University of Mumbai

JOURNAL

PSDS101: PROGRAMMING PARADIGM

(MSc. Computer Science with specialization in Data Science 2021)

Submitted by

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Roll No. 16

1. Write a Program in python to Regular Expression to NFA

Source Code :

```
inp = "((e+a).b*)*"#input("")
"""
Give your input in the above variable
a and b are the only terminals accepted by this script
e denotes epsilon
. is used for "and" operation Eg. ab = a.b
+ is used for "or" operation Eg. a|b = a+b
* is the Kleene's Closure operator. You can give star operator after any closing brackets and terminals
"""

_="-"
start = 1 # denotes start of e-nfa table
end = 1 # denotes end of our table which is initially same as start
cur = 1 # denotes current position of our pointer
# this is intitial e-nfa table with only one state which is start and end both
table = [["state","epsilon","a","b"],
[1,_,_,_]]
def print_t(table):
"""
This function prints the e-nfa table
"""
i = table[0]
print(f'{i[0]: <10}'+f'| {i[1]: <10}'+f'| {i[2]: <10}'+f'| {i[3]: <10}')
print("-"*46)
for i in table[1:]:
try:
x = " ".join([str(j) for j in i[1]])
except:
x = ""
try:
y = " ".join([str(j) for j in i[2]])
except:
y = ""
try:
z = " ".join([str(j) for j in i[3]])
except:
z = ""
print(f'{i[0]: <10}'+f'| {x: <10}'+f'| {y: <10}'+f'| {z: <10}')
```

```
def e_(cur,ed=end):
"""
this fuction adds epsilon to the table
"""
temp = table[cur]
try:
table[cur] = [cur,temp[1].append(cur+1),temp[2],temp[3]]
except:
table[cur] = [cur,[cur+1],temp[2],temp[3]]
try:
nv = table([cur+1])
except:
table.append([ed+1,_,_,_])
ed+=1
return ed

def a_(cur,ed=end):
temp = table[cur]
try:
table[cur] = [cur,temp[1],temp[2].append(cur+1),temp[3]]
except:
table[cur] = [cur,temp[1],[cur+1],temp[3]]
try:
nv = table([cur+1])
except:
table.append([ed+1,_,_,_])
ed+=1
return ed

def b_(cur,ed=end):
temp = table[cur]
try:
table[cur] = [cur,temp[1],temp[2],temp[3].append(cur+1)]
except:
table[cur] = [cur,temp[1],temp[2],[cur+1]]
try:
nv = table([cur+1])
except:
table.append([ed+1,_,_,_])
ed+=1
return ed

def or_b(cur,ed=end):
temp = table[cur]
try:
```

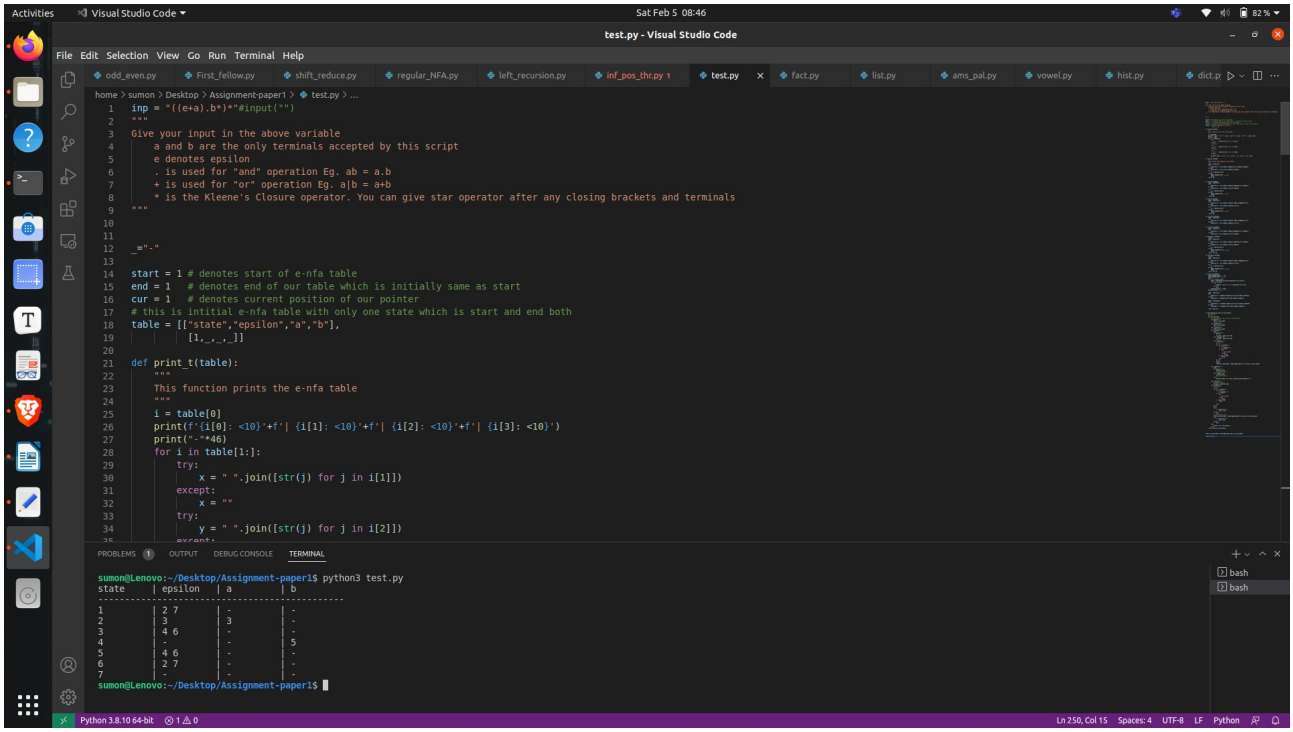
```
table[cur] = [cur,temp[1],temp[2],temp[3].append(cur+1)]
except:
table[cur] = [cur,temp[1],temp[2],[cur+1]]

def or_a(cur,ed=end):
temp = table[cur]
try:
table[cur] = [cur,temp[1],temp[2].append(cur+1),temp[3]]
except:
table[cur] = [cur,temp[1],[cur+1],temp[3]]

def and_a(cur,ed=end):
cur+=1
temp = table[cur]
try:
table[cur] = [cur,temp[1],temp[2].append(cur+1),temp[3]]
except:
table[cur] = [cur,temp[1],[cur+1],temp[3]]
try:
nv = table([cur+1])
except:
table.append([cur+1,_,_,_])
ed+=1
return cur,ed

def and_b(cur,ed=end):
cur+=1
temp = table[cur]
try:
table[cur] = [cur,temp[1],temp[2],temp[3].append(cur+1)]
except:
table[cur] = [cur,temp[1],temp[2],[cur+1]]
try:
nv = table([cur+1])
except:
table.append([cur+1,_,_,_])
ed+=1
return cur,ed

def star(cur,ed=end):
table.append([ed+1,_,_,_])
table.append([ed+2,_,_,_])
ed+=2
for i in range(cur,ed):
temp = [table[ed-i+cur][0]]+table[ed-i+cur-1][1:4]
for j in [1,2,3]:
```

