Manual Técnico

UNIVERSIDAD
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1803

Docente:

Roberto Florez Rueda y
laboratorio

Curso:

Teoría de lenguajes y
laboratorio

Por:

Laura Vanessa Tascón

Ingeniería de Sistemas

Facultad de Ingeniería

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Objetivos

Se ha creado dicho documento con el propósito de mostrar cómo fue diseñado el sistema para la práctica l de Teoría de lenguajes y laboratorio, cuya necesidad es la de reconocer y validar cadenas de texto en base a expresiones regulares, al mismo tiempo este documento da referencias de como interactuar con el programa en caso de ser actualizado, modificado o como dar mantenimiento en caso de fallo.

Objetivos específicos

- Guía de instalación del sistema
- Requerimientos para la ejecución
- Diagramas

Alcance

Este documento está dirigido a cualquier programador con conocimientos básicos en Python y en el manejo de expresiones regulares para la creación de Autómatas finitos determinísticos

Requerimientos técnicos

Software

- Python 3
- Algún editor de texto como Visual Studio Code, Sublime Text, Nano o cualquier otro que sirva para correr código Python
- Windows

Hardware

- Computadora, sea portátil o de escritorio (mouse, teclado, cpu, monitor)

Requerimientos mínimos de hardware

- Teclado, pantalla, cpu, mouse

Requerimientos mínimos de software

- Privilegios de administrador NO
- Sistema operativo Windows xp 7

Herramientas utilizadas para el desarrollo

- Interfaz gráfica con Tkinter para hacer más ameno el manejo de la aplicación
- Un editor de texto para Python, en este caso se uso Visual Studio Code

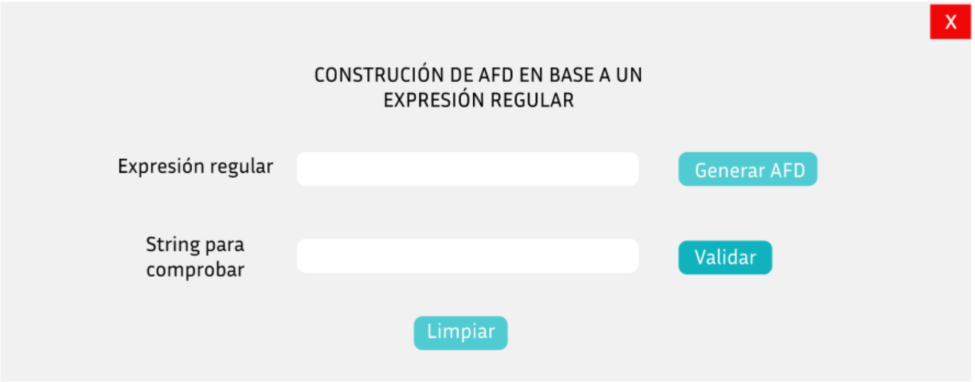
Instalación

Para poder correr el programa debe instalar Python 3 para poder compilar el código.

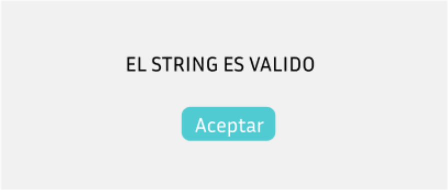
Análisis

- **Propósito**
  El propósito de este proyecto es poder validar strings pertenecientes a una expresión regular por medio de un autómata finito determinístico basado en la expresión regular.

- **Historias de usuario y mockup**
  https://docs.google.com/spreadsheets/d/1GVAYT_StjnFkaTWQaQSnclAtKP1nI3P3/edit?usp=sharing&ouid=102312595000450157281&rtpof=true&sd=true

