lack a basic understanding of how these tools perform in different educational settings, as well as the potential they could have to replace traditional forms of instruction (Jalil *et al.* , 2023). However, we must always keep in mind that electronic media can spread misleading or biased content about an object or event ( Tandoc *et al.* , 2018). Because of this, there is a current

debate about the ethics of using AI, automated mass manipulation and misinformation, and the mass production of low-quality content (Illia *et al.* , 2023).

The responsible use of AI can give us a lot when we know and know what to expect when we apply it. However, it is important to keep in mind that the tool can sometimes return erroneous results if we are not clear when we write the *script* of instructions that we want Chat GPT to perform. This set of instructions is known as a command *prompt* .

In fact, in certain cases, Chat GPT returns an erroneous response that has nothing to do with the topic or the request that has been requested, even though the instructions have been clear and concise. This is known as *hallucination* (Esnaola and Ramón, 2023; Bang *et al.* , 2023)

This is the reason why a user must have prior knowledge about the topic being investigated, since otherwise they can fall into a situation of misinformation. For example, in Hosseini *et al.* . (2023) the OpenAI chat was asked to write an article of 300 words, but the result was a text of 356. Also in this work, hallucinations were reported when the OpenAI chat was asked the following question: “ Did Immanuel Kant believe that ought can it imply ?” (in Spanish the question would be: did Immanuel Kant believe that duty implies ability?) (Hosseini *et al.* , 2023).

Currently, some people have used it to ask him about different topics, which, in some cases, are everyday. In Bouschery *et al.* . (2022) presents the application example of language models based on transformers, which can be used to generate new ideas for the purpose of solving problems and innovating, which is important for companies seeking to optimize their performance. These models can generate original and useful ideas with just a few samples of *brainstorming results* , so users can train them to create more creative or deterministic responses. In that same work, an example of the application of a transformer-based model was presented to offer ideas on how to improve a portable electric pump intended for *camping* ( Bouschery *et al.* , 2022).

AI in the academic world, in this case GPT Chat, has a high application potential, since the use of computing equipment is necessary in different areas of science. Being science requires the use of *software* for different purposes, such as the simulation of phenomena and systems in areas of engineering ( Chaturvedi , 2017 ), as well as for data analysis for any branch of knowledge ( Wickham and Wickham , 2017). ), among them, education, biology, administration, etc.



Since science is constantly changing, it is necessary to have versatile tools that contribute to its advancement; For this reason, ChatGPT has the potential to be used in science and engineering, as it can provide coherent, human-like responses in natural language. This is especially useful in applications like customer service *chatbots and language translation*. In fact, its ability to produce more human responses than other natural language processing models leads to more meaningful and engaging conversations, thereby improving the user experience ( Kalla and Smith, 2023). This feature is important for the educational sector because it can allow students to have a better understanding of the information that AI is presenting.

ChatGPT 's customization makes it flexible, so it can be tailored to the user's specific needs. In education, this characteristic plays a very important role because it allows it to be implemented in any subject at any educational level, even university (Esnaola and Ramón, 2023), which can serve as support inside and outside the classroom to obtain learning. significant (Díaz Barriga Arceo and Hernández Rojas, 2010).

Likewise, it is important to highlight that ChatGPT can process large volumes of information and generate quick responses ( Kalla and Smith, 2023). In this sense, and according to the ChatGPT online help , it has a capacity of 4096 tokens for the GPT3.5 version <sup>2</sup>.

Given the usefulness of Chat GPT in different areas, such as education, the way in which information should be requested should be delved into. Therefore, in this work a syntax (with practical application examples) for the ChatGPT-3.5 command *prompt is proposed* as an assistant in educational processes.

## Methodology

The objective of this study was to carry out an exhaustive documentary investigation about ChatGPT by analyzing a representative sample of 30 current scientific articles and 15 relevant journalistic articles on the subject. In addition, more than 10 books specialized in calculus were consulted, 10 in electrical and electronic circuits, and 5 in differential equations, as well as in related areas such as automatic control from various authors and publishers in English and Spanish languages.

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<sup>2</sup> Each token is equal to 4 characters in the English language, that is, 100 tokens are equivalent to 75 words.

For the search procedure, the Google Scholar portal was used, where keywords such as *ChatGPT* or *prompt were written. for ChatGPT* . Likewise, information was searched in the databases of Hindawi , Redalyc, Scielo, ArXiv , among others. This research was carried out in order to propose a syntax for the *prompt* in the graphical user interface and to use it in a generalized way when a request is made.

According to the literature reviewed in this article, the command *prompt in the context of ChatGPT* refers to the text, script, or instructions that are provided to the language model to guide its response. In other words, it is a way of telling the model what type of information or task is expected of it.

On this topic, Peña (2022) warns that the analysis of information is crucial to understanding the issue at hand. According to the author, to carry out an effective analysis it is essential to take into account several criteria, including “the identification of key words, understanding, mastery or familiarity with the topic discussed, knowledge of the meaning of the words, characterization of the structure of the text , among others” (p. 2 ). Consequently, these aspects are fundamental to identify the relevant points of each investigation and structure the information in a manner consistent with prior knowledge and the objectives of the investigation.

For his part, Rojas Crotte (2011) refers to the sources of information used in research as *conservative units of information* , which have the function of storing or containing data that serve as theoretical support.

