

Name: Anjali Pingle

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Roll No: 30

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Design and implementation of Modern Compilers

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Practical NO 1

Aim : Write a program to construct NDFA

Install package automata-lib

By using the following command:

```
pip install automata-lib
```

```
D:\Python>
D:\Python>pip install automata-lib
Collecting automata-lib
  Downloading automata_lib-5.0.0-py3-none-any.whl (32 kB)
Collecting pydot
  Downloading pydot-1.4.2-py2.py3-none-any.whl (21 kB)
Collecting pyparsing>=2.1.4
  Downloading pyparsing-3.0.7-py3-none-any.whl (98 kB)
----- 98.0/98.0 KB 622.8 kB/s eta 0:00:00
Installing collected packages: pyparsing, pydot, automata-lib
Successfully installed automata-lib-5.0.0 pydot-1.4.2 pyparsing-3.0.7
```

Code:

```
from automata.fa.nfa import NFA
```

```
class NDFA:
```

```
    def __init__(self):
```

```
        state_set = set(input("Enter state set>\t"))
```

```
        input_symbols = set(input("Enter input symbol set>\t"))
```

```
        initial_state = input("Enter the initial state>\t")
```

```
        final_states = set(input("Enter the final state(s)>\t"))
```

```
        rule_count = int(input("Enter the number of rules you
want to add>\t"))
```

```
        rules = []
```

```

for counter in range(rule_count):
    rules.append(input("Enter rule " + str(counter + 1) +
">\t").replace(" ", ""))
    rules = self.get_transitions(rules)

self.nfa = NFA(
    states = state_set,
    input_symbols = input_symbols,
    transitions = rules,
    initial_state = initial_state,
    final_states = final_states
)

del state_set, input_symbols, initial_state, final_states,
rules.

```

```

def get_transitions(self, rules):
    rules = [i.split("-") for i in rules]
    rules_dict = {}

    for rule in rules:
        if rule[0] not in rules_dict:
            rules_dict[rule[0]] = {rule[1][1]:rule[1][0]}

```

```
        print("If:", rules_dict)
    else:
        rules_dict[rule[0]][rule[1][0]] = rule[1][1]
        print("Else:", rules_dict)
    return rules_dict
```

```
def print_stats(self):
    print("\n\nSet of states are > ", self.nfa.states)
    print("Input symbols are > ", self.nfa.input_symbols)
    print("Transitions are > ")
    for transition in self.nfa.transitions:
        print(transition, self.nfa.transitions[transition])
    print("Initial state > ", self.nfa.initial_state)
    print("Final states > ", self.nfa.final_states)
```

```
def print_transition_table(self):
    input_symbols = list(self.nfa.input_symbols)
    transitions = self.nfa.transitions

    print("\n\nTransition table is > ")
```

```
#print(f"States\t\t{input_symbols[0]}\t\t{input_symbols[1]}")
```

```

        print("States\t\t" + str(input_symbols[0]) + "\t\t" +
              str(input_symbols[1]))

    for transition in transitions:

        for input_symbol in input_symbols:

            try:

                temp = transitions[transition][input_symbol]

                del temp

            except KeyError:

                transitions[transition][input_symbol] = "-"

# print(f"{transition}\t\t{transitions[transition][input_symbols
# [0]]}\t\t{transitions[transition][input_symbols[1]]}")

        print(transition + "\t\t" +
              transitions[transition][input_symbols[0]] + "\t\t" +
              transitions[transition][input_symbols[1]])

    del input_symbols, transitions

if __name__ == "__main__":

    ndfa = NDFA()

    ndfa.print_stats()

    ndfa.print_transition_table()

```

Output:

```
----- RESTART: C:\Users\Admin\Downloads\ndia.py -----
Enter state set> WAM
Enter input symbol set> 01
Enter the initial state> W
Enter the final state(s)> M
Enter the number of rules you want to add> 3
Enter rule 1> W - 0A
Enter rule 2> A - 1M
Enter rule 3> M - 0W
If: {'W': {'0': 'A'}}
If: {'W': {'0': 'A'}, 'A': {'1': 'M'}}
If: {'W': {'0': 'A'}, 'A': {'1': 'M'}, 'M': {'0': 'W'}}
Set of states are > {'W', 'A', 'M'}
Input symbols are > {'1', '0'}
Transitions are >
W {'0': 'A'}
A {'1': 'M'}
M {'0': 'W'}
Initial state > W
Final states > {'M'}
Transition table is >
States      1      0
W           -      A
A           M      -
M           -      W
```

PRACTICAL NO 2

Aim: Write a program to convert the given Right linear grammar to Left Linear Grammar form.