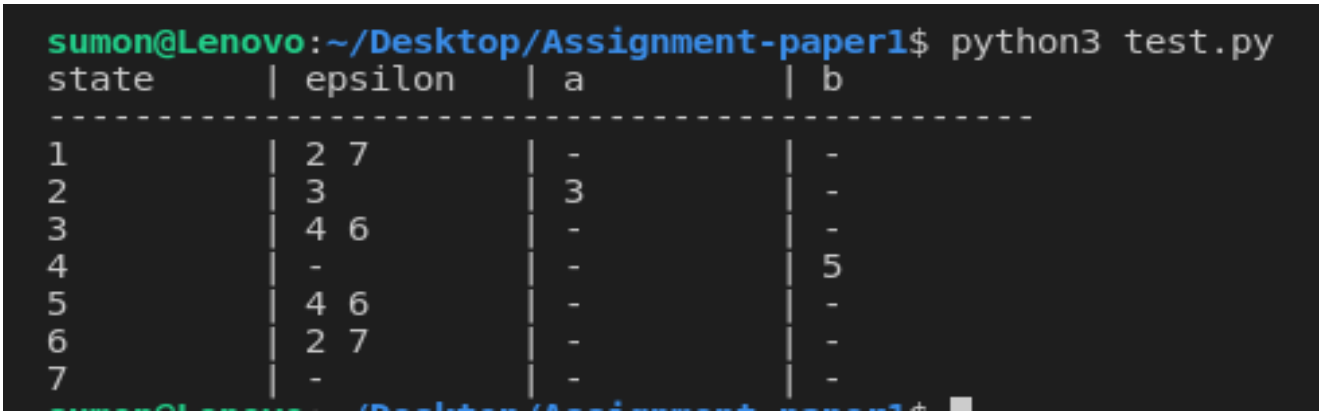
```
try:
temp[j] = [x+1 for x in table[ed-i+cur-1][j]]
except:
pass
table[ed-i+cur] = temp
table[cur]=[cur,_,_,_]

temp = table[cur]
try:
table[cur] = [temp[0],temp[1]+[cur+1,ed],temp[2],temp[3]]
except:
table[cur] = [temp[0],[cur+1,ed],temp[2],temp[3]]

temp = table[ed-1]
try:
table[ed-1] = [temp[0],temp[1]+[cur+1,ed],temp[2],temp[3]]
except:
table[ed-1] = [temp[0],[cur+1,ed],temp[2],temp[3]]

return ed-1,ed


def mod_table(inp,start,cur,end,table):
#print(inp)
k = 0
while k<len(inp):
#print(start,cur,end,k,inp[k:],len(table)-1)
if inp[k]=="a":
end = a_(cur,end)
#print("in a_")
elif inp[k]=="b":
end = b_(cur,end)
#print("in b_")
elif inp[k]=="e":
end = e_(cur,end)
elif inp[k]==".":
k+=1
if inp[k]=="a":
#k-=1
cur,end = and_a(cur,end)
elif inp[k]=="b":
cur,end = and_b(cur,end)
#k-=1
elif inp[k]=="(":
li = ["("]
l = k
for i in inp[k+1:]:
```

```
if i == "(":
li.append("(")
if i == ")":
try:
del li[-1]
except:
break
if len(li)==0:
break
l+=1
m = k
k=l+1
cur+=1
start,cur,end,table = mod_table(inp[m+1:l+1],start,cur,end,table)
elif inp[k]=="+":
k+=1
if inp[k]=="a":
or_a(cur,end)
#print("in or_a")
elif inp[k]=="b":
or_b(cur,end)
#print("in or_b")
else:
print(f"ERROR at{k }Done:{inp[:k+1]}Rem{inp[k+1:]}")
elif inp[k]=="*":
#print("in star")
cur,end = star(cur,end)
elif inp[k]=="(":
li = ["("]
l = k
for i in inp[k+1:]:
if i == "(":
li.append("(")
if i == ")":
try:
del li[-1]
except:
break
if len(li)==0:
break
l+=1
m = k
```

```
k=l+1
try:
if inp[k+1]=="*":
cur_ = cur
except:
pass
#print(inp[m+1:l+1])
start,cur,end,table = mod_table(inp[m+1:l+1],start,cur,end,table)
try:
if inp[k+1]=="*":
cur = cur_
except:
pass
else:
print(f'error{k}{inp[k]}')
k+=1
return start,cur,end,table

start,cur,end,table = mod_table(inp,start,cur,end,table)
print_t(table)
```

