UNIVERSIDAD DE SAN CARLOS DE GUATEMALA

FACULTAD DE INGENIERIA

ESCUELA DE CIENCIAS Y SISTEMAS

LABORATORIO DE LENGUAJES Y COMPILADORES 2

MANUAL TECNICO

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SECCION: A

ANALIZADOR LEXICO(SCANNER)

Reglas Léxicas: Creación de las reglas léxicas que el compilador utilizara durante la ejecución del programa.

```
reserveds = {
    # EJECUCION DDL
    'BEGIN'      : 'RW_begin',
    'END'        : 'RW_end',
    'SELECT'     : 'RW_select',
    'FROM'       : 'RW_from',
    'WHERE'      : 'RW_where',
    'DECLARE'    : 'RW_declare',
    'SET'        : 'RW_set',
    'CREATE'     : 'RW_create',
    'DATA'       : 'RW_data',
    'BASE'       : 'RW_base',
    'USE'        : 'RW_use',
    'TABLE'      : 'RW_table',
    'PRIMARY'    : 'RW_primary',
    'FOREING'    : 'RW_foreing',
    'KEY'        : 'RW_key',
    'REFERENCE'  : 'RW_ref',
    'ALTER'      : 'RW_alter',
    'ADD'        : 'RW_add',
    'DROP'       : 'RW_drop',
    'COLUMN'     : 'RW_column',
    'RENAME'     : 'RW_rename',
    'TO'         : 'RW_to',
    'INSERT'     : 'RW_insert',
    'INTO'       : 'RW_into',
    'VALUES'     : 'RW_values',
    'AS'         : 'RW_as',
    'UPDATE'     : 'RW_update',
    'TRUNCATE'   : 'RW_truncate',
    'DELETE'     : 'RW_delete',
    'THEN'       : 'RW_then',
    'WHEN'       : 'RW_when',
    'NOT'        : 'RW_not',
```

```
    # EJECUCION DML
    'IF'         : 'RW_if',
    'ELSE'       : 'RW_else',
    'CASE'       : 'RW_case',
    'WHILE'      : 'RW_while',
    'FOR'        : 'RW_for',
    'IN'         : 'RW_in',
    'LOOP'       : 'RW_loop',
    'BREAK'      : 'RW_break',
    'CONTINUE'   : 'RW_continue',
    'FUNCTION'   : 'RW_function',
    'RETURNS'    : 'RW_returns',
    'RETURN'     : 'RW_return',
    'PROCEDURE'  : 'RW_procedure',
    'PRINT'      : 'RW_print',
    'TRUNCATE'   : 'RW_truncate',
    'CONCATENAR' : 'RW_concatenar',
    'SUBSTRAER'  : 'RW_substraer',
    'HOY'        : 'RW_hoy',
    'CONTAR'     : 'RW_contar',
    'CAST'       : 'RW_cast',
    # TIPOS DE DATOS
    'INT'        : 'RW_int',
    'BIT'        : 'RW_bit',
    'DECIMAL'    : 'RW_decimal',
    'DATE'       : 'RW_date',
    'DATETIME'   : 'RW_datetime',
    'NCHAR'      : 'RW_nchar',
    'NVARCHAR'   : 'RW_nvarchar',
    'NULL'       : 'RW_null',
}
```

```
tokens = tuple(reserveds.values()) + (
    'TK_lpar',
    'TK_rpar',
    'TK_semicolon',
    'TK_comma',
    'TK_dot',
    'TK_plus',
    'TK_minus',
    'TK_mult',
    'TK_div',
    'TK_mod',
    'TK_equalequal',
    'TK_equal',
    'TK_notequal',
    'TK_lessequal',
    'TK_greatequal',
    'TK_less',
    'TK_great',
    'TK_and',
    'TK_or',
    'TK_not',
    'TK_id',
    'TK_field',
    'TK_date',
    'TK_datetime',
    'TK_nvarchar',
    'TK_decimal',
    'TK_int',
)
```

```
# SIGNOS DE AGRUPACIÓN Y FINALIZACIÓN
t_TK_lpar       = r'\('
t_TK_rpar       = r'\)'
t_TK_semicolon  = r'\;'
t_TK_comma      = r'\,'
t_TK_dot        = r'\.\.'
# OPERACIONES ARITMETICAS
t_TK_plus       = r'\+'
t_TK_minus      = r'\-'
t_TK_mult       = r'\*'
t_TK_div        = r'\/'
t_TK_mod        = r'\%'
# OPERADORES RELACIONALES
t_TK_equalequal = r'\=\='
t_TK_equal      = r'\='
t_TK_notequal   = r'\!\='
t_TK_lessequal  = r'\<\='
t_TK_greatequal = r'\>\='
t_TK_less       = r'\<'
t_TK_great      = r'\>'
t_TK_and        = r'\&\&'
t_TK_or         = r'\|\|'
t_TK_not        = r'\!'
```

Expresión Regulares: Definición de las expresiones regulares que el programa podrá utilizar en la lectura de las entradas que esta recibe.

```
def t_newline(t):
    r'\n | \r'
    t.lexer.lineno += 1

t_ignore = ' \t'

def t_comments(t):
    r'\-\-([^\r\n]*)?'
    t.lexer.lineno += 1
    t.lexer.skip(1)

def t_commentm(t):
    r'[/][*][^*]*[*]+([^/*][^*]*[*]+)*[/]'
    t.lexer.lineno += len(t.value.split('\n'))
    t.lexer.skip(1)

def t_TK_id(t):
    r'\@(\_)*[a-zA-Z][a-zA-Z0-9\_]*'
    return t

def t_TK_field(t):
    r'(\_)*[a-zA-Z][a-zA-Z0-9\_]*'
    t.type = reserveds.get(t.value.upper(), 'TK_field')
    return t

def t_TK_date(t):
    r'\"\d\d\d\d\-\d\d\-\d\d\"'
    t.value = t.value[1 : len(t.value) - 1]
    return t
```

```
def t_TK_nvarchar(t):
    r'\"(([^\n\"\\]|\\.)*)\"'
    t.value = t.value[1 : len(t.value) - 1]
    return t

def t_TK_decimal(t):
    r'[0-9]+\.[0-9]+'
    return t

def t_TK_int(t):
    r'[0-9]+'
    return t

def t_error(t):
    errors.append(Error(t.lexer.lineno, t.lexer.lexpos + 1, TypeError.LEXICAL, f'Caracter no reconocido. «{t.value[0]}»'))
    t.lexer.skip(1)

import ply.lex as Scanner
scanner = Scanner.lex()
```

ANALIZADOR SINTACTICO(PARSER)

