LAB ASSIGNMENT-1

Submitted for

COMPILER CONSTRUCTION (UCS802)

Submitted by

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Submitted to

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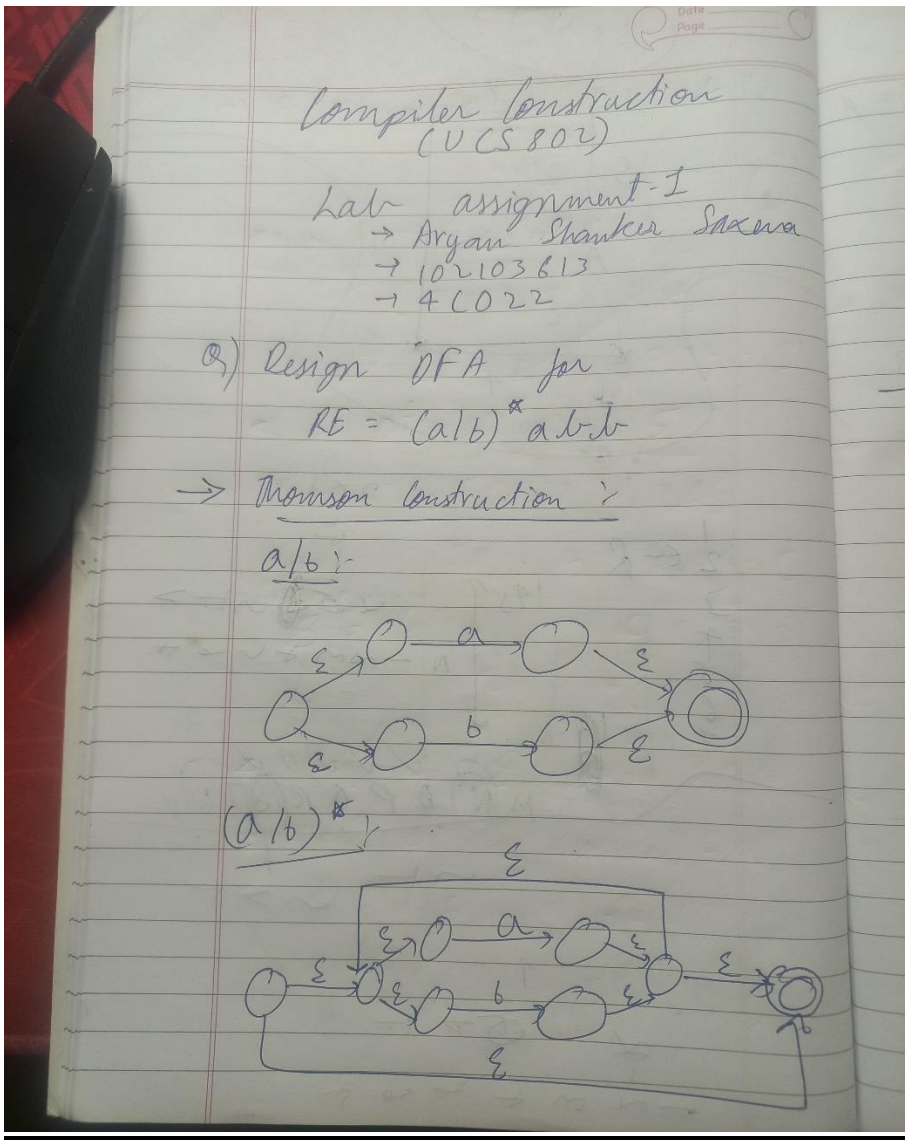
QUESTION:

Design a Minimized DFA for the Regular Expression (a/b)*abb i.e. All strings ending with abb.

Note: ***THE CODE IS TYPE WRITTEN IT IS JUST THE BACKGROUND OF VSCode THAT MIGHT MAKE IT LOOK LIKE AN IMAGE BUT IT IS PURE TEXT***

SOLVED ON PAPER:



classmate
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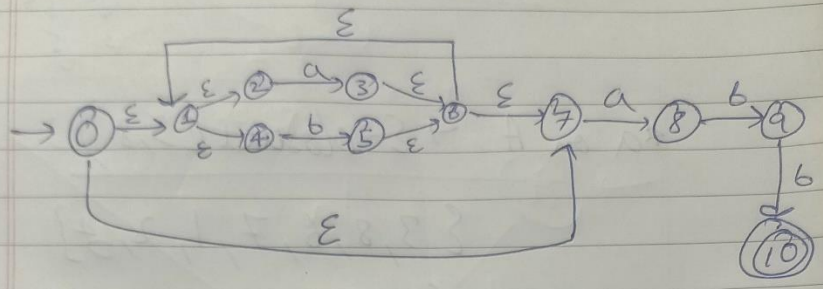
$(a|b)^*abb$:-