Output :





2. Write a program in phyton for Elimination of Left Recursion

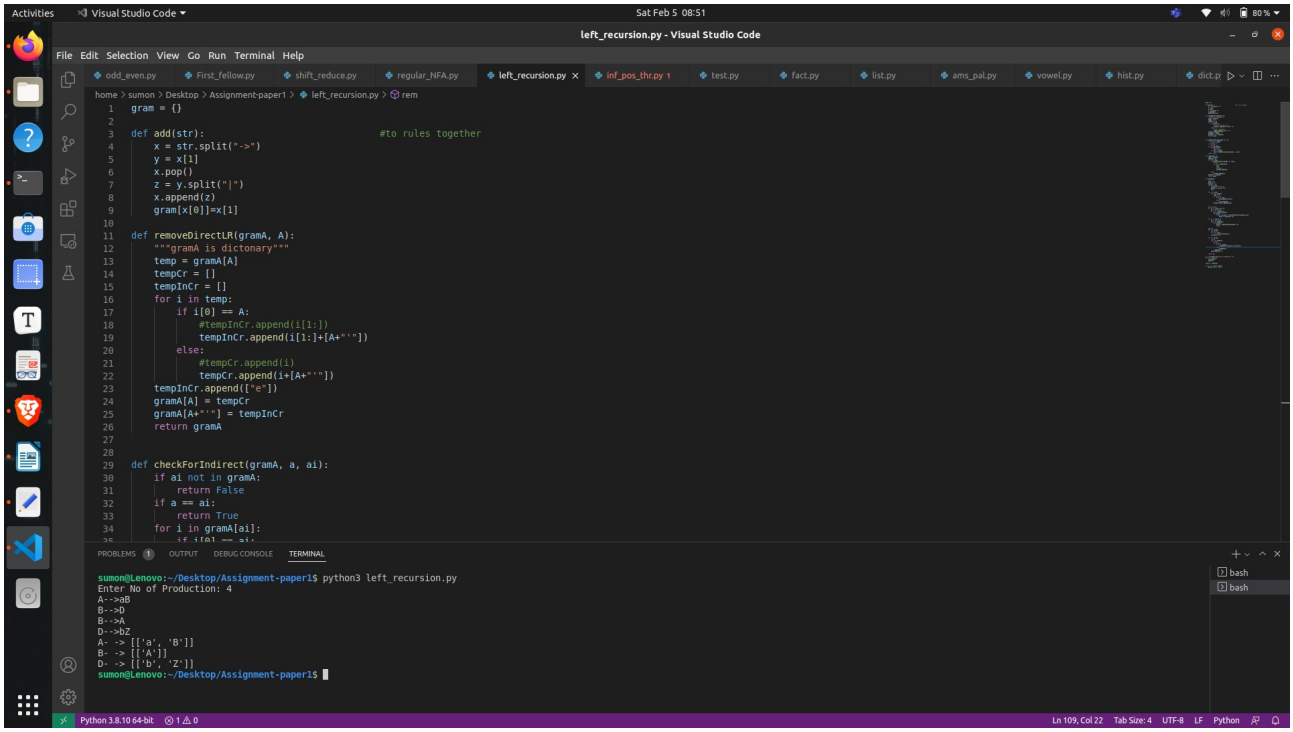
Source Code :