Gramática: Creación de las reglas sintácticas que el programa aceptará y leerá durante la ejecución de este mismo.

```
def p_INIT(t: Prod):
    '''INIT : INSTRUCTIONS
            |'''
    if len(t) == 2 : t[0] = t[1]
    else           : t[0] = []

def p_INSTRUCTIONS(t: Prod):
    '''INSTRUCTIONS : INSTRUCTIONS INSTRUCTION
                    | INSTRUCTION'''
    if len(t) == 3 : t[1].append(t[2]); t[0] = t[1]
    else           : t[0] = [t[1]]
```

```
def p_INSTRUCTION(t: Prod):
    '''INSTRUCTION  : CREATEDB TK_semicolon
                    | USEDB TK_semicolon
                    | CREATETABLE TK_semicolon
                    | ALTERTAB TK_semicolon
                    | DROPTAB TK_semicolon
                    | INSERTREG TK_semicolon
                    | UPDATETAB TK_semicolon
                    | TRUNCATETAB TK_semicolon
                    | DELETETAB TK_semicolon
                    | SELECT TK_semicolon
                    | DECLAREID TK_semicolon
                    | ASIGNID TK_semicolon
                    | IFSTRUCT TK_semicolon
                    | CASESTRUCT_S TK_semicolon
                    | WHILESTRUCT TK_semicolon
                    | FORSTRUCT TK_semicolon
                    | FUNCDEC TK_semicolon
                    | CALLFUNC TK_semicolon
                    | ENCAP TK_semicolon
                    | PRINT TK_semicolon
                    | RW_break TK_semicolon
                    | RW_continue TK_semicolon
                    | RW_return EXP TK_semicolon
                    | RW_return TK_semicolon'''
    types = ['RW_break', 'RW_continue', 'RW_return']
    if not t.slice[1].type in types                    : t[0] = t[1]
    elif t.slice[1].type == 'RW_break'                 : pass
    elif t.slice[1].type == 'RW_continue'              : pass
    elif t.slice[1].type == 'RW_return' and len(t) == 4 : t[0] = Return(t.lineno(1), t.lexpos(1), t[2])
    elif t.slice[1].type == 'RW_return'                : t[0] = Return(t.lineno(1), t.lexpos(1), None)
```

```python
# Crear DB
def p_CREATEDB(t: Prod):
    '''CREATEDB     : RW_create RW_data RW_base TK_field'''
    xml.createDataBase(t[4])

# Usar DB
def p_USEDB(t: Prod):
    '''USEDB    : RW_use TK_field'''
    setUsedDatabase(t[2])

# Declaración de Variables
def p_DECLAREID(t: Prod):
    '''DECLAREID    : RW_declare DECLIDS
                    | RW_declare TK_id TYPE TK_equal EXP'''
    if len(t) == 3:   t[0] = InitID(t.lineno(1), t.lexpos(1), t[2][0], t[2][1], None)
    elif len(t) == 6: t[0] = InitID(t.lineno(1), t.lexpos(1), t[2],    t[3],    t[5])

def p_DECLIDS(t: Prod):
    '''DECLIDS  : DECLIDS TK_comma DECLID
                | DECLID'''
    if len(t) == 4: t[1][0].append(t[3][0]); t[1][1].append(t[3][1]); t[0] = t[1]
    else:           t[0] = [[t[1][0]], [t[1][1]]]

def p_DECLID(t: Prod):
    '''DECLID : TK_id TYPE'''
    t[0] = [t[1], t[2]]

# Asignación de Variables
def p_ASIGNID(t: Prod):
    '''ASIGNID : RW_set TK_id TK_equal EXP'''
    t[0] = AsignID(t.lineno(1), t.lexpos(1), t[2], t[4])
```

```python
# Mostrar valores de Variables
def p_SELECT(t: Prod):
    '''SELECT   : RW_select FIELDS RW_from TK_field RW_where EXP
                | RW_select FIELDS RW_from TK_field
                | RW_select LIST_IDS'''
    if len(t) == 7   : t[0] = Select(t.lineno(1), t.lexpos(1), t[4], t[2], t[6])
    elif len(t) == 5 : t[0] = Select(t.lineno(1), t.lexpos(1), t[4], t[2], None)
    else             : t[0] = Select_prt(t.lineno(1), t.lexpos(1), t[2])

def p_FIELDS(t: Prod):
    '''FIELDS   : LIST_IDS
                | TK_mult'''
    t[0] = t[1]

def p_LIST_IDS(t: Prod):
    '''LIST_IDS : LIST_IDS TK_comma IDS
                | IDS'''
    if len(t) == 4 : t[1].append(t[3]); t[0] = t[1]
    else           : t[0] = [t[1]]

def p_IDS(t: Prod):
    '''IDS  : EXP RW_as TK_nvarchar
            | EXP RW_as TK_field
            | EXP'''
    if len(t) == 4 : t[0] = [t[1], t[3]]
    else           : t[0] = [t[1], '']

# Creación de Tablas
def p_CREATETABLE(t: Prod):
    '''CREATETABLE : RW_create RW_table TK_field TK_lpar ATTRIBUTES TK_rpar'''
    t[0] = CreateTable(t.lineno(1), t.lexpos(1), t[3], t[5])
```

```
def p_ATTRIBUTES(t: Prod):
    '''ATTRIBUTES   : ATTRIBUTES TK_comma ATTRIBUTE
                    | ATTRIBUTE'''
    if len(t) == 4: t[1].append(t[3]); t[0] = t[1]
    else:           t[0] = [t[1]]

def p_ATTRIBUTE(t: Prod):
    '''ATTRIBUTE    : TK_field TYPE TK_lpar TK_int TK_rpar PROPS
                    | TK_field TYPE PROPS
                    | TK_field TYPE TK_lpar TK_int TK_rpar
                    | TK_field TYPE
                    | RW_foreing RW_key TK_lpar TK_field TK_rpar RW_ref TK_field TK_lpar TK_field TK_rpar'''
    if len(t) == 7   : t[0] = Attribute(t.lineno(1), t.lexpos(1), t[1], t[2], t[4], t[6])
    elif len(t) == 4 : t[0] = Attribute(t.lineno(1), t.lexpos(1), t[1], t[2], None, t[3])
    elif len(t) == 6 : t[0] = Attribute(t.lineno(1), t.lexpos(1), t[1], t[2], t[4])
    elif len(t) == 3 : t[0] = Attribute(t.lineno(1), t.lexpos(1), t[1], t[2], None)
    else             : t[0] = ForeignKey(t.lineno(1), t.lexpos(1), t[4], t[7], t[9])

def p_PROPS(t: Prod):
    '''PROPS    : RW_not RW_null RW_primary RW_key FKEY
                | RW_not RW_null RW_primary RW_key
                | RW_primary RW_key RW_not RW_null FKEY
                | RW_primary RW_key RW_not RW_null
                | RW_not RW_null FKEY
                | RW_not RW_null
                | RW_primary RW_key FKEY
                | RW_primary RW_key
                | FKEY'''
    if len(t) == 5 or len(t) == 6 and t.slice[1].type == 'RW_not'     : t[0] = {'notNull': True,  'primaryKey': True }
    if len(t) == 5 or len(t) == 6 and t.slice[1].type == 'RW_primary' : t[0] = {'notNull': True,  'primaryKey': True }
    if len(t) == 3 or len(t) == 4 and t.slice[1].type == 'RW_not'     : t[0] = {'notNull': True,  'primaryKey': False}
    if len(t) == 3 or len(t) == 4 and t.slice[1].type == 'RW_primary' : t[0] = {'notNull': False, 'primaryKey': True }
    if len(t) == 2                                                    : t[0] = {'notNull': False, 'primaryKey': False}

    if len(t) == 6 or len(t) == 4 or len(t) == 2                      : t[0].update(t[len(t) - 1])
    else                                                              : t[0].update({'foreignKey': False})
```

```
def p_FKEY(t: Prod):
    '''FKEY : RW_ref TK_field TK_lpar TK_field TK_rpar'''
    t[0] = {'foreignKey': True, 'table': t[2], 'field': t[4]}

# Alter Table
def p_ALTERTAB(t: Prod):
    '''ALTERTAB : RW_alter RW_table TK_field ACTION'''
    t[0] = AlterTable(t.lineno(1), t.lexpos(1), t[3], t[4][0], t[4][1], t[4][2], t[4][3])

def p_ACTION(t: Prod):
    '''ACTION   : RW_add TK_field TYPE
                | RW_drop TK_field
                | RW_rename RW_to TK_field
                | RW_rename RW_column TK_field RW_to TK_field'''
    if   t.slice[1].type == 'RW_add'    : t[0] = [t[1],        t[2], None, t[3]]
    elif t.slice[1].type == 'RW_drop'   : t[0] = [t[1],        t[2], None, None]
    elif t.slice[2].type == 'RW_to'     : t[0] = [t[1] + t[2], t[3], None, None]
    elif t.slice[2].type == 'RW_column' : t[0] = [t[1] + t[2], t[3], t[5], None]

# Eliminar Tabla
def p_DROPTAB(t: Prod):
    '''DROPTAB : RW_drop RW_table TK_field'''
    t[0] = DropTable(t.lineno(1), t.lexpos(1), t[3])

# Insertar registros
def p_INSERTREG(t: Prod):
    '''INSERTREG : RW_insert RW_into TK_field TK_lpar LIST_ATTRIBS TK_rpar RW_values TK_lpar LIST_EXPS TK_rpar'''
    t[0] = InsertTable(t.lineno(1), t.lexpos(1), t[3], t[5], t[9])


def p_LIST_ATTRIBS(t: Prod):
    '''LIST_ATTRIBS : LIST_ATTRIBS TK_comma TK_field
                    | TK_field'''
    if len(t) == 4 : t[1].append(t[3]); t[0] = t[1]
    else           : t[0] = [t[1]]
```

```python
def p_LIST_EXPS(t: Prod):
    '''LIST_EXPS    : LIST_EXPS TK_comma EXP
                    | EXP'''
    if len(t) == 4 : t[1].append(t[3]); t[0] = t[1]
    else           : t[0] = [t[1]]

# Actualizar Tabla
def p_UPDATETAB(t: Prod):
    '''UPDATETAB : RW_update TK_field RW_set VALUESTAB RW_where EXP'''
    t[0] = UpdateTable(t.lineno(1), t.lexpos(1), t[2], t[4][0], t[4][1], t[6])

def p_VALUESTAB(t: Prod):
    '''VALUESTAB    : VALUESTAB TK_comma VALUETAB
                    | VALUETAB '''
    if len(t) == 4: t[1][0].append(t[3][0]); t[1][1].append(t[3][1]); t[0] = t[1]
    else:           t[0] = [[t[1][0]], [t[1][1]]]

def p_VALUETAB(t: Prod):
    '''VALUETAB : TK_field TK_equal EXP'''
    t[0] = [t[1], t[3]]

# Truncate
def p_TRUNCATETAB(t: Prod):
    '''TRUNCATETAB : RW_truncate RW_table TK_field'''
    t[0] = TruncateTable(t.lineno(1), t.lexpos(1), t[3])

# Eliminar Registros
def p_DELETETAB(t: Prod):
    '''DELETETAB : RW_delete RW_from TK_field RW_where EXP'''
    t[0] = DeleteTable(t.lineno(1), t.lexpos(1), t[3], t[5])
```

```python
# Estructura IF
def p_IFSTRUCT(t: Prod):
    '''IFSTRUCT : RW_if EXP RW_then INSTRUCTIONS RW_else INSTRUCTIONS RW_end RW_if
                | RW_if EXP RW_then INSTRUCTIONS RW_end RW_if
                | RW_if EXP RW_begin INSTRUCTIONS RW_end'''
    if len(t) == 9   : t[0] = If(t.lineno(1), t.lexpos(1), t[2], Block(t.lineno(1), t.lexpos(1), t[4]), Block(t.lineno(1), t.lexpos(1), t[6]))
    elif len(t) == 7 : t[0] = If(t.lineno(1), t.lexpos(1), t[2], Block(t.lineno(1), t.lexpos(1), t[4]), None)
    elif len(t) == 6 : t[0] = If(t.lineno(1), t.lexpos(1), t[2], Block(t.lineno(1), t.lexpos(1), t[4]), None)

# Estructura CASE
def p_CASESTRUCT_S(t: Prod):
    '''CASESTRUCT_S : RW_case EXP WHENELSE RW_end RW_as TK_field
                    | RW_case EXP WHENELSE RW_end RW_as TK_nvarchar
                    | RW_case EXP WHENELSE RW_end
                    | RW_case WHENELSE RW_end RW_as TK_field
                    | RW_case WHENELSE RW_end RW_as TK_nvarchar
                    | RW_case WHENELSE RW_end'''
    if len(t) == 7   : t[0] = Case(t.lineno(1), t.lexpos(1), t[2], t[3][0], t[3][1], t[6])
    elif len(t) == 5 : t[0] = Case(t.lineno(1), t.lexpos(1), t[2], t[3][0], t[3][1], None)
    elif len(t) == 6 : t[0] = Case(t.lineno(1), t.lexpos(1), None, t[2][0], t[2][1], t[5])
    elif len(t) == 4 : t[0] = Case(t.lineno(1), t.lexpos(1), None, t[2][0], t[2][1], None)

def p_WHENELSE(t: Prod):
    '''WHENELSE : WHENS ELSE
                | WHENS
                | ELSE'''
    if len(t) == 3                                  : t[0] = [t[1], t[2]]
    elif len(t) == 2 and t.slice[1].type == 'WHENS' : t[0] = [t[1], None]
    else                                            : t[0] = [None, t[1]]

def p_WHENS(t: Prod):
    '''WHENS    : WHENS WHEN
                | WHEN'''
    if len(t) == 3 : t[1].append(t[2]); t[0] = t[1]
    else           : t[0] = [t[1]]
```

```
def p_WHEN(t: Prod):
    '''WHEN : RW_when EXP RW_then EXP'''
    t[0] = When(t.lineno(1), t.lexpos(1), t[2], t[4])

def p_ELSE(t: Prod):
    '''ELSE : RW_else RW_then EXP'''
    t[0] = t[3]

# PRINT
def p_PRINT(t: Prod):
    '''PRINT : RW_print EXP'''

# Estructura WHILE
def p_WHILESTRUCT(t: Prod):
    '''WHILESTRUCT : RW_while EXP ENCAP'''
    t[0] = While(t.lineno(1), t.lexpos(1), t[2], t[3])

# Estructura FOR
def p_FORSTRUCT(t: Prod):
    '''FORSTRUCT : RW_for TK_id RW_in EXP TK_dot EXP ENCAP RW_loop'''

# Funciones y métodos
def p_FUNCDEC(t: Prod):
    '''FUNCDEC  : RW_create RW_function TK_field TK_lpar PARAMS TK_rpar RW_returns TYPE ENCAP
                | RW_create RW_function TK_field TK_lpar TK_rpar RW_returns TYPE ENCAP
                | RW_create RW_procedure TK_field PARAMS RW_as ENCAP
                | RW_create RW_procedure TK_field RW_as ENCAP
                | RW_create RW_procedure TK_field TK_lpar PARAMS TK_rpar ENCAP
                | RW_create RW_procedure TK_field ENCAP'''
    if len(t) == 10  : t[0] = Function(t.lineno(1), t.lexpos(1), t[3], t[5], t[9], t[8])
    elif len(t) == 9 : t[0] = Function(t.lineno(1), t.lexpos(1), t[3],   [], t[8], t[7])
    elif len(t) == 7 : t[0] = Function(t.lineno(1), t.lexpos(1), t[3], t[4], t[6], Type.NULL)
    elif len(t) == 6 : t[0] = Function(t.lineno(1), t.lexpos(1), t[3],   [], t[5], Type.NULL)
    elif len(t) == 8 : t[0] = Function(t.lineno(1), t.lexpos(1), t[3], t[5], t[7], Type.NULL)
    else             : t[0] = Function(t.lineno(1), t.lexpos(1), t[3],   [], t[4], Type.NULL)
```

```
def p_PARAMS(t: Prod):
    '''PARAMS   : PARAMS TK_comma PARAM
                | PARAM'''
    if len(t) == 4 : t[1].append(t[3]); t[0] = t[1]
    else           : t[0] = [t[1]]

def p_PARAM(t: Prod):
    '''PARAM    : TK_id RW_as TYPE'''
    t[0] = Parameter(t.lineno(1), t.lexpos(1), t[1], t[3])

# Encapsulamiento de Sentencias
def p_ENCAP(t: Prod):
    '''ENCAP    : RW_begin INSTRUCTIONS RW_end
                | RW_begin RW_end'''
    if len(t) == 4 : t[0] = Block(t.lineno(1), t.lexpos(1), t[2])
    else           : t[0] = Block(t.lineno(1), t.lexpos(1), [])

# Llamada a funciones y métodos
def p_CALLFUNC(t: Prod):
    '''CALLFUNC : TK_field TK_lpar ARGS TK_rpar
                | TK_field TK_lpar TK_rpar'''
    if len(t) == 5 : t[0] = CallFunction(t.lineno(1), t.lexpos(1), t[1], t[3])
    else           : t[0] = CallFunction(t.lineno(1), t.lexpos(1), t[1],  [] )

def p_ARGS(t: Prod):
    '''ARGS : ARGS TK_comma EXP
            | EXP'''
    if len(t) == 4 : t[1].append(t[3]); t[0] = t[1]
    else           : t[0] = [t[1]]
```

```
def p_EXP(t: Prod):
    '''EXP  : ARITHMETICS
            | RELATIONALS
            | LOGICS
            | CAST
            | NATIVEFUNC
            | CALLFUNC
            | TERNARY
            | TK_id
            | TK_field
            | TK_nvarchar
            | TK_int
            | TK_decimal
            | TK_date
            | TK_datetime
            | RW_null
            | TK_lpar EXP TK_rpar'''
    types = ['ARITHMETICS', 'RELATIONALS', 'LOGICS', 'CAST', 'NATIVEFUNC', 'CALLFUNC', 'TERNARY']
    if t.slice[1].type in types           : t[0] = t[1]
    elif t.slice[1].type == 'TK_id'       : t[0] = AccessID(t.lineno(1), t.lexpos(1), t[1])
    elif t.slice[1].type == 'TK_field'    : t[0] = Field(t.lineno(1), t.lexpos(1), t[1])
    elif t.slice[1].type == 'TK_nvarchar' : t[0] = Primitive(t.lineno(1), t.lexpos(1), t[1], Type.NVARCHAR)
    elif t.slice[1].type == 'TK_int'      : t[0] = Primitive(t.lineno(1), t.lexpos(1), t[1], Type.INT)
    elif t.slice[1].type == 'TK_decimal'  : t[0] = Primitive(t.lineno(1), t.lexpos(1), t[1], Type.DECIMAL)
    elif t.slice[1].type == 'TK_date'     : t[0] = Primitive(t.lineno(1), t.lexpos(1), t[1], Type.DATE)
    elif t.slice[1].type == 'TK_datetime' : t[0] = Primitive(t.lineno(1), t.lexpos(1), t[1], Type.DATETIME)
    elif t.slice[1].type == 'RW_null'     : t[0] = Primitive(t.lineno(1), t.lexpos(1), t[1], Type.NULL)
    else                                  : t[0] = t[2]
```

