

```

#!/usr/bin/env python3
# FILE: compiler.py
# FINAL PROJECT
# Professor Ahmadnia
# Group: Kevin Vuong, Anika Corpus, Christopher Grant
# Description: This program reads source code from a file, outputs it w/o comments and
properly formatted spaces.
#           It then tokenizes and then parses the source code and checks if it has
correct grammar.

from text_clean import *

from tokenizer import *

from LL_parser import *

from code_generator import *

def main():
    # First, remove all the comments
    with open("finalv1.txt") as source_file:
        new_file = open('finalv2.txt', mode='w+', encoding='utf-8')
        comment_removal(source_file, new_file)
        new_file.close()

    # Clean the spaces
    content = clean_text('finalv2.txt')

    token_list = tokenizer(content)

    if token_list == -1:
        exit(1)

    terminal_list = ['P', 'Q', 'R', 'S', '0', '1', '2', '3', '4', '5', '6', '7', '8', '9',
'PROGRAM', 'BEGIN', 'END.',
                    'INTEGER', 'PRINT', '+', '-', '/', '*', '(', ')', ',', ';', '=', ':',
'$']

    predict_table = {
        'W': {'P': 'aaa', 'Q': 'aaa', 'R': 'aaa', 'S': 'aaa', '0': 'aaa', '1': 'aaa', '2':
'aaa', '3': 'aaa', '4': 'aaa', '5': 'aaa', '6': 'aaa', '7': 'aaa', '8': 'aaa', '9': 'aaa',
'PROGRAM': 'PROGRAM B ; D BEGIN I END.', 'BEGIN': 'aaa', 'END.': 'aaa', 'INTEGER': 'aaa',
'PRINT': 'aaa', '+': 'aaa', '-': 'aaa', '/': 'aaa', '*': 'aaa', '(': 'aaa', ')': 'aaa', ',':
'aaa', ';': 'aaa', '=': 'aaa', ':': 'aaa', '$': 'aaa'},
        'B': {'P': 'UC', 'Q': 'UC', 'R': 'UC', 'S': 'UC', '0': 'aaa', '1': 'aaa', '2': 'aaa',
'3': 'aaa', '4': 'aaa', '5': 'aaa', '6': 'aaa', '7': 'aaa', '8': 'aaa', '9': 'aaa',
'PROGRAM': 'aaa', 'BEGIN': 'aaa', 'END.': 'aaa', 'INTEGER': 'aaa', 'PRINT': 'aaa', '+': 'aaa',
'-': 'aaa', '/': 'aaa', '*': 'aaa', '(': 'aaa', ')': 'aaa', ',': 'aaa', ';':
'aaa', '=': 'aaa', ':': 'aaa', '$': 'aaa'},
        'C': {'P': 'UC', 'Q': 'UC', 'R': 'UC', 'S': 'UC', '0': 'OC', '1': 'OC', '2': 'OC',
'3': 'OC', '4': 'OC', '5': 'OC', '6': 'OC', '7': 'OC', '8': 'OC', '9': 'OC', 'PROGRAM': '
aaa', 'BEGIN': 'aaa', 'END.': 'aaa', 'INTEGER': 'aaa', 'PRINT': 'aaa', '+': 'lambda', '-':
'lambda', '/': 'lambda', '*': 'lambda', '(': 'aaa', ')': 'lambda', ',': 'lambda', ';': 'aaa',
':': 'lambda', '=': 'lambda', ':': 'aaa', '$': 'aaa'},
