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Topic: To Find First and Follow

Aim: Write a code to find first and follow.

Introduction:

First ()-

If x is a terminal, then FIRST(x) = { 'x' }
If x-> Є, is a production rule, then add Є to FIRST(x).
If X->Y1 Y2 Y3….Yn is a production,
FIRST(X) = FIRST(Y1)
If FIRST(Y1) contains Є then FIRST(X) = { FIRST(Y1) – Є } U { FIRST(Y2) }
If FIRST (Yi) contains Є for all i = 1 to n, then add Є to FIRST(X).

Follow ()-

FOLLOW(S) = { $ } // where S is the starting Non-Terminal
If A -> pBq is a production, where p, B and q are any grammar symbols,
then everything in FIRST(q) except Є is in FOLLOW(B).
If A->pB is a production, then everything in
FOLLOW(A) is in FOLLOW(B).If A->pBq is a
production and FIRST(q) contains Є,
then FOLLOW(B) contains { FIRST(q) – Є } U FOLLOW(A)

Source code:

```
import sys

sys.setrecursionlimit(60)

def first(string):

    #print("first({})".format(string))

    first_ = set()

    if string in non_terminals:

        alternatives = productions_dict[string]

        for alternative in alternatives:

            first_2 = first(alternative)

            first_ = first_ |first_2

    elif string in terminals:
```

```
        first_ = {string}
    elif string==" or string=='@':
        first_ = {'@'}
    else:
        first_2 = first(string[0])
        if '@' in first_2:
            i = 1
            while '@' in first_2:
                #print("inside while")
                first_ = first_ | (first_2 - {'@'})
                #print('string[i:]=', string[i:])
                if string[i:] in terminals:
                    first_ = first_ | {string[i:]}
                    break
                elif string[i:] == '':
                    first_ = first_ | {'@'}
                    break
                first_2 = first(string[i:])
                first_ = first_ | first_2 - {'@'}
                i += 1
        else:
            first_ = first_ | first_2
    #print("returning for first({})".format(string),first_)
    return  first_
def follow(nT):
    #print("inside follow({})".format(nT))
    follow_ = set()
    #print("FOLLOW", FOLLOW)
    prods = productions_dict.items()
```

```
    if nT==starting_symbol:
        follow_ = follow_ | {'$'}
    for nt,rhs in prods:
        #print("nt to rhs", nt,rhs)
        for alt in rhs:
            for char in alt:
                if char==nT:
                    following_str = alt[alt.index(char) + 1:]
                    if following_str==":
                        if nt==nT:
                            continue
                        else:
                            follow_ = follow_ | follow(nt)
                    else:
                        follow_2 = first(following_str)
                        if '@' in follow_2:
                            follow_ = follow_ | follow_2-{'@'}
                            follow_ = follow_ | follow(nt)
                        else:
                            follow_ = follow_ | follow_2
    #print("returning for follow({})".format(nT),follow_)
    return follow_
no_of_terminals=int(input("Enter no. of terminals: "))
terminals = []
print("Enter the terminals :")
for _ in range(no_of_terminals):
    terminals.append(input())
no_of_non_terminals=int(input("Enter no. of non terminals: "))
non_terminals = []
```

```
print("Enter the non terminals :")
for _ in range(no_of_non_terminals):
    non_terminals.append(input())
starting_symbol = input("Enter the starting symbol: ")
no_of_productions = int(input("Enter no of productions: "))
productions = []
print("Enter the productions:")
for _ in range(no_of_productions):
    productions.append(input())
#print("terminals", terminals)
#print("non terminals", non_terminals)
#print("productions",productions)
productions_dict = {}
for nT in non_terminals:
    productions_dict[nT] = []
#print("productions_dict",productions_dict)
for production in productions:
    nonterm_to_prod = production.split("->")
    alternatives = nonterm_to_prod[1].split("/")
    for alternative in alternatives:
        productions_dict[nonterm_to_prod[0]].append(alternative)
#print("productions_dict",productions_dict)
#print("nonterm_to_prod",nonterm_to_prod)
#print("alternatives",alternatives)
FIRST = {}
FOLLOW = {}
for non_terminal in non_terminals:
    FIRST[non_terminal] = set()
for non_terminal in non_terminals:
```

```
    FOLLOW[non_terminal] = set()
#print("FIRST",FIRST)
for non_terminal in non_terminals:
    FIRST[non_terminal] = FIRST[non_terminal] | first(non_terminal)
#print("FIRST",FIRST)
FOLLOW[starting_symbol] = FOLLOW[starting_symbol] | {'$'}
for non_terminal in non_terminals:
    FOLLOW[non_terminal] = FOLLOW[non_terminal] | follow(non_terminal)
#print("FOLLOW", FOLLOW)
print("{: ^20}{: ^20}{: ^20}".format('Non Terminals','First','Follow'))
for non_terminal in non_terminals:
    print("{: ^20}{: ^20}{:
^20}".format(non_terminal,str(FIRST[non_terminal]),str(FOLLOW[non_terminal])))
```