## Materials

The computer used in this work had a Linux operating system, specifically the Ubuntu 18.04.6 LTS version, with a 64-bit architecture. In addition, it had an Intel Core i7-7700 processor with a speed of 3.60 GHz and 8 cores. In terms of graphics, it had an NVIDIA GTX 1050Ti video card. The Maple 2019, Orcad *software* were also installed on the machine. Pspice 16.6 for Windows in its 64-bit version, the gcc compiler in its version 7.5.0, and Python 3.6 or higher versions. For text editing, both Geany and Texmaker can be used , and for composing documents in LaTeX you can use Texlive on the Linux platform.



## Results

This section shows examples of academic requests made to ChatGPT-3, which teachers at different academic levels can use as teaching strategies. In addition, the responses generated by ChatGPT-3.5 to these requests are included to analyze their quality and relevance. These examples seek to demonstrate the ability of the natural language model to solve various academic tasks and provide useful information to users.

Interactions with artificial intelligence were carried out by accessing the page [www.openai.com](http://www.openai.com). Once on the website, you must press the *sign up button*, which will take us to a site where it asks us to create an account to access. If you have a Gmail email account, then we tell you to continue with Google ( *continue with Google* ). Subsequently, the language model must be chosen (in this case, ChatGPT ).

### Case study 1

Generation of a document in LaTeX

- Prompt = ““Prepare a LaTeX presentation using beamer using the Frankfurt theme and importing the package for 3 slides with the respective comments in the code:  
Add example text indicating the name of the person, date and content of the presentation ” “

Reply from ChatGPT

```
\documentclass { beamer }
% Presentation topic
\usetheme { Frankfurt}

% Package to use custom colors
\usepackage { xcolor }

% Definition of custom colors
\definecolor { myblue } {RGB} {52, 152, 219}
\definecolor { mywhite } {RGB} {255, 255, 255}

% Presentation information
\title { Example Presentation}
\author { Name of person}
\institute { Date of presentation}
\date {Presentation content}
% Beginning of document
```

```
\begin{document}
% Slide 1 \begin{frame}
\titlename \end{frame}

% Slide 2
\begin{frame} {Slide 2 title}
Example text for slide 2.
\end{frame}

% Slide 3
\begin{frame} {Slide 3 title}
Example text for slide 3.
\end{frame}

% End of document
\end{document}
```

## Case study 2

Write a code in the C programming language to find the root of the quadratic equation  $f(x) = x^2 - 5$ , using the Newton-Raphson numerical method.

- Prompt = ““Write code in C that uses Newton Raphson's method to determine the root of  $x^2-5=0$ : Add comments so people can understand each section of the code”“

Reply from ChatGPT

Here is an example of C code that uses the Newton-Raphson method to find the root of the equation  $x^2-5=0$ :

```
#include <stdio.h>
#include <math.h>

// Definition of the function f(x) = x^2 - 5
double f(double x) {
    return pow(x, 2) - 5;
}

// Derivative of the function f(x) = 2x
double df(double x) {
    return 2 * x;
}

int main() {
    double x0, x1, eps = 1e-5;
    int i = 0, itermax = 100;

    // We ask the user to enter an initial value x0
    printf("Enter an initial value for x: ");
```

```
scanf ( "% lf", &x0);

// We iterate until we find the root or until we reach the maximum number of
iterations
while (i < itermax ) {
x1 = x0 - f(x0) / df (x0); // We calculate the following approximation of the root

// If the approximation is close enough to the root, we end the loop
if (fabs(f(x1)) < eps) {
break;
}

x0 = x1; // Update the value of x0
i++; // We increase the iteration counter
}

// Print the result
if (i < itermax ) {
printf ( "The root is: %.5f\n", x1);
} else {
printf ( "Could not find root in %d iterations\n", itermax );
}

return 0;
}
```

### Case study 3

Write the code to graph the function in the Maple programming language  $f(x, y) = \frac{\sin(\sqrt{x^2+y^2})}{\sqrt{x^2+y^2}}$ .

- Prompt = ““Generates the maple code to graph the 3D function given by  $f(x, y) = \sin(\sqrt{x^2+y^2}) / \sqrt{x^2+y^2}$  on the intervals  $-10 \leq x \leq 10$ ,  $-10 \leq y \leq 10$ . Use the command plot3d :”“

Reply from ChatGPT

Here is the Maple code to plot the function  $f(x, y)$  in 3D using the plot3d command:

```
f: = (x, y) -> sin ( sqrt ( x^2 + y^2)) / sqrt (x^2 + y^2);
plot3d(f(x,y), x = -10 .. 10, y = -10 .. 10, axes = boxed, style = surface, shading = zhue ,
orientation = [70, 60]);”
```

#### Case study 4

Solve the nonlinear equation of a circuit with 2 rectifier diodes given by

$$Ri + 2V_T \ln(i) - V_T \ln(I_{S1}) - V_T \ln(I_{S2}) - V = 0(1)$$

With values of  $V = 3V$ ,  $R = 5\Omega$ ,  $I_{S1} = 1E - 12V$ ,  $I_{S2} = 1E - 9V$ ,  $V_T = 26.85mv$ , published in (Sandoval -Hernández *et al.*, 2019).