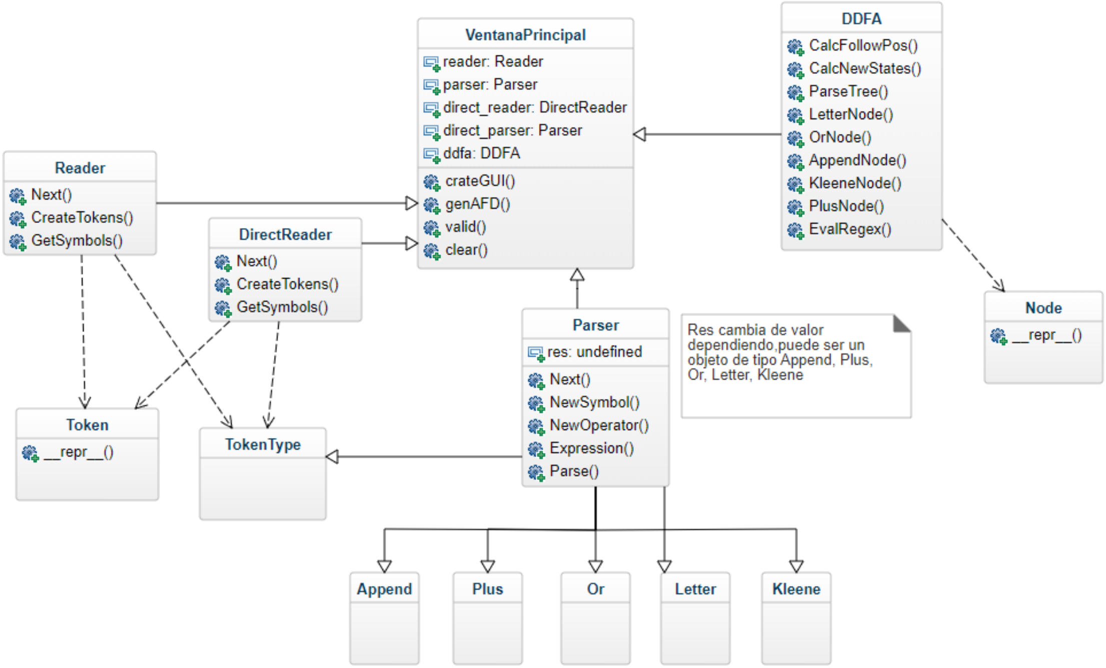


CONSTRUCIÓN DE AFD EN BASE A UN EXPRESIÓN REGULAR



EL STRING ES VALIDO

- ### Diagrama de clases

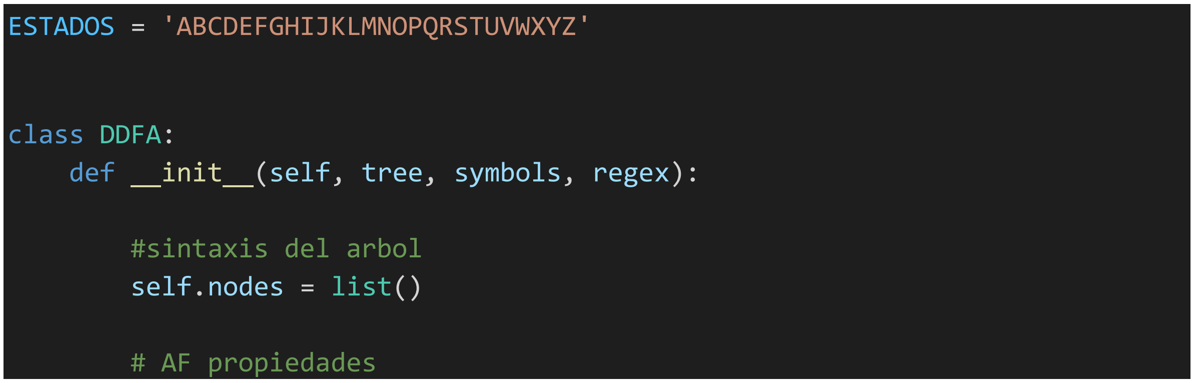


Configuración

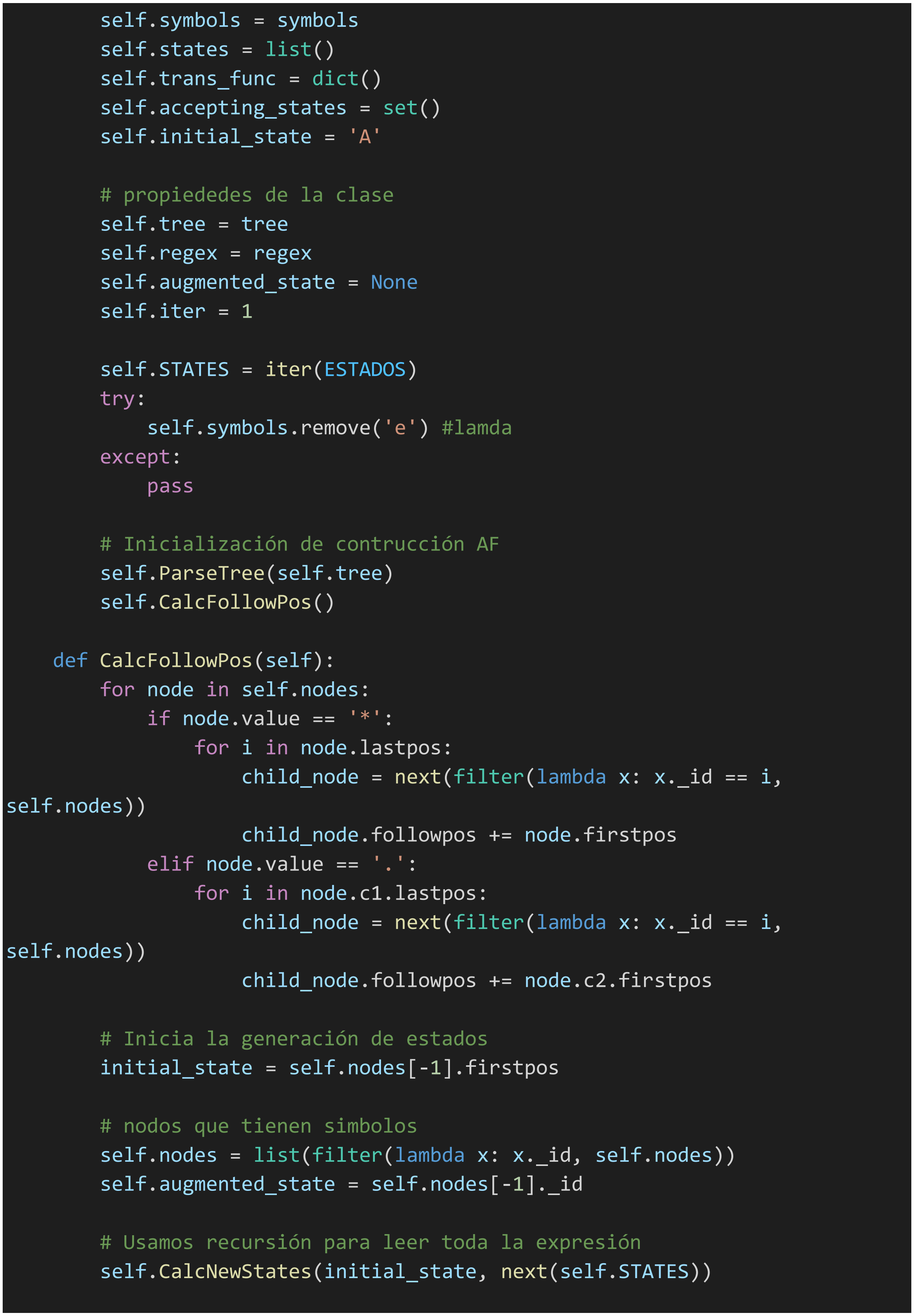
No es necesaria una configuración del sistema