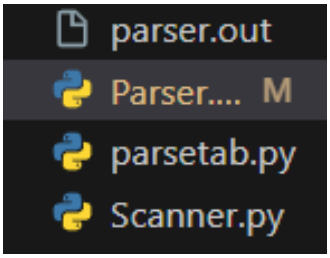
```
def p_ARITHMETICS(t: Prod):
    '''ARITHMETICS  : EXP TK_plus EXP
                    | EXP TK_minus EXP
                    | EXP TK_mult EXP
                    | EXP TK_div EXP
                    | EXP TK_mod EXP
                    | TK_minus EXP %prec TK_uminus'''
    if t.slice[1].type != 'TK_minus' : t[0] = Arithmetic(t.lineno(1), t.lexpos(1), t[1], t[2], t[3])
    else                             : t[0] = Arithmetic(t.lineno(1), t.lexpos(1), None, t[1], t[2])

def p_RELATIONALS(t: Prod):
    '''RELATIONALS  : EXP TK_equalequal EXP
                    | EXP TK_equal EXP
                    | EXP TK_notequal EXP
                    | EXP TK_lessequal EXP
                    | EXP TK_greatequal EXP
                    | EXP TK_less EXP
                    | EXP TK_great EXP'''
    t[0] = Relational(t.lineno(1), t.lexpos(1), t[1], t[2], t[3])

def p_LOGICS(t: Prod):
    '''LOGICS   : EXP TK_and EXP
                | EXP TK_or EXP
                | TK_not EXP'''
    if t.slice[2].type != 'RW_not'   : t[0] = Logic(t.lineno(1), t.lexpos(1), t[1], t[2], t[3])
    else                             : t[0] = Logic(t.lineno(1), t.lexpos(1), None, t[2], t[3])

def p_CAST(t: Prod):
    '''CAST : RW_cast TK_lpar EXP RW_as TYPE TK_rpar'''
    t[0] = Cast(t.lineno(1), t.lexpos(1), t[3], t[5])
```

```python
# Funciones Nativas
def p_NATIVEFUNC(t: Prod):
    '''NATIVEFUNC   : RW_concatenar TK_lpar EXP TK_comma EXP TK_rpar
                    | RW_substraer TK_lpar EXP TK_comma EXP TK_comma EXP TK_rpar
                    | RW_hoy TK_lpar TK_rpar'''
    if len(t) == 7   : t[0] = Concatenar(t.lineno(1), t.lexpos(1), t[3], t[5])
    elif len(t) == 9 : t[0] = Substraer(t.lineno(1), t.lexpos(1), t[3], t[5], t[7])
    else             : t[0] = Hoy(t.lineno(1), t.lexpos(1))

def p_TERNARY(t: Prod):
    '''TERNARY : RW_if TK_lpar EXP TK_comma EXP TK_comma EXP TK_rpar'''

def p_TYPE(t: Prod):
    '''TYPE : RW_int
            | RW_bit
            | RW_decimal
            | RW_date
            | RW_datetime
            | RW_nchar
            | RW_nvarchar'''
    if t.slice[1].type == 'RW_int'        : t[0] = Type.INT
    elif t.slice[1].type == 'RW_bit'      : t[0] = Type.BIT
    elif t.slice[1].type == 'RW_decimal'  : t[0] = Type.DECIMAL
    elif t.slice[1].type == 'RW_date'     : t[0] = Type.DATE
    elif t.slice[1].type == 'RW_datetime' : t[0] = Type.DATETIME
    elif t.slice[1].type == 'RW_nchar'    : t[0] = Type.NCHAR
    elif t.slice[1].type == 'RW_nvarchar' : t[0] = Type.NVARCHAR

from interpreter.Scanner import *

def p_error(t: LexToken):
    errors.append(Error(t.lineno, t.lexpos + 1, TypeError.SYNTAX, f'No se esperaba «{t.value}»'))

import ply.yacc as Parser
parser = Parser.yacc()
```

Precedencias: Durante la ejecución el programa tomara algunas reglas léxicas (Token's) como prioridad.

```python
precedence = (
    ('left', 'TK_or'),
    ('left', 'TK_and'),
    ('right', 'TK_not'),
    ('left', 'TK_equalequal', 'TK_equal', 'TK_notequal'),
    ('left', 'TK_less', 'TK_lessequal', 'TK_great', 'TK_greatequal'),
    ('left', 'TK_plus', 'TK_minus'),
    ('left', 'TK_mult', 'TK_div', 'TK_mod'),
    ('right', 'TK_uminus'),
)
```

Archivos generados por la herramienta PLY:



PATRON INTERPRETE

Para la creación de este proyecto se utilizo el patrón interprete como modelo a seguir para la implementación de las deferentes clases donde se trabajaron las funcionalidades de este mismo.

Clase Expresión: Se construyo una clase padre llamada expresión que se implementará en las expresiones que el programa podrá ejecutar durante la interacción con este mismo.

```python
from abc import ABC, abstractmethod
from utils.TypeExp import TypeExp

class Expression(ABC):
    def __init__(self, line: int, column: int, typeExp: TypeExp):
        self.line = line
        self.column = column
        self.typeExp = typeExp
        self.trueLabel = ''
        self.falseLabel = ''

    @abstractmethod
    def setField(self, field):
        pass

    @abstractmethod
    def execute(self, env):
        pass

    @abstractmethod
    def compile(self, env, c3dgen):
        pass

    @abstractmethod
    def ast(self, ast):
        pass
```

Clase Instrucción: Se construyo una clase padre llamada Instrucción que se implementará en las Instrucciones que el programa podrá ejecutar durante la interacción con este mismo.

```python
from abc import ABC, abstractmethod
from utils.TypeInst import TypeInst
from statements.Env.Env import Env
from statements.Env.AST import AST, ReturnAST

class Instruction(ABC):
    def __init__(self, line: int, column: int, typeInst: TypeInst):
        self.line = line
        self.column = column
        self.typeInst = typeInst

    @abstractmethod
    def execute(self, env: Env) -> any:
        pass

    @abstractmethod
    def compile(self, env, c3dgen):
        pass

    @abstractmethod
    def ast(self, ast: AST) -> ReturnAST:
        pass
```

Las expresiones que el programa utilizara son las siguientes:

AccessID

```python
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.Objects.Table import Field
from statements.Abstracts.Expression import Expression
from statements.Env.Symbol import Symbol
from utils.TypeExp import TypeExp
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class AccessID(Expression):
    def __init__(self, line: int, column: int, id: str):
        super().__init__(line, column, TypeExp.ACCESS_ID)
        self.id = id

    def setField(self, _: dict[str, Field]):
        pass

    def execute(self, env: Env) -> ReturnType:
        value: Symbol | None = env.getValue(self.id)
        if value:
            return ReturnType(value.value, value.type)
        return ReturnType('NULL', Type.NULL)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="{self.id}"];'
        return ReturnAST(dot, id)
```

Arithmetic

```python
from statements.Abstracts.Expression import Expression
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.Objects.Table import Field
from utils.TypeExp import TypeExp
from utils.DomineOp import plus, minus, mult, div
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class Arithmetic(Expression):
    def __init__(self, line: int, column: int, exp1: Expression, sign: str, exp2: Expression):
        super().__init__(line, column, TypeExp.ARITHMETIC_OP)
        self.exp1 = exp1
        self.sign = sign
        self.exp2 = exp2
        self.type: Type = Type.NULL

    def setField(self, field: dict[str, Field]) -> any:
        if self.exp1:
            self.exp1.setField(field)
        self.exp2.setField(field)

    def execute(self, env: Env) -> ReturnType:
        match self.sign:
            case '+':
                return self.plus(env)
            case '-':
                if self.exp1 != None:
                    return self.minus(env)
                return self.negative(env)
            case '*':
                return self.mult(env)
            case '/':
                return self.div(env)
            case _:
                return ReturnType('NULL', Type.NULL)
```

```python
def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
    pass

def plus(self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    self.type = plus[value1.type.value][value2.type.value]
    if self.type != Type.NULL:
        if self.type == Type.BIT:
            return ReturnType(1 if int(value1.value) == 1 or int(value2.value) == 1 else 0, self.type)
        elif self.type == Type.INT:
            return ReturnType(int(int(value1.value) + int(value2.value)), self.type)
        elif self.type == Type.DECIMAL:
            return ReturnType(float(value1.value) + float(value2.value), self.type)
        elif self.type == Type.NVARCHAR or self.type == Type.NCHAR:
            return ReturnType(f'{value1.value}{value2.value}', self.type)
    env.setError('Los tipos no son válidos para operaciones aritméticas', self.exp2.line, self.exp2.column)
    return ReturnType('NULL', self.type)

def minus(self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    self.type = minus[value1.type.value][value2.type.value]
    if self.type != Type.NULL:
        if self.type == Type.INT:
            return ReturnType(int(value1.value) - int(value2.value), self.type)
        elif self.type == Type.DECIMAL:
            return ReturnType(float(value1.value) - float(value2.value), self.type)
    env.setError('Los tipos no son válidos para operaciones aritméticas', self.exp2.line, self.exp2.column)
    return ReturnType('NULL', self.type)
```

```python
def negative(self, env: Env) -> ReturnType:
    value: ReturnType = self.exp2.execute(env)
    self.type = value.type
    if self.type == Type.INT or self.type == Type.DECIMAL:
        return ReturnType(-value.value, self.type)
    env.setError('Los tipos no son válidos para operaciones aritméticas', self.exp2.line, self.exp2.column)
    return ReturnType('NULL', Type.NULL)

def mult(self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    self.type = mult[value1.type.value][value2.type.value]
    if self.type == Type.BIT:
            return ReturnType(1 if int(value1.value) == 1 and int(value2.value) == 1 else 0, self.type)
    elif self.type == Type.INT:
        return ReturnType(int(value1.value) * int(value2.value), self.type)
    elif self.type == Type.DECIMAL:
        return ReturnType(float(value1.value) * float(value2.value), self.type)
    elif self.type == Type.DATE or self.type == Type.DATETIME:
            return ReturnType(f'{value1.value}{value2.value}', self.type)
    elif self.type == Type.NVARCHAR or self.type == Type.NCHAR:
            return ReturnType(f'{value1.value}{value2.value}', self.type)
    env.setError('Los tipos no son válidos para operaciones aritméticas', self.exp2.line, self.exp2.column)
    return ReturnType('NULL', self.type)
```

```python
def div(self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    self.type = div[value1.type.value][value2.type.value]
    if self.type == Type.INT:
        if value2.value != 0:
            return ReturnType(int(float(value1.value) / float(value2.value)), self.type)
        env.setError('No se puede dividir entre 0', self.exp2.line, self.exp2.column)
        return
    elif self.type == Type.DECIMAL:
        if value2.value != 0:
            return ReturnType(float(value1.value) / float(value2.value), self.type)
        env.setError('No se puede dividir entre 0', self.exp2.line, self.exp2.column)
        return
    elif self.type == Type.DATE or self.type == Type.DATETIME:
            return ReturnType(f'{value1.value}{value2.value}', self.type)
    elif self.type == Type.NVARCHAR or self.type == Type.NCHAR:
            return ReturnType(f'{value1.value}{value2.value}', self.type)
    env.setError('Los tipos no son válidos para operaciones aritméticas', self.exp2.line, self.exp2.column)
    return ReturnType('NULL', self.type)

def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="{self.sign}"];'
    value1: ReturnAST
    if self.exp1 != None:
        value1 = self.exp1.ast(ast)
        dot += '\n' + value1.dot
        dot += f'\nnode_{id} -> node_{value1.id};'
    value2: ReturnAST = self.exp2.ast(ast)
    dot += '\n' + value2.dot
    dot += f'\nnode_{id} -> node_{value2.id};'
    return ReturnAST(dot, id)
```

CallFunction

```python
from statements.Abstracts.Expression import Expression
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.Env.Symbol import Symbol
from utils.Parameter import Parameter
from statements.Instructions.Function import Function
from statements.Objects.Table import Field
from utils.TypeExp import TypeExp
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class CallFunction(Expression):
    def __init__(self, line: int, column: int, id: str, args: list[Expression]):
        super().__init__(line, column, TypeExp.CALL_FUNC)
        self.id = id
        self.args = args

    def setField(self, _: dict[str, Field]) -> any:
        pass
```

```python
def execute(self, env: Env) -> ReturnType:
    func: Function = env.getFunction(self.id)
    if func:
        envFunc: Env = Env(env, f'Funcion ${self.id.lower()}')
        if len(func.parameters) == len(self.args):
            value: ReturnType
            param: Parameter
            for i in range(len(func.parameters)):
                value = self.args[i].execute(env)
                param = func.parameters[i]
                if value.type == param.type or param.type == Type.DECIMAL and value.type == Type.INT:
                    if not param.id.lower() in envFunc.ids:
                        envFunc.ids[param.id.lower()] = Symbol(value.value, param.id.lower(), param.type)
                        #symTable.push(new SymTab(param.line, param.column + 1, true, true, param.id.toLowerCase(), envFunc.name, param.type))
                        continue
                    env.setError('No puede haber parámetros distintos con el mismo nombre', param.line, param.column)
                    return
                env.setError(f'Se esperaba un tipo de dato "{self.getType(param.type)}" para el parámetro "{param.id}"', param.line, param.colum
                return
            execute: ReturnType = func.block.execute(envFunc)
            if execute:
                if execute.value == TypeExp.RETURN:
                    return
                return execute
            return
        env.setError(f'Cantidad errónea de parámetros enviados', self.line, self.column)
        return
    env.setError(f'La Función "{self.id}" no existe, línea {self.line} columna {self.column}', self.line, self.column)

def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
    pass
```

```python
    pass

def getType(type: Type) -> str:
    match type:
        case Type.INT:
            return "INT"
        case Type.DECIMAL:
            return "DECIMAL"
        case Type.NVARCHAR:
            return "NVARCHAR"
        case Type.BOOLEAN:
            return "BOOLEAN"
        case Type.DATE:
            return "DATE"
        case Type.TABLE:
            return "TABLE"
        case _:
            return "NULL"

def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="CALL FUNC"]'
    dot += f'\nnode_{id}_name[label="{self.id}"]'
    dot += f'\nnode_{id} -> node_{id}_name'
    param: ReturnAST
    if len(self.args) > 0:
        for i in range(len(self.args)):
            param = self.args[i].ast(ast)
            dot += '\n' + param.dot
            dot += f'\nnode_{id}_name -> node_{param.id}'
    return ReturnAST(dot, id)
```