- Prompt = ““ Determine the current  $i$  by the classical perturbation method in the equation  $R \cdot i + 2 \cdot V_T \cdot \ln(i) - V_T \cdot \ln(I_{S1}) - V_T \cdot \ln(I_{S2}) - V = 0$ , where  $R$ ,  $I_{S1}$ ,  $I_{S2}$ ,  $V$  are constants: Consider  $V_T$  the disturbance parameter and the current expansion as  $i = i_0 + i_1 \cdot V_T + i_2 \cdot V_T^2 + i_3 \cdot V_T^3 + \dots$  use the Taylor series for the logarithm: ”“

Reply from ChatGPT

The Taylor series for the natural logarithm is:

$$\ln(1 + x) = x - x^2/2 + x^3/3 - x^4/4 + \dots$$

Applying this Taylor series, the original equation becomes:

$$R(i_0 + i_1 V_T + i_2 V_T^2 + i_3 V_T^3 + \dots) + 2V_T [i_0 + i_1 V_T + i_2 V_T^2 + i_3 V_T^3 + \dots] - V_T \ln(I_{S1}) - V_T \ln(I_{S2}) - V = 0$$

Simplifying and grouping the terms of the same power of  $V_T$ , we obtain:

$$(i_0 R + 2V_T i_0 - V_T \ln(I_{S1}) - V_T \ln(I_{S2}) - V) + (i_1 R + 2V_T i_1) V_T + (i_2 R + 2V_T i_2) V_T^2 + (i_3 R + 2V_T i_3) V_T^3 + \dots = 0$$

Equating the coefficients of each power of  $V_T$  to zero, we obtain a set of equations for  $i_0$ ,  $i_1$ ,  $i_2$ ,  $i_3$ , ...:

$$i_0 R - V_T \ln(I_{S1}) - V_T \ln(I_{S2}) - V = 0 \quad i_1 R + 2i_0 = 0 \quad i_2 R + 2i_1 = 0 \quad i_3 R + 2i_2 = 0$$

...

Solving this recursive sequence of equations, we find:

$$i_0 = (V + V_T \ln(I_{S1}) + V_T \ln(I_{S2})) / R \quad i_1 = -2i_0/R \quad i_2 = 4i_0/R \quad i_3 = -8i_0/R \dots$$

Substituting these values into the expression for  $i$ , we obtain the solution by the perturbation method:

$$i = (V + V_T \ln(I_{S1}) + V_T \ln(I_{S2})) / R - 2V_T (V + V_T \ln(I_{S1}) + V_T \ln(I_{S2})) / R^2 + 4V_T^2 (V + V_T \ln(I_{S1}) + V_T \ln(I_{S2})) / R^3 - 8V_T^3 (V + V_T \ln(I_{S1}) + V_T \ln(I_{S2})) / R^4 + \dots$$

### Case study 5a

Use of a *prompt* to formally and accurately request the requirements requested in the subject of Electrical Circuits in an Engineering degree . In this example, ChatGPT is asked to serve as a teacher of the electrical circuits subject, where he also has knowledge of differential equations (Kelly, 2020) and Python (Chollet, 2021).

- Prompt = ““ From this moment on, you are a teacher who teaches the subject of electrical circuits. You have advanced knowledge of differential equations and Laplace transforms. You also have advanced knowledge of Python 3.6. Your answers will be concrete, precise and clear. The response will have the following structure:  
Introduction: You will explain each concept of alternating current electrical circuits. You will give clear examples that are easy to reproduce.  
Python code: For each answer you will generate a Python code that helps us visually understand the ideas explained. The mathematical calculations must be done by Python using SymPy . You will present the graphs with the axes labeled, the curves labeled, you will mark the points of interest with symbols or marks and labels to make the figure more self-explanatory . You will not use the ' scatter ' attribute in plot commands made with the Matplotlib library . You will use different colors for curves, symbols and marks in order to make the figure more didactic. The Python code will be presented complete, unified, with comments in each section so that students understand each command in Python. You will import the sympy , numpy and matplotlib libraries to use them in the code”“

### Case study 5b

Discharging a capacitor in a series circuit with a resistor (Dorf, 2018).

- Prompt = ““ Explain the series circuit that has a voltage source of zero volts, a resistor of 1000 ohms and a capacitor of 10 microfarads with an initial condition of 10 V”“

Reply from ChatGPT

The series circuit described consists of a 1000 ohm resistor, a 10 microfarad capacitor, and a voltage source of 0V with an initial capacitor voltage condition of 10V. Since there is no voltage at the source, the circuit is in a steady state and there is no current flowing through the circuit. However, as the capacitor has an initial charge, it will begin to discharge through the resistor, generating a current in the circuit and a voltage drop across the resistor.

As the capacitor discharges, its voltage will decrease exponentially until it reaches a value of 0V, meaning that all the energy stored in the capacitor has been released as current. The equation that describes the voltage across the capacitor as a function of time is  $v_c(t) = V_0 e^{-\frac{t}{RC}}$ , where  $V_0$  is the initial voltage of the capacitor (in this case 10V),  $t$  is the time elapsed since the start of the discharge,  $R$  is the resistance in ohms and  $C$  is the capacitance in farads.