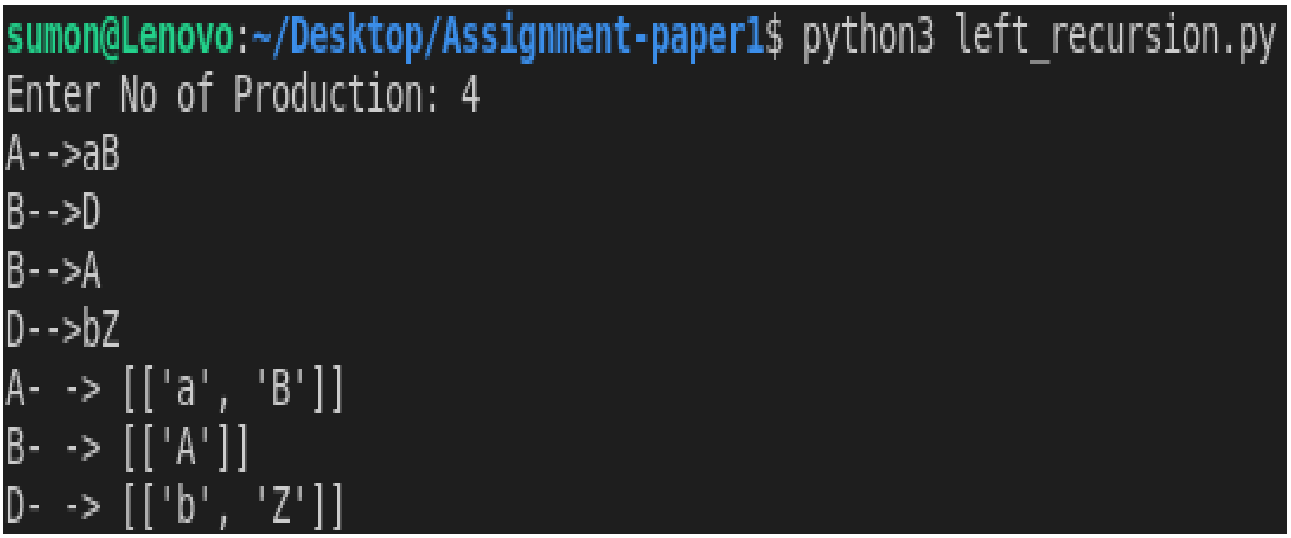
```
gram = {}

def add(str): #to rules together
x = str.split("->")
y = x[1]
x.pop()
z = y.split("|")
x.append(z)
gram[x[0]]=x[1]

def removeDirectLR(gramA, A):
"""gramA is dictonary"""
temp = gramA[A]
tempCr = []
tempInCr = []
for i in temp:
if i[0] == A:
#tempInCr.append(i[1:])
tempInCr.append(i[1:]+[A+"'"])
else:
#tempCr.append(i)
tempCr.append(i+[A+"'"])
tempInCr.append(["e"])
gramA[A] = tempCr
gramA[A+"'"] = tempInCr
return gramA

def checkForIndirect(gramA, a, ai):
if ai not in gramA:
```

```
return False
if a == ai:
return True
for i in gramA[ai]:
if i[0] == ai:
return False
if i[0] in gramA:
return checkForIndirect(gramA, a, i[0])
return False

def rep(gramA, A):
temp = gramA[A]
newTemp = []
for i in temp:
if checkForIndirect(gramA, A, i[0]):
t = []
for k in gramA[i[0]]:
t=[]
t+=k
t+=i[1:]
newTemp.append(t)

else:
newTemp.append(i)
gramA[A] = newTemp
return gramA

def rem(gram):
c = 1
conv = {}
gramA = {}
revconv = {}
for j in gram:
conv[j] = "A"+str(c)
gramA["A"+str(c)] = []
c+=1

for i in gram:
for j in gram[i]:
temp = []
for k in j:
if k in conv:
temp.append(conv[k])
else:
temp.append(k)
gramA[conv[i]].append(temp)
```

```
#print(gramA)
for i in range(c-1,0,-1):
ai = "A"+str(i)
for j in range(0,i):
aj = gramA[ai][0][0]
if ai!=aj :
if aj in gramA and checkForIndirect(gramA,ai,aj):
gramA = rep(gramA, ai)

for i in range(1,c):
ai = "A"+str(i)
for j in gramA[ai]:
if ai==j[0]:
gramA = removeDirectLR(gramA, ai)
break

op = {}
for i in gramA:
a = str(i)
for j in conv:
a = a.replace(conv[j],j)
revconv[i] = a

for i in gramA:
l = []
for j in gramA[i]:
k = []
for m in j:
if m in revconv:
k.append(m.replace(m,revconv[m]))
else:
k.append(m)
l.append(k)
op[revconv[i]] = l

return op

n = int(input("Enter No of Production: "))
for i in range(n):
txt=input()
add(txt)

result = rem(gram)

for x,y in result.items():
print(f'{x} -> {y}')
```

Output :





3. Write a program in phyton for Computation of First and Follow sets

Source Code :

```
gram = {
"E":["E+T","T"],
"T":["T*F","F"],
"F":["(E)","i"]
}

def removeDirectLR(gramA, A):
"""gramA is dictonary"""
temp = gramA[A]
tempCr = []
tempInCr = []
for i in temp:
if i[0] == A:
#tempInCr.append(i[1:])
tempInCr.append(i[1:]+[A+"'"])
else:
#tempCr.append(i)
tempCr.append(i+[A+"'"])
tempInCr.append(["e"])
gramA[A] = tempCr
gramA[A+"'"] = tempInCr
return gramA

def checkForIndirect(gramA, a, ai):
if ai not in gramA:
return False
if a == ai:
return True
for i in gramA[ai]:
if i[0] == ai:
return False
if i[0] in gramA:
return checkForIndirect(gramA, a, i[0])
return False

def rep(gramA, A):
temp = gramA[A]
newTemp = []
for i in temp:
if checkForIndirect(gramA, A, i[0]):
t = []
for k in gramA[i[0]]:
```