Cast

```python
import re
from statements.Objects.Table import Field
from utils.TypeExp import TypeExp
from statements.Env.AST import AST, ReturnAST
from statements.Abstracts.Expression import Expression
from statements.Env.Env import Env
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class Cast(Expression):
    def __init__(self, line: int, column: int, value: Expression, destinyType: Type):
        super().__init__(line, column, TypeExp.CAST)
        self.value = value
        self.destinyType = destinyType

    def setField(self, _: dict[str, Field]) -> any:
        pass

    def execute(self, env: Env) -> ReturnType:
        value: ReturnType = self.value.execute(env)
        if value.value == Type.BIT:
            if self.destinyType == Type.INT:
                return ReturnType(int(value.value), Type.INT)
            if self.destinyType == Type.NVARCHAR:
                return ReturnType(str(value.
            if self.destinyType == Type.NCHA
                return ReturnType(str(value.value), Type.NCHAR)
            env.setError(f'No hay casteo de "{self.getType(value.type)}" a "{self.getType(self.destinyType)}"', self.value.line, self.value.column)
            return ReturnType('NULL', Type.NULL)
```

(variable) value: Literal[Type.BIT]

```python
        if value.type == Type.INT:
            if self.destinyType == Type.DECIMAL:
                return ReturnType(float(value.value), Type.DECIMAL)
            if self.destinyType == Type.NVARCHAR:
                return ReturnType(str(value.value), Type.NVARCHAR)
            env.setError(f'No hay casteo de "{self.getType(value.type)}" a "{self.getType(self.destinyType)}"', self.value.line, self.value.column)
            return ReturnType('NULL', Type.NULL)

        if value.type == Type.DECIMAL:
            if self.destinyType == Type.INT:
                return ReturnType(int(value.value), Type.INT)
            if self.destinyType == Type.NVARCHAR:
                return ReturnType(str(value.value), Type.NVARCHAR)
            if self.destinyType == Type.NCHAR:
                return ReturnType(str(value.value), Type.NCHAR)
            env.setError(f'No hay casteo de "{self.getType(value.type)}" a "{self.getType(self.destinyType)}"', self.value.line, self.value.column)
            return ReturnType('NULL', Type.NULL)

        if value.type == Type.DATE:
            if self.destinyType == Type.NVARCHAR:
                return ReturnType(str(value.value), Type.NVARCHAR)
            if self.destinyType == Type.NCHAR:
                return ReturnType(str(value.value), Type.NCHAR)
            env.setError(f'No hay casteo de "{self.getType(value.type)}" a "{self.getType(self.destinyType)}"', self.value.line, self.value.column)
            return ReturnType('NULL', Type.NULL)

        if value.type == Type.NVARCHAR:
            if self.destinyType == Type.INT:
                asciiz = sum(ord(character) for character in value.value)
                return ReturnType(int(asciiz), Type.INT)
            if self.destinyType == Type.BOOLEAN:
                return ReturnType(value.value.toLowerCase() == 'true', Type.BOOLEAN)
            env.setError(f'No hay casteo de "{self.getType(value.type)}" a "{self.getType(self.destinyType)}"', self.value.line, self.value.column)
            return ReturnType('NULL', Type.NULL)
```

```python
        if value.type == Type.NVARCHAR:
            if self.destinyType == Type.INT:
                asciiz = sum(ord(character) for character in value.value)
                return ReturnType(int(asciiz), Type.INT)
            if self.destinyType == Type.BOOLEAN:
                return ReturnType(value.value.toLowerCase() == 'true', Type.BOOLEAN)
            env.setError(f'No hay casteo de "{self.getType(value.type)}" a "{self.getType(self.destinyType)}"', self.value.line, self.value.column)
            return ReturnType('NULL', Type.NULL)

        if value.type == Type.NCHAR:
            if self.destinyType == Type.INT:
                asciiz = sum(ord(character) for character in value.value)
                return ReturnType(int(asciiz), Type.INT)
            if self.destinyType == Type.BOOLEAN:
                return ReturnType(value.value.toLowerCase() == 'true', Type.BOOLEAN)
            env.setError(f'No hay casteo de "{self.getType(value.type)}" a "{self.getType(self.destinyType)}"', self.value.line, self.value.column)
            return ReturnType('NULL', Type.NULL)
        env.setError(f'No hay casteo de "{self.getType(value.type)}" a "{self.getType(self.destinyType)}"', self.value.line, self.value.column)
        return ReturnType('NULL', Type.NULL)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass
```

```python
def getType(self, type: Type) -> str:
    match type:
        case Type.INT:
            return "INT"
        case Type.DECIMAL:
            return "DECIMAL"
        case Type.NVARCHAR:
            return "NVARCHAR"
        case Type.BOOLEAN:
            return "BOOLEAN"
        case Type.DATE:
            return "DATE"
        case Type.TABLE:
            return "TABLE"
        case _:
            return "NULL"

def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="CAST"];'
    value1: ReturnAST = self.value.ast(ast)
    dot += '\n' + value1.dot
    dot += f'\nnode_{id}_type[label="{self.getType(self.destinyType)}"];'
    dot += f'\nnode_{id} -> node_{value1.id};'
    dot += f'\nnode_{id} -> node_{id}_type;'
    return ReturnAST(dot, id)
```

Concatenar

```python
from statements.Abstracts.Expression import Expression
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class Concatenar(Expression):
    def __init__(self, line: int, column: int, exp1: Expression, exp2: Expression):
        super().__init__(line, column, TypeInst.NATIVE_FUNC)
        self.exp1 = exp1
        self.exp2 = exp2

    def setField(self, field):
        pass

    def execute(self, env: Env) -> any:
        exp1 = self.exp1.execute(env)
        exp2 = self.exp2.execute(env)
        return ReturnType(exp1.value + exp2.value, Type.NVARCHAR)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="CONCATENAR"];'
        value1: ReturnAST = self.exp1.ast(ast)
        dot += '\n' + value1.dot
        value2: ReturnAST = self.exp2.ast(ast)
        dot += '\n' + value2.dot
        dot += f'\nnode_{id} -> node_{value1.id};'
        dot += f'\nnode_{id} -> node_{value2.id};'
        return {dot: dot, id: id}
```

Field

```python
from utils.TypeExp import TypeExp
from statements.Env.AST import AST, ReturnAST
from statements.Abstracts.Expression import Expression
from statements.Env.Env import Env
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class Field(Expression):
    def __init__(self, line: int, column: int, id: str):
        super().__init__(line, column, TypeExp.FIELD)
        self.id = id
        self.field: dict[str, any] = {}
        self.isFieldName: bool = False

    def setIsFieldName(self, isFieldName: bool):
        self.isFieldName = isFieldName

    def setField(self, field: dict[str, any]) -> any:
        self.field = field

    def execute(self, env: Env) -> ReturnType:
        if not self.isFieldName:
            if self.id.lower() in self.field:
                return self.field[self.id.lower()].values[0].getData()
            env.setError(f'No existe el campo {self.id.lower()}', self.line, self.column)
            return ReturnType('NULL', Type.NULL)
        return ReturnType(self.id, Type.NULL)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="{self.id}"];'
        return ReturnAST(dot, id)
```

Hoy

```python
from statements.Abstracts.Expression import Expression
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from utils.TypeInst import TypeInst
from datetime import datetime
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class Hoy(Expression):
    def __init__(self, line: int, column: int):
        super().__init__(line, column, TypeInst.NATIVE_FUNC)

    def setField(self, field):
        pass

    def execute(self, _: Env) -> any:
        dateT = datetime.now()
        f = "%d-%m-%Y %H:%M"
        return ReturnType(dateT.strftime(f), Type.NVARCHAR)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="HOY"];'
        return ReturnAST(dot, id)
```

Logic

```python
from statements.Objects.Table import Field
from utils.TypeExp import TypeExp
from statements.Env.AST import AST, ReturnAST
from statements.Abstracts.Expression import Expression
from statements.Env.Env import Env
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class Logic(Expression):
    def __init__(self, line: int, column: int, exp1: Expression, sign: str, exp2: Expression):
        super().__init__(line, column, TypeExp.NATIVE_FUNC)
        self.exp1 = exp1
        self.sign = sign
        self.exp2 = exp2

    def setField(self, field: dict[str, Field]) -> any:
        if self.exp1:
            self.exp1.setField(field)
        self.exp2.setField(field)

    def execute(self, env: Env) -> ReturnType:
        match self.sign.upper():
            case '&&':
                return self.and_(env)
            case '||':
                return self.or_(env)
            case '!':
                return self.not_(env)
            case _:
                return ReturnType('NULL', Type.NULL)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass
```

```python
    def and_(self, env: Env) -> ReturnType:
        value1: ReturnType = self.exp1.execute(env)
        value2: ReturnType = self.exp2.execute(env)
        self.type = Type.BOOLEAN
        return ReturnType(value1.value and value2.value, self.type)

    def or_(self, env: Env) -> ReturnType:
        value1: ReturnType = self.exp1.execute(env)
        value2: ReturnType = self.exp2.execute(env)
        self.type = Type.BOOLEAN
        return ReturnType(value1.value or value2.value, self.type)

    def not_(self, env: Env) -> ReturnType:
        value: ReturnType = self.exp2.execute(env)
        self.type = Type.BOOLEAN
        return ReturnType(not value.value, self.type)

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="{self.sign}"];'
        value1: ReturnAST
        if self.exp1 != None:
            value1 = self.exp1.ast(ast)
            dot += '\n' + value1.dot
            dot += f'\nnode_{id} -> node_{value1.id};'
        value2: ReturnAST = self.exp2.ast(ast)
        dot += '\n' + value2.dot
        dot += f'\nnode_{id} -> node_{value2.id};'
        return ReturnAST(dot, id)
```

Primitive

```python
from statements.Abstracts.Expression import Expression
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.Objects.Table import Field
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type
from utils.TypeExp import TypeExp

class Primitive(Expression):
    def __init__(self, line: int, column: int, value: any, type: Type):
        super().__init__(line, column, TypeExp.PRIMITIVE)
        self.value = value
        self.type = type

    def setField(self, _: dict[str, Field]) -> any:
        pass

    def execute(self, _: Env) -> ReturnType:
        match self.type:
            case Type.INT:
                return ReturnType(int(self.value), self.type)
            case Type.DECIMAL:
                return ReturnType(float(self.value), self.type)
            case Type.DATE:
                return ReturnType(str(self.value), self.type)
            case Type.DATETIME:
                return ReturnType(str(self.value), self.type)
            case _:
                self.value = self.value.replace('\\n', '\n')
                self.value = self.value.replace('\\t', '\t')
                self.value = self.value.replace('\\"', '\"')
                self.value = self.value.replace("\\'", '\'')
                self.value = self.value.replace('\\\\', '\\')
                return ReturnType(self.value, self.type)
```

```python
    def compile(self, _: Env, c3dgen: C3DGen) -> ReturnC3D:
        match self.type:
            case Type.INT:
                return ReturnC3D(isTmp = False, strValue = str(self.value), type = self.type)
            case Type.DECIMAL:
                return ReturnC3D(isTmp = False, strValue = str(self.value), type = self.type)
            case _:
                self.value = self.value.replace('\\n', '\n')
                self.value = self.value.replace('\\t', '\t')
                self.value = self.value.replace('\\"', '\"')
                self.value = self.value.replace("\\'", '\'')
                self.value = self.value.replace('\\\\', '\\')
                tmp = c3dgen.newTmp()
                c3dgen.addAsign(tmp, 'H')
                for ascii in self.value:
                    c3dgen.addSetHeap('H', ord(ascii))
                    c3dgen.nextHeap()
                c3dgen.addSetHeap('H', '-1')
                c3dgen.nextHeap()
                return ReturnC3D()

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="{self.value}"];'
        return ReturnAST(dot, id)
```