Diseño de arquitectura

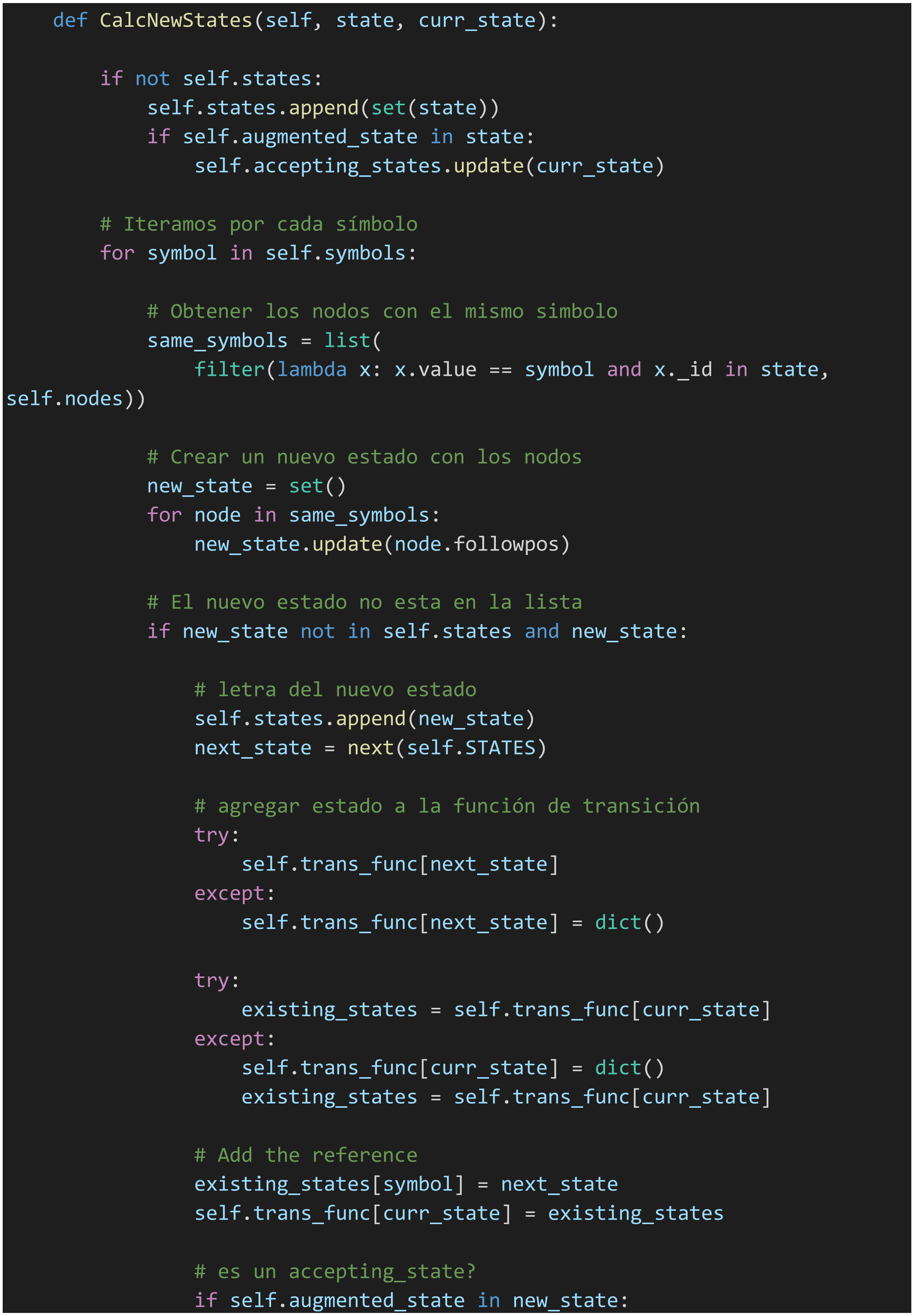
- ### Desarrollo
  ### afd



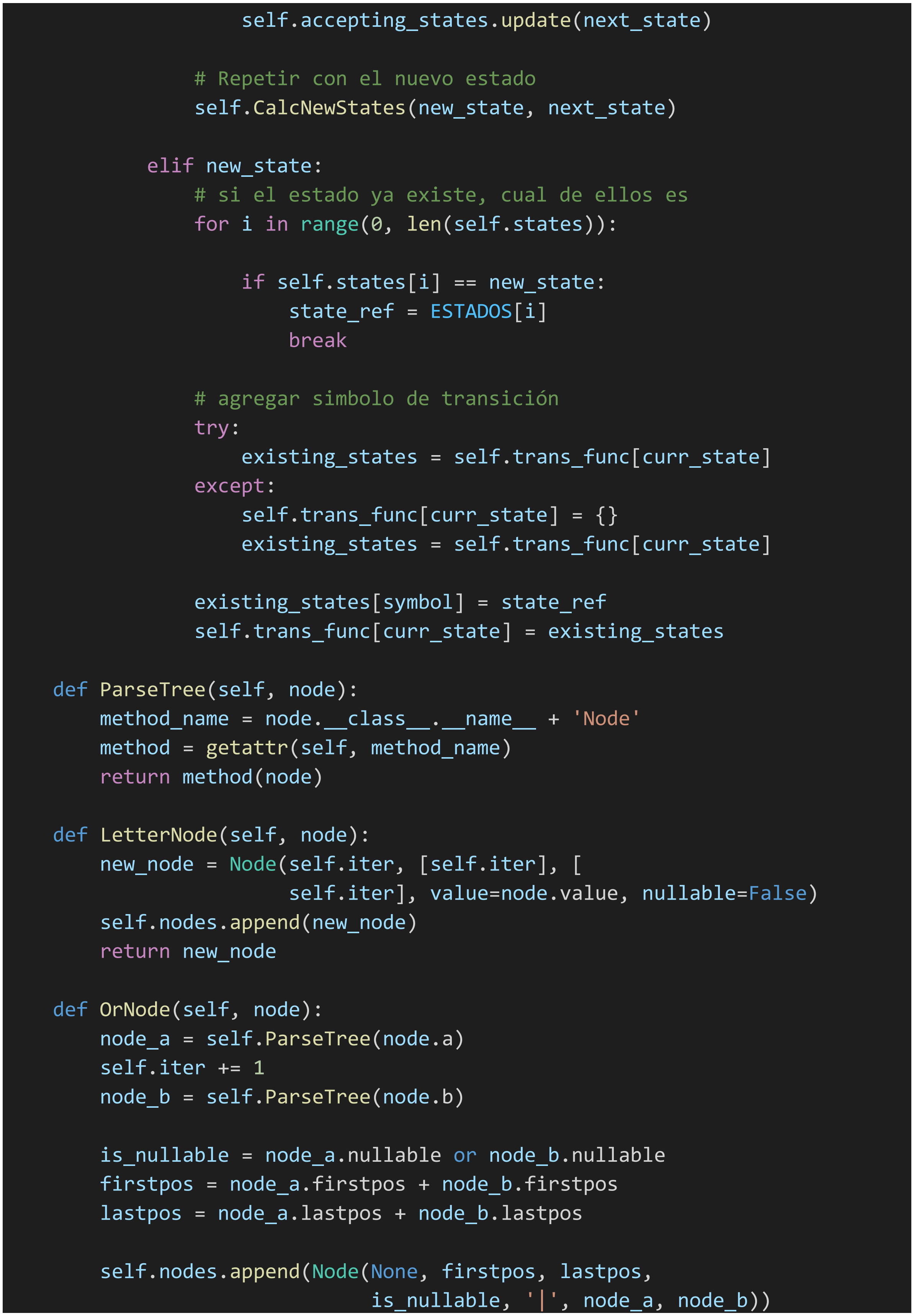
```
ESTADOS = 'ABCDEFGHIJKLMNOPQRSTUVWXYZ'


class DDFA:
    def __init__(self, tree, symbols, regex):

        #sintaxis del arbol
        self.nodes = list()

        # AF propiedades
```



```
        self.symbols = symbols
        self.states = list()
        self.trans_func = dict()
        self.accepting_states = set()
        self.initial_state = 'A'

        # propiededes de la clase
        self.tree = tree
        self.regex = regex
        self.augmented_state = None
        self.iter = 1

        self.STATES = iter(ESTADOS)
        try:
            self.symbols.remove('e') #lamda
        except:
            pass

        # Inicialización de contrucción AF
        self.ParseTree(self.tree)
        self.CalcFollowPos()

    def CalcFollowPos(self):
        for node in self.nodes:
            if node.value == '*':
                for i in node.lastpos:
                    child_node = next(filter(lambda x: x._id == i,
self.nodes))
                    child_node.followpos += node.firstpos
            elif node.value == '.':
                for i in node.c1.lastpos:
                    child_node = next(filter(lambda x: x._id == i,
self.nodes))
                    child_node.followpos += node.c2.firstpos

        # Inicia la generación de estados
        initial_state = self.nodes[-1].firstpos

        # nodos que tienen simbolos
        self.nodes = list(filter(lambda x: x._id, self.nodes))
        self.augmented_state = self.nodes[-1]._id

        # Usamos recursión para leer toda la expresión
        self.CalcNewStates(initial_state, next(self.STATES))
```