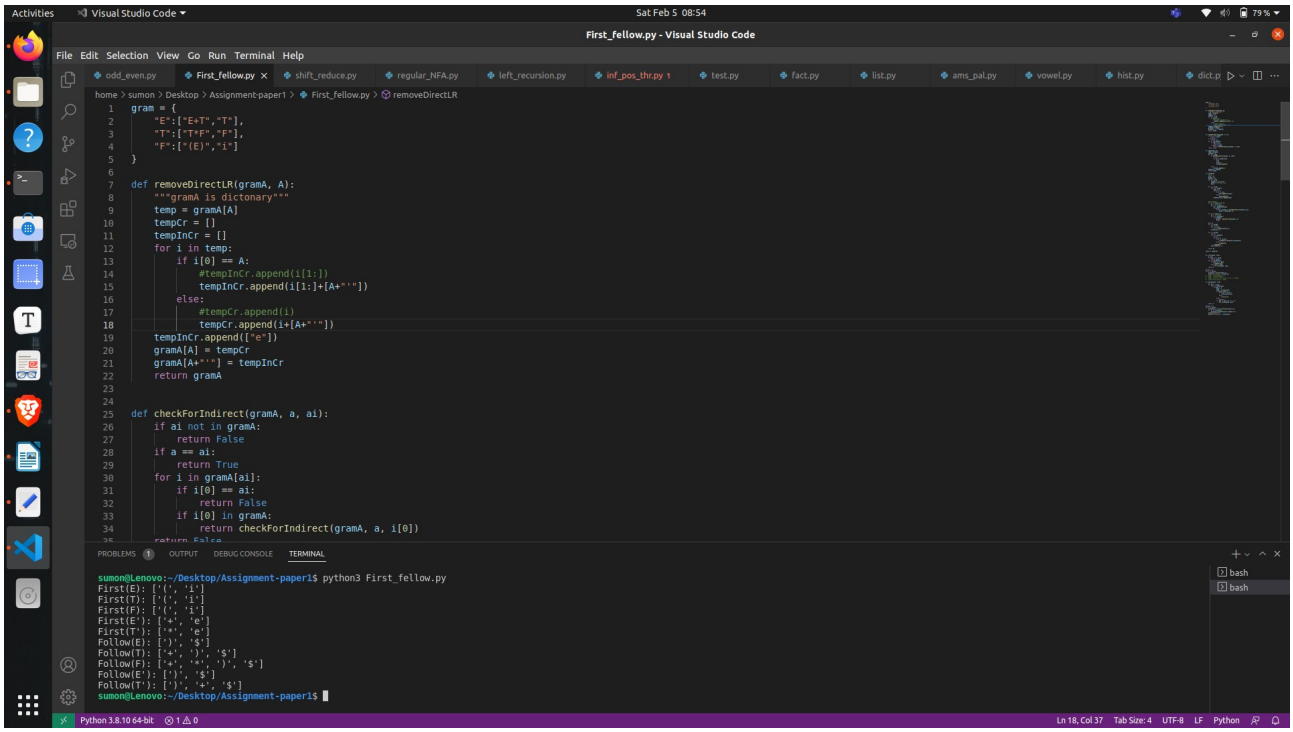
```
t=[]
t+=k
t+=i[1:]
newTemp.append(t)

else:
newTemp.append(i)
gramA[A] = newTemp
return gramA

def rem(gram):
c = 1
conv = {}
gramA = {}
revconv = {}
for j in gram:
conv[j] = "A"+str(c)
gramA["A"+str(c)] = []
c+=1

for i in gram:
for j in gram[i]:
temp = []
for k in j:
if k in conv:
temp.append(conv[k])
else:
temp.append(k)
gramA[conv[i]].append(temp)

#print(gramA)
for i in range(c-1,0,-1):
ai = "A"+str(i)
for j in range(0,i):
aj = gramA[ai][0][0]
if ai!=aj :
if aj in gramA and checkForIndirect(gramA,ai,aj):
gramA = rep(gramA, ai)

for i in range(1,c):
ai = "A"+str(i)
for j in gramA[ai]:
if ai==j[0]:
gramA = removeDirectLR(gramA, ai)
break

op = {}
```

```
for i in gramA:
a = str(i)
for j in conv:
a = a.replace(conv[j],j)
revconv[i] = a

for i in gramA:
l = []
for j in gramA[i]:
k = []
for m in j:
if m in revconv:
k.append(m.replace(m,revconv[m]))
else:
k.append(m)
l.append(k)
op[revconv[i]] = l

return op

result = rem(gram)

def first(gram, term):
a = []
if term not in gram:
return [term]
for i in gram[term]:
if i[0] not in gram:
a.append(i[0])
elif i[0] in gram:
a += first(gram, i[0])
return a

firsts = {}
for i in result:
firsts[i] = first(result,i)
print(f'First({i}):',firsts[i])
# temp = follow(result,i,i)
# temp = list(set(temp))
# temp = [x if x != "e" else "$" for x in temp]
# print(f'Follow({i}):',temp)

def follow(gram, term):
a = []
for rule in gram:
for i in gram[rule]:
if term in i:
```

```
temp = i
indx = i.index(term)
if indx+1!=len(i):
if i[-1] in firsts:
a+=firsts[i[-1]]
else:
a+=[i[-1]]
else:
a+=["e"]
if rule != term and "e" in a:
a+= follow(gram,rule)
return a
```

```
follows = {}
for i in result:
follows[i] = list(set(follow(result,i)))
if "e" in follows[i]:
follows[i].pop(follows[i].index("e"))
follows[i]+=["$"]
print(f'Follow({i}):',follows[i])
```

Output :



```
sumon@Lenovo:~/Desktop/Assignment-paper1$ python3 First_fellow.py
First(E): ['(', 'i']
First(T): ['(', 'i']
First(F): ['(', 'i']
First(E'): ['+', 'e']
First(T'): ['*', 'e']
Follow(E): [')', '$']
Follow(T): ['+', ')', '$']
Follow(F): ['+', '*', ')', '$']
Follow(E'): [')', '$']
Follow(T'): [')', '+', '$']
```