Relacional

```python
from statements.Objects.Table import Field
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type
from utils.TypeExp import TypeExp
from statements.Env.AST import AST, ReturnAST
from statements.Abstracts.Expression import Expression
from statements.Env.Env import Env

class Relational(Expression):
    def __init__(self, line: int, column: int, exp1: Expression, sign: str, exp2: Expression):
        super().__init__(line, column, TypeExp.RELATIONAL_OP)
        self.exp1 = exp1
        self.sign = sign
        self.exp2 = exp2

    def setField(self, field: dict[str, Field]) -> any:
        self.exp1.setField(field)
        self.exp2.setField(field)
```

```python
def execute(self, env: Env) -> ReturnType:
    match self.sign:
        case '==':
            return self.equal(env)
        case '=':
            return self.equal(env)
        case '!=':
            return self.notEqual(env)
        case '>=':
            return self.greatEqual(env)
        case '<=':
            return self.lessEqual(env)
        case '>':
            return self.great(env)
        case '<':
            return self.less(env)
        case _:
            return ReturnType('NULL', Type.NULL)

def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
    pass

def equal (self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    if value1.type in [Type.INT, Type.DECIMAL]:
        if value2.type in [Type.INT, Type.DECIMAL]:
            return ReturnType(value1.value == value2.value, Type.BOOLEAN)
        env.setError("Los tipos no son válidos para operaciones relacionales (==)", self.exp2.line, self.exp2.column)
        return ReturnType('NULL', Type.NULL)
    if value1.type in [Type.NVARCHAR, Type.NCHAR] and value2.type in [Type.NVARCHAR, Type.NCHAR]:
        return ReturnType(value1.value == value2.value, Type.BOOLEAN)
    env.setError("Los tipos no son válidos para operaciones relacionales (==)", self.exp2.line, self.exp2.column)
    return ReturnType('NULL', Type.NULL)
```

```
def notEqual(self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    if value1.type == Type.INT or value1.type == Type.DECIMAL:
        if value2.type == Type.INT or value2.type == Type.DECIMAL:
            return ReturnType(value1.value != value2.value, Type.BOOLEAN)
        env.setError("Los tipos no son válidos para operaciones relacionales (!=)", self.exp2.line, self.exp2.column)
        return ReturnType('NULL', Type.NULL)
    if value1.type in [Type.NVARCHAR, Type.NCHAR] and value2.type in [Type.NVARCHAR, Type.NCHAR]:
        return ReturnType(value1.value != value2.value, Type.BOOLEAN)
    env.setError("Los tipos no son válidos para operaciones relacionales (!=)", self.exp2.line, self.exp2.column)
    return ReturnType('NULL', Type.NULL)

def greatEqual(self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    if value1.type in [Type.INT, Type.DECIMAL]:
        if value2.type in [Type.INT, Type.DECIMAL]:
            return ReturnType(value1.value >= value2.value, Type.BOOLEAN)
        env.setError("Los tipos no son válidos para operaciones relacionales (>=)", self.exp2.line, self.exp2.column)
        return ReturnType('NULL', Type.NULL)
    if value1.type in [Type.NVARCHAR, Type.NCHAR] and value2.type in [Type.NVARCHAR, Type.NCHAR]:
        return ReturnType(value1.value >= value2.value, Type.BOOLEAN)
    env.setError("Los tipos no son válidos para operaciones relacionales (>=)", self.exp2.line, self.exp2.column)
    return ReturnType('NULL', Type.NULL)
```

```
def lessEqual(self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    if value1.type in [Type.INT, Type.DECIMAL]:
        if value2.type in [Type.INT, Type.DECIMAL]:
            return ReturnType(value1.value <= value2.value, Type.BOOLEAN)
        env.setError("Los tipos no son válidos para operaciones relacionales (<=)", self.exp2.line, self.exp2.column)
        return ReturnType('NULL', Type.NULL)
    if value1.type in [Type.NVARCHAR, Type.NCHAR] and value2.type in [Type.NVARCHAR, Type.NCHAR]:
        return ReturnType(value1.value <= value2.value, Type.BOOLEAN)
    env.setError("Los tipos no son válidos para operaciones relacionales (<=)", self.exp2.line, self.exp2.column)
    return ReturnType('NULL', Type.NULL)

def great(self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    if value1.type in [Type.INT, Type.DECIMAL]:
        if value2.type in [Type.INT, Type.DECIMAL]:
            return ReturnType(value1.value > value2.value, Type.BOOLEAN)
        env.setError("Los tipos no son válidos para operaciones relacionales (>)", self.exp2.line, self.exp2.column)
        return ReturnType('NULL', Type.NULL)
    if value1.type in [Type.NVARCHAR, Type.NCHAR] and value2.type in [Type.NVARCHAR, Type.NCHAR]:
        return ReturnType(value1.value > value2.value, Type.BOOLEAN)
    env.setError("Los tipos no son válidos para operaciones relacionales (>)", self.exp2.line, self.exp2.column)
    return ReturnType('NULL', Type.NULL)
```

```
def less(self, env: Env) -> ReturnType:
    value1: ReturnType = self.exp1.execute(env)
    value2: ReturnType = self.exp2.execute(env)
    if value1.type in [Type.INT, Type.DECIMAL]:
        if value2.type in [Type.INT, Type.DECIMAL]:
            return ReturnType(value1.value < value2.value, Type.BOOLEAN)
        env.setError("Los tipos no son válidos para operaciones relacionales (<)", self.exp2.line, self.exp2.column)
        return ReturnType('NULL', Type.NULL)
    if value1.type in [Type.NVARCHAR, Type.NCHAR] and value2.type in [Type.NVARCHAR, Type.NCHAR]:
        return ReturnType(value1.value < value2.value, Type.BOOLEAN)
    env.setError("Los tipos no son válidos para operaciones relacionales (<)", self.exp2.line, self.exp2.column)
    return ReturnType('NULL', Type.NULL)

def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="{self.sign}"];'
    value1: ReturnAST = self.exp1.ast(ast)
    dot += '\n' + value1.dot
    dot += f'\nnode_{id} -> node_{value1.id};'
    value2: ReturnAST = self.exp2.ast(ast)
    dot += '\n' + value2.dot
    dot += f'\nnode_{id} -> node_{value2.id};'
    return ReturnAST(dot, id)
```

Return

```python
from statements.Objects.Table import Field
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type
from utils.TypeExp import TypeExp
from statements.Env.AST import AST, ReturnAST
from statements.Abstracts.Expression import Expression
from statements.Env.Env import Env

class Return(Expression):
    def __init__(self, line: int, column: int, exp: Expression):
        super().__init__(line, column, TypeExp.RETURN)
        self.exp = exp

    def setField(self, _: dict[str, Field]) -> any:
        pass

    def execute(self, env: Env) -> ReturnType:
        if self.exp:
            value: ReturnType = self.exp.execute(env)
            return ReturnType(value.value, value.type)
        return ReturnType(self.typeExp, Type.NULL)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="RETURN"];'
        if self.exp:
            value1: ReturnAST = self.exp.ast(ast)
            dot += '\n' + value1.dot
            dot += f'\nnode_{id} -> node_{value1.id};'
        return ReturnAST(dot, id)
```

Subtraer

```python
from statements.Abstracts.Expression import Expression
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type
from utils.TypeInst import TypeInst

class Substraer(Expression):
    def __init__(self, line: int, column: int, string: Expression, exp1: Expression, exp2: Expression):
        super().__init__(line, column, TypeInst.NATIVE_FUNC)
        self.string = string
        self.exp1 = exp1
        self.exp2 = exp2

    def setField(self, field):
        pass

    def execute(self, env: Env) -> any:
        string: ReturnType = self.string.execute(env)
        exp1: ReturnType = self.exp1.execute(env)
        exp2: ReturnType = self.exp2.execute(env)
        if string.type in [Type.NVARCHAR, Type.NCHAR]:
            if exp1.type == Type.INT:
                if exp2.type == Type.INT:
                    return ReturnType(string.value[exp1.value - 1:exp2.value], Type.NVARCHAR)
                env.setError("Los tipos no son válidos para operaciones relacionales (<)", self.exp2.line, self.exp2.column)
                return ReturnType('NULL', Type.NULL)
            # error
            return ReturnType('NULL', Type.NULL)
        # error
        return ReturnType('NULL', Type.NULL)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass
```

(class) ReturnC3D

```python
def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="SUBSTRAER"];'
    string: ReturnAST = self.string.ast(ast)
    dot += '\n' + string.dot
    value1: ReturnAST = self.exp1.ast(ast)
    dot += '\n' + value1.dot
    value2: ReturnAST = self.exp2.ast(ast)
    dot += '\n' + value2.dot
    dot += f'\nnode_{id} -> node_{string.id};'
    dot += f'\nnode_{id} -> node_{value1.id};'
    dot += f'\nnode_{id} -> node_{value2.id};'
    return ReturnAST(dot, id)
```

Las Instrucciones que el programa utilizara son las siguientes:

AlterTable

```python
from statements.Abstracts.Instruction import Instruction
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type
from utils.TypeInst import TypeInst

class AlterTable(Instruction):
    def __init__(self, line: int, column: int, id: str, action: str, field1: str, field2: str, type: Type):
        super().__init__(line, column, TypeInst.ALTER_TABLE)
        self.id = id
        self.action = action
        self.field1 = field1
        self.field2 = field2
        self.type = type

    def execute(self, env: Env) -> any:
        if self.action.lower() == 'add':
            env.addColumn(self.id, self.field1, self.type, self.line, self.column)
            return
        if self.action.lower() == 'drop':
            env.dropColumn(self.id, self.field1, self.line, self.column)
            return
        if self.action.lower() == 'renameto':
            env.renameTo(self.id, self.field1, self.line, self.column)
        if self.action.lower() == 'renamecolumn':
            env.renameColumn(self.id, self.field1, self.field2, self.line, self.column)
```

```python
def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
    pass

def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="ALTER TABLE"];'
    match self.action.lower():
        case 'add':
            dot += f'node_{id}_action[label="ADD"];'
            dot += f'\nnode_{id}_table[label="{self.id}"];'
            dot += f'\nnode_{id}_field1[label="{self.field1}"];'
            dot += f'\nnode_{id}_type[label="{self.getType(self.type)}"];'
            dot += f'\nnode_{id}_action -> node_{id}_table;'
            dot += f'\nnode_{id}_action -> node_{id}_field1;'
            dot += f'\nnode_{id}_action -> node_{id}_type;'
        case 'drop':
            dot += f'node_{id}_action[label="DROP"];'
            dot += f'\nnode_{id}_table[label="{self.id}"];'
            dot += f'\nnode_{id}_field1[label="{self.field1}"];'
            dot += f'\nnode_{id}_action -> node_{id}_table;'
            dot += f'\nnode_{id}_action -> node_{id}_field1;'
        case 'renameto':
            dot += f'node_{id}_action[label="RENAME TO"];'
            dot += f'\nnode_{id}_table[label="{self.id}"];'
            dot += f'\nnode_{id}_field1[label="{self.field1}"];'
            dot += f'\nnode_{id}_action -> node_{id}_table;'
            dot += f'\nnode_{id}_action -> node_{id}_field1;'
        case 'renamecolumn':
            dot += f'node_{id}_action[label="RENAME COLUMN"];'
            dot += f'\nnode_{id}_table[label="{self.id}"];'
            dot += f'\nnode_{id}_field1[label="{self.field1}"];'
            dot += f'\nnode_{id}_field2[label="{self.field2}"];'
            dot += f'\nnode_{id}_action -> node_{id}_table;'
            dot += f'\nnode_{id}_action -> node_{id}_field1;'
            dot += f'\nnode_{id}_action -> node_{id}_field2;'
    dot += f'\nnode_{id} -> node_{id}_action;'
    return ReturnAST(dot, id)
```

```python
def getType(type: Type) -> str:
    match type:
        case Type.INT:
            return "INT"
        case Type.DOUBLE:
            return "DOUBLE"
        case Type.VARCHAR:
            return "VARCHAR"
        case Type.BOOLEAN:
            return "BOOLEAN"
        case Type.DATE:
            return "DATE"
        case Type.TABLE:
            return "TABLE"
        case _:
            return "NULL"
```

AsignID

```python
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.Abstracts.Instruction import Instruction
from statements.Abstracts.Expression import Expression
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type

class AsignID(Instruction):
    def __init__(self, line: int, column: int, id: str, value: Expression):
        super().__init__(line, column, TypeInst.ASIGN_ID)
        self.id = id
        self.value = value

    def execute(self, env: Env):
        value = self.value.execute(env)
        env.reasignID(self.id, value, self.line, self.column)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="SET"];'
        value1: ReturnAST = self.value.ast(ast)
        dot += f'\nnode_{id}_id[label="{self.id}"]'
        dot += f'\nnode_{id} -> node_{id}_id'
        dot += '\n' + value1.dot
        dot += f'\nnode_{id} -> node_{value1.id};'
        return ReturnAST(dot, id)
```

Block

```python
from statements.Abstracts.Instruction import Instruction
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type

class Block(Instruction):
    def __init__(self, line: int, column: int, instructions: list[Instruction]):
        super().__init__(line, column, TypeInst.BLOCK_INST)
        self.instructions = instructions

    def execute(self, env: Env) -> any:
        newEnv: Env = Env(env, env.name)
        for instruction in self.instructions:
            try:
                ret = instruction.execute(newEnv)
                if ret:
                    return ret
            except: {}

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="BEGIN-END"];'
        value1: ReturnAST
        for i in range(len(self.instructions)):
            value1 = self.instructions[i].ast(ast)
            dot += '\n' + value1.dot
            dot += f'\nnode_{id} -> node_{value1.id};'
        return ReturnAST(dot, id)
```