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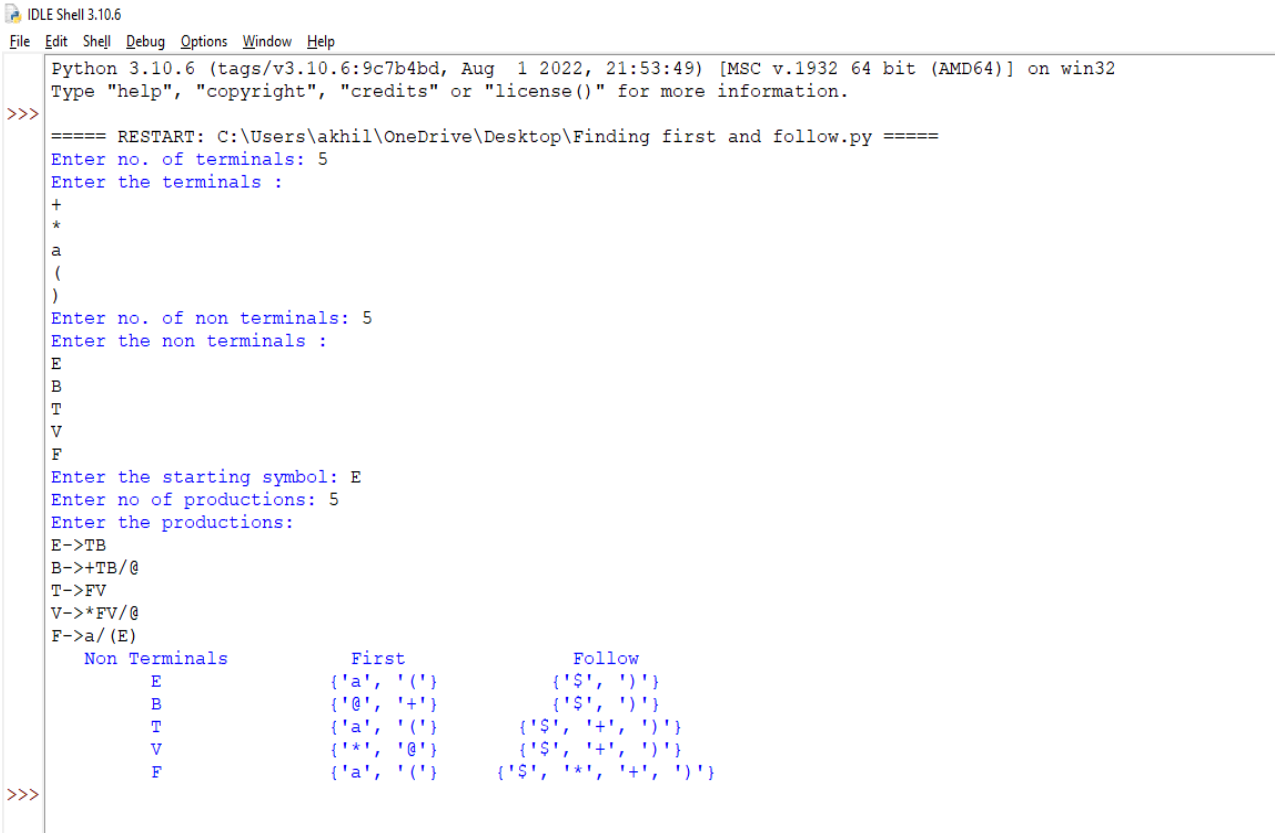
Output:



Course: Msc CS 1 **Subject:** Compiler