        'D': {'P': 'aaa', 'Q': 'aaa', 'R': 'aaa', 'S': 'aaa', '0': 'aaa', '1': 'aaa', '2':
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        'G': {'P': 'BZ', 'Q': 'BZ', 'R': 'BZ', 'S': 'BZ', '0': 'aaa', '1': 'aaa', '2': 'aaa',
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'PROGRAM': 'aaa', 'BEGIN': 'aaa', 'END.': 'aaa', 'INTEGER': 'aaa', 'PRINT': 'aaa', '+': 'aaa',
'-': 'aaa', '/': 'aaa', '*': 'aaa', '(': 'aaa', ')': 'aaa', ',': 'aaa', ';':
'aaa', '=': 'aaa', ':': 'aaa', '$': 'aaa'},
        'Z': {'P': 'aaa', 'Q': 'aaa', 'R': 'aaa', 'S': 'aaa', '0': 'aaa', '1': 'aaa', '2':
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aaa', '-': 'aaa', '/': 'aaa', '*': 'aaa', '(': 'aaa', ')': 'aaa', ',': 'G', ';': 'aaa',
':': 'lambda', '=': 'aaa', ':': 'aaa', '$': 'aaa'},

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'H': {'P': 'aaa', 'Q': 'aaa', 'R': 'aaa', 'S': 'aaa', '0': 'aaa', '1': 'aaa', '2':  
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, '-': 'aaa', '/': 'aaa', '*': 'aaa', '(' : 'aaa', ')': 'aaa', ',': 'aaa', '.': 'aaa', ';':  
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, '+': 'aaa', '-': 'aaa', '/': 'aaa', '*': 'aaa', '(' : 'aaa', ')': 'aaa', ',': 'aaa', '.':  
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' : 'aaa', 'BEGIN': 'aaa', 'END.': 'aaa', 'INTEGER': 'aaa', 'PRINT': 'aaa', '+': 'lambda',  
, '-': 'lambda', '/': 'lambda', '*': 'lambda', '(' : 'aaa', ')': 'lambda', ',': 'aaa', '.': '  
aaa', ';': 'lambda', '=': 'aaa', ':': 'aaa', '$': 'aaa'},
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        'O': {'P': 'aaa', 'Q': 'aaa', 'R': 'aaa', 'S': 'aaa', '0': '0', '1': '1', '2': '2',
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BEGIN': 'aaa', 'END.': 'aaa', 'INTEGER': 'aaa', 'PRINT': 'aaa', '+': 'aaa', '-': 'aaa', '/'
: 'aaa', '*': 'aaa', '(' : 'aaa', ')': 'aaa', ',': 'aaa', '.': 'aaa', ';': 'aaa', '=': 'aaa'
, ':': 'aaa', '$': 'aaa'},
        'U': {'P': 'P', 'Q': 'Q', 'R': 'R', 'S': 'S', '0': 'aaa', '1': 'aaa', '2': 'aaa', '
3': 'aaa', '4': 'aaa', '5': 'aaa', '6': 'aaa', '7': 'aaa', '8': 'aaa', '9': 'aaa', 'PROGRAM
': 'aaa', 'BEGIN': 'aaa', 'END.': 'aaa', 'INTEGER': 'aaa', 'PRINT': 'aaa', '+': 'aaa', '-'
: 'aaa', '/': 'aaa', '*': 'aaa', '(' : 'aaa', ')': 'aaa', ',': 'aaa', '.': 'aaa', ';': 'aaa'
, '=': 'aaa', ':': 'aaa', '$': 'aaa'},
    }