Case

```python
from statements.Abstracts.Expression import Expression
from statements.Abstracts.Instruction import Instruction
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from utils.TypeInst import TypeInst
from statements.Instructions.When import When
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class Case(Instruction):
    def __init__(self, line: int, column: int, arg: Expression, whens: list[When], else_: Expression, alias: str):
        super().__init__(line, column, TypeInst.CASE)
        self.arg = arg
        self.whens = whens
        self.else_ = else_
        self.alias = alias

    def execute(self, env: Env) -> any:
        envCase: Env = Env(env, 'case')
        if self.whens:
            if self.arg:
                arg: ReturnType = self.arg.execute(env)
                for when_ in self.whens:
                    when_.setWhen(arg)
                    when_exe: ReturnType = when_.execute(envCase)
                    if when_exe:
                        env.setPrint(f'{self.alias + ": " if self.alias else ""}' + when_exe.value + f'. {when_.line}:{when_.column}')
                        return
            else:
                for when_ in self.whens:
                    when_exe: ReturnType = when_.execute(envCase)
                    if when_exe:
                        env.setPrint(f'{self.alias + ": " if self.alias else ""}' + when_exe.value + f'. {when_.line}:{when_.column}')
                        return
        if self.else_:
            default_: ReturnType = self.else_.execute(envCase)
            if default_:
                env.setPrint(f'{self.alias + ": " if self.alias else ""}' + default_.value + f'. {self.else_.line}:{self.else_.column}')
                return

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="CASE"];'
        arg_: ReturnAST
        when: ReturnAST
        default_: ReturnAST
        if self.arg:
            arg_ = self.arg.ast(ast)
            dot += '\n' + arg_.dot
            dot += f'\nnode_{id} -> node_{arg_.id};'
        for i in range(len(self.whens)):
            when = self.whens[i].ast(ast)
            dot += '\n' + when.dot
            dot += f'\nnode_{id} -> node_{when.id};'
        if self.else_:
            dot += f'node_{id}_else[label="ELSE"];'
            default_ = self.else_.ast(ast)
            dot += '\n' + default_.dot
            dot += f'\nnode_{id}_else -> node_{default_.id};'
            dot += f'\nnode_{id} -> node_{id}_else;'
        if self.alias:
            dot += f'\nnode_{id}_as[label="AS"];'
            dot += f'\nnode_{id}_alias[label="{self.alias}"];'
            dot += f'\nnode_{id}_as -> node_{id}_alias;'
            dot += f'\nnode_{id} -> node_{id}_as;'
        return ReturnAST(dot, id)
```

CreateTable

```python
from statements.Abstracts.Instruction import Instruction
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.Objects.Table import Table
from utils.TypeInst import TypeInst
from utils.Attribute import Attribute
from utils.ForeignKey import ForeignKey
from utils.Global import *
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type

class CreateTable(Instruction):
    def __init__(self, line: int, column: int, name: str, attribs: list[Attribute | ForeignKey]):
        super().__init__(line, column, TypeInst.CREATE_TABLE)
        self.name = name
        self.attribs = attribs

    def execute(self, env: Env) -> any:
        table = Table(self.name.lower(), self.attribs)
        env.saveTable(self.name, table, self.line, self.column)

        #-----------------XML-----------------
        xml.createTable(getUsedDatabase(), self.name.lower())
        for attrib in self.attribs:
            if type(attrib) == Attribute:
                xml.createColumn(getUsedDatabase(), self.name.lower(), attrib.id, self.getTypeOf(attrib.type).lower(), attrib.length, attrib.props['
```

```python
def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
    pass

def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="TABLE"];'
    dot += f'\nnode_{id}_name[label="{self.name}"]'
    dot += f'\nnode_{id}_fields[label="CAMPOS"]'
    for i in range(len(self.attribs)):
        if type(self.attribs[i]) == Attribute:
            dot += f'\nnode_{id}_field_{i}[label={self.attribs[i].id}]'
            dot += f'\nnode_{id}_fields -> node_{id}_field_{i};'
        elif type(self.attribs[i]) == ForeignKey:
            pass
    dot += f'\nnode_{id} -> node_{id}_name;'
    dot += f'\nnode_{id} -> node_{id}_fields;'
    return ReturnAST(dot, id)

def getTypeOf(self, type: Type) -> str:
    match type:
        case Type.INT:
            return "INT"
        case Type.DECIMAL:
            return "DECIMAL"
        case Type.NCHAR:
            return "NCHAR"
        case Type.NVARCHAR:
            return "NVARCHAR"
        case Type.BIT:
            return "BIT"
        case Type.DATE:
            return "DATE"
        case Type.TABLE:
            return "TABLE"
        case _:
            return "NULL"
```

DeleteTable

```python
from statements.Abstracts.Expression import Expression
from statements.Abstracts.Instruction import Instruction
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type

class DeleteTable(Instruction):
    def __init__(self, line: int, column: int, id: str, condition: Expression):
        super().__init__(line, column, TypeInst.DELETE_TABLE)
        self.id = id
        self.condition = condition

    def execute(self, env: Env) -> any:
        if self.condition:
            env.deleteTable(self.id, self.condition, self.line, self.column)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="DELETE"];'
        dot += f'\nnode_{id}_tableName[label="{self.id}"];'
        dot += f'\nnode_{id} -> node_{id}_tableName;'
        condition = self.condition.ast(ast)
        dot += f'\n{condition.dot}'
        dot += f'\nnode_{id} -> node_{condition.id};'
        return ReturnAST(dot, id)
```

DropTable

```python
from statements.Abstracts.Instruction import Instruction
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type

class DropTable(Instruction):
    def __init__(self, line: int, column: int, id: str):
        super().__init__(line, column, TypeInst.DELETE_TABLE)
        self.id = id

    def execute(self, env: Env) -> any:
        env.dropTable(self.id, self.line, self.column)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="DROP"];'
        dot += f'\nnode_{id}_drop[label="{self.id}"]'
        dot += f'\nnode_{id} -> node_{id}_drop;'
        return ReturnAST(dot, id)
```

Function

```python
from statements.Abstracts.Instruction import Instruction
from statements.Env.Env import Env
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type
from utils.Parameter import Parameter
from statements.Env.AST import AST, ReturnAST

class Function(Instruction):
    def __init__(self, line: int, column: int, id: str, parameters: list[Parameter], block: Instruction, type: Type):
        super().__init__(line, column, TypeInst.INIT_FUNCTION)
        self.id = id
        self.parameters = parameters
        self.block = block
        self.type = type

    def execute(self, env: Env) -> any:
        env.saveFunction(self.id, self)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="FUNCTION"];'
        dot += f'\nnode_{id}_name[label="{self.id}"];'
        dot += f'\nnode_{id} -> node_{id}_name;'
        if len(self.parameters) > 0:
            dot += f'\nnode_{id}_params[label="PARAMS"];'
            for i in range(len(self.parameters)):
                dot += f'\nnode_{id}_param_{i}[label="{self.parameters[i].id}"];'
                dot += f'\nnode_{id}_params -> node_{id}_param_{i};'
            dot += f'\nnode_{id}_name -> node_{id}_params;'
        inst: ReturnAST = self.block.ast(ast)
        dot += '\n' + inst.dot
        dot += f'\nnode_{id}_name -> node_{inst.id};'
        return ReturnAST(dot, id)
```

If

```python
from statements.Abstracts.Expression import Expression
from statements.Abstracts.Instruction import Instruction
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type
from utils.TypeInst import TypeInst

class If(Instruction):
    def __init__(self, line: int, column: int, condition: Expression, block: Instruction, except_: Instruction):
        super().__init__(line, column, TypeInst.IF)
        self.condition = condition
        self.block = block
        self.except_ = except_

    def execute(self, env: Env) -> any:
        condition: ReturnType = self.condition.execute(env)
        if condition.value: # if (condicion)
            block: ReturnType = self.block.execute(env) # instrucciones
            if block:
                return block
            return
        # else
        if self.except_:
            except_: ReturnType = self.except_.execute(env)
            if except_:
                return except_
        return

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass
```

InitID

```python
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.Abstracts.Instruction import Instruction
from statements.Abstracts.Expression import Expression
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type
from utils.TypeInst import TypeInst
from typing import Union, List

class InitID(Instruction):
    def __init__(self, line: int, column: int, id: Union[str, List[str]], type: Union[Type, List[Type]], value: Union[Expression, None]):
        super().__init__(line, column, TypeInst.INIT_ID)
        self.id = id
        self.type = type
        self.value = value

    def execute(self, env: Env) -> any:
        if type(self.id) == str and type(self.type) == Type and self.value:
            value: ReturnType = self.value.execute(env)
            if value.type == self.type or self.type == Type.DECIMAL and value.type == Type.INT or \
            self.type == Type.BIT and value.type == Type.INT and int(value.value) in [0, 1] or \
            self.type == Type.NCHAR and value.type == Type.NVARCHAR:
                env.saveID(self.id, value.value, self.type, self.line, self.column)
            else:
                env.setError('Los tipos no coinciden en la declaración', self.line, self.column)
        elif type(self.id) == list and type(self.type) == list and not self.value:
            for i in range(len(self.id)):
                env.saveID(self.id[i], 'NULL', self.type[i], self.line, self.column)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass
```

```python
    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="DECLARE"];'
        if type(self.id) == str and type(self.type) == Type and self.value:
            dot += f'\nnode_{id}_type[label="{self.getType(self.type)}"];'
            dot += f'\nnode_{id} -> node_{id}_type;'
            dot += f'\nnode_{id}_id[label="{self.id}"];'
            dot += f'\nnode_{id}_type -> node_{id}_id;'
            value : ReturnAST = self.value.ast(ast)
            dot += '\n'+value.dot
            dot += f'\nnode_{id}_type -> node_{value.id};'
        elif type(self.id) == list and type(self.type) == list and not self.value:
            for i in range(len(self.id)):
                dot += f'\nnode_{id}_type_{i}[label="{self.getType(self.type[i])}"];'
                dot += f'\nnode_{id} -> node_{id}_type_{i};'
                dot += f'\nnode_{id}_id_{i}[label="${self.id[i]}"];'
                dot += f'\nnode_{id}_type_{i} -> node_{id}_id_{i};'
        return ReturnAST(dot, id)

    def getType(self, type: Type) -> str:
        match type:
            case Type.INT:
                return "INT"
            case Type.DECIMAL:
                return "DECIMAL"
            case Type.NCHAR:
                return "NCHAR"
            case Type.NVARCHAR:
                return "NVARCHAR"
            case Type.DECIMAL:
                return "BOOLEAN"
            case Type.DATE:
                return "DATE"
            case Type.TABLE:
                return "TABLE"
            case _:
                return "NULL"
```

InsertTable

```python
from statements.Abstracts.Instruction import Instruction
from statements.Abstracts.Expression import Expression
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type

class InsertTable(Instruction):
    def __init__(self, line: int, column: int, name: str, fields: list[str], values: list[Expression]):
        super().__init__(line, column, TypeInst.INSERT_TABLE)
        self.name = name
        self.fields = fields
        self.values = values

    def execute(self, env: Env) -> any:
        if len(self.fields) == len(self.values):
            env.insertTable(self.name, self.fields, self.values, self.line, self.column)
            return
        if len(self.fields) < len(self.values):
            env.setError('Inserta más valores de los esperados', self.line, self.column)
            return
        env.setError('Inserta menos valores de los esperados', self.line, self.column)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass
```

```python
    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="INSERT"];'
        dot += f'\nnode_{id}_table[label="{self.name}"];'
        dot += f'\nnode_{id}_fields[label="FIELDS"];'
        for i in range(len(self.fields)):
            dot += f'\nnode_{id}_field_{i}[label="{self.fields[i]}"];'
            dot += f'\nnode_{id}_fields -> \nnode_{id}_field_{i};'
        dot += f'\nnode_{id}_values[label="VALORES"];'
        value: ReturnAST
        for i in range(len(self.values)):
            value = self.values[i].ast(ast)
            dot += '\n' + value.dot
            dot += f'\nnode_{id}_values -> node_{value.id};'
        dot += f'\nnode_{id}_table -> node_{id}_fields;'
        dot += f'\nnode_{id}_table -> node_{id}_values;'
        dot += f'\nnode_{id} -> node_{id}_table'
        return ReturnAST(dot, id)
```

Select_prt

```python
from statements.Abstracts.Instruction import Instruction
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class Select_prt(Instruction):
    def __init__(self, line: int, column: int, expression: list[list[any]]):
        super().__init__(line, column, TypeInst.SELECT)
        self.expression = expression

    def execute(self, env: Env) -> any:
        value: ReturnType
        for i in range(len(self.expression)):
            value = self.expression[i][0].execute(env) if self.expression[i] else None
            if value:
                if self.expression[i][1] != '':
                    env.setPrint(self.expression[i][1] + ': ' + str(value.value))
                else:
                    env.setPrint(value.value)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        c3dgen.addComment('---------- Print ----------')
        if len(self.expression) > 0:
            for exp in self.expression:
                value: ReturnC3D = exp[0].compile(env, c3dgen)
                if value.type == Type.INT:
                    c3dgen.addPrintf('d', '(int) ' + value.strValue)
                elif value.type == Type.DECIMAL:
                    c3dgen.addPrintf('f', '(float) ' + value.strValue)
            c3dgen.addPrint("\n")
        c3dgen.addComment("-------- Fin Print --------")
```

```python
    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="SELECT"];'
        value: ReturnAST
        for i in range(len(self.expression)):
            value = self.expression[i][0].ast(ast)
            if self.expression[i][1] != '':
                dot += f'\nnode_{id}_AS{i}[label="AS"];'
                dot += f'\nnode_{id} -> node_{id}_AS{i};'
                dot += f'\n{value.dot}'
                dot += f'\nnode_{id}_AS{i} -> node_{value.id};'
                dot += f'\nnode_{id}_ASTXT{i}[label="{self.expression[i][1]}"];'
                dot += f'\nnode_{id}_AS{i} -> node_{id}_ASTXT{i};'
            else:
                dot += f'\n{value.dot}'
                dot += f'\nnode_{id} -> node_{value.id};'
        return ReturnAST(dot, id)
```