→ DFA Subset Construction :-

State	a	b	ε_1	ε_2
0	–	–	1	7
1	–	–	2	4
2	3	–	–	–
3	–	–	6	–
4	–	5	–	–
5	–	–	6	–
6	–	–	7	1
7	8	–	–	–
8	–	9	–	–
9	–	10	–	–
10	–	–	–	–

→ ε-closure (0) = {0, 1, 2, 4, 7} = A

a ↓ 3, b ↓ 5, a ↓ 8

* a on A → ε-closure (3,8) =

{3, 8, 6, 7, 1, 2, 4}

→ {1, 2, 3, 4, 6, 7, 8} = B

* b on A → ε-closure (5) =

→ {5, 6, 7, 1, 2, 4}

= {1, 2, 4, 5, 6, 7} = C

Now,

B = {1, 2, 3, 4, 6, 7, 8}

a ↓ 3, b ↓ 5, a ↓ 8, b ↓ 9

* a on B → ε-closure (3,8) = B

* b on B → ε-closure (5,9)

→ {5, 9, 10, 2, 4, 7}

→ {1, 2, 4, 5, 6, 7, 9} = D

Now,

$C = \{1, 2, 4, 5, 6, 7\}$

a → 3, b → 5, a → 8

* a on C → ε-closure(3,8) = B

* b on C → ε-closure(5) = C

Then,

$D = \{1, 2, 4, 5, 6, 7, 9\}$

a → 3, b → 5, a → 8, b → 10

* a on D → ε-closure(3,8) = B

* b on D → ε-closure(5,10)