```

```

    parse_status = predictive_parser(token_list, predict_table, terminal_list,
starting_symbol='W')

```

```

    if parse_status is True:
        code_generator(content.split('\n'), 'main.cpp')

```

```

if __name__ == "__main__":
    main()

```

```

# FILE: text_clean.py
# FINAL PROJECT
# Professor Ahmadnia
# Group: Kevin Vuong, Anika Corpus, Christopher Grant
# Description: This program provides functionality for removing comments and formatting the spaces.

```

```

import re

```

```

def comment_remover(file_read, file_write):
    """
    Removes the comments from the text file (file_read) and writes it to another file (
    file_write).

```

```

    :param file_read: The text file being read from
    :param file_write: The text file being written into
    :return: None
    """

```

```

    content = file_read.readlines()
    content = ''.join(content)

    # The pattern to remove multi-line comments
    mult_line_comment_pattern = '//.*\n.*//'
    content = re.sub(mult_line_comment_pattern, '', content, 0)

```

```

    # The pattern to remove single-line comments
    single_line_comment_pattern = '//.*//'
    content = re.sub(single_line_comment_pattern, '', content, 0)

```

```

    file_write.writelines(content)

```

```

def space_formatter(expr):
    """
    Formats the spaces of a line of text

```

```

    Arguments:
        expr: a line of text

```

```

    Returns:
        line: the line of processed text

```

```

    """
    token_list = expr.split(" ")
    content = ''

```

```

    # This loop removes elements with empty string contents
    for token in token_list:
        if re.match(r'^\s*\n\s*$', token):
            continue
        content = content + token.strip()

```

```

    # This section adds the appropriate spaces for the reserved words
    reserved_pattern = r'(\s*PROGRAM\s*|\s*INTEGER\s*|\s*PRINT\s*|\s*BEGIN\s*|\s*END\s*\.\s*)'
    matched = re.match(reserved_pattern, content)
    word = ''
    if matched is not None:
        word = matched.group()

```

```

    if word == 'PROGRAM':
        content = re.sub(r'(\s*PROGRAM\s*)', 'PROGRAM ', content, 0)

```

```

    if word == 'INTEGER':
        content = re.sub(r'(\s*INTEGER\s*)', 'INTEGER ', content, 0)

```

```

    if word == 'PRINT':
        content = re.sub(r'(\s*PRINT\s*)', 'PRINT ', content, 0)

```

```

    if word == 'BEGIN':

```

```

        content = re.sub(r'\s*BEGIN\s*', 'BEGIN', content, 0)

    if word == 'END.':
        content = re.sub(r'\s*END.\s*', 'END.', content, 0)

    # This section adds the appropriate spaces for the symbols
    symbolic_pattern = r'(\=|\*|\-|\,|\:|\(|\)|\<|\=|\+|\;|)'
    matched = re.findall(symbolic_pattern, content)

    for word in matched:
        if word == '=':
            content = re.sub(r'\s*=\s*', ' = ', content, 0)

        if word == ',':
            content = re.sub(r'\s*,\s*', ' , ', content, 0)

        if word == ';':
            content = re.sub(r'\s*;\s*', ' ;', content, 0)

        if word == '(':
            content = re.sub(r'\s*\(\s*', ' ( ', content, 0)

        if word == ')':
            content = re.sub(r'\s*\)\s*', ' ) ', content, 0)

        if word == '+':
            content = re.sub(r'\s*\+\s*', ' + ', content, 0)

        if word == '-':
            content = re.sub(r'\s*\-\s*', ' - ', content, 0)

        if word == '*':
            content = re.sub(r'\s*\*\s*', ' * ', content, 0)

        if word == ':':
            content = re.sub(r'\s*\:\s*', ' : ', content, 0)

    return content+'\n'

def clean_text(filename):
    """
    Cleans up the spaces in the text file.

    :rtype: lines_content: The entire content of the string cleaned up
    :param filename: The name of the file you want to clean
    """
    file = open('finalv2.txt', mode='r+', encoding='utf-8')
    lines_read = file.readlines()
    lines_content = ''

    for line in lines_read:
        # Ignore lines that only contain the newline character
        if re.match(pattern=r'\s*\n\s*', string=line):
            continue

        line = space_formatter(line)
        lines_content = lines_content + line

    # Writes the cleaned up text to the text file
    with open(filename, mode='w+') as new_file:
        new_file.writelines(lines_content.strip())

    return lines_content.strip()

def main():
    # First, remove all the comments

```

```
with open("finalv1.txt") as source_file:
    new_file = open('finalv2.txt', mode='w+', encoding='utf-8')
    comment_remover(source_file, new_file)
    new_file.close()

# Clean the spaces
content = clean_text('finalv2.txt')
print(content)

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