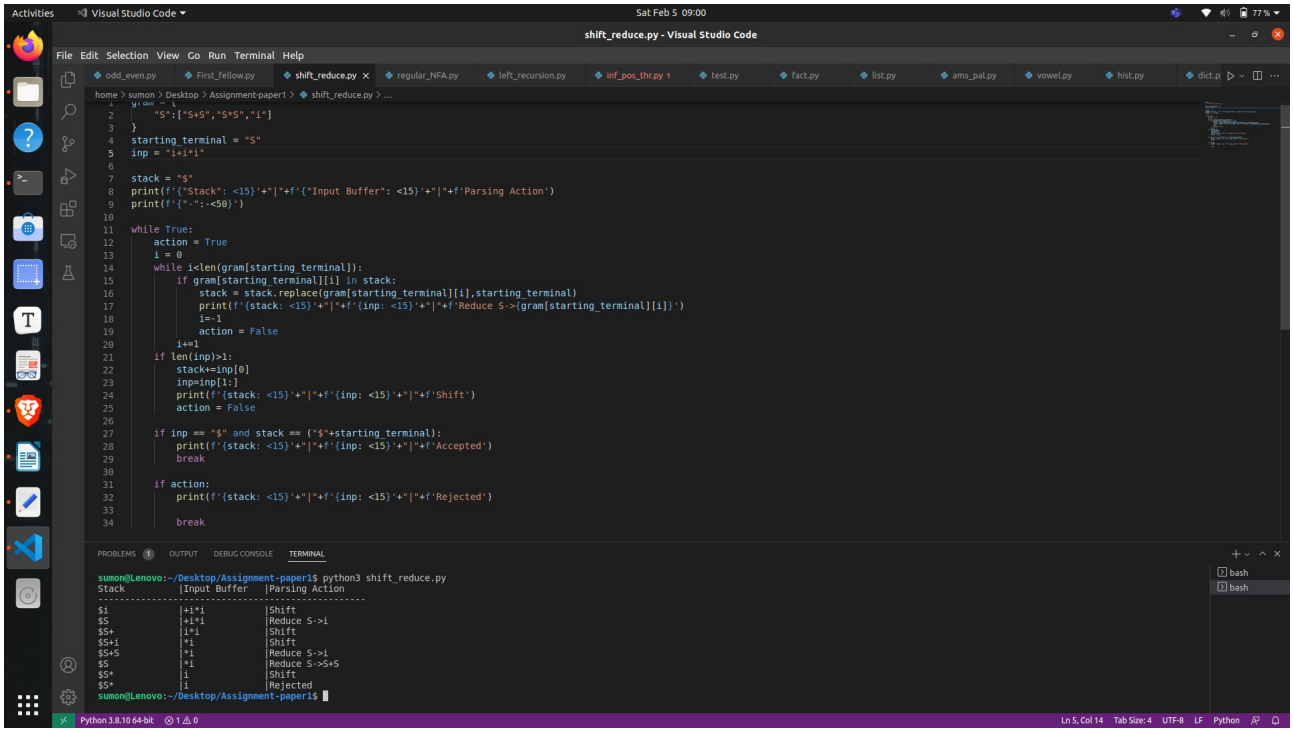
4. Write a program in phyton for the Implementation of Shift Reduce Parsing

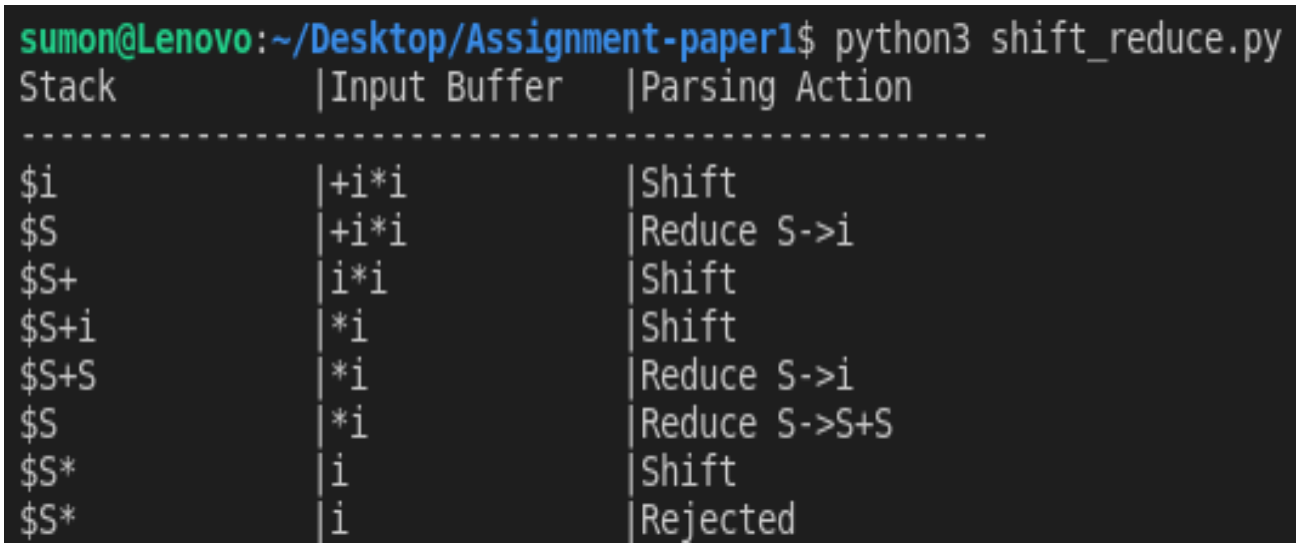
Source Code :

```
gram = {
"S":["S+S","S*S","i"]
}
starting_terminal = "S"
inp = "i+i*i"
"""
stack = "$"
print(f'{"Stack": <15}'+"|"+f'{"Input Buffer": <15}'+"|"+f'Parsing Action')
print(f'{"-":-<50}')
while True:
action = True
i = 0
while i<len(gram[starting_terminal]):
if gram[starting_terminal][i] in stack:
stack = stack.replace(gram[starting_terminal][i],starting_terminal)
print(f'{stack: <15}'+"|"+f'{inp: <15}'+"|"+f'Reduce S->{gram[starting_terminal][i]}')
i=-1
action = False
i+=1
if len(inp)>1:
stack+=inp[0]
inp=inp[1:]
print(f'{stack: <15}'+"|"+f'{inp: <15}'+"|"+f'Shift')
action = False
```

```
if inp == "$" and stack == ("$"+starting_terminal):
print(f'{stack: <15}'+"|"+f'{inp: <15}'+"|"+f'Accepted')
break

if action:
print(f'{stack: <15}'+"|"+f'{inp: <15}'+"|"+f'Rejected')
break
```