→ {5, 6, 7, 1, 2, 4, 10}

→ {1, 2, 4, 5, 6, 7, 10} = E

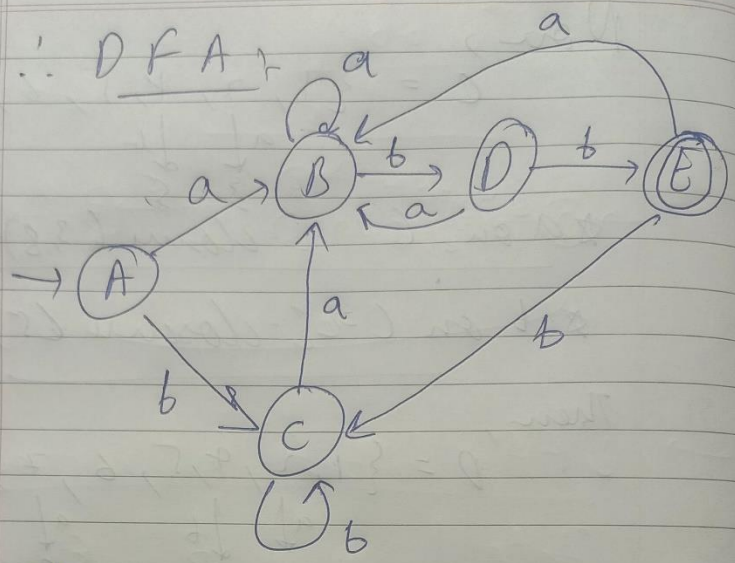
finally,

$E = \{1, 2, 4, 5, 6, 7, 10\}$

a on E → ε-closure(3,8) = B

b on E → ε-closure(5) = C

∴ DFA :-



→ Minimize DFA :-

State	a	b
A	B	C
B	B	D
C	B	C
D	B	E
E	B	C

$\Pi_0 = \{ \{E\}, \{A, B, C, D\} \}$

$\Pi_1 = \{ \{E\}, \{D\}, \{A, B, C\} \}$

$\Pi_2 = \{ \{E\}, \{D\}, \{B\}, \{A, C\} \}$

$\Pi_3 = \{ \{E\}, \{D\}, \{B\}, \{C\}, \{A\} \}$

PYTHON CODE:

```
class NFA:
    def __init__(self):
        self.states = {i: {'a': None, 'b': None, 'ε1': None, 'ε2': None} for i in range(11)}

    def add_transition(self, state, symbol, next_state):
        if symbol in self.states[state]:
            self.states[state][symbol] = next_state

    def print_nfa(self):
        print("State | a  | b  | ε1 | ε2")
        print("-------------------------")
        for state, transitions in self.states.items():
            print(f"  {state}  | {transitions['a']} | {transitions['b']} | {transitions['ε1']} |
{transitions['ε2']}")

# Initializing the NFA with correct transitions
nfa = NFA()
nfa.add_transition(0, 'ε1', 1)
nfa.add_transition(0, 'ε2', 7)
nfa.add_transition(1, 'ε1', 2)
nfa.add_transition(1, 'ε2', 4)
nfa.add_transition(2, 'a', 3)
nfa.add_transition(3, 'ε1', 6)
nfa.add_transition(4, 'b', 5)
nfa.add_transition(5, 'ε1', 6)
nfa.add_transition(6, 'ε1', 7)
nfa.add_transition(6, 'ε2', 1)
nfa.add_transition(7, 'a', 8)
nfa.add_transition(8, 'b', 9)
nfa.add_transition(9, 'b', 10)
print("Regular Expression: (a/b)*abb")
```

```
print("")
print("Submitted by: Aryan Shanker Saxena (102103613)")
print("")
nfa.print_nfa()
print("")


# epsilon_closure function to use the nfa.states dictionary
def epsilon_closure(nfa_states, state):
    stack = [state]
    closure = set(stack)

    while stack:
        current = stack.pop()
        for next_state in [nfa_states[current]['ε1'], nfa_states[current]['ε2']]:
            if next_state and next_state not in closure:
                closure.add(next_state)
                stack.append(next_state)
    return closure
epsilon_closure_set = epsilon_closure(nfa.states, 0)
print("ε-closure(0):", epsilon_closure_set)
epsilon_closure_set = epsilon_closure(nfa.states, 1)
print("ε-closure(1):", epsilon_closure_set)
epsilon_closure_set = epsilon_closure(nfa.states, 2)
print("ε-closure(2):", epsilon_closure_set)
epsilon_closure_set = epsilon_closure(nfa.states, 3)
print("ε-closure(3):", epsilon_closure_set)
epsilon_closure_set = epsilon_closure(nfa.states, 4)
print("ε-closure(4):", epsilon_closure_set)
epsilon_closure_set = epsilon_closure(nfa.states, 5)
print("ε-closure(5):", epsilon_closure_set)
epsilon_closure_set = epsilon_closure(nfa.states, 6)
print("ε-closure(6):", epsilon_closure_set)
epsilon_closure_set = epsilon_closure(nfa.states, 7)
print("ε-closure(7):", epsilon_closure_set)
```

```
epsilon_closure_set = epsilon_closure(nfa.states, 8)
print("ε-closure(8):", epsilon_closure_set)
epsilon_closure_set = epsilon_closure(nfa.states, 9)
print("ε-closure(9):", epsilon_closure_set)
epsilon_closure_set = epsilon_closure(nfa.states, 10)
print("ε-closure(10):", epsilon_closure_set)
print("")

# The subset construction to pass the correct argument
def subset_construction(nfa):
    dfa_states = {}
    unmarked_states = []
    initial_state = epsilon_closure(nfa.states, 0)
    dfa_states[frozenset(initial_state)] = {}

    unmarked_states.append(initial_state)

    while unmarked_states:
        current_set = unmarked_states.pop(0)
        for symbol in ['a', 'b']:
            new_set = set()
            for state in current_set:
                if nfa.states[state][symbol] is not None:
                    new_set.update(epsilon_closure(nfa.states, nfa.states[state][symbol]))
            if new_set and frozenset(new_set) not in dfa_states:
                unmarked_states.append(new_set)
                dfa_states[frozenset(new_set)] = {}
            dfa_states[frozenset(current_set)][symbol] = frozenset(new_set)

    return dfa_states

# Construct DFA from NFA
dfa = subset_construction(nfa)
```