CODE:

```
def get_transitions(rules):  
    my_dict={}  
    ld=""  
    res=dict()  
    r=""  
    for i in rules:  
        my_dict[i[0]]=i[1][1],i[1][0]  
    for sub in my_dict:  
        if isinstance(my_dict[sub],list):  
            res[sub]=ld.join([str(ele) for ele in my_dict[sub]])  
        print("Left linear grammar is:")  
    for item in res:  
        r+=item+"-"+str(res[item])+"\n"  
    print(str(r))  
  
rule_count=int(input("Enter rule count>\t"))
```

```
rules=[]

for i in range(rule_count):

    rules.append(input("Enter right linear grammar"+">\t"))

rules=[i.split("->") for i in rules]

print(rules)

get_transitions(rules)
```

OUTPUT:

```
= RESTART: C:\Users\Admin\Desktop\Msc CS\SEM 2\Compiler\Practicals\Practical 2(A
).py
Enter rule count>          2
Enter right linear grammar> S->uP
Enter right linear grammar> T->qW
[['S', 'uP'], ['T', 'qW']]
Left linear grammar is:
Left linear grammar is:
S-Pu
T-Wq
```


PRACTICAL NO 3

Aim: Write a code to generate DAG for input arithmetic expression.

CODE:

```
def funct1(x):  
    main=[]  
  
    for i in range(0,x):  
        y=input()  
        main.append(y)  
  
    print("Label Operator left Right")  
  
    for i in range(0,x):  
        q=main[i]  
  
        if q[0] not in res:  
            res.append(q[0])  
  
        if(len(q)>3):  
            print(" ",q[0]," ",q[3]," ",q[2]," ",q[4])  
        else:  
            print(" ",q[0]," ",q[1]," ",q[2]," ")  
  
    print(main)  
  
    print(res)
```

```
print("Enter number of 3 address code")
```

```
x=input()
```

```
x=int(x)
```

```
res=[]
```

```
funct1(x)
```

Output:

```
= RESTART: C:/Users/Admin/Desktop/Msc CS/
Enter number of 3 address code
4
t=a-b
r=a-c
o=t*r
q=o
Label Operator left Right
      t      -      a      b
      r      -      a      c
      o      *      t      r
      q      =      o
['t=a-b', 'r=a-c', 'o=t*r', 'q=o']
['t', 'r', 'o', 'q']
|
```

PRACTICAL NO 4

Aim: Write a code for triples.

Code:

```
def funct1(x):  
    main=[]  
    for i in range(0,x):  
        y=input()  
        main.append(y)  
    print("Address operator argument 1 argument2")  
    for i in range(0,x):  
        g=main[i]  
        if g[0] not in res:  
            res.append(g[0])  
        e=funct2(g[2])  
        if(len(g)>3):  
            r=funct2(g[4])  
            print("  (",i,")", "  ",g[3], "  ",e, "  ",r)  
        else:  
            print("  (",i,")", "  ",g[1], "  ",e, "  ")
```

```
    print(main)

    print(res)
def funct2(g):
    try:
        z=res.index(g)

        return(z)
    except:
        return(g)
print("Enter number of production")
x=input()
x=int(x)
res=[]
funct1(x)
```

Output:

```
y
Enter number of production
4
t=a-b
u=a-c
w=t*u
e=w
Address operator argument 1 argument2
  ( 0 )      -      a      b
  ( 1 )      -      a      c
  ( 2 )      *      0      1
  ( 3 )      =      2
['t=a-b', 'u=a-c', 'w=t*u', 'e=w']
['t', 'u', 'w', 'e']
|
```

PRACTICAL NO 5

Aim: Write the code for Postfix Evaluation

CODE:

```
def postfix_evaluation(s):  
    s=s.split()  
    n=len(s)  
    stack=[]  
    for i in range(n):  
        if s[i].isdigit():  
            stack.append(int(s[i]))  
        elif s[i]=="+":  
            a=stack.pop()  
            b=stack.pop()  
            stack.append(int(a)+int(b))  
        elif s[i]=="*":  
            a=stack.pop()  
            b=stack.pop()  
            stack.append(int(a)*int(b))  
        elif s[i]=="/":
```

```
        a=stack.pop()
        b=stack.pop()
        stack.append(int(a)/int(b))
    elif s[i]=="-":
        a=stack.pop()
        b=stack.pop()
        stack.append(int(a)-int(b))
    return stack.pop()
```

```
s="8 7 8 * + 4 -"
val=postfix_evaluation(s)
print(val)
```