Output :





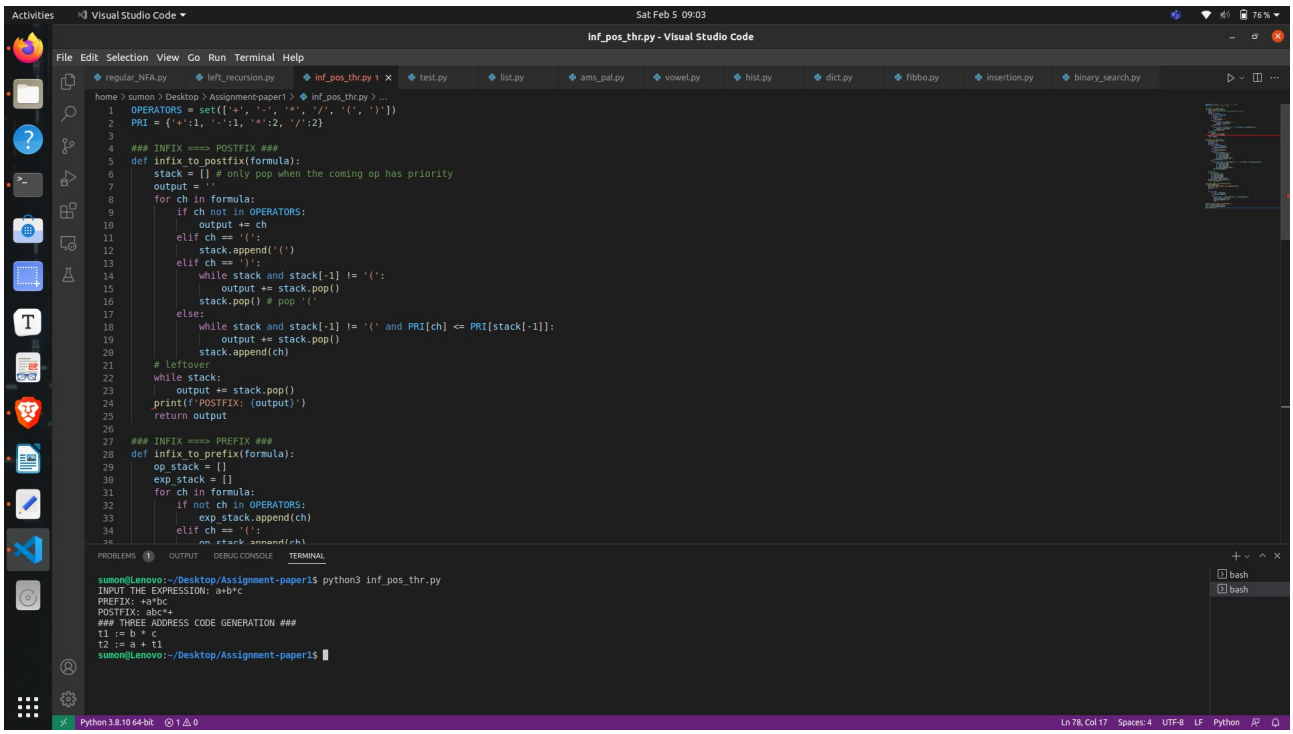
5. Write a program in phyton for intermediate Code Generation: Three Address Code, Postfix, Prefix