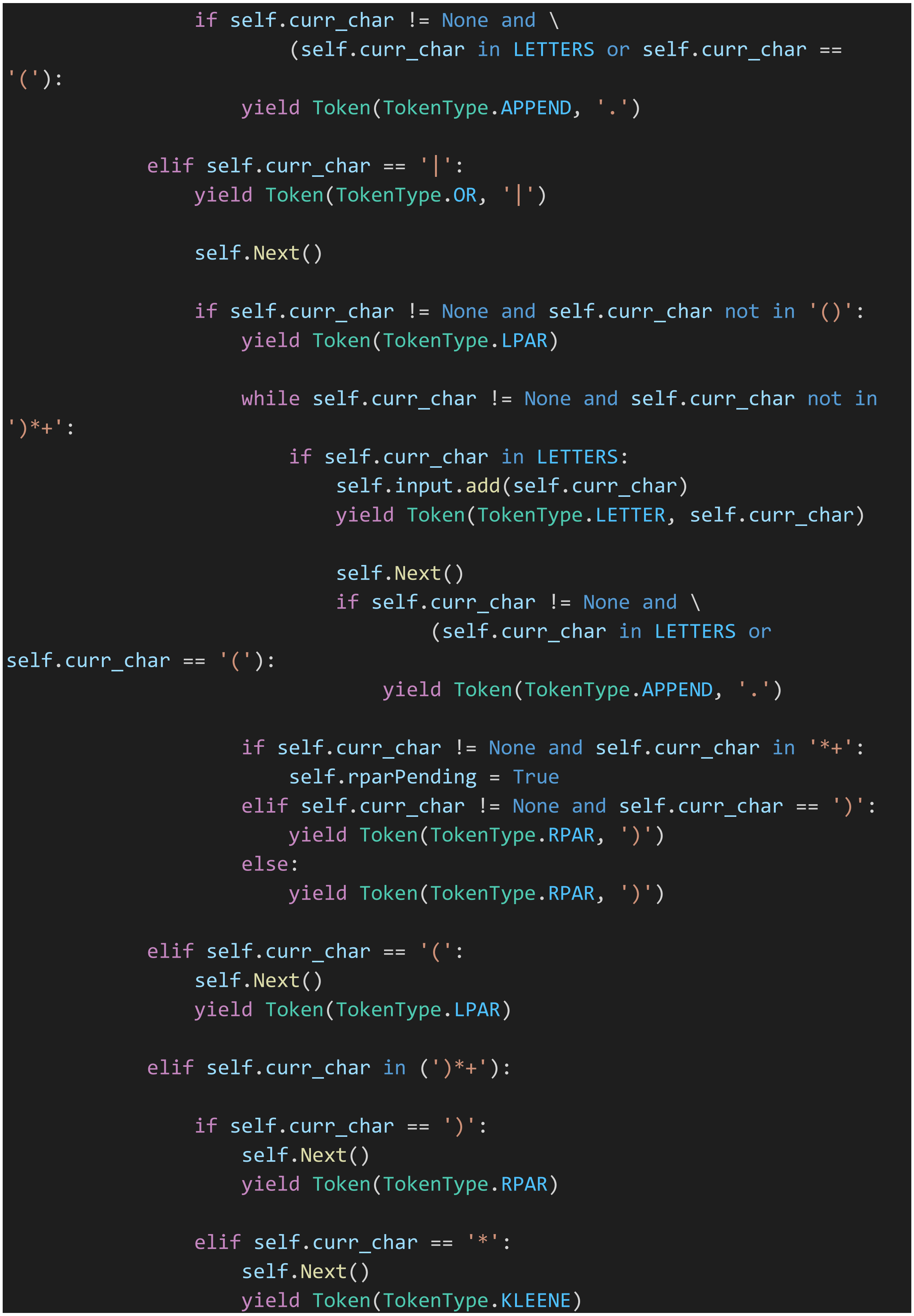
```
    def CalcNewStates(self, state, curr_state):

        if not self.states:
            self.states.append(set(state))
            if self.augmented_state in state:
                self.accepting_states.update(curr_state)

        # Iteramos por cada símbolo
        for symbol in self.symbols:

            # Obtener los nodos con el mismo simbolo
            same_symbols = list(
                filter(lambda x: x.value == symbol and x._id in state,
self.nodes))

            # Crear un nuevo estado con los nodos
            new_state = set()
            for node in same_symbols:
                new_state.update(node.followpos)

            # El nuevo estado no esta en la lista
            if new_state not in self.states and new_state:

                # letra del nuevo estado
                self.states.append(new_state)
                next_state = next(self.STATES)

                # agregar estado a la función de transición
                try:
                    self.trans_func[next_state]
                except:
                    self.trans_func[next_state] = dict()

                try:
                    existing_states = self.trans_func[curr_state]
                except:
                    self.trans_func[curr_state] = dict()
                    existing_states = self.trans_func[curr_state]

                # Add the reference
                existing_states[symbol] = next_state
                self.trans_func[curr_state] = existing_states

                # es un accepting_state?
                if self.augmented_state in new_state:
```



```
                    self.accepting_states.update(next_state)

                # Repetir con el nuevo estado
                self.CalcNewStates(new_state, next_state)

            elif new_state:
                # si el estado ya existe, cual de ellos es
                for i in range(0, len(self.states)):

                    if self.states[i] == new_state:
                        state_ref = ESTADOS[i]
                        break

                # agregar simbolo de transición
                try:
                    existing_states = self.trans_func[curr_state]
                except:
                    self.trans_func[curr_state] = {}
                    existing_states = self.trans_func[curr_state]

                existing_states[symbol] = state_ref
                self.trans_func[curr_state] = existing_states

    def ParseTree(self, node):
        method_name = node.__class__.__name__ + 'Node'
        method = getattr(self, method_name)
        return method(node)

    def LetterNode(self, node):
        new_node = Node(self.iter, [self.iter], [
                        self.iter], value=node.value, nullable=False)
        self.nodes.append(new_node)
        return new_node

    def OrNode(self, node):
        node_a = self.ParseTree(node.a)
        self.iter += 1
        node_b = self.ParseTree(node.b)

        is_nullable = node_a.nullable or node_b.nullable
        firstpos = node_a.firstpos + node_b.firstpos
        lastpos = node_a.lastpos + node_b.lastpos

        self.nodes.append(Node(None, firstpos, lastpos,
                               is_nullable, '|', node_a, node_b))
        return Node(None, firstpos, lastpos, is_nullable, '|', node_a,
node_b)

    def AppendNode(self, node):
        node_a = self.ParseTree(node.a)
        self.iter += 1
        node_b = self.ParseTree(node.b)

        is_nullable = node_a.nullable and node_b.nullable
        if node_a.nullable:
            firstpos = node_a.firstpos + node_b.firstpos
        else:
            firstpos = node_a.firstpos

        if node_b.nullable:
            lastpos = node_b.lastpos + node_a.lastpos
        else:
            lastpos = node_b.lastpos

        self.nodes.append(
            Node(None, firstpos, lastpos, is_nullable, '.', node_a, node_b))

        return Node(None, firstpos, lastpos, is_nullable, '.', node_a,
node_b)

    def KleeneNode(self, node):
        node_a = self.ParseTree(node.a)
        firstpos = node_a.firstpos
        lastpos = node_a.lastpos
        self.nodes.append(Node(None, firstpos, lastpos, True, '*', node_a))
        return Node(None, firstpos, lastpos, True, '*', node_a)

    def PlusNode(self, node):
        node_a = self.ParseTree(node.a)

        self.iter += 1

        node_b = self.KleeneNode(node)

        is_nullable = node_a.nullable and node_b.nullable
        if node_a.nullable:
            firstpos = node_a.firstpos + node_b.firstpos
        else:
            firstpos = node_a.firstpos
        if node_b.nullable:
            lastpos = node_b.lastpos + node_a.lastpos
        else:
            lastpos = node_b.lastpos

        self.nodes.append(
            Node(None, firstpos, lastpos, is_nullable, '.', node_a, node_b))

        return Node(None, firstpos, lastpos, is_nullable, '.', node_a, node_b)



    def EvalRegex(self):
        curr_state = 'A'
        for symbol in self.regex:

            if not symbol in self.symbols:
                return 'No'

            try:
                curr_state = self.trans_func[curr_state][symbol]
            except:
                if curr_state in self.accepting_states and symbol in self.trans_func['A']:
                    curr_state = self.trans_func['A'][symbol]
                else:
                    return 'No'

        return 'Yes' if curr_state in self.accepting_states else 'No'




class Node:
    def __init__(self, _id, firstpos=None, lastpos=None, nullable=False, value=None, c1=None, c2=None):
        self._id = _id
        self.firstpos = firstpos
        self.lastpos = lastpos
        self.followpos = list()
        self.nullable = nullable
        self.value = value
        self.c1 = c1
        self.c2 = c2
    def __repr__(self):
        return f'''
    id: {self._id}
    value: {self.value}
    firstpos: {self.firstpos}
    lastpos: {self.lastpos}
    followpos: {self.followpos}
    nullabe: {self.nullable}
    '''
```