OUTPUT:

```
Y
-60
|
```

PRACTICAL NO 6

Aim: Write a code to generate 3 address code

Code:

```
postfix=input("Enter postfix expression").split()
```

```
operators=['+', '-', '/', '*', '^']
```

```
stack=[]
```

```
result=""
```

```
str1=""
```

```
count=0
```

```
print("3 address code")
```

```
for i in postfix:
```

```
    if i not in operators:
```

```
        stack.append(i)
```

```
        print("Stack-",stack)
```

```
    else:
```

```
        op1=stack.pop()
```

```
        op2=stack.pop()
```

```
        result=op2+i+op1
```

```
        str1='T'+str(count)
```



```
stack.append(str1)

print("T",count,"=",result)

count+=1
```

Output:

```
- RESTART: C:\Users\Admin\Desktop\misc\CS\SEM 2\Computer
y
Enter postfix expression a b c + / d *
3 address code
Stack- ['a']
Stack- ['a', 'b']
Stack- ['a', 'b', 'c']
T 0 = b+c
T 1 = a/T0
Stack- ['T1', 'd']
T 2 = T1*d
>
```

PRACTICAL NO 7

Aim: Write a program to demonstrate loop jamming for given code sequence containing loop.

Code: Loop Jamming

```
import time
```

```
from datetime import datetime
```

```
def func1(arr1,arr2,arr3):
```

```
    t1=datetime.now()
```

```
    start=time.time()
```

```
    print(t1.minute,":",t1.second,":",t1.microsecond)
```

```
    for i in range (0,10000000):
```

```
        sum=0
```

```
        for j in range(0,len(arr1)):
```

```
            sum=sum+arr1[j]
```

```
        for k in range(0,len(arr2)):
```

```
            sum=sum+arr2[k]
```

```
        for l in range(0,len(arr3)):
```

```
            sum=sum+arr3[l]
```

```
    if(sum!=210):
```

```
print(false)
```

```
tm=datetime.now()
```

```
done=time.time()
```

```
elapsed=done-start
```

```
print(t1.minute,":",t1.second,":",t1.microsecond)
```

```
print("First loop Difference",elapsed)
```

```
start=time.time()
```

```
for i in range(0,10000000):
```

```
    sum=0
```

```
    for j in range(0,len(arr1)):
```

```
        sum=sum+arr1[j]
```

```
        sum=sum+arr2[j]
```

```
        sum=sum+arr3[j]
```

```
    if(sum!=210):
```

```
        print(false)
```

```
tn=datetime.now()
```

```
done=time.time()

elapsed=done-start

print(t1.minute,":",t1.second,":",t1.microsecond)

print("second loop Difference",elapsed)
```

```
arr1=[10,20,30]

arr2=[20,10,30]

arr3=[40,40,10]

func1(arr1,arr2,arr3)
```

OUTPUT:

```
Python 3.10.3 (tags/v3.10.3:a342a49, Mar 16 2022, 13:07:40) [MSC v.
AMD64] on win32
Type "help", "copyright", "credits" or "license()" for more informa
= RESTART: C:/Users/Admin/Desktop/Msc CS/SEM 2/Compiler/Practicals,
)-Loop Jamming.py

= RESTART: C:/Users/Admin/Desktop/Msc CS/SEM 2/Compiler/Practicals,
)-Loop Jamming.py
53 : 14 : 254787
53 : 14 : 254787
First loop Difference 21.988343715667725
53 : 14 : 254787
second loop Difference 10.30445909500122
|
```

PRACTICAL NO 8

Aim: Write a program to demonstrate loop unrolling for given code sequence containing loop.

Loop Unrolling

Code:

```
import time

from datetime import datetime

def funct1():

    arr=[]

    arr1=[]

    t1=datetime.now()

    start=t1.microsecond

    print(start)

    for i in range(0,1000):

        arr.insert(0,i)

    print(arr)

    t2=datetime.now()

    end1=t2.microsecond

    print(end1)
```

```

for i in range(0,1000,4):
    arr1.insert(0,i)
    arr1.insert(0,i+1)
    arr1.insert(0,i+2)
    arr1.insert(0,i+3)

print(arr1)

t3=datetime.now()

end2=t3.microsecond

print(end2)

print("Before unrolling:",end1-start)

print("After unrolling:",end2-end1)

funct1()

```

OUTPUT:

```

----- RESTART: C:\Users\AQUILA\DO
833747
Squeezed text (54 lines).
112643
Squeezed text (54 lines).
369812
Before unrolling: -721104
After unrolling: 257169
|

```