The Python code to simulate this circuit and plot the voltage across the capacitor as a function of time is:

```
import numpy as np
import matplotlib.pyplot as plt

# Define symbolic variables
t = sympy.symbols('t')
V0, R, C = sympy.symbols('V0 R C', positive=True)

# Define equation for the voltage across the capacitor
Vc = V0 * sympy.exp ( -t / (R * C))

# Substitute numeric values
Vc_num = Vc.subs([(V0, 10), (R, 1000), (C, 10e-6)])

# Create function to evaluate the equation numerically
Vc_func = sympy.lambdify (t, Vc_num )

# Create time array and calculate voltage on the capacitor
t_array = np.linspace (0, 0.01, 1000)
Vc_array = Vc_func ( t_array )

# Graph results
plt.plot ( t_array , Vc_array )
plt.xlabel ('Time(s)')
plt.ylabel ('Voltage across capacitor (V)')
plt.title ('Discharge of a capacitor')
plt.show ()
```

This code defines the equation for the voltage across the capacitor, substitutes numerical values for the resistance and capacitance, creates a function to evaluate the equation numerically, and then graphs the result. The resulting figure shows the voltage across the capacitor decreasing exponentially until it reaches 0 V.



### Case study 5c

Generate the Netlist of the capacitive resistive circuit with initial conditions ( Sedra *et al.* , 2020).

- Prompt = ““Generates orcad netlist pspice for the series circuit that has a voltage source of zero volts, a resistor of 1000 ohms and a capacitor of 10 microfarads with initial condition of 10 V

Reply from ChatGPT

Here is the OrCAD netlist PSpice for the described circuit:

```
RC series circuit with initial condition
V1 1 0 DC 0V
C1 1 2 10u IC=10V
R1 2 0 1k
.TRAN 0 10m 0 1u
.PROBE
.END
```

“

### Case study 6a

ChatGPT as a teacher's assistant in front of a group in the single variable calculus subject ( Leithold , 2012).

- Prompt = ““ From this moment on, you are a mathematics teacher of the subject calculus of one variable for high school and engineering students. You have advanced knowledge of Python 3.6. Your answers will be concrete, precise and clear.

The response will have the following structure:

Introduction: You will explain the concept in mathematical terms in the easiest way to understand.

Importance: You will give examples for each area: medicine, electricity and biology.

Python code: For each answer you will generate a Python code that helps us visually understand the ideas explained. Calculations of derivatives and integrals must be done by Python using SymPy . You will generate the Python codes with comments so that the students can understand them. You will present the graphs with the axes labeled, the curves labeled, you will mark the points of interest with symbols or marks and labels to make the figure more self-explanatory . You will use for loops of at least 100 iterations to evaluate the functions before graphing them. You will not use the ' scatter ' attribute in commands for plots made with the matplotlib library . You will

use different colors for curves, symbols and marks in order to make the figure more didactic. The Python code will be presented complete and unified. You will import the sympy, numpy and matplotlib libraries to use in the code.

Analogy: You will give an analogy with the physics of the requested concept in everyday terms so that a young person in high school can understand it.

### Case study 6b

Explain Simpson's one-third rule  $1/3$  (Burden *et al.*, 2015).

- Prompt = “”Explain what Simpson’s one-third rule consists of: generate a Python code in which the area under the curve is represented.””.

Reply from ChatGPT

Introduction : Simpson's one-third rule is a method for approximating the integral of a function. This method is based on the idea of approximating the curve using a quadratic polynomial, and then calculating the integral of that polynomial. It is a more precise method than the trapezoidal rule, since it uses a parabola-shaped curve to approximate the function.

Importance: Simpson's one-third rule is used in various areas, such as medicine, where it can be used to approximate the dose of a medication needed to treat a disease as a function of time. In electricity, it can be used to approximate electric current in a circuit. In biology, it can be used to approximate the growth rate of a population.

Python Code: Below is code in the Python programming language that uses Simpson's one-third rule to approximate the area under the curve of a function.

```
import numpy as np
import matplotlib.pyplot as plt
from sympy import *
x = symbols('x')

# We define the function
def f(x):
    return x**3 + 2**x**2 + x

# We define the integration limits
a = 0
b = 2

# We evaluate the function at the limits of integration
fa = f(a)
fb = f(b)
```

```
# We define the number of subintervals
n = 6

# We calculate the width of the subintervals
h = (b - a) / n

# We calculate the sum of the even values of the function
sp = 0
for i in range( 2, n, 2):
    xi = a + i * h
    sp += f(xi)

# We calculate the sum of the odd values of the function
if = 0
for i in range(1, n, 2):
    xi = a + i * h
    if += f(xi)

# We apply Simpson's formula 1/3
integral = h / 3 * (fa + 4 * si + 2 * sp + fb)

# We print the result
print ( "The integral of the function is:", integral)

# We graph the function
x_vals = np.linspace (a,b,100)
y_vals = [f( x_val ) for x_val in x_vals ]
plt.plot ( x_vals , y_vals , label ='f(x)')
plt.fill _between ( x_vals , y_vals , 0, alpha=0.2)
plt.xlabel ('x')
plt.ylabel ('y')
plt.legend ()
plt.show ()
```

In this code, we first define the function we want to integrate, in this case  $f(x) = x^3 + 2x^2 + x$ . Next, we define the limits of integration,  $a=0$  and  $b=2$ , and the number of subintervals  $n=6$ . Next, we calculate the width of the subintervals  $h$ , and add the even and odd values of the function. Finally, we apply Simpson's 1/3 formula and calculate the integral of the function. In the graph you can see the function and the approximate area under the curve.