direct_reader

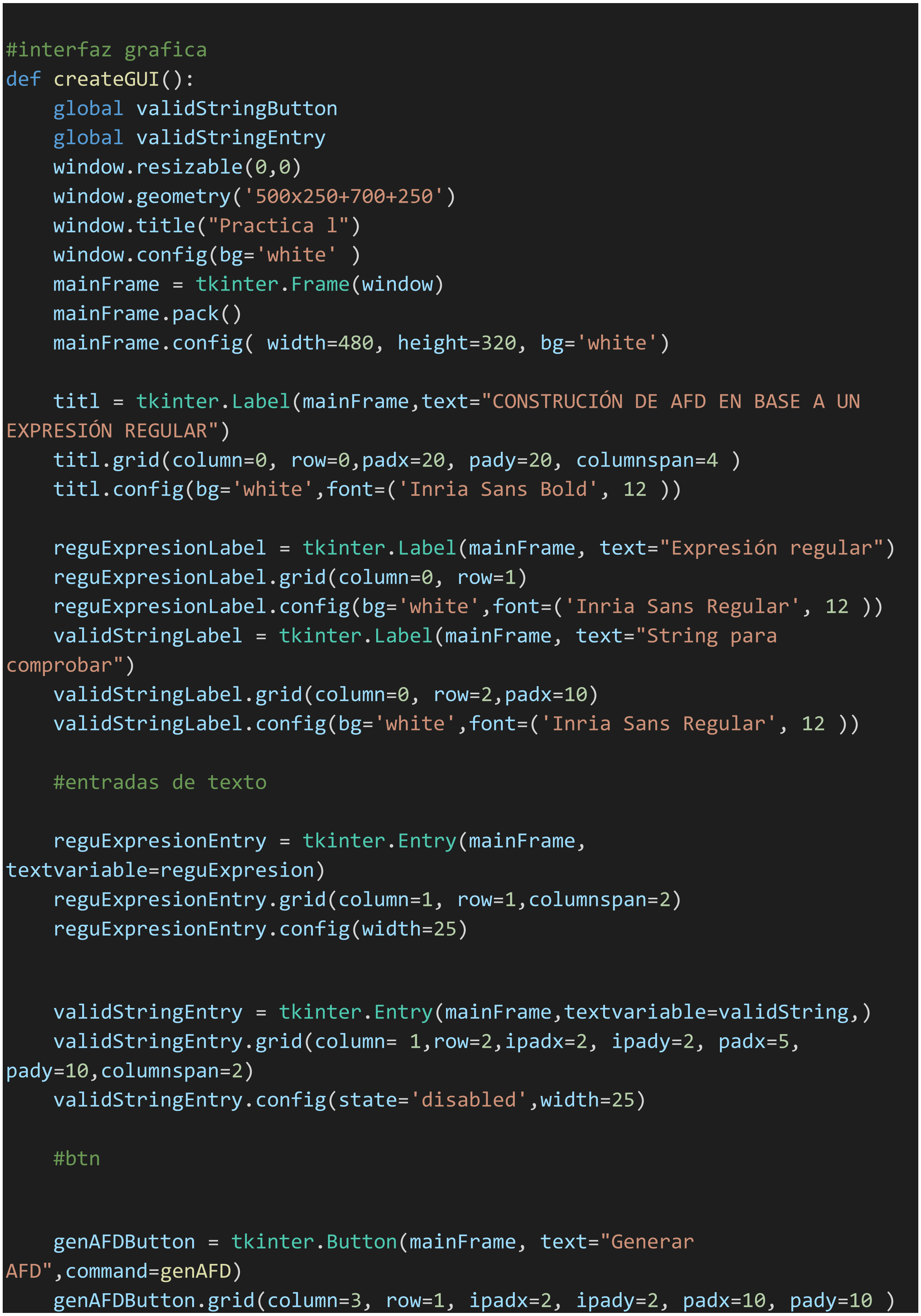
```
from tokens import Token, TokenType

LETTERS = 'abcdefghijklmnopqrstuvwxyz01234567890.'


class DirectReader:

    def __init__(self, string: str):
        self.string = iter(string.replace(' ', ''))
        self.input = set()
        self.rparPending = False
        self.Next()

    def Next(self):
        try:
            self.curr_char = next(self.string)
        except StopIteration:
            self.curr_char = None

    def CreateTokens(self):
        while self.curr_char != None:

            if self.curr_char in LETTERS:
                self.input.add(self.curr_char)
                yield Token(TokenType.LETTER, self.curr_char)

                self.Next()

                # para finalizar, se verifica si necesitamos agregar un
token append
```



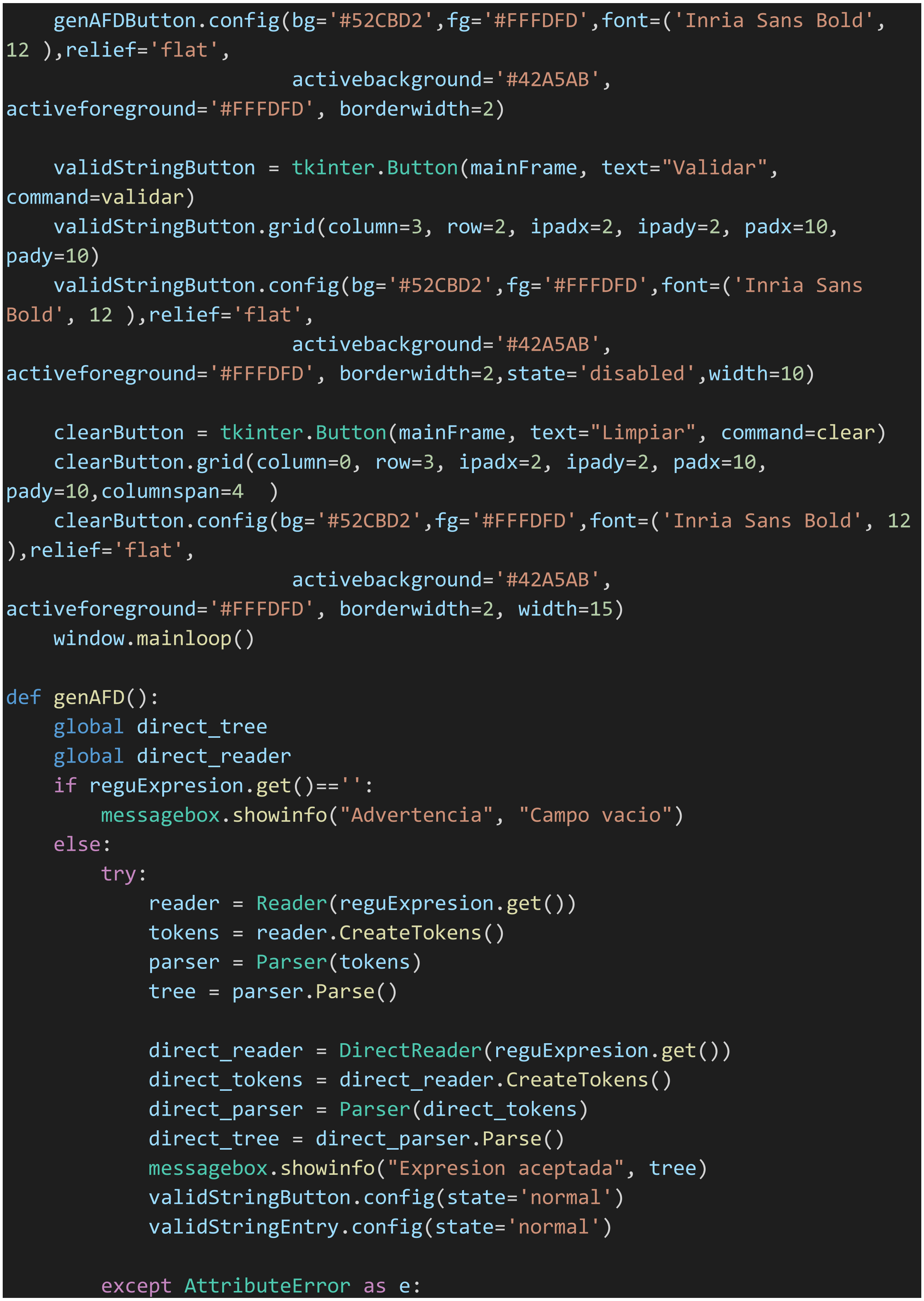
```
                if self.curr_char != None and \
                        (self.curr_char in LETTERS or self.curr_char ==
'('):
                    yield Token(TokenType.APPEND, '.')

            elif self.curr_char == '|':
                yield Token(TokenType.OR, '|')

                self.Next()

                if self.curr_char != None and self.curr_char not in '()':
                    yield Token(TokenType.LPAR)

                    while self.curr_char != None and self.curr_char not in
')*+':
                        if self.curr_char in LETTERS:
                            self.input.add(self.curr_char)
                            yield Token(TokenType.LETTER, self.curr_char)

                            self.Next()
                            if self.curr_char != None and \
                                    (self.curr_char in LETTERS or
self.curr_char == '('):
                                yield Token(TokenType.APPEND, '.')

                    if self.curr_char != None and self.curr_char in '*+':
                        self.rparPending = True
                    elif self.curr_char != None and self.curr_char == ')':
                        yield Token(TokenType.RPAR, ')')
                    else:
                        yield Token(TokenType.RPAR, ')')

            elif self.curr_char == '(':
                self.Next()
                yield Token(TokenType.LPAR)

            elif self.curr_char in (')*+'):

                if self.curr_char == ')':
                    self.Next()
                    yield Token(TokenType.RPAR)

                elif self.curr_char == '*':
                    self.Next()
                    yield Token(TokenType.KLEENE)
                elif self.curr_char == '+':
                    self.Next()
                    yield Token(TokenType.PLUS)


                if self.rparPending:
                    yield Token(TokenType.RPAR)
                    self.rparPending = False

                #para finalizar, se verifica si necesitamos agregar un token
append
                if self.curr_char != None and \
                        (self.curr_char in LETTERS or self.curr_char ==
'('):
                    yield Token(TokenType.APPEND, '.')

            else:
                raise Exception(f'Invalid entry: {self.curr_char}')

        yield Token(TokenType.APPEND, '.')
        yield Token(TokenType.LETTER, '#')

    def GetSymbols(self):
        return self.input
```