Select

```python
from statements.Abstracts.Instruction import Instruction
from statements.Abstracts.Expression import Expression
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.Expressions.Primitive import Primitive
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type

class Select(Instruction):
    def __init__(self, line: int, column: int, id: str, fields: list[list[any]] or str, condition: Expression):
        super().__init__(line, column, TypeInst.SELECT)
        self.id = id
        self.fields = fields
        self.condition = condition

    def execute(self, env: Env) -> any:
        self.condition = self.condition if self.condition else Primitive(self.line, self.column, 'true', Type.BOOLEAN)
        env.selectTable(self.id, self.fields, self.condition, self.line, self.column)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass
```

```python
def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="SELECT"];'
    dot += f'\nnode_{id}_id[label="{self.id}"];'
    dot += f'\nnode_{id} -> node_{id}_id;'
    dot += f'\nnode_{id}_fields[label="FIELDS"];'
    dot += f'\nnode_{id}_id -> node_{id}_fields;'
    dot += f'\nnode_{id}_condition[label="CONDITION"];'
    dot += f'\nnode_{id}_id -> node_{id}_condition;'
    if type(self.fields) == str:
        dot += f'\nnode_{id}_star[label="*"];'
        dot += f'\nnode_{id}_fields -> node_{id}_star;'
    else:
        value: ReturnAST
        for i in range(len(self.fields)):
            value = self.fields[i][0].ast(ast)
            if self.fields[i][1] != '':
                dot += f'\nnode_{id}_AS${i}[label="AS"];'
                dot += f'\nnode_{id}_fields -> node_{id}_AS{i};'
                dot += f'\n{value.dot};'
                dot += f'\nnode_{id}_AS{i} -> node_{value.id};'
                dot += f'\nnode_{id}_ASTXT{i}[label="{self.fields[i][1]}"];'
                dot += f'\nnode_{id}_AS{i} -> node_{id}_ASTXT{i};'
            else:
                dot += f'\n{value.dot}'
                dot += f'\nnode_{id}_fields -> node_{value.id};'
    if self.condition:
        condition = self.condition.ast(ast)
        dot += f'\n{condition.dot}'
        dot += f'\nnode_{id}_condition -> node_{condition.id};'
    return ReturnAST(dot, id)
```

TruncateTable

```python
from statements.Abstracts.Instruction import Instruction
from utils.TypeInst import TypeInst
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type

class TruncateTable(Instruction):
    def __init__(self, line: int, column: int, id: str):
        super().__init__(line, column, TypeInst.TRUNCATE_TABLE)
        self.id = id

    def execute(self, env: Env) -> any:
        env.truncateTable(self.id, self.line, self.column)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="TRUNCATE"];'
        dot += f'\nnode_{id}_truncate[label="{self.id}"]'
        dot += f'\nnode_{id} -> node_{id}_truncate;'
        return ReturnAST(dot, id)
```

UpdateTable

```python
from statements.Abstracts.Instruction import Instruction
from statements.Abstracts.Expression import Expression
from utils.TypeInst import TypeInst
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnC3D, Type

class UpdateTable(Instruction):
    def __init__(self, line: int, column: int, id: str, fields: list[str], values: list[Expression], condition: Expression):
        super().__init__(line, column, TypeInst.UPDATE_TABLE)
        self.id = id
        self.fields = fields
        self.values = values
        self.condition = condition

    def execute(self, env: Env) -> any:
        env.updateTable(self.id, self.fields, self.values, self.condition, self.line, self.column)
        return

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass
```

```python
def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="UPDATE"];'
    dot += f'\nnode_{id}_set[label="SET"];'
    dot += f'\nnode_{id} -> node_{id}_set;'
    dot += f'\nnode_{id}_condition[label="CONDITION"];'
    dot += f'\nnode_{id} -> node_{id}_condition;'
    value: ReturnAST
    for i in range(len(self.fields)):
        dot += f'\nnode_{id}_field{i}[label="{self.fields[i]}"]'
        dot += f'\nnode_{id}_set -> node_{id}_field{i};'
        value = self.values[i].ast(ast)
        dot += f'\n{value.dot}'
        dot += f'\nnode_{id}_field{i} -> node_{value.id};'
    condition = self.condition.ast(ast)
    dot += f'\n{condition.dot}'
    dot += f'\nnode_{id}_condition -> node_{condition.id};'
    return ReturnAST(dot, id)
```

Truncate

```python
from statements.Abstracts.Instruction import Instruction
from statements.Abstracts.Expression import Expression
from utils.TypeInst import TypeInst
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D, Type

class When(Instruction):
    def __init__(self, line: int, column: int, when_: Expression, result: Expression):
        super().__init__(line, column, TypeInst.WHEN)
        self.when_ = when_
        self.result = result
        self.whenEvaluate = None

    def setWhen(self, whenEvaluate: ReturnType):
        self.whenEvaluate = whenEvaluate

    def execute(self, env: Env) -> ReturnType:
        envWhen: Env = Env(env, f'{env.name} when')
        when_: ReturnType = self.when_.execute(envWhen)
        if self.whenEvaluate:
            whenE: ReturnType = self.whenEvaluate
            envWhen.name = f'{envWhen.name} {when_.value}'
            if when_.value == whenE.value:
                result: ReturnType = self.result.execute(envWhen)
                return result
        else:
            condition: ReturnType = self.when_.execute(env)
            if condition.value:
                return self.result.execute(env)
```

```python
        else:
            condition: ReturnType = self.when_.execute(env)
            if condition.value:
                return self.result.execute(env)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass

    def ast(self, ast: AST) -> ReturnAST:
        id = ast.getNewID()
        dot = f'node_{id}[label="WHEN"];'
        dot += f'node_{id}_cond[label="CONDICION"];'
        dot += f'node_{id}_result[label="RESULT"];'
        cond: ReturnAST = self.when_.ast(ast)
        result: ReturnAST = self.result.ast(ast)
        dot += '\n' + cond.dot
        dot += '\n' + result.dot
        dot += f'\nnode_{id}_cond -> node_{cond.id};'
        dot += f'\nnode_{id}_result -> node_{result.id};'
        dot += f'\nnode_{id} -> node_{id}_cond;'
        dot += f'\nnode_{id} -> node_{id}_result;'
        return ReturnAST(dot, id)
```

While

```python
from statements.Abstracts.Instruction import Instruction
from statements.Abstracts.Expression import Expression
from utils.TypeInst import TypeInst
from statements.C3D.C3DGen import C3DGen
from utils.Type import ReturnType, ReturnC3D
from statements.Env.AST import AST, ReturnAST
from statements.Env.Env import Env


class While(Instruction):
    def __init__(self, line: int, column: int, condition: Expression, block: Instruction):
        super().__init__(line, column, TypeInst.LOOP_WHILE)
        self.condition = condition
        self.block = block

    def execute(self, env: Env) -> any:
        whileEnv: Env = Env(env, f'{env.name} while')
        condition: ReturnType = self.condition.execute(whileEnv)
        while condition.value:
            block: ReturnType = self.block.execute(whileEnv)
            if block:
                if block.value == TypeInst.CONTINUE:
                    condition = self.condition.execute(whileEnv)
                    continue
                elif block.value == TypeInst.BREAK:
                    break
                return block
            condition = self.condition.execute(whileEnv)

    def compile(self, env: Env, c3dgen: C3DGen) -> ReturnC3D:
        pass
```

```python
def ast(self, ast: AST) -> ReturnAST:
    id = ast.getNewID()
    dot = f'node_{id}[label="WHILE"];'
    dot += f'\nnode_{id}_cond[label="CONDICION"]'
    cond: ReturnAST = self.condition.ast(ast)
    dot += '\n' + cond.dot
    dot += f'\nnode_{id}_cond -> node_{cond.id};'
    inst: ReturnAST = self.block.ast(ast)
    dot += '\n' + inst.dot
    dot += f'\nnode_{id} -> node_{inst.id};'
    dot += f'\nnode_{id} -> node_{id}_cond;'
    return ReturnAST(dot, id)
```