Analogy: Simpson's one-third rule is like a roulette wheel that is divided into several segments, where each segment has a certain amount

## Discussion

In a recent study (Zhang *et al.* , 2022), the performance of ChatGPT in posture detection was evaluated using a direct question template. The authors presented the results obtained by interrogating the model about the polarity of a *tweet* 's stance towards a specific target. On the other hand, in Yang *et al.* . (2023) a similar methodology was used to explore the performance of ChatGPT

in aspect- and query-based text summarization tasks. In this regard, it is highlighted that these tasks involve generating personalized summaries for specific aspects or queries instead of a general condensed version of the entire document. The work also mentions significant contributions, such as being the first systematic attempt to extend the use of large language models beyond the generation of generic summaries and providing ideas for future research directions.

In the literature reviewed, the authors have taken care to use clear wording to request some activity from artificial intelligence, that is, using keywords in the *prompts* to tell ChatGPT what task it should perform. However, they do not implement a standardized writing syntax, as occurs when writing a sentence within programming languages, such as C, Python, among others.

For this reason, we - based on the fundamentals of programming languages, such as the handling of alphanumeric character strings - propose the use of a syntax that consists of the word *prompt* accompanied by a sign = and two pairs of double quotes ", which They can encompass more than one sentence, separated by a period or a colon, as follows:

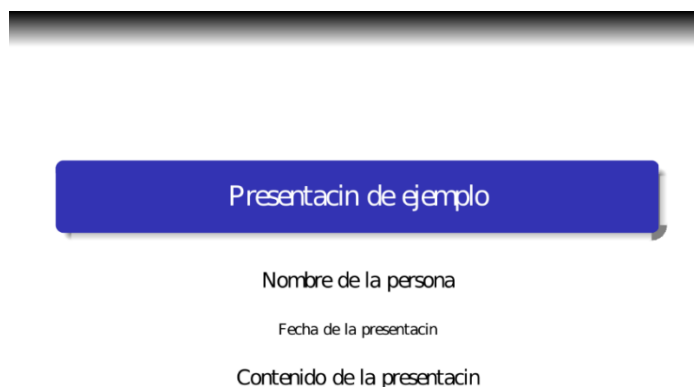
Prompt =“ “sentence of statement 1:  
sentence of statement 2:  
:  
sentence of statement n”“

This *prompt* follows the syntax rules used when working with OpenAI in Python and when using API (application programming interface) keys for authentication. For more details you can visit the help at [www.open.com](http://www.open.com).

To show its use, this work presents six case studies where this syntax has been implemented for the *prompt* . With this, a better interaction has been achieved in all of them , since the ChatGPT responses were more specific. These case studies are linked to the generation of code for a programming language, as well as numerical evaluation. Next, we will explain the first four case studies.

- In the first example of use given to ChatGPT-3, it was asked to generate a LaTeX template using the Beamer package with the Frankfurt environment for 3 slides, which has been widely used for the creation of scientific presentations that contain a large number of mathematical expressions. The generated code was tested and compiled without errors in the Texmaker editor . Figure 2 shows the slide generated with the code that ChatGPT created .

**Figure 2.** Beamer presentation generated with the code created by ChatGPT



Source: self made

Now, it is essential to consider the level of support that the educator receives in order to enhance his pedagogical work, given that this allows him to design teaching resources that improve his teaching practice ( Díaz Barriga Arceo and Hernández Rojas, 2010; Esnaola and Ramón, 2023 ). Likewise, it is feasible to obtain a pre-designed structure in LaTeX that facilitates the writing of books, theses or scientific articles. Additionally, ChatGPT support may be required to create slides, Excel spreadsheets, or Word documents.

- In the second example, the AI was asked to generate code in the C language of the Newton-Raphson numerical method to determine the roots of a quadratic equation  $f(x) = x^2 - 5$ . Among the starting points that were proposed to the algorithm was  $x = 0.1$  , with which the equal root was obtained 2.236067977. It is worth mentioning that the code was tested by replacing the original function with others, and in all cases where it tried to find a real root it was successful in determining it. The purpose of requesting a programming code to evaluate procedures, as in this case, is to reduce errors caused by the lack of significant digits found (Sandoval-Hernández *et al* .,

2021). ChatGPT , when evaluating arithmetic operations, shows deficiencies in its numerical engine.

In Table 1 we present some proposed numbers from which their square root was extracted using the requested routine, against the roots that ChatGPT determined and returned to us through its graphical interface. Likewise, a significant digit analysis is offered that was carried out with the following formula:

$$DS = -\log_{10} \left( \left| \frac{V_E - V_A}{V_E} \right| \right), \quad (1)$$

where DS is the significant digits,  $V_E$  is the exact value and  $V_A$  the approximate value (Sandoval-Hernández *et al.* , 2021).