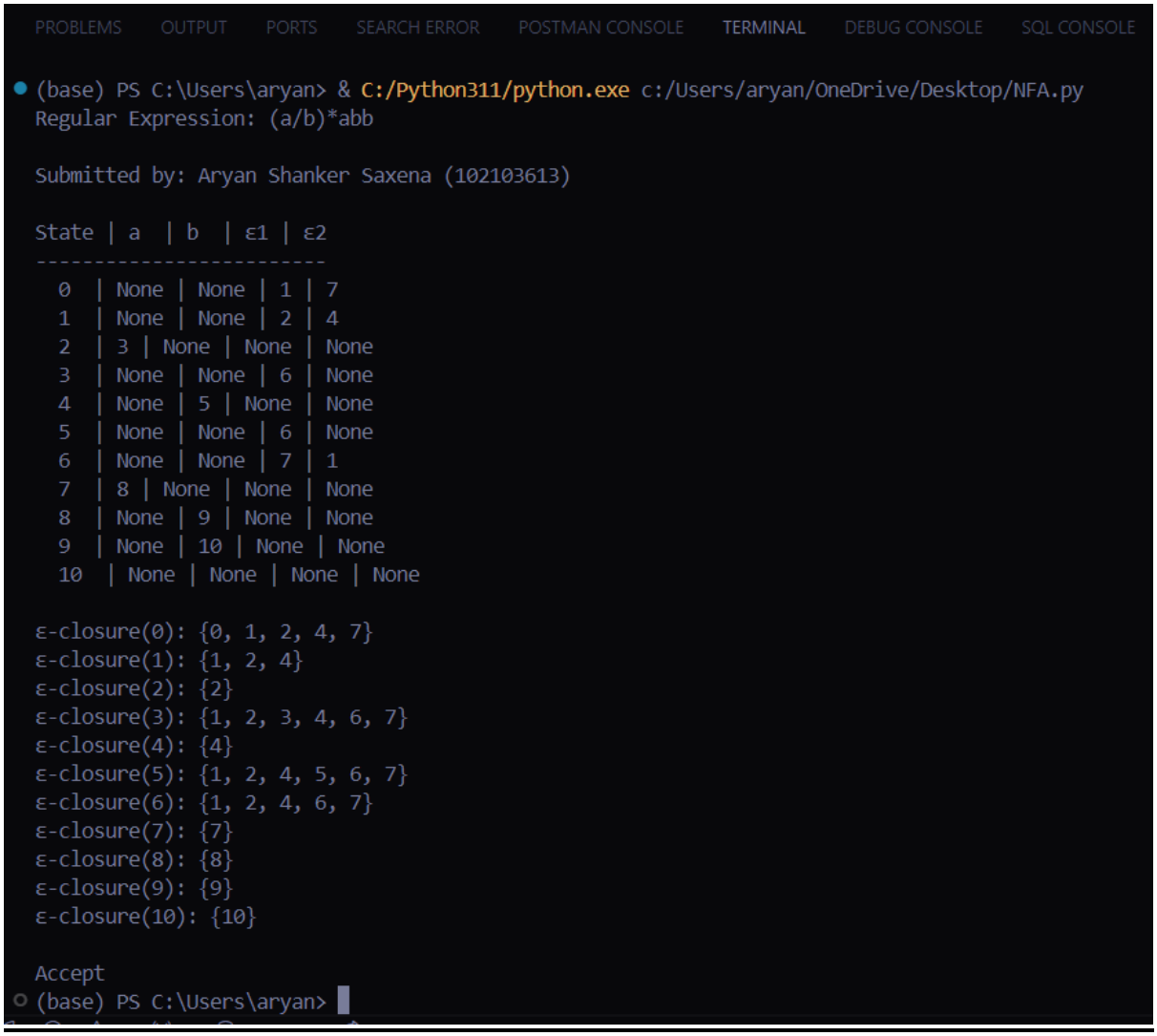
```
accepting_states = set()
for state in dfa:
    if 10 in state:
        accepting_states.add(state)


# Function to check if string is accepted
def check_string(dfa, string):
    current_state = frozenset(epsilon_closure(nfa.states, 0))
    for char in string:
        if char in dfa[current_state]:
            current_state = dfa[current_state][char]
        else:
            return "Not Accepted"
    if current_state in accepting_states:
        return "Accept"
    return "Not Accepted"



result = check_string(dfa, "abbabb")
print(result)
```

OUTPUT:


PROBLEMS OUTPUT PORTS SEARCH ERROR POSTMAN CONSOLE TERMINAL DEBUG CONSOLE SQL CONSOLE
(base) PS C:\Users\aryan> & C:/Python311/python.exe c:/Users/aryan/OneDrive/Desktop/NFA.py
Regular Expression: (a/b)*abb
Submitted by: Aryan Shanker Saxena (102103613)
State | a | b | ε1 | ε2
0 | None | None | 1 | 7
1 | None | None | 2 | 4
2 | 3 | None | None | None
3 | None | None | 6 | None
4 | None | 5 | None | None
5 | None | None | 6 | None
6 | None | None | 7 | 1
7 | 8 | None | None | None
8 | None | 9 | None | None
9 | None | 10 | None | None
10 | None | None | None | None
ε-closure(0): {0, 1, 2, 4, 7}
ε-closure(1): {1, 2, 4}
ε-closure(2): {2}
ε-closure(3): {1, 2, 3, 4, 6, 7}
ε-closure(4): {4}
ε-closure(5): {1, 2, 4, 5, 6, 7}
ε-closure(6): {1, 2, 4, 6, 7}
ε-closure(7): {7}
ε-closure(8): {8}
ε-closure(9): {9}
ε-closure(10): {10}
Accept
(base) PS C:\Users\aryan>

Output when the string does not end in abb: