

LAB ASSIGNMENT-2

Submitted for

COMPILER CONSTRUCTION (UCS802)

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QUESTION:

Design a SLR parser for the grammar given below:

$E \rightarrow E+T/T$

$T \rightarrow T * F / F$

$F \rightarrow (E)/id$

PYTHON CODE:

```
from collections import deque
from typing import List, Dict, Tuple, Set

class Action:
    def __init__(self, type: str, state: int):
        self.type = type
        self.state = state

# Creating ACTION and GOTO tables
action_table: Dict[int, Dict[str, Action]] = {
    0: {"id": Action("shift", 5), "(" : Action("shift", 4)},
    1: {"+": Action("shift", 6), "$": Action("accept", 0)},
    2: {"+": Action("reduce", 2), "*": Action("shift", 7), ")": Action("reduce", 2), "$": Action("reduce", 2)},
    3: {"+": Action("reduce", 4), "*": Action("reduce", 4), ")": Action("reduce", 4), "$": Action("reduce", 4)},
    4: {"id": Action("shift", 5), "(" : Action("shift", 4)},
    5: {"+": Action("reduce", 6), "*": Action("reduce", 6), ")": Action("reduce", 6), "$": Action("reduce", 6)},
```

```

        6: {"id": Action("shift", 5), "(": Action("shift",
4)},
        7: {"id": Action("shift", 5), "(": Action("shift",
4)},
        8: {"+": Action("shift", 6), ")": Action("shift",
11)},
        9: {"+": Action("reduce", 1), "*": Action("shift",
7), ")": Action("reduce", 1), "$": Action("reduce",
1)},
        10: {"+": Action("reduce", 3), "*":
Action("reduce", 3), ")": Action("reduce", 3), "$":
Action("reduce", 3)},
        11: {"+": Action("reduce", 5), "*":
Action("reduce", 5), ")": Action("reduce", 5), "$":
Action("reduce", 5)},
    }

```

```

goto_table: Dict[int, Dict[str, int]] = {
    0: {"E": 1, "T": 2, "F": 3},
    4: {"E": 8, "T": 2, "F": 3},
    6: {"T": 9, "F": 3},
    7: {"F": 10},
}

```

```

productions: List[Tuple[str, int]] = [
    ("E'", 1), # Dummy production to initialize the
parse
    ("E", 3), # E -> E + T
    ("E", 1), # E -> T
    ("T", 3), # T -> T * F
    ("T", 1), # T -> F
    ("F", 3), # F -> ( E )
    ("F", 1) # F -> id
]

```

```

# FIRST and FOLLOW sets for non-terminals
first_set: Dict[str, Set[str]] = {
    "E": {"id", "("},
    "T": {"id", "("},
    "F": {"id", "("},
}

follow_set: Dict[str, Set[str]] = {
    "E": {")", "+", "$"},
    "T": {"+", "*", ")", "$"},
    "F": {"*", "+", ")", "$"},
}

def print_first_and_follow_sets():
    print("FIRST Sets:")
    for non_terminal, symbols in first_set.items():
        print(f"FIRST({non_terminal}) = {{ { '
'.join(symbols)} }}"

    print("\nFOLLOW Sets:")
    for non_terminal, symbols in follow_set.items():
        print(f"FOLLOW({non_terminal}) = {{ { '
'.join(symbols)} }}"

def print_action_and_goto_tables():
    terminals = ["id", "+", "*", "(", ")", "$"]
    non_terminals = ["E", "T", "F"]

    print("\nACTION Table:")
    print(f"{'State':<8}", end="")
    for term in terminals:
        print(f"{term:<8}", end="")
    print("\n" + "-" * (8 + len(terminals) * 8))

```

```

    for state in range(12):
        print(f"{state:<8}", end="")
        for term in terminals:
            action = action_table.get(state,
{}).get(term)
            if action:
                if action.type == "shift":
                    print(f"s{action.state:<7}",
end="")

                elif action.type == "reduce":
                    print(f"r{action.state:<7}",
end="")

                elif action.type == "accept":
                    print(f"acc{' ':<6}", end="")
            else:
                print(" " * 8, end="")
        print()

    print("\nGOTO Table:")
    print(f"{'State':<8}", end="")
    for non_term in non_terminals:
        print(f"{non_term:<8}", end="")
    print("\n" + "-" * (8 + len(non_terminals) * 8))

    for state in range(12):
        print(f"{state:<8}", end="")
        for non_term in non_terminals:
            next_state = goto_table.get(state,
{}).get(non_term, " ")
            print(f"{next_state:<8}", end="")
        print()

def slr_parser(tokens: List[str]):

```

```

state_stack = deque([0])
symbol_stack = deque()

i = 0
while True:
    state = state_stack[-1]
    token = tokens[i]

    if token not in action_table.get(state, {}):
        print("Status: Rejected")
        return

    action = action_table[state][token]

    if action.type == "shift":
        state_stack.append(action.state)
        symbol_stack.append(token)
        i += 1
    elif action.type == "reduce":
        production_idx = action.state
        prod_len = productions[production_idx][1]
        non_terminal =
productions[production_idx][0]

        for _ in range(prod_len):
            state_stack.pop()
            symbol_stack.pop()

        next_state = goto_table[state_stack[-
1]][non_terminal]
        state_stack.append(next_state)
        symbol_stack.append(non_terminal)
    elif action.type == "accept":
        print("Status: Accepted")

```

```

        return

if __name__ == "__main__":

    print_first_and_follow_sets()
    print_action_and_goto_tables()

    print("\nThe input string to parse: id + id * id")
    input_tokens = ["id", "+", "id", "*", "id", "$"]
    slr_parser(input_tokens)

```

OUTPUT:

Output:

FIRST Sets:

FIRST(E) = { (id }

FIRST(T) = { (id }

FIRST(F) = { (id }

FOLLOW Sets:

FOLLOW(E) = { + \$) }

FOLLOW(T) = { + * \$) }

FOLLOW(F) = { + * \$) }

ACTION Table:

State	id	+	*	()	\$

0	s5			s4		
1		s6				acc
2		r2	s7		r2	r2
3		r4	r4		r4	r4
4	s5			s4		
5		r6	r6		r6	r6
6	s5			s4		
7	s5			s4		
8		s6			s11	
9		r1	s7		r1	r1
10		r3	r3		r3	r3
11		r5	r5		r5	r5

GOTO Table:

State	E	T	F

0	1	2	3
1			
2			
3			
4	8	2	3
5			
6		9	3
7			10
8			
9			
10			
11			

For $id * id + id$:

```
The input string to parse: id + id * id  
Status: Accepted
```

For $id * id + F$:

```
The input string to parse: id + id * F  
Status: Rejected
```