**Table 1.** Significant digits of square roots calculated by ChatGPT

Numerical value	exact root	GPT Chat Root	Significant digits
05.00	002.236067977	002.23606798	8.8
87.11	009.333273809	009.337057764	3.3
319.37	017.870926109	017.88472524	3.1
9855.776	099.276261009	099.27783387	4.8
10557.1311	102.747900708	102.75376923	4.2
101013.1900	317.825722685	317.95356021	3.4

Source: self made

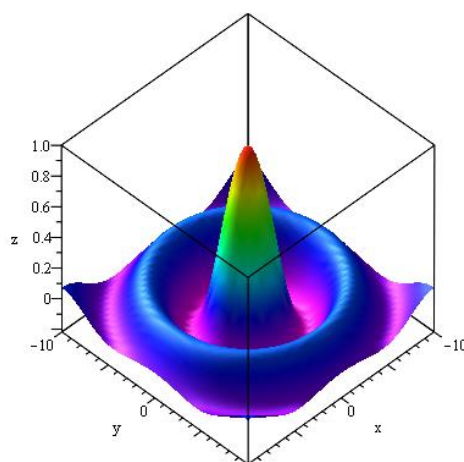
For example, in the case of the root of 5, a value of eight significant digits (8.8) was obtained. The decimal part indicates that we are close to obtaining 9 digits. In the case of the root of 87.11, three significant digits were obtained, that is, one for the integer part and two in the decimal part. From these results it can be seen that as the magnitude of the number increases, the significant digits of the decimal part tend to decrease.

Let's now look at the square root of 101013.1900. In this case, 3 significant digits were obtained that correspond to the integer part and zero for the decimal part. Therefore, as the complexity of the numbers increases, the precision of the square root becomes less accurate.

- In the third example, the AI was asked to generate Maple code to graph a function in three dimensions. In Maple the correct code was executed and the graph of the three-dimensional function was obtained. Figure 3 shows the graph obtained from the code generated by ChatGPT .



**Figure 3.** Three-dimensional function



Source: self made

- ChatGPT was asked to solve a nonlinear algebraic equation using the classical perturbation method. In a first attempt, ChatGPT delivered a solution of 1.235 mA, while in a second attempt the solution obtained was 2.09293 mA. Subsequently, when evaluating the numerical values in the algebraic solution delivered by ChatGPT using Maple, a value of 0.346426847 A was obtained, which differs significantly from the exact value of the circuit solution, equal to  $i = 0.3605A$ , published in Sandoval-Hernández *et al.* (2019). This finding shows errors in the results obtained when using ChatGPT, as reported in Hosseini *et al.* (2023). Likewise, it is important to note that ChatGPT does not provide exact solutions for the numerical evaluation of algebraic expressions that involve large arithmetic calculations. However, by asking ChatGPT to use a programming language such as C or Python it is possible to obtain exact results, as will be demonstrated in the following application example.

The last two case studies are very similar in terms of the structure of the *prompt* used, which consists of several indications. In both cases, ChatGPT was asked to assume the role of teacher in different sessions in the subjects Electrical Circuits and Calculus, respectively. In reality, the role of teacher given to ChatGPT is to serve as our assistant in class to speed up teaching practice, that is, to make it more meaningful. Likewise, our students can be instructed to use ChatGPT outside of class to collaborate on a proposed activity.

It should be noted that in these requests the answers provided were asked to include an introduction and implementation in Python code, so that students could run them in a programming environment such as Geany or CodeBlocks. Likewise, it was specified that the graphs must have labeled axes, use different colors and symbols, and that comments be added to the lines of code to facilitate their understanding.

At the beginning of the conversation with ChatGPT in its graphical user interface, the script of instructions was written considering the following format:

At this moment all the instructions that I indicate will have the command prompt with the following format. Are you ready?

```
prompt =“ “ sentence for command1:
        sentence for command2:
        ;““,
```

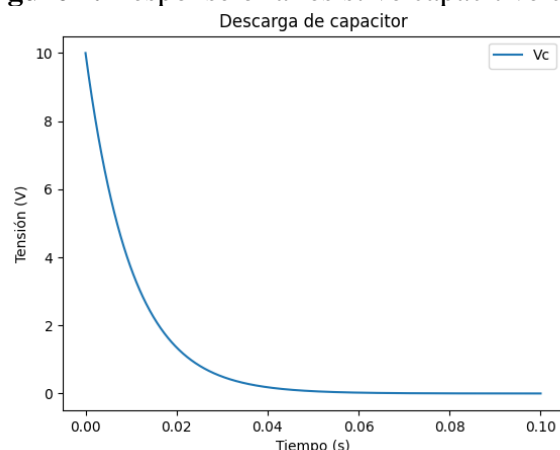
where commands are all the instructions that you must follow to carry out the requested tasks.

ChatGPT 's abilities to produce more precise and detailed responses, which helps users to clearly understand the concepts presented. The teaching assistance provided by ChatGPT offers an extremely valuable resource for teachers in their teaching practice, as it allows them to design more versatile teaching resources adapted to the specific needs of students.

One of the most notable advantages is the possibility of promoting transversal learning, which involves the inclusion of graphics and codes in Python and C in the answers. In this way, students can apply theoretical knowledge in practical situations, which is essential for meaningful learning. In addition, autonomous learning is promoted, since students can learn to learn, as well as develop skills to solve problems independently. In short, ChatGPT teaching assistance is offered as a highly valuable tool for teaching and learning, allowing teachers to enhance their teaching practice and students to develop essential skills for their academic and personal training.

- In the fifth example, after entering the *prompt* , the AI generated an introduction with definitions and examples of the concepts and their respective examples in Python. Figure 4 shows the response of a series capacitive resistive circuit for case 5b when the voltage source has been disconnected. In this case, the initial condition was that the capacitor be charged to 10V. The code generated by ChatGPT worked correctly, and compiled without errors on Geany for Linux.