main

```
from asyncio.windows_events import NULL
from pickle import FALSE
from reader import Reader
from parsing import Parser
from afd import DDFA
from direct_reader import DirectReader
from cgitb import text
from tkinter import CENTER, messagebox, ttk as ttk
import tkinter
from tkinter import StringVar, font
from turtle import title

#var global
window = tkinter.Tk()
reguExpresion = StringVar()
validString = StringVar()
```



```
#interfaz grafica
def createGUI():
    global validStringButton
    global validStringEntry
    window.resizable(0,0)
    window.geometry('500x250+700+250')
    window.title("Practica l")
    window.config(bg='white' )
    mainFrame = tkinter.Frame(window)
    mainFrame.pack()
    mainFrame.config( width=480, height=320, bg='white')

    titl = tkinter.Label(mainFrame,text="CONSTRUCIÓN DE AFD EN BASE A UN
EXPRESIÓN REGULAR")
    titl.grid(column=0, row=0,padx=20, pady=20, columnspan=4 )
    titl.config(bg='white',font=('Inria Sans Bold', 12 ))

    reguExpresionLabel = tkinter.Label(mainFrame, text="Expresión regular")
    reguExpresionLabel.grid(column=0, row=1)
    reguExpresionLabel.config(bg='white',font=('Inria Sans Regular', 12 ))
    validStringLabel = tkinter.Label(mainFrame, text="String para
comprobar")
    validStringLabel.grid(column=0, row=2,padx=10)
    validStringLabel.config(bg='white',font=('Inria Sans Regular', 12 ))

    #entradas de texto

    reguExpresionEntry = tkinter.Entry(mainFrame,
textvariable=reguExpresion)
    reguExpresionEntry.grid(column=1, row=1,columnspan=2)
    reguExpresionEntry.config(width=25)


    validStringEntry = tkinter.Entry(mainFrame,textvariable=validString,)
    validStringEntry.grid(column= 1,row=2,ipadx=2, ipady=2, padx=5,
pady=10,columnspan=2)
    validStringEntry.config(state='disabled',width=25)

    #btn


    genAFDButton = tkinter.Button(mainFrame, text="Generar
AFD",command=genAFD)
    genAFDButton.grid(column=3, row=1, ipadx=2, ipady=2, padx=10, pady=10 )
```



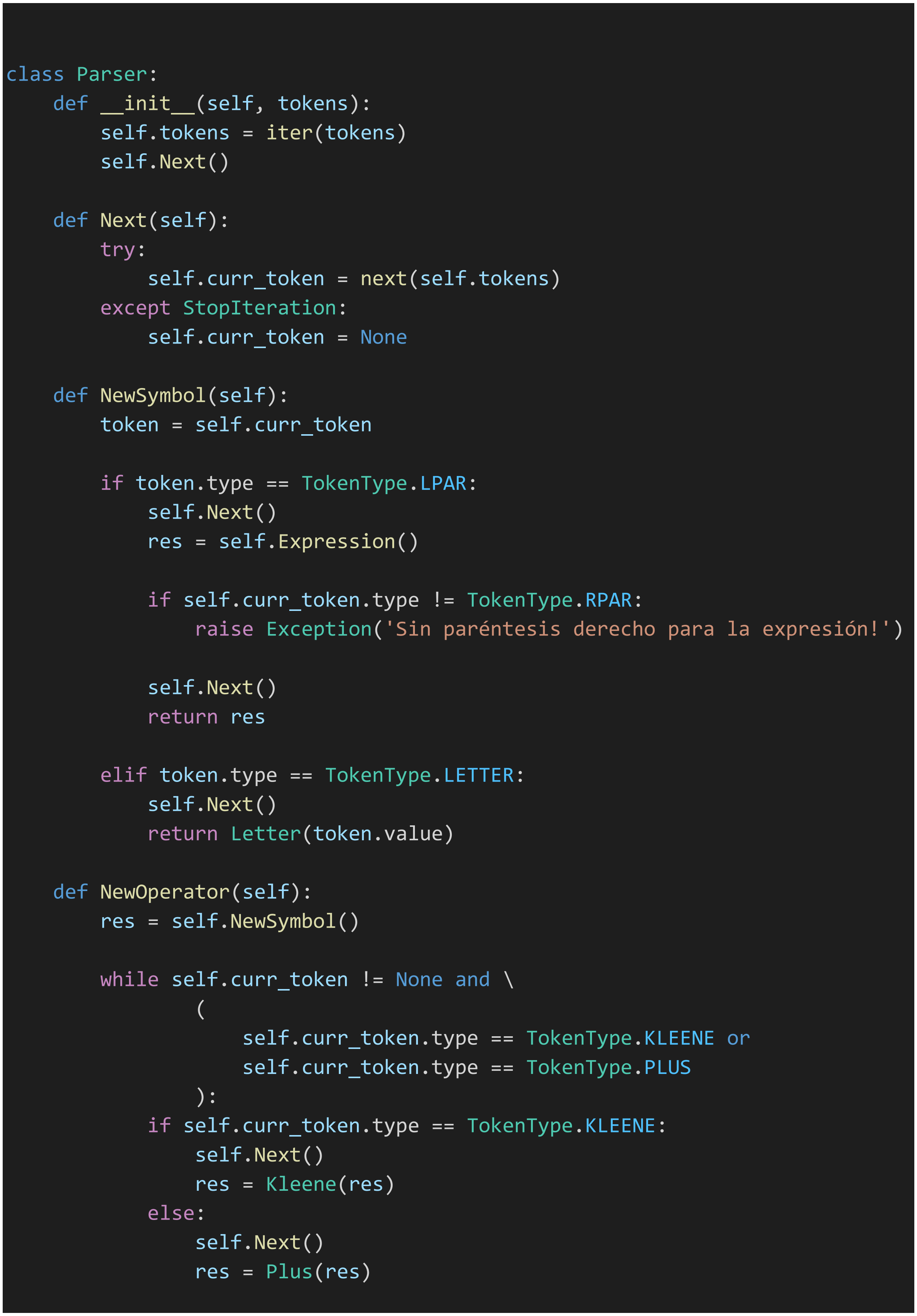
```
    genAFDButton.config(bg='#52CBD2',fg='#FFFDFD',font=('Inria Sans Bold',
12 ),relief='flat',
                        activebackground='#42A5AB',
activeforeground='#FFFDFD', borderwidth=2)

    validStringButton = tkinter.Button(mainFrame, text="Validar",
command=validar)
    validStringButton.grid(column=3, row=2, ipadx=2, ipady=2, padx=10,
pady=10)
    validStringButton.config(bg='#52CBD2',fg='#FFFDFD',font=('Inria Sans
Bold', 12 ),relief='flat',
                        activebackground='#42A5AB',
activeforeground='#FFFDFD', borderwidth=2,state='disabled',width=10)

    clearButton = tkinter.Button(mainFrame, text="Limpiar", command=clear)
    clearButton.grid(column=0, row=3, ipadx=2, ipady=2, padx=10,
pady=10,columnspan=4  )
    clearButton.config(bg='#52CBD2',fg='#FFFDFD',font=('Inria Sans Bold', 12
),relief='flat',
                        activebackground='#42A5AB',
activeforeground='#FFFDFD', borderwidth=2, width=15)
    window.mainloop()

def genAFD():
    global direct_tree
    global direct_reader
    if reguExpresion.get()=='':
        messagebox.showinfo("Advertencia", "Campo vacio")
    else:
        try:
            reader = Reader(reguExpresion.get())
            tokens = reader.CreateTokens()
            parser = Parser(tokens)
            tree = parser.Parse()

            direct_reader = DirectReader(reguExpresion.get())
            direct_tokens = direct_reader.CreateTokens()
            direct_parser = Parser(direct_tokens)
            direct_tree = direct_parser.Parse()
            messagebox.showinfo("Expresion aceptada", tree)
            validStringButton.config(state='normal')
            validStringEntry.config(state='normal')

        except AttributeError as e:
            messagebox.showinfo("ERROR:", "Expresión invalida (missing
parenthesis)")

        except Exception as e:
            messagebox.showinfo("ERRPR: ",e)
        pass

def validar():
    if reguExpresion.get()=='':
        messagebox.showinfo("Advertencia", "Campo vacio")
    else:
        ddfa = DDFA(direct_tree, direct_reader.GetSymbols(),
validString.get())
        ddfa_regex = ddfa.EvalRegex()
        messagebox.showinfo("Pertenece la cadena a la expresión
regular?",ddfa_regex)
        validString.set("")
        pass

def clear():
    reguExpresion.set("")
    validString.set("")

    pass

if __name__ == "__main__":
    createGUI()
```