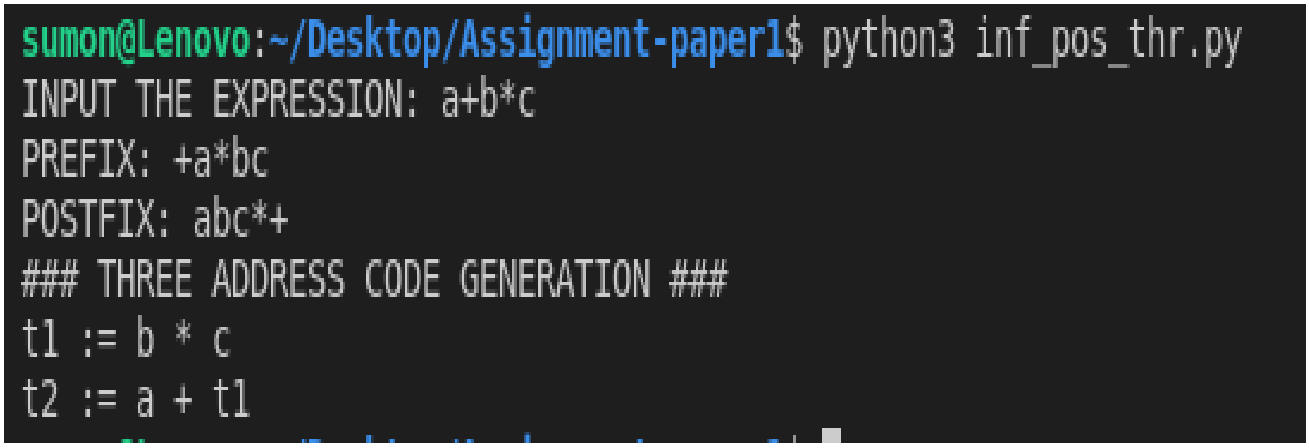
Source Code :

```
OPERATORS = set(['+', '-', '*', '/', '(', ')'])
PRI = {'+':1, '-':1, '*':2, '/':2}

### INFIX ===> POSTFIX ###
def infix_to_postfix(formula):
stack = [] # only pop when the coming op has priority
output = ''
for ch in formula:
if ch not in OPERATORS:
output += ch
elif ch == '(':
stack.append('(')
elif ch == ')':
while stack and stack[-1] != '(':
output += stack.pop()
stack.pop() # pop '('
else:
while stack and stack[-1] != '(' and PRI[ch] <= PRI[stack[-1]]:
output += stack.pop()
stack.append(ch)
# leftover
while stack:
output += stack.pop()
print(f'POSTFIX: {output}')
return output

### INFIX ===> PREFIX ###
def infix_to_prefix(formula):
op_stack = []
exp_stack = []
for ch in formula:
if not ch in OPERATORS:
exp_stack.append(ch)
elif ch == '(':
op_stack.append(ch)
```

```
elif ch == ')':
while op_stack[-1] != '(':
op = op_stack.pop()
a = exp_stack.pop()
b = exp_stack.pop()
exp_stack.append( op+b+a )
op_stack.pop() # pop '('
else:
while op_stack and op_stack[-1] != '(' and PRI[ch] <= PRI[op_stack[-1]]:
op = op_stack.pop()
a = exp_stack.pop()
b = exp_stack.pop()
exp_stack.append( op+b+a )
op_stack.append(ch)

# leftover
while op_stack:
op = op_stack.pop()
a = exp_stack.pop()
b = exp_stack.pop()
exp_stack.append( op+b+a )
print(f'PREFIX: {exp_stack[-1]}')
return exp_stack[-1]

### THREE ADDRESS CODE GENERATION ###
def generate3AC(pos):
print("### THREE ADDRESS CODE GENERATION ###")
exp_stack = []
t = 1

for i in pos:
if i not in OPERATORS:
exp_stack.append(i)
else:
print(f't{t} := {exp_stack[-2]} {i} {exp_stack[-1]}')
exp_stack=exp_stack[:-2]
exp_stack.append(f't{t}')
t+=1

expres = input("INPUT THE EXPRESSION: ")
pre = infix_to_prefix(expres)
pos = infix_to_postfix(expres)
generate3AC(pos)
```

Output :


Activities
Visual Studio Code
Sat Feb 5 09:03
inf_pos_thr.py - Visual Studio Code
File Edit Selection View Go Run Terminal Help
regular_NFA.py
left_recursion.py
inf_pos_thr.py 1
test.py
list.py
ams_pal.py
vowel.py
hist.py
dict.py
fibbo.py
insertion.py
binary_search.py
home > sumon > Desktop > Assignment-paper1 > inf_pos_thr.py > ...
OPERATORS = set(['+', '-', '*', '/', '(', ')'])
PRI = {'+':1, '-':1, '*':2, '/':2}
INFIX ===> POSTFIX
def infix_to_postfix(formula):
stack = [] # only pop when the coming op has priority
output = ''
for ch in formula:
if ch not in OPERATORS:
output += ch
elif ch == '(':
stack.append('(')
elif ch == ')':
while stack and stack[-1] != '(':
output += stack.pop()
stack.pop() # pop '('
else:
while stack and stack[-1] != '(' and PRI[ch] <= PRI[stack[-1]]:
output += stack.pop()
stack.append(ch)
# leftover
while stack:
output += stack.pop()
print(f'POSTFIX: {output}')
return output
INFIX ===> PREFIX
def infix_to_prefix(formula):
op_stack = []
exp_stack = []
for ch in formula:
if not ch in OPERATORS:
exp_stack.append(ch)
elif ch == '(':
PROBLEMS 1
OUTPUT
DEBUG CONSOLE
TERMINAL
sumon@Lenovo:~/Desktop/Assignment-paper1$ python3 inf_pos_thr.py
INPUT THE EXPRESSION: a+b*c
PREFIX: +a*bc
POSTFIX: abc*+
THREE ADDRESS CODE GENERATION
t1 := b * c
t2 := a + t1
sumon@Lenovo:~/Desktop/Assignment-paper1$
bash
bash
Python 3.8.10 64-bit
Ln 78, Col 17
Spaces: 4
UTF-8
LF
Python


sumon@Lenovo:~/Desktop/Assignment-paper1$ python3 inf_pos_thr.py
INPUT THE EXPRESSION: a+b*c
PREFIX: +a*bc
POSTFIX: abc*+
THREE ADDRESS CODE GENERATION
t1 := b * c
t2 := a + t1