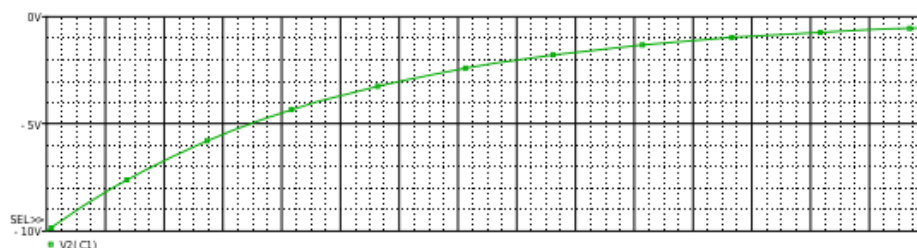
**Figure 4.** Response of a resistive capacitive circuit



Source: self made

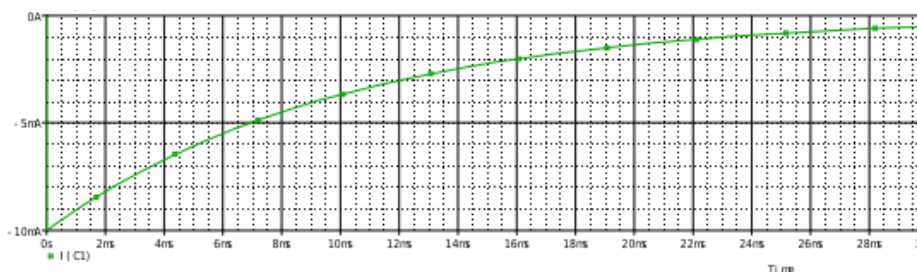
- ChatGPT was asked to generate the circuit netlist . This code was introduced to Orcad Pspice 16.6. Figures 5 and 6 present the simulation results using the netlist generated by ChatGPT . These simulations were set at 2 millisecond intervals. Here it can be seen that the sign of the electric current and the voltage of the circuit are negative in relation to figure 4. This can be analyzed from Kirchoff's laws.

**Figure 5.** Voltage response across the circuit capacitor



Source: self made

**Figure 6.** Current response in the resistive-capacitive electrical circuit

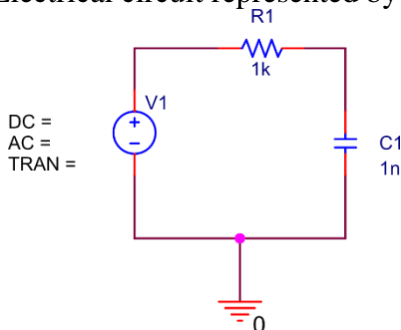


Source: self made

Figure 7 presents the capacitive resistive circuit represented by the netlist that Chat GPT was asked to make. To explain the process, it is assumed that the voltage source initially had a voltage of 10 V. After a while, the source now has a value of 0V, which is equivalent

to having a short circuit in electrical circuit analysis ( Dorf , 2018). In this way, we now have a capacitor in parallel with a resistor.

**Figure 7.** Electrical circuit represented by the netlist .



Source: self made

Assuming that after a considerable time the capacitor has reached the final voltage, this is  $v_C = V$ , then we can apply Kirchhoff's law of voltages in the mesh of figure 5 having the following:

$$-v(t) + v_R + v_C(t) = 0 . (2)$$

The solution of this differential equation is again of the type  $v_C(t) = A + Be^{-\frac{t}{\tau}}$ . To determine the value of the constants  $A$  and  $B$  we apply the initial conditions:

- Initial condition for fully charged capacitor  $v_C(t = 0) = V$ .
- Final condition when the capacitor is completely discharged  $v_C(t = \infty) = 0$ .

The solution is  $v_C(t) = Ve^{-\frac{t}{\tau}}$ . The constant  $\tau = RC$  is the time it takes for the capacitor to reach the value of  $0.367V$  [V]. The voltage across the resistor  $R$  is obtained knowing that  $v_R(t) + v_C(t) = 0$ , while the current is deduced by applying Ohm's law to the resistor. Finally, the voltage and current in the circuit are given by

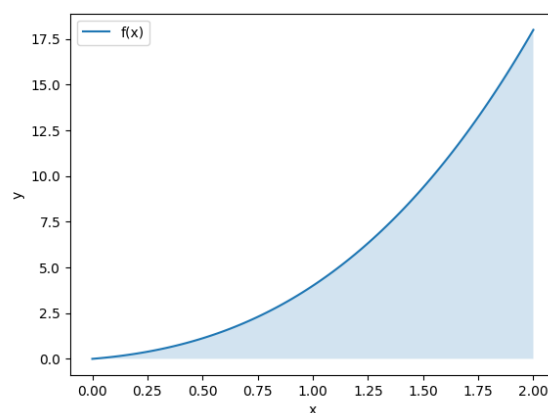
$$v_R(t) = -Ve^{-\frac{t}{\tau}}, [V] \quad (3)$$

$$i(t) = -\frac{V}{R}e^{-\frac{t}{\tau}}, [TO]. \quad (4)$$

Figure 4 is in accordance with Figure 6. In Figure 4, the sign of the voltage is positive because the voltage on the capacitor is considered from the solution of the equation that determines the voltage on a capacitor ( Dorf , 2018) . However, figure 5 shows us the voltage with a negative sign as it is a mesh voltage where this value is given by equation 3. Likewise, the circuit current has a negative sign and that of equation 4. In this case of study, you can clearly see the assistance of ChatGPT in teaching, where teacher intervention is clearly necessary to clarify these concepts. That is, their role cannot be replaced, as some people fear can happen. However, it is also appropriate to mention that this can represent a challenge for students and, therefore, favor autonomous learning.