nodes

```
#tipos de clases segun el simbolo
class Letter:
    def __init__(self, value):
        self.value = value

    def __repr__(self):
        return f'{self.value}'


class Append():
    def __init__(self, a, b):
        self.a = a
        self.b = b
    def __repr__(self):
        return f'({self.a}.{self.b})'


class Or():
    def __init__(self, a, b):
        self.a = a
        self.b = b

    def __repr__(self):
        return f'({self.a}|{self.b})'


class Kleene():
    def __init__(self, a):
        self.a = a

    def __repr__(self):
        return f'{self.a}*'


class Plus():
    def __init__(self, a):
        self.a = a

    def __repr__(self):
        return f'{self.a}+'



class Expression():
    def __init__(self, a, b=None):
        self.a = a
        self.b = b

    def __repr__(self):
        if self.b != None:
            return f'{self.a}{self.b}'
        return f'{self.a}'
```

parsing

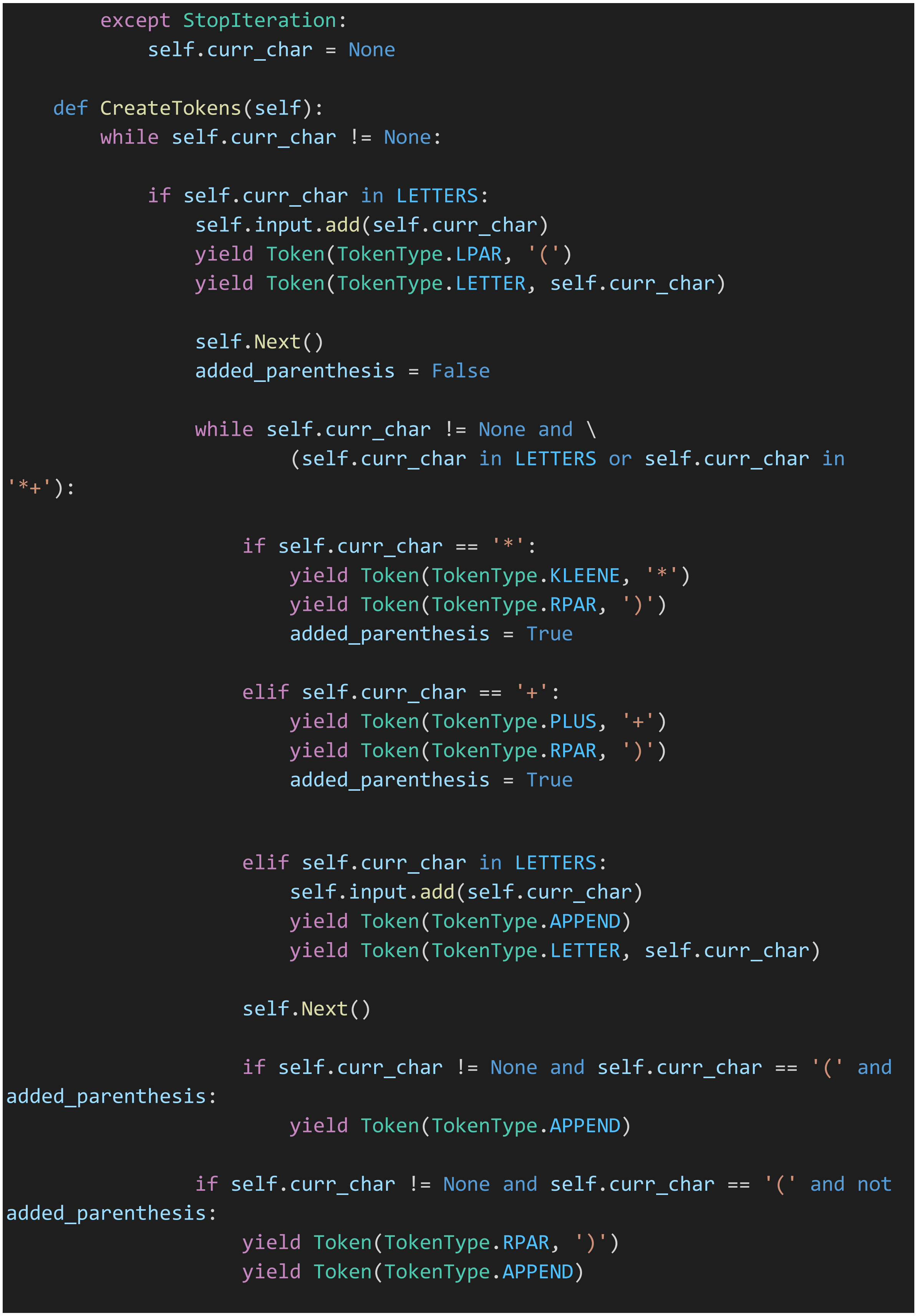
```
from tokens import TokenType
from nodes import *
```



```python
class Parser:
    def __init__(self, tokens):
        self.tokens = iter(tokens)
        self.Next()

    def Next(self):
        try:
            self.curr_token = next(self.tokens)
        except StopIteration:
            self.curr_token = None

    def NewSymbol(self):
        token = self.curr_token

        if token.type == TokenType.LPAR:
            self.Next()
            res = self.Expression()

            if self.curr_token.type != TokenType.RPAR:
                raise Exception('Sin paréntesis derecho para la expresión!')

            self.Next()
            return res

        elif token.type == TokenType.LETTER:
            self.Next()
            return Letter(token.value)

    def NewOperator(self):
        res = self.NewSymbol()

        while self.curr_token != None and \
                (
                    self.curr_token.type == TokenType.KLEENE or
                    self.curr_token.type == TokenType.PLUS
                ):
            if self.curr_token.type == TokenType.KLEENE:
                self.Next()
                res = Kleene(res)
            else:
                self.Next()
                res = Plus(res)
        return res

    def Expression(self):
        res = self.NewOperator()

        while self.curr_token != None and \
                (
                    self.curr_token.type == TokenType.APPEND or
                    self.curr_token.type == TokenType.OR
                ):
            if self.curr_token.type == TokenType.OR:
                self.Next()
                res = Or(res, self.NewOperator())

            elif self.curr_token.type == TokenType.APPEND:
                self.Next()
                res = Append(res, self.NewOperator())

        return res

    def Parse(self):
        if self.curr_token == None:
            return None

        res = self.Expression()

        return res
```