```
# FILE: token.py
# FINAL PROJECT
# Professor Ahmadnia
# Group: Kevin Vuong, Anika Corpus, Christopher Grant
# Description: The token class enables parsing of the string input.

class Token:
    """
    A token class that categorizes a string. The 'token' is the category and the 'value' is
    the specific string of the
    category.
    """
    def __init__(self, token, value, line_number):
        self.token = token
        self.value = value
        self.line_number = line_number

    def get_type(self):
        return self.token

    def get_value(self):
        return self.value

    def get_line_num(self):
        return self.line_number
```

```

# FILE: tokenizer.py
# FINAL PROJECT
# Professor Ahmadnia
# Group: Kevin Vuong, Anika Corpus, Christopher Grant
# Description: Provides a function to parse the source code for tokens.

import re

from token import *

def tokenizer(string):
    """
    Creates a list of tokens from the input string

    :param string: The source code
    :return: A list of tokens. Returns -1 if a token is not recognizable.
    """
    content_lines = string.split('\n')

    token_list = []
    reserved_pattern = r'^(PROGRAM|INTEGER|PRINT|BEGIN|END\.)$'
    symbol_pattern = r'^(=|\/|\*|\+|\-|\;|\:|\,|\(|\)|\)|\$)'
    number_pattern = r'^(\+|\-)?[0-9]+$'
    identifier_pattern = r'^(P|Q|R|S)+(P|Q|R|S|[0-9])*$'

    line_number = 1 # used to keep track of line number
    for line in content_lines:
        words_list = line.split()
        for word in words_list:
            if re.match(reserved_pattern, word): # Check for reserved word token
                reserved = Token('RESERVED', word, line_number)
                token_list.append(reserved)

            elif re.match(number_pattern, word): # Check for number token
                for symbol in word:
                    if re.match('(\+|\-)', symbol):
                        sign = Token('SIGN', symbol, line_number)
                        token_list.append(sign)
                    elif re.match('[0-9]', symbol):
                        digit = Token('DIGIT', symbol, line_number)
                        token_list.append(digit)

            elif re.match(symbol_pattern, word): # Check for symbol token
                symbol = Token('SYMBOL', word, line_number)
                token_list.append(symbol)

            elif re.match(identifier_pattern, word): # Check for identifier token
                for symbol in word:
                    if re.match(r'(P|Q|R|S)', symbol):
                        _id = Token('ID', symbol, line_number)
                        token_list.append(_id)
                    elif re.match(r'[0-9]', symbol):
                        more_id_digit = Token('MORE_ID_DIGIT', symbol, line_number)
                        token_list.append(more_id_digit)
                else:
                    print('Unknown word: ' + word, 'on line', line_number)
                    return -1

            line_number += 1
        # For debug purposes
        # for token in token_list:
        #     print(token.get_type(), ':', token.get_value(), ':', token.get_line_num())

    return token_list

```



```

#!/usr/bin/env python3
# FILE: LL_parser.py
# FINAL PROJECT
# Professor Ahmadnia
# Group: Kevin Vuong, Anika Corpus, Christopher Grant
# Description: This program provides a function to parse a tokenized list of input string to
check
#               whether the input string is a valid string based on the Predictive Parsing
table.

import re

from token import *

def syntax_error_handler_1(error_value, line_number):
    """
    Handles the error condition in the terminal if-block

    :param error_value: The symbol under question
    :param line_number: The line number where the error has occurred
    :return:
    """
    if re.match(r':', error_value):
        print('Line ' + str(line_number) + ':', 'Missing a colon (:)')
    elif re.match(r';', error_value):
        print('Line ' + str(line_number - 1) + ':', 'Expected a semicolon')
    elif re.match(r'\)', error_value):
        print('Line ' + str(line_number) + ':', 'Expected a ')')

def syntax_error_handler_2(error_value, line_number):
    """
    Handles the error condition in the non-terminal if-block

    :param error_value: The symbol under question
    :param line_number: The line number where the error has occurred
    :return: None
    """
    error_line = 'Line ' + str(line_number - 1) + ':'

    if re.match(r'(P|Q|R|S|BEGIN)', error_value):
        print(error_line, 'Missing a semicolon (;)')
    elif re.match(r';', error_value):
        print('Line ' + str(line_number) + ':', 'Missing an expression')
    elif re.match(r'\)', error_value):
        print('Line ' + str(line_number) + ':', 'Invalid expression')

def predictive_parser(token_list, predict_table, terminal_list, starting_symbol):
    """
    Determines whether the input string is accepted or rejected based on the prediction
table.