- *prompt* was written in which ChatGPT was now asked to serve as a teacher of the subject Calculus for high school and engineering students. In this regard, ChatGPT begins to provide an explanation of concepts and definitions of the aforementioned subject, as well as analogies with biology and electricity. In case 6a, an explanation and a Python example of Simpson's 1/3 rule were requested. The AI proposed to integrate the function  $y=x^3+2x^2+x$  on the interval  $[0,2]$ . Then, when executing the Python implementation of Simpson's rule in Geany, a value equal to 11.333333333333332 was obtained , which is in accordance with the exact value when analytically integrating the proposed function.

**Figure 8.** Area under the curve with Simpson's 1/3 rule in Python



Source: self made

Finally, in the tests carried out it was found that when ChatGPT is asked to perform algebraic calculations, on some occasions the expressions it displayed appear graphically, but on other occasions as strings of letters or the way in which an equation is written in Latex . However, when regenerating the response, it sometimes changed the way it presented

calculations symbolically, just like Maple or Mathematica does . The same thing happened when he was asked in an experiment to determine the Laplace transform of the function over time  $f(t) = 2t + e^{-8t} \cos 6t$ .

## Conclusions

The objective of this study has been to present a standardized *prompt proposal* to interact with ChatGPT , so that personalized information could be obtained, according to our interests. In relation to this *prompt* , the need to develop an efficient, clear and structured syntax that allows artificial intelligence to correctly interpret the request command has become evident. To achieve this, the application of a syntax similar to that used in programming languages in the handling of alphanumeric strings has been considered, where keywords and spaces are crucial for the correct functioning of the system.

In other works it has been observed that clarity and precision in the formulation of the order are essential to obtain more precise and relevant results. In the case studies presented in this work, a standard syntax has been used, which manages a clear structure of what is requested from ChatGPT in order to reduce errors in the results, as well as possible hallucinations.

On the other hand, it should be noted that it is essential to know the limitations of any tool. In the case of ChatGPT , the problem with numerical calculations - such as the case of the square root - can be overcome by requesting the generation of a code, which, in our example, was in Python language to carry out this operation and use other computational resources.

Likewise, it should be mentioned that all the codes generated in the different case studies presented in this work, in different programming languages, were executed on platforms such as GNU C, Orcad Pspice , Maple and Python, where they worked successfully according to what was asked of ChatGPT . In addition, they were modified to carry out other simulations linked to the topics of each case study. In short, the application of ChatGPT in the aforementioned case studies can serve to accelerate the teaching and learning processes in the respective disciplines that were addressed in said cases.

Now, to give ChatGPT academic use, teachers must be explicit in the orders they wish to communicate to said AI so that it responds correctly. This requires them to know how to



interact with ChatGPT , which will allow them to design more meaningful activities for students.

For this reason, it is necessary to propose an initiative to incorporate *prompt* engineering in the curriculum of relevant subjects such as *Research Methods* and *Reading and oral and written expression* in different subsystems of secondary education in Mexico, such as in the technological baccalaureate offered by the General Directorate of Industrial Technological Education. Likewise, this initiative can be implemented at the university level so that students are able to develop their own *prompts* according to their needs. Therefore, it is expected that this study will contribute significantly to the improvement of the quality of education in Mexico and the preparation of students to face current and future challenges.

### **Future lines of research**

This work focused on the applications of Chat GPT3.5 as a teacher's assistant and as a guide for students in their activities. However, it remains pending to provide training to teachers from the different disciplinary fields so that they can develop their own *prompts* with the proposed syntax. In this way, they will be able to create their own teaching resources and subsequently carry out research regarding the learning of students who have used ChatGPT .

In addition, we consider it necessary to test academic documents using the Python programming language to carry out Embeddings and Fine Tuning procedures in order to reduce hallucinations by ChatGPT . For example, ChatGPT can be provided with documents with approximate mathematical methods for higher mathematics courses—such as the classical perturbation method (Sandoval-Hernández *et al .*, 2021)—in order to carry out reliable procedures using this methodology to develop approximations to nonlinear equations. Thus, more didactic university classes and students with more significant learning could be achieved . Finally, it is necessary to carry out the corresponding tests using ChatGPT 4 to determine its potential in the generation of teaching material.

## Limitations

ChatGPT natural language model has limitations in terms of the information it can provide due to its implementation and pre-training, since it does not have a database with absolute and universal knowledge. In this sense, it is important to keep in mind that even though a *prompt is written* explicitly with the structure presented, it may happen that ChatGPT hallucinates and offers erroneous information.

Therefore, it is necessary for users to be concise and careful in their writing to avoid possible misinterpretations and maximize the precision of the answers provided. In addition, you must have previous experience before using ChatGPT academically, as well as know the disciplinary area you will venture into. If students use ChatGPT, they must receive advice to avoid falling into misinformation. Finally, it must be remembered that it is necessary at all times to have an internet connection to access this tool.

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