reader

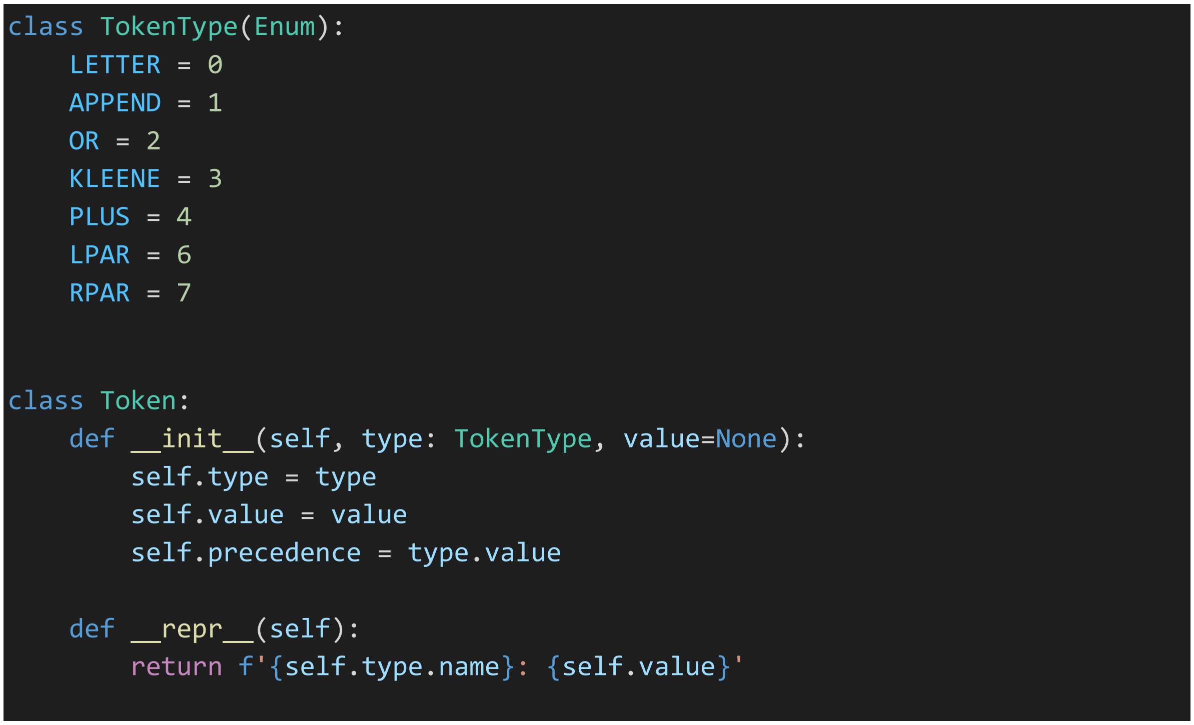
```
from tokens import Token, TokenType

LETTERS = 'abcdefghijklmnopqrstuvwxyz01234567890.'


class Reader:
    def __init__(self, string: str):
        self.string = iter(string.replace(' ', ''))
        self.input = set()
        self.Next()

    def Next(self):
        try:
            self.curr_char = next(self.string)
```



```
        except StopIteration:
            self.curr_char = None

    def CreateTokens(self):
        while self.curr_char != None:

            if self.curr_char in LETTERS:
                self.input.add(self.curr_char)
                yield Token(TokenType.LPAR, '(')
                yield Token(TokenType.LETTER, self.curr_char)

                self.Next()
                added_parenthesis = False

                while self.curr_char != None and \
                        (self.curr_char in LETTERS or self.curr_char in
'*+'):

                    if self.curr_char == '*':
                        yield Token(TokenType.KLEENE, '*')
                        yield Token(TokenType.RPAR, ')')
                        added_parenthesis = True

                    elif self.curr_char == '+':
                        yield Token(TokenType.PLUS, '+')
                        yield Token(TokenType.RPAR, ')')
                        added_parenthesis = True


                    elif self.curr_char in LETTERS:
                        self.input.add(self.curr_char)
                        yield Token(TokenType.APPEND)
                        yield Token(TokenType.LETTER, self.curr_char)

                    self.Next()

                    if self.curr_char != None and self.curr_char == '(' and
added_parenthesis:
                        yield Token(TokenType.APPEND)

                if self.curr_char != None and self.curr_char == '(' and not
added_parenthesis:
                    yield Token(TokenType.RPAR, ')')
                    yield Token(TokenType.APPEND)
                elif not added_parenthesis:
                    yield Token(TokenType.RPAR, ')')

            elif self.curr_char == '|':
                self.Next()
                yield Token(TokenType.OR, '|')

            elif self.curr_char == '(':
                self.Next()
                yield Token(TokenType.LPAR)

            elif self.curr_char in (')*+'):

                if self.curr_char == ')':
                    self.Next()
                    yield Token(TokenType.RPAR)

                elif self.curr_char == '*':
                    self.Next()
                    yield Token(TokenType.KLEENE)

                elif self.curr_char == '+':
                    self.Next()
                    yield Token(TokenType.PLUS)



                # para finalizar, se verifica si necesitamos agregar un
token append
                if self.curr_char != None and \
                        (self.curr_char in LETTERS or self.curr_char ==
'('):
                    yield Token(TokenType.APPEND, '.')

            else:
                raise Exception(f'Entrada invalida: {self.curr_char}')

    def GetSymbols(self):
        return self.input
```

tokens

```
from enum import Enum
```



```python
class TokenType(Enum):
    LETTER = 0
    APPEND = 1
    OR = 2
    KLEENE = 3
    PLUS = 4
    LPAR = 6
    RPAR = 7


class Token:
    def __init__(self, type: TokenType, value=None):
        self.type = type
        self.value = value
        self.precedence = type.value

    def __repr__(self):
        return f'{self.type.name}: {self.value}'
```