    :param token_list: a list of tokens to parse (basically, the input string in tokenized
form)
    :param predict_table: the prediction table being used
    :param terminal_list: a list of terminals for the grammar
    :param starting_symbol: the symbol to which the grammar starts with
    :return: Returns -1 if input string is rejected, otherwise returns 0 if accepted
    """

    stack = ['$ ', starting_symbol] # Push the end-of-input symbol and the starting symbol
    i = 0 # Keeps track which token is currently being read

    # Add ending symbol to the end of the input
    ending_symbol = Token('$ ', '$ ', 0)
    token_list.append(ending_symbol)

    while stack: # loop until stack is empty

```

```

top_of_stack = stack[len(stack) - 1]
token_read = token_list[i]
char_read = token_read.get_value() # Gets the actual terminal of the token

if top_of_stack in terminal_list: # Terminal
    if top_of_stack == char_read:
        stack.pop()
        i = i + 1
    else:
        print('\n1: The grammar has rejected the input string')
        print(top_of_stack, char_read)
        syntax_error_handler_1(top_of_stack, token_read.get_line_num())
        return -1
    else: # Non-terminal
        if predict_table[top_of_stack][char_read] is not 'aaa': # If table entry is
not an empty entry
            entry = stack.pop()
            if predict_table[entry][char_read] is not 'lambda':
                # Push the entry into the stack in reverse order
                for symbol in reversed(predict_table[entry][char_read].split()):
                    if re.match(r'PROGRAM|BEGIN|END\.|INTEGER|PRINT', symbol):
                        stack.append(symbol)
                    else:
                        for non_terminal in reversed(symbol):
                            stack.append(non_terminal)
            else:
                print('2: The grammar has rejected the input string')
                print(top_of_stack, char_read)
                syntax_error_handler_2(char_read, token_read.get_line_num())
                return -1
        print(stack)

print('The grammar has accepted the input string\n')
return True

```

```

# FILE: code_generator.py
# FINAL PROJECT
# Professor Ahmadnia
# Group: Kevin Vuong, Anika Corpus, Christopher Grant
# Description: Provides function to generate C++ code with the given source code.

import re

def code_generator(source, filename):
    """
    Generates source code from input source code

    :param source: A list. Contains the source code (where each line is an element of the
    list)
    :param filename: The name of the file you want to output the generated source code to
    :return: Returns True upon successful completion
    """
    # Stores the string to be written to the file.
    content = ''

    # Go through each line, converting it to C++
    for line in source:
        if re.match(r'PRINT', line):
            line = re.sub(r'PRINT\s*\(', 'cout <<', line, 0)
            line = re.sub(r'\)\s*;', 'endl ;\n', line, 0)
            content += line
            continue

        if re.match(r'^PROGRAM', line):
            content += '#include <iostream>\nusing namespace std ;\n'
        elif re.match(r'^BEGIN', line):
            content += 'int main()\n{\n'
        elif re.match(r'^INTEGER', line):
            line = re.sub(r'INTEGER\s*:', 'int', line)
            content += line + '\n'
        elif re.match(r'^(P|Q|R|S)+(P|Q|R|S|[0-9])*', line):
            content += '\t' + line + '\n'
        elif re.match(r'END\.', line):
            content += '\treturn 0 ;\n}'

    # Write the code generated to the file
    file = open(filename, mode='w')
    file.writelines(content)
    file.close()

    return True

```