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Experiment 5 - FIRST and FOLLOW Computation

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CSE A2

Experiment 5

Aim:
To write a program to perform first and follow using Python language.

Algorithm:
For computing the first:
1. If X is a terminal then FIRST(X) = {X}
   Example: F -> I | id
   We can write it as FIRST(F) -> { (, id)
2. If X is a non-terminal like E -> T then to get FIRSTI substitute T with other productions until you get a terminal as the first symbol
3. If X -> ε then add ε to FIRST(X).

For computing the follow:
1. Always check the right side of the productions for a non-terminal, whose FOLLOW set is being found. (never see the left side).
2. (a) If that non-terminal (S,A,B…) is followed by any terminal (a,b…,*,+,(,)…) , then add that terminal into the FOLLOW set.
   (b) If that non-terminal is followed by any other non-terminal then add FIRST of other nonterminal into the FOLLOW set.

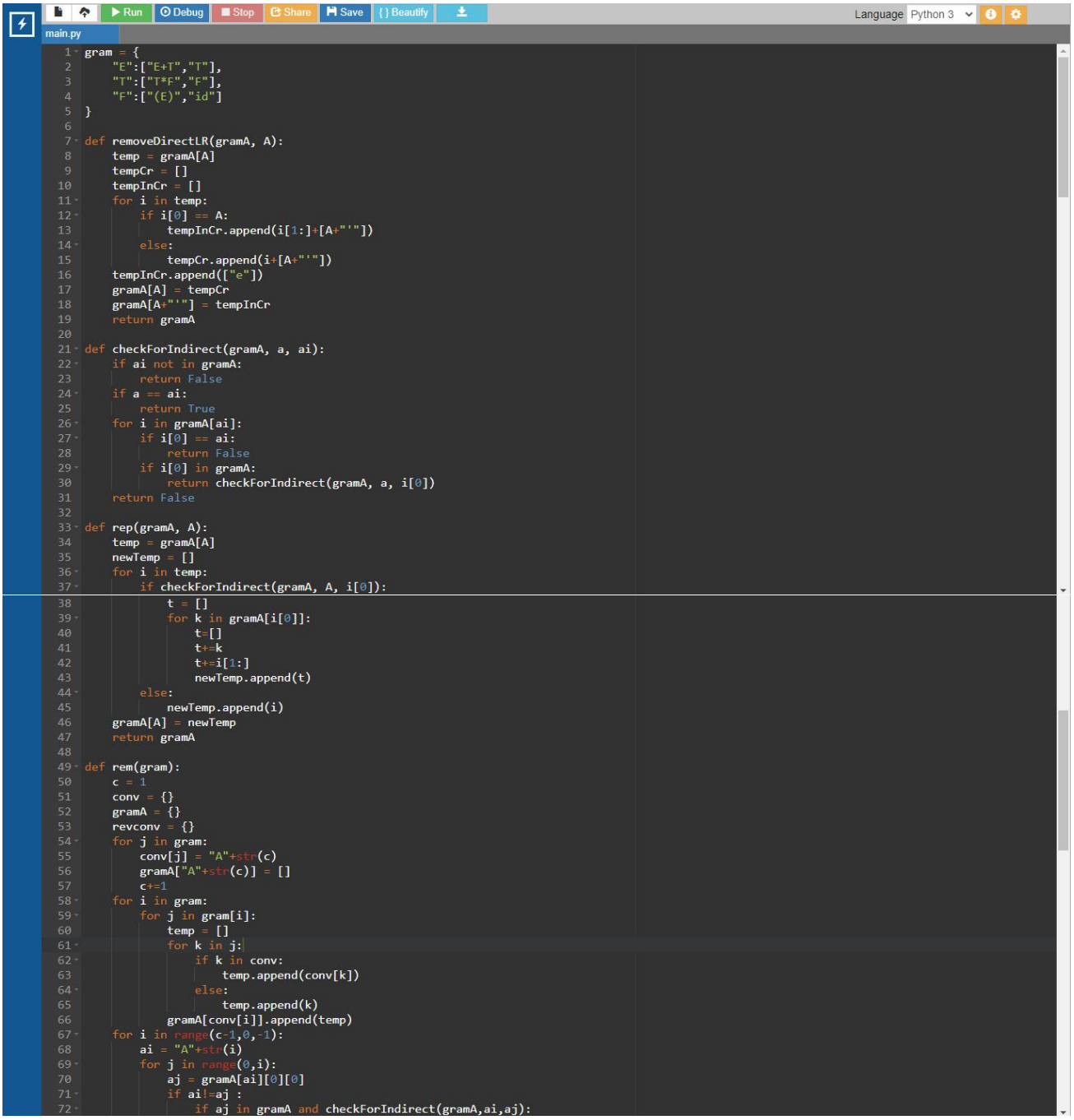
Code:

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

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

```
                    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)
    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])

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])
```




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

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

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:

```
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'): [')', '+', '$']


...Program finished with exit code 0
Press ENTER to exit console.
```

Result:

A program for FIRST and FOLLOW computation was run successfully.