Los entornos que se utilizaron para la creación del programa son los siguientes:

```python
from utils.Outs import printConsole, errors
from utils.Type import Type, ReturnType
from utils.Error import Error
from utils.TypeError import TypeError
from statements.Env.Symbol import Symbol
from statements.Abstracts.Expression import Expression
from utils.Global import *
from statements.Env.SymbolTable import symTable
from statements.Env.SymTab import SymTab

class Env:
    def __init__(self, previous: 'Env' or None, name: str):
        self.ids: dict[str, Symbol] = {}
        self.functions: dict[str, any] = {}
        self.tables: dict[str, any] = {}
        self.previous = previous
        self.name = name

    # === VARIABLES ===
    def saveID(self, id: str, value: any, type: Type, line: int, column: int):
        env: Env = self
        if id.lower() not in env.ids:
            env.ids[id.lower()] = Symbol(value, id.lower(), type)
            #-------------- NUEVO ---------------
            symTable.push(SymTab(line, column + 1, True, True, id.lower(), env.name, type))
        else:
            self.setError('Redeclaración de variable existente', line, column)

    def getValue(self, id: str) -> Symbol:
        env: Env = self
        while env:
            if id.lower() in env.ids:
                return env.ids.get(id.lower())
            env = env.previous
        return None
```

```python
def reasignID(self, id: str, value: ReturnType, line: int, column: int) -> bool:
    env: Env = self
    while env:
        if id.lower() in env.ids:
            symbol: Symbol = env.ids.get(id.lower())
            if value.type == symbol.type or symbol.type == Type.DECIMAL and value.type == Type.INT or \
            symbol.type == Type.BIT and value.type == Type.INT and int(value.value) in [0, 1] or \
            symbol.type == Type.NCHAR and value.type == Type.NVARCHAR:
                symbol.value = value.value
                env.ids[id.lower()] = symbol
                return True
            env.setError(f'Los tipos no coinciden en la asignación. Intenta asignar un "{env.getTypeOf(value.type)}" a un "{env.getTypeOf(symbol
            return False
        env = env.previous
    self.setError('Resignación de valor a variable inexistente', line, column)
    return False

# === FUNCTIONS ===
def saveFunction(self, id: str, func: any):
    env: Env = self
    if not id.lower() in env.functions:
        env.functions[id.lower()] = func
        #------------ NUEVO ---------------
        symTable.push(SymTab(func.line, func.column + 1 , False, False, id.lower(), env.name, Type.NULL))
    else:
        self.setError('Redefinición de función existente', func.line, func.column)

def getFunction(self, id: str) -> any:
    env: Env = self
    while env:
        if id.lower() in env.functions:
            return env.functions.get(id.lower())
        env = env.previous
    return None
```

```python
def saveTable(self, id: str, table: any, line: int, column: int):
    env: Env = self
    if not id.lower() in env.tables:
        env.tables[id.lower()] = table
        self.setPrint(f'Tabla \'{id.lower()}\' creada. {line}:{column + 1}')
        #------------ NUEVO ----------------
        symTable.push(SymTab(line, column + 1, False, False, id.lower(), env.name, Type.TABLE))
    else:
        self.setError('Redefinición de tabla existente', line, column)

def insertTable(self, id: str, fields: list[str], values: list[Expression], line: int, column: int) -> bool:
    env: Env = self
    while env:
        if id.lower() in env.tables:
            if env.tables.get(id.lower()).validateFields(fields):
                newRow: dict[str, list[any]] = env.tables.get(id.lower()).getFieldsRow()
                result: ReturnType
                dataXml = []
                for i in range(len(fields)):
                    result = values[i].execute(self)
                    newRow[fields[i].lower()] = [result.type, result.value]
                    dataXml.append({"value": result.value, "column": fields[i].lower()})
                if env.tables.get(id.lower()).insert(env, newRow, line, column):
                    #------------ NUEVO ----------------
                    res = xml.insert(getUsedDatabase(), id.lower(), dataXml)
                    if not res[0]:
                        self.setPrint(res[1])
                        return False
                    self.setPrint(f'Registro insertado exitosamente en Tabla \'{id.lower()}\'. {line}:{column + 1}')
                    return True
                return False
            self.setError(f'Inserta dato en columna inexistente en Tabla \'{id.lower()}\'', line, column)
            return False
        env = env.previous
    self.setError('Insertar en tabla inexistente', line, column)
    return False
```

```python
def truncateTable(self, id: str, line: int, column: int) -> bool:
    env: Env = self
    while env:
        if id.lower() in env.tables:
            env.tables.get(id.lower()).truncate()
            self.setPrint(f'Registros eliminados de Tabla \'{id.lower()}\'. {line}:{column + 1}')
            return True
        env = env.previous
    self.setError('Truncar tabla inexistente', line, column)
    return False

def dropTable(self, id: str, line: int, column: int) -> bool:
    env: Env = self
    while env:
        if id.lower() in env.tables:
            del env.tables[id.lower()]
            self.setPrint(f'Tabla \'{id.lower()}\' eliminada. {line}:{column + 1}')
            return True
        env = env.previous
    self.setError('Eliminación de tabla inexistente', line, column)
    return False

def deleteTable(self, id: str, condition: Expression, line: int, column: int):
    env: Env = self
    while env:
        if id.lower() in env.tables:
            env.tables.get(id.lower()).deleteWhere(condition, self)
            self.setPrint(f'Eliminación de Tabla \'{id.lower()}\'. {line}:{column + 1}')
            return
        env = env.previous
    self.setError('Eliminar registro en tabla inexistente', line, column)
    return False
```

```
def deleteTable(self, id: str, condition: Expression, line: int, column: int):
    env: Env = self
    while env:
        if id.lower() in env.tables:
            env.tables.get(id.lower()).deleteWhere(condition, self)
            self.setPrint(f'Eliminación de Tabla \'{id.lower()}\'. {line}:{column + 1}')
            return
        env = env.previous
    self.setError('Eliminar registro en tabla inexistente', line, column)
    return False

def updateTable(self, id: str, fields: list[str], values: list[Expression], condition: Expression, line: int, column: int):
    env: Env = self
    while env:
        if id.lower() in env.tables:
            env.tables.get(id.lower()).updateWhere(condition, fields, values, self)
            self.setPrint(f'Tabla \'{id.lower()}\' actualizada. {line}:{column + 1}')
            return True
        env = env.previous
    self.setError('Actualizar registro en tabla inexistente', line, column)
    return False

def selectTable(self, id: str, fields: list[list[any]] or str, condition: Expression, line: int, column: int):
    env: Env = self
    while env:
        if id.lower() in env.tables:
            table = env.tables.get(id.lower()).select(fields, condition, self)
            self.setPrint(f'Selección en Tabla \'{id.lower()}\'. {line}:{column + 1}')
            env.selectPrint(table if table else [])
            return True
        env = env.previous
    self.setError('Selección en tabla inexistente', line, column)
    return False
```

```
def addColumn(self, id: str, newColumn: str, type: Type, line: int, column: int) -> bool:
    env: Env = self
    while env:
        if id.lower() in env.tables:
            if not newColumn.lower() in env.tables.get(id.lower()).fields:
                env.tables.get(id.lower()).addColumn(newColumn, type)
                self.setPrint(f'Columna {newColumn.lower()} insertada exitosamente en Tabla \'{id.lower()}\'. {line}:{column + 1}')
                return True
            self.setError(f'Ya hay una columna {newColumn.lower()} en Tabla \'{id.lower()}\'', line, column)
            return False
        env = env.previous
    self.setError('Alterar tabla inexistente', line, column)
    return False

def dropColumn(self, id: str, dropColumn: str, line: int, column: int) -> bool:
    env: Env = self
    while env:
        if id.lower() in env.tables:
            if dropColumn.lower() in env.tables.get(id.lower()).fields:
                env.tables.get(id.lower()).dropColumn(dropColumn)
                self.setPrint(f'Columna {dropColumn.lower()} eliminada exitosamente de la Tabla \'{id.lower()}\'. {line}:{column + 1}')
                return True
            self.setError(f'La columna {dropColumn.lower()} no existe en Tabla \'{id.lower()}\'', line, column)
            return False
        env = env.previous
    self.setError('Alterar tabla inexistente', line, column)
    return False
```

```
def renameTo(self, id: str, newId: str, line: int, column: int) -> bool:
    env: Env = self
    while env:
        if id.lower() in env.tables:
            table = env.tables.get(id.lower())
            if table:
                table.renameTo(newId.lower())
                env.tables[newId.lower()] = table
                del env.tables[id.lower()]
                self.setPrint(f'Tabla \'{id.lower()}\' renombrada como {newId.lower()}. {line}:{column + 1}')
                return True
        env = env.previous
    self.setError(f'La tabla \'{id.lower()}\' no existe', line, column)
    return False

def renameColumn(self, id: str, currentColumn: str, newColumn: str, line: int, column: int) -> bool:
    env: Env = self
    while env:
        if id.lower() in env.tables:
            if currentColumn.lower() in env.tables.get(id.lower()).fields:
                env.tables.get(id.lower()).renameColumn(currentColumn.lower(), newColumn.lower())
                self.setPrint(f'Columna {currentColumn.lower()} actualizada exitosamente a {newColumn.lower()}. {line}:{column + 1}')
                return True
            self.setError(f'La columna {currentColumn.lower()} no existe en Tabla \'{id.lower()}\'', line, column)
            return False
        env = env.previous
    self.setError('Alterar tabla inexistente', line, column)
    return False
```

```python
# === UTILS ===
def setPrint(self, print_: str):
    printConsole.append([print_])

def selectPrint(self, select: list[list[any]]):
    printConsole.extend(select)

def setError(self, errorD: str, line: int, column: int):
    if not self.match(errorD, line, column + 1):
        errors.append(Error(line, column + 1, TypeError.SEMANTIC, errorD))

def match(self, err: str, line: int, column: int):
    for error in errors:
        if(error.__str__() == (Error(line, column, TypeError.SEMANTIC, err)).__str__()):
            return True
    return False

def getTypeOf(self, type: Type) -> str:
    match type:
        case Type.INT:
            return "INT"
        case Type.DECIMAL:
            return "DECIMAL"
        case Type.NCHAR:
            return "NCHAR"
        case Type.NVARCHAR:
            return "NVARCHAR"
        case Type.BIT:
            return "BIT"
        case Type.DATE:
            return "DATE"
        case Type.TABLE:
            return "TABLE"
        case _:
            return "NULL"
```

Abstract Sintact Tree (AST)

```python
class AST:
    def __init__(self):
        self.nodeID: int = 0

    def getNewID(self) -> int:
        self.nodeID += 1
        return self.nodeID

class ReturnAST:
    def __init__(self, dot: str, id: int):
        self.dot = dot
        self.id = id
```

Tabla de símbolos

```python
from statements.Env.SymTab import SymTab

class SymbolTable:
    def __init__(self):
        self.symbols = []

    def push(self, sym: SymTab):
        if self.validateSymbol(sym):
            self.symbols.append(sym)

    def pop(self, id):
        for i in range(len(self.symbols)):
            if self.symbols[i].id == id:
                self.symbols.pop(i)
                break

    def validateSymbol(self, sym: SymTab):
        for i in self.symbols:
            if i.hash() == sym.hash():
                return False
        return True

    def getDot(self):
        dot = 'digraph SymbolsTable {graph[fontname="Arial" labelloc="t" bgcolor="#252526" fontcolor="white"];node[shape=none fontname="Arial"];labe
        for i in range(len(self.symbols)):
            self.symbols[i].num = i + 1
            dot += self.symbols[i].getDot()
        dot += '</table>>];}'
        return dot

    def print(self):
        print('TABLA DE SÍMBOLOS')
        for sym in self.symbols:
            print(sym.toString())
```

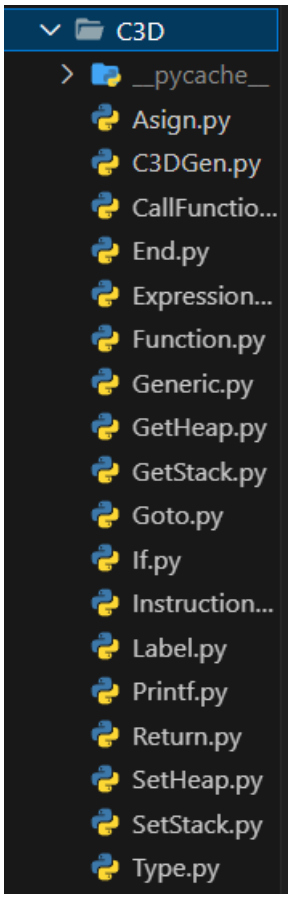
```python
    def print(self):
        print('TABLA DE SÍMBOLOS')
        for sym in self.symbols:
            print(sym.toString())

    def splice(self):
        self.symbols.clear()

    def toString(self):
        table = '╒═' + '═'.repeat(69) + '═╕'
        table += '\n│ ' + ' '.repeat(26) + 'TABLA DE SÍMBOLOS' + ' '.repeat(26) + ' │'
        table += '\n╞═' + '═'.repeat(20) + '═╤═' + '═'.repeat(10) + '═╤═' + '═'.repeat(15) + '═╤═' + '═'.repeat(5) + '═╤═' + '═'.repeat(7) + '═╡'
        table += '\n│ ' + 'ID'.padEnd(20) + ' │ ' + 'TIPO'.padEnd(10) + ' │ ' + 'ENTORNO'.padEnd(15) + ' │ ' + 'LINEA'.padEnd(5) + ' │ ' + 'COLUMNA'
        table += '\n╞═' + '═'.repeat(20) + '═╪═' + '═'.repeat(10) + '═╪═' + '═'.repeat(15) + '═╪═' + '═'.repeat(5) + '═╪═' + '═'.repeat(7) + '═╡'
        for sym in self.symbols:
            table += '\n' + sym.toString()
        table += '\n╘═' + '═'.repeat(20) + '═╧═' + '═'.repeat(10) + '═╧═' + '═'.repeat(15) + '═╧═' + '═'.repeat(5) + '═╧═' + '═'.repeat(7) + '═╛'
        return table

symTable = SymbolTable()
```

```python
from utils.Type import Type

class Symbol:
    def __init__(self, value: any, id: str, type: Type):
        self.value = value
        self.id = id.lower()
        self.type = type

    def __str__(self) -> str:
        return f'{self.id}: {self.type} = {self.value}'
```

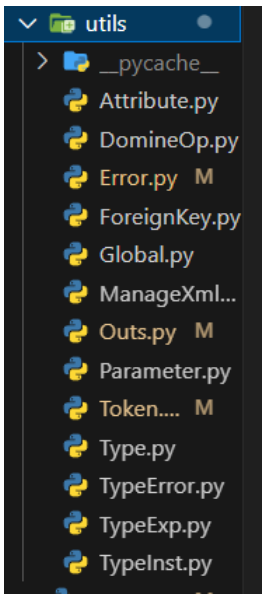
```python
from utils.Type import Type


class SymTab:
    def __init__(self, line, column, isVariable, isPrimitive, id, nameEnv, type: Type):
        self.num = 0
        self.line = line
        self.column = column
        self.isVariable = isVariable
        self.isPrimitive = isPrimitive
        self.id = id
        self.nameEnv = nameEnv
        self.type = type

    def toString(self):
        return '| ' + f'{self.id}'.ljust(20) + ' | ' + f'{self.getType(self.type)}'.ljust(10) + ' | ' + f'{self.nameEnv}'.ljust(15) + ' | ' + f'{sel

    def hash(self):
        return f'{self.id}_{self.type}_{self.nameEnv}_{self.line}_{self.column}_{self.isVariable}_{self.isPrimitive}'

    def getDot(self):
        if self.isPrimitive or self.isVariable:
            if self.isPrimitive:
                if self.isVariable:
                    return f'<tr><td bgcolor="white">{self.num}</td><td bgcolor="white">{self.id}</td><td bgcolor="white">Variable</td><td bgcolor="
                return f'<tr><td bgcolor="white">{self.num}</td><td bgcolor="white">{self.id}</td><td bgcolor="white">Función</td><td bgcolor="white
        if self.type != Type.NULL:
            return f'<tr><td bgcolor="white">{self.num}</td><td bgcolor="white">{self.id}</td><td bgcolor="white">Función</td><td bgcolor="white">{se
        return f'<tr><td bgcolor="white">{self.num}</td><td bgcolor="white">{self.id}</td><td bgcolor="white">Método</td><td bgcolor="white">{self.g
```

```python
def getType(self, type: Type):
    switcher = {
        Type.BIT: "BIT",
        Type.INT: "INT",
        Type.DECIMAL: "DECIMAL",
        Type.NCHAR: "VARCHAR",
        Type.NVARCHAR: "VARCHAR",
        Type.DATETIME: "DATETIME",
        Type.BOOLEAN: "BOOLEAN",
        Type.DATE: "DATE",
        Type.TABLE: "TABLE",
        Type.NULL: "NULL"
    }
    return switcher.get(type, "UNKNOWN")
```

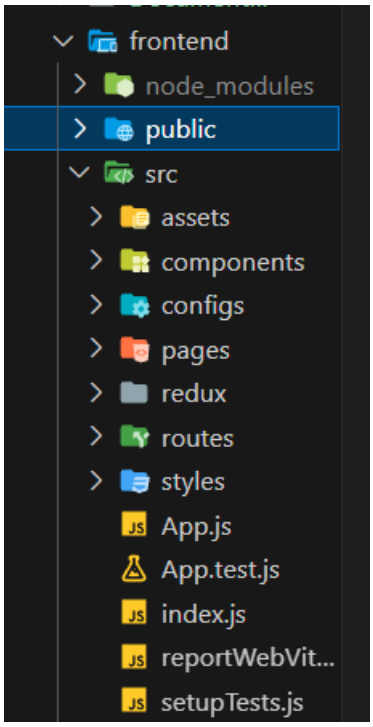
Codigo De Tres Direcciones(C3D) Clases



Clases de apoyo



Frontend


frontend
node_modules
public
src
assets
components
configs
pages
redux
routes
styles
App.js
App.test.js
index.js
reportWebVit...
setupTests.js